Department for Transport

Transport Technology and Standards (TTS) Compendium of Research

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Transport Technology and Standards (TTS) Compendium of Research 2006-2008

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Transport Technology and Standards - Research Overview

TTS Division has primary objectives to support policies delivering the Public Service Agreement (PSA) targets through safer engineering of vehicles, and provide smarter and sustainable transport choices through supporting smart ticketing and Intelligent Transport Systems research. In meeting these objectives, research is undertaken with the following aims:

- to investigate the causes and consequences of road accidents and develop vehicle based measures to reduce accidents and casualties,
- to strengthen our knowledge and evidence base upon which decisions are taken, and
- to ensure that regulatory standards keep pace with technological development, thereby minimising burdens on industry while maintaining safety standards.

TTS Division has responsibilities for transport technology and standards research programmes. This compendium contains information about projects repeated in the last compendium of 2006 and up to March 2008.

The projects detailed in this compendium are grouped according to general themes. For each theme both recently completed and ongoing projects are listed.

Reports and papers published in this compendium can be obtained either from the DfT's website or where these are shown as available, from the contractor. A list of contractors, with relevant contact details, who have undertaken the research projects can be found at Annex A.

This compendium will be available on the DfT's website only. http://www.dft.gov.uk

Further information about the research being conducted by the Department can be obtained from the Research Database at http://www.rmd.dft.gov.uk/.

THEME 1

Primary and Electronic Safety

This theme draws together the vehicle engineering aspects which can seek to reduce the risk of an accident occurring". Considerable improvements in the past five to ten years have been made on vehicle design and construction towards both occupant and pedestrian safety, but more has to be done to prevent accidents from occurring in the first place. Primary safety covers vehicle systems that help drivers avoid accidents happening (for example braking), whilst eSafety achieves the same objectives using intelligent technologies (such as electronic stability control).

This theme has projects falling into three broad areas:

- vehicle dynamic safety;
- vision/conspicuity; and,
- electronic systems.

In this theme projects support our commitment to improve primary vehicle safety which includes aspects of vehicle construction such as braking, tyres, steering, suspension, lighting, electronic driver aids etc. and improve user understanding of the technology and its application.

Projects completing this year have included research on the Occlusion method used for assessing in-vehicle information systems, another looking at compliance of commercial vehicle trailer braking systems and a further two looking at In-Vehicle Information systems. In addition the PReVENT sub project Response 3 was completed and a Code of Practice for Advanced Driver Assistance Systems.

New research taking the primary theme forward includes a feasibility study for equipment database and exposure data evaluation, this is a forward looking evaluation looking at the potential for accident and exposure data to provide information on the effectiveness of primary safety systems.

Under the electronics sub theme is a long-term project to consider the use of Intelligent Speed Adaptation (ISA) to reduce accidents and casualties. This project builds upon commitments in the Road Safety Strategy and the Speed policy review and has undertaken the first two (out of four trials) to understand better the behavioural aspects of drivers using this technology. The first two trials were held in Leeds, a largely urbanised area, the final two were held in Leicestershire, a largely rural area. A large truck and a motorcycle were equipped with ISA systems as demonstrators of ISA on other vehicle applications.

Recently Completed Projects

S0021/ VD Framework arrangement on vehicle lighting research

Background

The lights on vehicles are fundamental primary safety requirements, helping to prevent accidents by aiding the driver to see the road ahead and allowing other road users to see the vehicle and understand the actions of the driver. Vehicle lights should provide a clear unambiguous signal to other road users.

Improving the lights fitted to vehicles could contribute to improvements in safety and may provide added benefit by reducing the power consumption of vehicles and hence their environmental impact. However, not all improvements in lighting are beneficial to all road users. In particular, the issue of glare needs to be carefully considered.

The majority of proposals for changes to lighting legislation come from the vehicle or component industry or from GTB (an international group of experts representing the lighting industry and test houses). There is a need for the Department to be able to respond to these proposals by, for example, testing new lighting products.

These tests provide essential scientific information to inform and support policy.

Summary

This call-off contract is being used to provide a quicker response to international proposals for revisions to the lighting requirements, and to reduce the administrative burden letting such projects.

The Department has contracts with four organisations under this agreement which enables us to select the organisation best suited to meet the timetable and work requirements.

This contract was used to support the Department's response to a European Commission consultation on the use of daytime running lights (DRL) on vehicles. DRL are intended to increase the conspicuity of vehicles during the daytime, however a review carried out by TRL Limited identified a number of areas of concern which the Department raised in its response to the consultation. These concerns included insufficient evidence to demonstrate that there would be no dis-benefit to vulnerable road users such as motorcyclists and pedestrians if other vehicles were fitted with DRL. The review also concluded that previous studies had overestimated the potential benefits of DRL.

Contractor	BSi Product Services / ESRI / TRL Limited / Scientifics Limited	
Report	Title	Reference
	Daytime Running Lights (DRL): A review of the reports from the European Commission by I Knight, B Sexton, R Bartlett, T Barlow, S Latham & I McCrae	PPR 170 http://www.dft.gov.uk/pgr/roads/vehicles/vssafety/drls/
Completion Date	June 2007	
Contact	Enquiries at TTS:	020 7944 5026

S0132/ VC VERTEC

Background

The EU is currently working towards the challenging target of a reduction in road fatalities of 50% by the year 2010. Up to now the strategy has been predominantly focused on secondary safety. VERTEC 2 aims to contribute to this EU objective by working on aspects of primary safety.

Summary

VERTEC stands for VEhicle, Road, Tyre, and Electronic Control Systems Interaction. The project was carried out by a consortium of 15 European Companies under the EC 5th Framework programme and TRLs involvement was also jointly funded by the UK Department for Transport and the Highways Agency.

The aim of the project was to increase vehicle primary safety by developing a fully integrated model for the simulation of the road-tyre-vehicle-driver system in the most potentially dangerous situations. This model was also to be the base for the development of an upgraded driving simulator. Special focus was drawn to the most advanced Vehicle Electronic Control Systems and the representation of both passenger cars and Heavy Good Vehicles (HGVs).

The main outputs of the project were the integrated simulation environment and an improved driving simulator for cars and trucks. The purpose of the outputs was to allow the partners of the consortium to detect and rank the most dangerous driving situations in order to define and supply guidelines for the design of safer roads, vehicles, tyres and electronic devices.

Full scale reference tests using a passenger car and an HGV, provided a database of experimental data to help design, develop and validate the best possible models for the vehicle, tyre, driver and road surface.

Simulation environments for both a passenger car and an HGV were successfully created. For the passenger car, two modelling environments were developed. The first was a very accurate vehicle dynamic simulation using a multi-body approach with a co-simulation between ADAMS and Matlab/Simulink. The second model was a simplified "real-time"

equivalent developed in Matlab/Simulink. The HGV vehicle model was built using the multi-body environments in ADAMS.

Guidelines for the design of electronic control systems showed that the tyre-characteristic had the strongest influence on the overall vehicle performance. The application of the model for providing variable posted speed limits as a function of the actual handling condition seemed to be the most promising as the model could be implemented on the road side and could

potentially provide a regular "refreshed" update of the posted limit.

Picture of VTI Driving Simulator used in VERTEC

Contractor	TRL Limited	
Report	Title	Reference
	VERTEC – Final Report for the DfT	PPR112
Completion Date	June 2006	
Contact	Enquiries at TRL: Enquiries at TTS:	01344 770699 020 7944 5026

S0313/ V6 A research programme to support policy development in the area of Intelligent Primary Safety Systems

Background

The emergence of new technologies either intended to improve road safety or with the potential to change the safety levels, has led to the need to develop a new strategic plan in this area and for the implementation of a coordinated research programme. The purpose of this was primarily to inform the policy development of the Department and to address knowledge gaps in order to promote effective primary safety improvements to vehicles.

Summary

A workshop was held in December 2006 where representatives from key UK research organisations were invited to present the priorities for research to address the needs of the Department regarding new intelligent primary safety systems. The groups attending were:

- Vehicle Safety Research Centre, Loughborough University;
- Birmingham Automotive Safety Centre;
- Cranfield Impact Centre, Cranfield University;
- Institute for Transport Studies, Leeds University;
- Transportation Research Group, University of Southampton; and
- Transport Research Laboratory Ltd.

Five of the groups subsequently produced a report presenting further details of their research priorities; the 40 separate recommendations were consolidated and assessed against the DfT aims and objectives. A smaller number of key research actions, in direct

support of DfT policy development, were identified and proposed to be implemented in two phases:

Phase 1

- state of the art review of existing technologies and safety performance;
- technology watch process to monitor new technologies in development and those approaching the market;
- review of accident data to identify key accident causation factors that could be addressed by as yet undeveloped technology solutions; and
- feasibility study for development of a database of safety equipment fitted to new cars and separately deriving data to measure the exposure of new systems to travel in order to measure crash involvement risks.

Phase 2

- development and application of a methodology to predict or measure the crash reduction effectiveness of new systems;
- development and application of a methodology to assess introduced risks from new equipment in cars (this equipment may not be intended to have a safety function); and
- a broad framework for a process that can be used to evaluate new Intelligent Primary Safety Systems is proposed and will facilitate a preliminary and detailed assessment of possible safety outcomes.

Finally, recommendations were given concerning UK actions within the broader context of new primary safety technology development and implementation, and a separate review of future accident data needs related to new technology assessment was recommended.

Contractor	Vehicle Safety Research Centre, Loughborough University	
Reports	Title	Reference
	A research programme to support policy development in the area of Intelligent Primary Safety Systems	EAPD 9/33/99
Completion date	August 2007	
Contact	Enquiries at VSRC: Enquiries at TTS:	01509 226931 020 7944 5026

S0327/ VD Guidelines for Routeing Assessment of Navigation

Background

Reducing congestion and ensuring road safety are two of the prime objectives of the Department. In-vehicle driver information systems, such as those providing navigation route guidance, can contribute towards achieving these objectives. However, the way in which these systems give information to drivers could impact adversely on both the policy objectives.

There are two types of in-vehicle route guidance systems - autonomous (or static) and dynamic. Autonomous route guidance system provides turn-by-turn route navigation. On the other hand, dynamic route guidance (DRG) system provides turn-by-turn route navigation according to prevailing traffic and road network conditions.

Apart from a brief 'draft' minimum requirements document, no agreed Guide or Checklist exists to carry out the assessment of routeing strategy of a navigation system. There is therefore a need for developing a Routeing Assessment Guide.

Summary

This project developed guidelines which can be used by a system manufacturer or service provider to design a route guidance system which gives a minimum level of safe performance. Systems designed to these guidelines should provide the driver with reliable, up to date, routeing information and reduce the risk that they will be directed onto roads that are not appropriate for their vehicle or journey.

The guidelines may also be used as the basis for developing procedures for the assessment of routing systems in the future.

Contractor	TRL Limited	
Reports	Title	Reference
	Guidelines for safe and effective vehicle routing	PPR091 www.trl.co.uk/store/report_detail.asp?srid=5452&pid=108
	Routing assessment of dynamic route guidance systems	PPR093 www.trl.co.uk/store/report_detail.asp?srid=5453&pid=108
Completion Date	May 2006	
Contact	Enquiries at TRL: Enquiries at TTS:	01344 770842 020 7944 5026

S0412/ V6 Phase 1 and 2 - A comparison of Vehicle National Construction Standards for vehicles in other EEA States with British SVA

S0412/ V6 Phase 3 - A comparison of National Construction Standards for North American and Japanese Trucks and Trailers of less than 10,000 lbs GVW with the requirements of the proposed new GB Approval Scheme

Background

New passenger cars and motorcycles are required to be type approved prior to being placed on the road. However, the Department recognised that a small percentage of vehicles are unable to gain type approval and implemented Single Vehicle Approval (SVA) schemes,

allowing vehicles to be approved individually for national use. This offers a cost effective route to registration for small volume manufacturers and some importers.

On occasions the importers from countries within the European Economic Area (EEA) seek "mutual recognition" to the exporting country's national technical construction standards. Under European Union provisions the responsibility for assessing whether the construction standards are equivalent to the national requirements is placed on the importing Member State. However, unless the standards and the means of certification in the exporting country are known, it is difficult to make accurate assessments.

At present, the Department has very limited data upon which to base such assessments. This project is expected to provide the necessary information with regards to the technical construction standards of the countries of EEA.

Summary

Project Overview for Phases 1 and 2:

Phase 1 of the project covered the national construction standards for vehicles in eight European Member States: Belgium, Cyprus, France, Germany, Ireland, Italy, Netherlands and Spain.

Phase 2 of the project covered the national construction standards for vehicles in a further seven European Member States: Czech Rep, Denmark, Greece, Hungary, Poland, Portugal and Sweden.

The objective of the first two phases was to ascertain whether the national construction standards of other European states for category M1 passenger cars, category N1 goods vehicles and category L two/three wheeled vehicles (including quad bikes) were compliant with the GB SVA schemes and therefore, whether they should be accepted under the terms of the Mutual Recognition Agreement.

Initially the project was spilt into four phases covering twenty-eight European states. A questionnaire was sent to the relevant authority in each state and national construction standards for the relevant categories of vehicles were also acquired for each of the states. Where the national construction standards for a state did not specify compliance with an EC directive or ECE regulation for a specific topic, technical experts were used to assess the national requirement against the requirements of GB Single Vehicle Approval schemes.

The project output for phases 1 and 2 was a report, which included a comparison matrix of the results, plus a handbook and wall chart providing a compliance statement for each state/topic.

At the end of phase 2, we refocused the research with a new third phase to assess the national construction standards of Canada, USA and Japan relating to light trucks and trailers.

Summary

Project Overview Phase 3:

Phase 3 covered the national construction standards of Canada and the USA for trucks and trailers with a GVW of less than 10,000 lbs and the national construction standards of Japan for trucks with a GVW of less than 10,000 lbs.

The objective of this phase was to ascertain the compliance of North American national certification requirements for trucks and trailers of less than 10,000 lbs GVW, and the

compliance of Japanese national approval requirements for trucks of less than 10,000 lbs GVW with the draft proposed GB scheme.

The analysis showed that as the majority of requirements relating to the different vehicle systems are not compliant trucks and trailers less than 10,000 lbs GVW entering the UK from North America and Japan should be subjected to an Approval under the draft proposed GB scheme.

Contractor	MIRA	
Reports	Title	Reference:
	End of Phase 1 report	1008597-001-02
	End of Phase 2 report	1008597-002-02
	End of Phase 3 report	1008597-003-01
	End of Project Report	
Completion date	December 2007	
Contact	Enquiries at MIRA: Enquiries at TTS:	02476 355000 020 7944 5026

S0425/ V6 Response 3 (EU 6th Framework)

Summary

RESPONSE 3 was an EU 6th Framework Programme project established to develop a code of practice for the development, testing and market introduction of Advanced Driver Assistance Systems (ADAS).

Advanced Driver Assistance Systems (ADAS) are active safety systems fitted in vehicles to support the driver, making the driving task safer and more comfortable. They help the driver in normal driving and critical situations to prevent accidents or mitigate their consequences. Examples include electronic stability programs, lane departure warning, speed alert, adaptive headlights, blind spot monitoring and collision warning systems. Future systems may take control from the driver in critical situations.

The final output of this project is a code of practice that will assist automotive manufacturers during the design and development stages to identify risks and develop processes to help with the assessment of the ADAS. It provides generic descriptions of procedures and processes for analysing user reactions, definitions of systems according to these requirements and validation procedures to demonstrate that safety related customer requirements are met.

A preliminary informal consultation was conducted by TRL with European Member States to obtain their first opinion on the Code of Practice. The results indicated that Public Authorities will support a self commitment to the Code of Practice from industry and they agree that the Code of Practice is sufficient to demonstrate adequate safety and fulfil the needs of their country in terms of ADAS approval but would be in favour of regulations or legislation stemming from the CoP in the future.

The Code of Practice that was developed by this project is available on the European Commission's PREVeNT website at:

http://prevent-ip.org/en/prevent_subprojects/horizontal_activities/response_3/

Contractor	**TRL Limited**	
Reports	Title	
	A Code Of Practice For Developing Advanced Driver Assistance Systems: Final Report On Work In The Response 3 Project Sally Cotter, Jean Hopkin and Keith Wood (TRL Limited) Published Project Report PPR 175 Code of Practice for the Design and Evaluation of ADAS RESPONSE 3	
Completion Date	November 2006	
Contact	Enquiries at TRL: Enquiries at TTS:	01344 770956 020 7944 5026

S0428/ V6 Occlusion: Protocol

Background

Over the past few years there has been an increased uptake of in-vehicle information systems (IVIS) such as satellite navigation and communication devices. Although there are potential benefits from such systems, there are also some negative safety issues. These include the possibility that in-vehicle systems may distract drivers, increase their workload or encourage them to engage in non-driving related tasks during their actual driving.

Summary

One method that is used to assess the potential negative effects of such new in-vehicle technologies is 'Occlusion' which assess the visual demand due to the use of visual displays or manual controls associated with the system. The Occlusion method determines visual demand and interruptability of a task by intermittent viewing of the in-vehicle system by means of specially designed goggles.

Visual Occlusion helps identify designs which require long single glance durations by drivers to assimilate information and complete a task using the in-vehicle system. The aim of this project was to develop a measurement protocol based on the Occlusion technique and to propose criteria for the acceptability of different systems. The work was undertaken in five separate work packages:

Work package 1. Age

The age of participants used to assess an in-vehicle system is likely to be important and it is possible that researchers may come to different conclusions about a specific task if they use

samples of people with widely varying ages. The results show that provided the age of participants is below 67 years there is no significant effect on the outcome of Occlusion trials.

Work Package 2. Consideration of different IVIS tasks, and expert evaluation

Four IVIS tasks were used throughout this project to assess the proposed protocol. This work package examined what aspects of tasks may be distracting/lack usability, how the results relate to theoretical task performance time and what a large sample of the UK driving public consider "acceptable" tasks to be performed on the roads.

Work Package 3. Benchmarking of different IVIS tasked to other impairment inducing factors and performance measures

In addition to the Occlusion method, other techniques exist to assess visual demand from IVIS tasks. One alternative is the Lane Change Task which requires a driving like task while the participant is also engaged in an IVIS task. This work package examined which of the two techniques is most sensitive to changes in driver performance due to visual demand.

The performance of drivers carrying out an IVIS task was also compared against reduced driver performance due to alcohol impairment to help identify which IVIS tasks may be acceptable while driving.

Work Package 4. Protocol development, reliability study and primary loading task

The primary purpose of the project was to develop and evaluate a suitable Occlusion protocol. The protocol was based on the ISO standard and used the results of the earlier work packages. The protocol was trialled by both TRL Ltd and Nottingham University and found to give reliable and comparable results.

Work Package 5. Set limits to allow performance measurements of specific IVIS tasks.

The Objective of this work package was to develop a benchmark or Demand Reference Level that can be used to identify In-vehicle devices, tasks or functions that involve an unacceptably high level of demand if used while driving. While a task that complies with this reference level may not necessarily be safe to use while driving, if does suggest that the visual demand required is within a bench mark limit.

Contractor	**TRL Limited**	
Reports	Title	Reference
	Development of an Occlusion Protocol with Design Limits for Assessing Driver Visual Demand	PPR 256
	Occlusion Protocol	PPR 259
Completion date	March 2008	
Contact	Enquiries at TRL: Enquiries at TTS:	01344 773131 020 7944 5026

S0514/ V6 Safety Improvements for Breakdown, Recovery and Other Vulnerable Vehicles

Background

Breakdown and vehicle recovery operators are particularly concerned about the safety of their employees when working on the road network. One area they feel could be improved is the conspicuity of their vehicles when stationary and attending a breakdown, particularly on the hard shoulder of motorways or in the live lane of single carriageway roads.

The Road Vehicles Lighting Regulations (RVLR) permit flashing amber beacons to be fitted on breakdown vehicles and used in the immediate vicinity of an accident or breakdown or while drawing a broken down vehicle to warn drivers of the presence of the vehicle. However, there have been calls from industry to permit the use of beacons in alternative colours to improve conspicuity, the preference being red.

The use of coloured beacons is restricted by the RVLR so that their effectiveness does not become diluted. Therefore, before the Department can consider the request for alternative colours, research is required to determine whether the safety risk experienced by breakdown operators is disproportionate to that encountered by other organisations working in similar environments (e.g. the Police and Highways Agency Traffic Officers).

Summary

The primary aim of this project was to examine accident data from a number of sources, including data supplied by recovery operators, to determine the factors relating to accidents and identify whether a lack of conspicuity or visibility was a contributing factor. It was found that the nature of the available data was insufficient to draw any significant conclusions on the causes of accidents involving recovery operators and none of the recovery operators collected data that would enable the cause of an incident to be determined.

A second stage of the project was implemented to design a methodology which could be used by the recovery operators to collect incident data that would assist in understanding whether a problem exists with incidents in the recovery industry. Provided this methodology is implemented, the data collected can then be analysed in the future to determine what specific issues require addressing. The following areas were considered to help develop a suitable methodology:

- gain an understanding of the end users who will report incidents;
- understand the strengths and abilities of the recovery truck driver to report incidents and be motivated to report data accurately;
- the type of data which is practical to collect, given any limitations described above;
- which methods may be appropriate to collect data;
- what is the nature of the database that is constructed?;
- what are the financial limitations that such a project will place on the industry?;
- understand how to feed back the findings from data collection to the industry;
- comprehend how we should communicate with the operators in the field;
- decide who maintains, owns and manipulates the data contained in the data base; and
- consider how incident data is used to change the industry.

A basic scheme has been developed that can be used by recovery operators to collect data which can be used in the future to identify the causes of incidents and help identify what counter measures may be most appropriate. This information has been disseminated to

industry and further work is now needed by those with an interest in this area, such as the SURVIVE partnership, to implement the methodology.

Contractor	TRL Limited	
Completion date		
Reports	Title:	Reference:
	Draft Final report	UPR SSI/xxx/07
Contact	Enquiries at TRL: Enquiries at TTS:	01344 773131 020 7944 5026

S0535/ V6 Heavy Vehicle Wheel Detachment – Phase I

Background

When a wheel becomes detached from a heavy vehicle it may simply come to rest without causing any further damage. However, in the wrong circumstances, it can collide with other vehicles or road users and cause an accident, and in some cases this has resulted in fatalities. Typically, it is only the more serious accidents that occur as a result of wheel detachment that are identified by standard reporting mechanisms. Such detachment of wheels from vehicles, particularly heavy commercial vehicles, has been a cause of concern for many years and there has been a considerable amount of investigative work and comment on the subject. Despite this previous research, comment and advice, there is evidence to suggest that wheel detachment still occurs.

Summary

This project is in two phases. The objective of phase 1 was to quantify the current frequency of wheel fixing problems and to assess the current practices within the industry in order to assess whether previous advice had a beneficial effect, and to identify new action that could be taken to reduce the scale of the problem.

The work involved:

- a survey run by VOSA and ACPO to investigate the current frequency of wheel fixing problems in the UK;
- a review of existing sources of data on wheel fixing problems;
- collection and analysis of information from other countries to assess the scale of the problem in the EU and elsewhere;
- a survey of heavy vehicle drivers, operators and manufacturers; and
- a review of current standards related to wheel fixings and procedures for wheel nut tightening.

The various studies that were carried out in this phase of the project produced variable estimates of the frequency of wheel fixing problems. Based on the data and a range of assumptions about the data, it was estimated that there were typically between 7,500 and 11,000 wheel fixing defects each year resulting in between 150 and 400 wheel detachments. Of the wheel detachments, it was estimated that between 50 and 134 would result in damage only accidents, 10 to 27 in injury accidents and three to seven in fatal accidents.

Phase 1 also concluded that maintenance remains a key issue for the current design of wheel fixing. The research identified that nearly all operators have procedures in place for wheel maintenance and many of the requirements are now common to all of them but there are still areas such as actual torque levels and the issue of lubrication where there is no standard approach. The surveys carried out during this project also identified there was variation in the degree of adherence to procedures with two per cent of drivers admitting to never carrying out daily visual checks, and five per cent of operators reported not checking wheel security during routine maintenance.

A range of measures potentially capable of reducing the frequency of occurrence or mitigating the consequences were identified. These ranged from indicators of wheel nut movement to a complete redesign on wheel fixing methods.

Contractor	**TRL Limited**	
Report	Title	Reference
	Heavy Vehicle Wheel Detachment: Frequency of Occurrence, Current Best Practice, and Potential Solutions – Phase 1 Report	PPR086
Completion Date	August 2006	
Contact	Enquiries at TRL: Enquiries at TTS:	01344 770699 020 7944 5026

S0701-V6 Heavy Vehicle Wheel Detachment – Phase II

Summary

Phase II of this project started in June 2007and aims to build upon the work carried out in Phase I in order to recommend a standardised best practice for wheel tightening and maintenance. The effectiveness of the countermeasures identified in Phase I in terms of their ability to prevent wheel detachment, will also be evaluated.

The research in Phase I showed that some guidance on best practice still disagreed on certain aspects of the procedures. Therefore the work in Phase II will use physical tests to investigate the consistency of clamp load generated by different tightening methods. Full vehicle tests will also be used to evaluate the different recommendations for re-torquing the wheels in order to provide further standardisation of best practice.

Phase I also identified a range of measures potentially capable of reducing the frequency of occurrence or mitigating the consequences. This included indicators of wheel nut movement, to a complete redesign on wheel fixing methods. Phase II will focus on evaluating the effectiveness of the identified countermeasures in terms of their ease of use, effectiveness and durability. Data will be gathered from simulated tests using a "Junkers" vibration machine using both new and used wheel studs and nuts.

The Junkers test is able to loosen nuts and reduce clamp load in a short space of time, thus allowing a range of variables to be assessed quickly. However, it does not necessarily accurately replicate on-road conditions. Therefore a programme of vehicle based accelerated wear tests will be carried out on a proving ground with repeated harsh cornering, braking,

acceleration, and driving over un-even surfaces to induce severe vibrations. These tests are capable of simulating a whole vehicle lifetime of wear in a relatively short period of time.

Contractor	TRL Limited	
Completion Date	August 2008	
Contact	Enquiries at TRL: Enquiries at TTS:	01344 770699 020 7944 5026

S0604/ V1 WP2 Parallel Exercise on Simulation and Physical Test

Background

The use of computer simulation as a development tool is widespread within the automotive industry and offers the benefits of fewer prototype vehicles, flexibility in product development and analysis of many scenarios. Recently CARS 21 (Competitive Automotive Regulatory System for the 21st century) recommended that EU legislation allow the use of virtual testing to provide flexibility and reduce costs for the European automotive industry. Replacing physical testing in type approval with simulations could offer more of those benefits and with growing pressure from the industry to consider permitting simulations in lieu of testing, the Department for Transport (DfT) was keen to review the associated benefits and risks.

This project was divided into three work packages; supply, test and simulation. The simulation undertaken by Arup is described here.

Summary

The project involved a combined test and simulation exercise based on the requirements of UN ECE Regulation 93 (Front under-run protection).

UN ECE Regulation 93 was chosen as the subject of the research project because it is a seemingly straightforward test on a structural sub-assembly. The front under-run protection device (FUPD) prevents a large vehicle from riding over the front impact structures of the smaller vehicles. The performance requirements of the legislation include:

- dimensional specifications for height, width and ground clearance; and
- a strength test with limits on rearward and upward deflection.

The aims of this research were to:

- indicate how simulation should be applied within the EC legislative framework;
- identify controls to ensure reliable simulations in a regulatory environment;
- indicate the confidence level that simulation can provide;
- identify procedures for evaluating computer simulations; and
- provide the foundation for future research, ensuring DfT's approach to simulation is appropriate in reducing the regulatory burden on manufacturers, whilst at the same time, encouraging improvements to vehicle safety.

The project scope was divided into three activities which covered:

- the development of an initial simulation model of a FUPD from data supplied by the component manufacturer. Results from the analysis where then compared to results obtained from a physical test to ascertain the level of correlation between the two

methods of testing. Modifications to the simulation model were made to improve correlation between the virtual and physical test in certain areas;
- the computer model of the FUPD was modified to demonstrate the sensitivity of the analysis technique and also its capability as a predictive tool. Following the computer analysis, a physical FUPD was modified in the same manner and tested. Results were then compared to provide a measure of confidence in the simulation technique; and
- an Impact Assessment considered the use of virtual testing to advance the safety of new vehicles and reduce road casualties, without increasing the burden on UK industry.

The project demonstrated that virtual and physical testing can provide similar results, but several concerns were highlighted including:

- the sensitivity of the physical test results to the test set up;
- the sensitivity of the simulation results to manufacturing tolerances;
- the sensitivity of the simulation results to the modelling methodology used;
- the definition of correlation between simulation and test;
- the need to specify model quality; and
- the ability of analysis techniques to assess design sensitivities to parameter variations, both in terms of real, such as gauge variation, and simulated, such as method of modelling welds.

The issues raised in the project highlight that although numerical simulation is widely used within the automotive industry its integration in to legislation requires further development.

In the medium term it could be envisaged that the simulation is combined with physical testing to further enhance the robustness of submitted designs and increase safety levels. Simulation could be used to help determine the worst case set-up for physical testing, be used to evaluate minor changes to designs following type approval or used to evaluate a number of additional scenarios.

In the long term, when suitable processes have been developed to ensure confidence in simulation results, numerical simulation could be used as an option to replace physical testing.

Contractor	**Arup**	
Papers	Title	Reference
	PPRO 4/12/29 WP2 Parallel Exercise on Simulation and Physical Test – Final Report	
	PPRO 4/12/29 WP2 Parallel Exercise on Simulation and Physical Test - Initial Regulatory Impact Assessment Rev D	
Completion date	July 2007	
Contact	Enquiries at Arup: Enquires at TTS:	0121 213 3304 020 7944 5026

UG 567 eCall - The Case for Deployment in the UK

Summary

eCall is an in-vehicle system that manually or automatically generates a call following an accident, establishing a voice link to the nearest emergency service and transmitting data giving vehicle details and location.

SBD was selected to carry out a study to look at the specific UK business case for eCall from a range of perspectives, including a cost-benefit analysis, and to establish if any barriers to deployment existed. The study also examined the opportunities eCall offers, especially if combined with other initiatives.

The project involved a review of eCall documentation and evidence in order to form and present an evidenced based opinion as to the robustness of the case for eCall in the UK.

The team consulted widely with industry players about the technology, service provision and business models, and with the emergency services about how eCall might deliver benefits in practice to society, industry and the individual.

The report concluded that when the full costs of implementing eCall were taken into account, including the in-car equipment, there would be a negative benefit - cost ratio in the UK. These results were shared with the European Commission.

The study was delivered to DfT in October 2006.

Contractor	SBD	
Report	Title	Reference:
	eCall - The Case for Deployment in the UK	SBD/TEL/1100a
Completion date	October 2006	
Contact	Enquiries at SBD: Enquiries at TTS:	01908 305101 020 7944 5026

Ongoing Projects

S0603/ V6 On The Spot Accident Investigation Project Phase 3

Background

The On-The-Spot (OTS) accident research project is undertaken to help ensure that the UK's roads become safer for everyone. The project enables expert investigators to attend the scene of an accident at the same time as the emergency services, with the aim of improving the understanding of the causes and consequences of road traffic accidents.

Summary

The OTS teams are based at TRL (Transport Research Laboratory) in Berkshire and VSRC (Vehicle Safety Research Centre, Loughborough University) in Nottingham. Together they investigate five hundred crashes in-depth per year. The project started in 2000 and entered into its third phase in 2006; to date the project has investigated over 3,200 accidents. The project has been jointly commissioned by: the Department for Transport (TTS, RS Divisions) and the Highways Agency.

Much of the information necessary to understand complex road safety questions can only be collected at the scene of a road traffic accident. The OTS project aims to collect these "perishable" data to enable these complex research questions to be answered.

The information collected at the scene includes information relating to: the speed of the vehicles prior to the impact, the dynamics of road users during impacts and the effects of new vehicle and highway safety features on the causes and consequences of accidents. The OTS investigators also interview drivers and witnesses at the scene to establish each road user's behaviour prior to the impact.

The information collected at the scene and from additional enquiries is then collated and recorded in a relational database, to enable accident trends to be identified. The accidents are sampled within a defined geographic region, that is representative of the wider GB accident profile. The teams are notified of the accident by the local emergency services, and attend the accident in a specially marked high visibility accident investigation vehicle.

Contractor	TRL Limited	
Completion date	ongoing	
Contacts	Enquiries at TRL: Enquiries at TTS:	01344 770364 020 7944 5026

S0713/ V6 In-Service Assessment of Agricultural Trailer & Trailed Appliance Braking System Condition and Performance

Background

An efficient vehicle braking system is central to safety during transport operations, be they on or off-road. Agricultural trailer & trailed appliance braking systems are frequently given insufficient consideration, both at the time of purchase and during subsequent use. Current levels of in-service maintenance are sometimes inadequate, although insufficient product specification reduces maintenance intervals to levels unlikely to be met on many UK farms. This, together with higher road speed operation of modern tractors, greatly increases the likelihood of premature system failure, accidents and transport-related fatalities. However, the relatively modest cost of selecting adequate-spec. trailer braking systems at time of purchase (or upgrading the running gear of existing on-farm trailers), makes this potentially economically viable. However, information is needed to inform users and purchasers of this equipment to highlight the attractiveness and practically of these potential solutions. This project aims to generate this material.

Summary

The projects aim is to generate information to underpin a HSE / DfT / Industry publicity campaign to raise user / prospective purchaser awareness of the inadequate performance of many in-service agricultural trailer braking systems, and the actions necessary to enable safer operation and compliance with future agricultural trailer and trailed appliance braking legislation, particularly regarding:

- the potential disparity between current tractor and trailer braking system performance;
- the economic and safety benefits of selecting adequate braking systems when purchasing new trailers and trailed appliances;
- the scope for (and economic benefits of) voluntarily upgrading existing trailer / trailed appliance braking systems to meet the requirements of forthcoming legislation; and
- the need for regular maintenance of agricultural trailer braking systems.

The Projects objectives were to:

- determine levels of braking system performance upon a representative range of typical agricultural trailers and trailed appliances, in 'as-found' on-farm condition;
- determine levels of braking system performance upon the selected trailers and trailed appliances following typical 'on-farm' maintenance and fault rectification;
- ascertain the ability of the selected vehicles to comply with future agricultural trailer braking system performance requirements and predict braking system performance and service life if operated frequently with modern (40–50 km/h) 'conventional' tractors; and
- determine the nature, cost and economic feasibility of any modifications necessary to enable the selected trailers and trailed appliances to comply with forthcoming agricultural vehicle braking legislation.

Muck spreading

Contractor	Scarlett Research Limited	
Completion date	August 2008	
Contacts	Enquiries at Scarlett Research: Enquiries at TTS:	01462 851470 andy.scarlett@scarlettresearch.co.uk 020 7944 5026

S181A/ VD Intelligent Speed Adaptation (2001–2006)

Background

Intelligent Speed Adaptation (ISA) is a system that provides information within the vehicle on the speed limit for the road currently being travelled on. That information can be used to display the current speed limit inside the vehicle and warn the driver when he or she is speeding (i.e. Advisory ISA); it can be linked to the vehicle engine and perhaps brakes to curtail speed to the speed limit for the road while allowing the driver to override the system (i.e. Voluntary ISA); or it can be linked to engine and brakes without the possibility of an override (i.e. Mandatory on Non-Overridable ISA).

The technology is of interest because of the known relationship between speed and risk of an accident and also because of the relationship between speed and injury severity in an accident.

Summary

The earlier External Vehicle Speed Control project demonstrated the viability of ISA technology. The Intelligent Speed Adaptation project was commissioned to investigate how drivers would behave when using a Voluntary ISA in everyday car driving. Important issues here were how different types of driver (younger/older, male/female, habitual speeder/non-speeder) would be affected in terms of speed choice by use of the system, how their attitudes to the system would evolve over time, and whether they would revert to their pre-ISA speeding behaviour once the system was switched off.

For the car trials, twenty identical vehicles (Skoda Fabia 1.4 Estate) were equipped with a Voluntary ISA system that limited vehicle speed to the speed limit but which the driver could override. The technical means to do this was through a system that was similar to current satellite navigation technology in that it combined a GPS (Global Positioning System) with a digital road map. However, unlike current SatNavs the map had encoded in it the speed limits for all roads in the trial area and for all the national (trunk) roads, i.e. motorways and major A roads. When ISA was enabled, the system defaulted to being on but the driver could opt out of the ISA system. It operated across the full range of speed limits from 20 mph to 70 mph, so that there was coverage on urban roads, rural roads and motorways. Data on speed, position and system status was recorded at 10Hz.

Four successive trials of six months each were conducted - two in a predominantly urban area (Leeds) and two in a predominantly rural area (southwest Leicestershire). In each area, one trial was with private motorists and one was with fleet drivers. Each driver experienced an initial month with no ISA, followed by four months of driving with ISA, followed by a final month with the system once again disabled. This experimental design allowed the comparison of speed choice while driving without ISA in the first month, with speed choice when driving with ISA active. It also allowed an examination of how drivers

adjusted to ISA over time and whether the experience of ISA affected their driving once the system was switched off i.e. in the final month.

The project examined also examined the feasibility of building a motorcycle with ISA. A number of design alternatives were considered and a mid range motorcycle was then fitted with an ISA system as "proof of concept". Limited trials held on a closed test track to assess ISA functionality and performance as well as user acceptance. Riders were given the opportunity to compare an advisory ISA and an assisting ISA system so that the researchers could compare rider attitudes to and behaviour with the alternatives. Attitudes to an "Information ISA" variant were also considered.

An HGV was also fitted with an ISA system which was adapted from the system used for the ISA car trials used in a short-haul delivery operation. The modified 7.5 tonne rigid truck was used for a field trial involving short-haul commercial operation in South-West Leicestershire.

Finally the project has estimated the potential impact of ISA on future accidents, and has estimated the overall future benefit-to-cost ratios from ISA introduction.

Contractor	**Institute for Transport Studies** **University of Leeds** **Mira Ltd**	
Completion Date	September 2008	
Contact	Enquiries at TTS: Enquiries at University of Leeds:	020 7944 5026 0113 3435348

THEME 2

Secondary Safety

This remains the largest theme in the TTS programme and continues to offer considerable potential for reducing the number and severity of casualties from accidents. Secondary safety can be defined "as all structural and design features that reduce the consequences of accidents as far as possible". Projects under this theme can be considered to fall into three broad areas;

- biomechanics;
- structural crashworthiness; and,
- restraint/safety systems.

These in turn cover specific topics such as the development of crash test dummies for use in regulatory testing, the crashworthiness of cars, Euro NCAP, air bags, seat belts and fixings, seating, child restraint systems and installation, interior fittings, motorcycle helmet safety performance and safer car fronts (pedestrian protection).

Cooperation with international partners brings added value to our research. Under the EU 6th Framework Integrated Project, we continue to support the participation of both Cranfield Impact Centre and the Transport Research Laboratory looking at advanced protection systems.

Completed projects this year included VC-COMPAT which explored car-to-car and car-to-truck compatibility to provide a clear and coherent way forward for addressing vehicle compatibility in Europe and the CHILD (CHild Injury Led Design) project. The output of CHILD enhanced the development of designs, methods, tests and tools to reduce the risk of injuries to children in the future.

The prevention of child casualties was also the focus of research into child restraint systems, in particular the validation protocols for the forthcoming programme of child seat consumer information. The aim of this project was to validate testing protocols and the rating scheme under development within the NPACS (New Programme on the Assessment of Child Seats) research project.

Other completed projects included Rear Impact Dummy Evaluation that compared results of the Hybrid III, Bio RID II and RID 3D under selected sled test conditions and helped form the UK's contribution to international activity aimed at mitigating the frequency and severity of low speed rear impact injuries.

Also completed was a review of Secondary Safety priorities, which reviewed current and past data on accidents and injuries within the secondary safety category. The output from this work will allow TTS to prioritise and target resources to deliver further worthwhile casualty savings. We have undertaken an additional work option within this project to provide data analysis to the European Enhanced Vehicle safety Committee (EEVC) providing evidence for development of European side impact test procedures.

The Department retains its leading role in implementing and supporting safety related consumer information. Motorcycle helmet safety ratings have been published by SHARP - the Safety Helmet Assessment and Rating Programme - set up by the Department in late 2007. SHARP enables riders to more easily select a helmet which matches their needs by providing them with an independent safety assessment of helmets sold in the UK. The SHARP RATING reflects the performance of each helmet model following a series of advanced laboratory tests and rates helmets from 1-5 stars. For passenger cars, the Department continues to support tests conducted under Euro NCAP, which is now firmly established as the definitive guide to vehicle safety and is well known to the car buying public.

Recently Completed Projects

S086D/ VF Improved Injury Criteria

Background

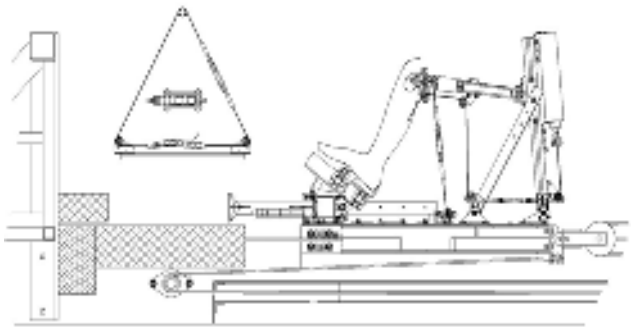
The Improved Injury Criteria Project commenced in June 2000 and was completed by the end of March 2006. Some of the work tasks that were undertaken as part of this project were part funded by the European Commission project FID (Improved Frontal Impact Protection through a World Frontal Impact Dummy). This was an EC Fifth Framework project involving collaboration between six European research institutes (TNO, TRL, BASt, INRETS, University of Madrid and University of Heidelberg).

Vehicle safety can be improved through legislative crash safety requirements as well as consumer testing, through which the results of independent crash tests are published and made available to the general public. In order to ensure that vehicle safety is optimised as far as possible for occupants and vulnerable road users, it is important that the performance measures used to assess vehicles in crash testing are continually improved and relate to real world conditions. These improvements need to reflect changes in vehicle design, advanced safety features and other technological developments, as well as ensuring that the test tool used to assess performance is based on the best available data. The principal objective of the overall Improved Injury Criteria Project programme was therefore to drive the development of safer vehicles in order to reduce the number of injuries to car occupants and pedestrians resulting from road traffic accidents. The prime focus of the project was to generate biomechanical data from PMHS (Post-Mortem Human Subjects) in order to provide the necessary information with which to assess dummy biofidelity and to develop injury criteria. The work was mainly focused on the leg (upper and lower) and material property testing for finite element modelling. The main tasks of the project are summarised below:

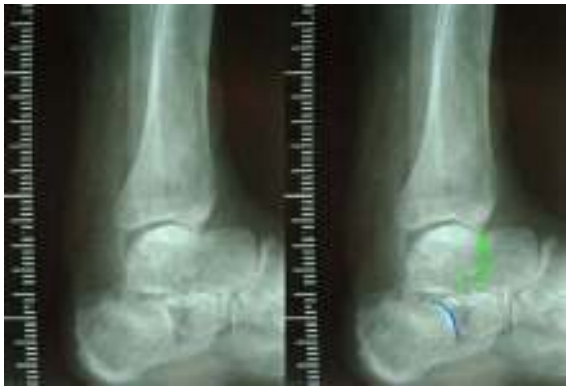
Summary

1. Lower Limb Biomechanical Testing

The results of the lower limb biomechanical testing undertaken at the University of Nottingham have been presented at the 18th International Technical Conference on the Enhanced Safety of Vehicles at Nagoya, Japan and a paper published in the proceedings of the conference. The work, and in particular the injury risk function for axial loading to the foot and ankle that was developed, has also been presented at the European Enhanced Vehicle-safety Committee (EEVC) Working Group 12.



Schematic of sled test assembly showing sled deceleration and foot loading devices



Talar neck fracture (green) and intra-articular fracture of the calcaneus (blue)

2. THOR-Alpha Evaluation

The biofidelity of the THOR-Lx advanced lower extremity was evaluated against target response corridors derived by the EEVC from work by TRL in collaboration with the University of Nottingham. The tests involved pendulum impacts to the ball and heel of the foot at a range of speeds. Subsequently biofidelity requirements (target corridors) were defined for the pendulum acceleration, axial tibial compressive force and tibial bending moment versus time.

The sensitivity of the THOR-alpha thorax and thoracic compression measurements to the position of the diagonal part of the seat-belt was evaluated in a small series of sled tests. It was found that the peak compression measurements in individual regions of both the thorax and abdomen were, as expected, sensitive to the seat-belt lie. However, the overall peak compression measurement at the thorax and abdomen (such as would be used for a compression-based injury criterion) was also sensitive to seat-belt lie and was found to be greatest with the seat-belt in its mid-position. There was less variation in the V*C injury criterion with changes in seat-belt lie.

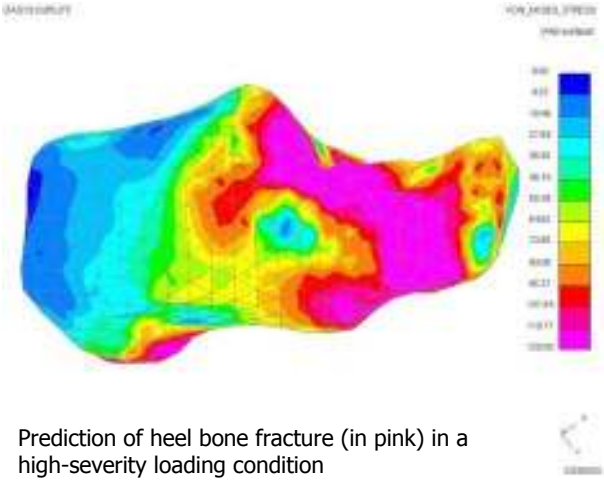
Seat-belt lie sensitivity tests with the THOR-Alpha prototype crash test dummy

3. Material Properties for Numerical Simulation

The aim of this task was to determine the mechanical properties of bone at high strain rates. Tests have been undertaken at the Royal Military College of Science at Shrivenham, with Imperial College responsible for the analysis and reporting. In addition, a confocal microscopy study was performed on the test samples to try and establish the effect of strain rate on the size of the damage region and the microcracking mechanism widely believed to be the cause of bone material non-linear behaviour.

4. Numerical Simulation of the Lower Limb

A lower limb FE model has been developed as part of the project. The model has been updated with new bone and ligament material properties and has been validated in a number of test configurations, based on PMHS tests undertaken by TRL with the University of Nottingham. The updated leg model was then incorporated in a simulation of the lower limb sled tests undertaken earlier in the project. The outcome of the development shows that the model could be used to investigate other loading regimes to assess the risk of injury relative to that identified in the existing PMHS tests.



Prediction of heel bone fracture (in pink) in a high-severity loading condition

Pendulum impactor validation of the finite

5. Upper Extremity Injury Study

The aim of this study was to obtain better quality information about the mechanism and probable cause of upper extremity injuries (clavicle to hand) sustained by front seat vehicle occupants as a result of a road traffic accident. The upper extremity injury study consisted of three programmes: a retrospective injury analysis of hospital records as well as accident data; a retrospective analysis of physiotherapy treatment records; and a prospective study following patients after their admission to a hospital emergency department. This task was completed in 2006. The results of the study have now been presented at the 20th International Technical Conference on the Enhanced Safety of Vehicles in Lyon, France and the supporting paper has been published in the conference proceedings.

Contractors	**TRL Limited**	
Reports	Title	Reference
TRL	FID accident analysis report	PR/SE/240/2001
	Annual report for improved injury criteria 2000-2001	PR/SE/260/01
	Analysis of injury data from the CCIS, SHIPS and TARN databases.	PR/SE/352/2001
	Annual report for improved injury criteria 2001-2002	PR/SE/485/2002
	Review of literature relating to upper extremity injuries	PR/SE/636/2002
	FID Deliverable 2 Part I: Accident analysis based on UK Co-operative Crash Injury Study (CCIS) database. FID EC project report. Contribution to a FID EC project report	
	FID Deliverable 4: Final report WP1 – frontal impact accident analysis	
	FID Deliverable 7: The development of an injury criterion for axial loading to the THOR-Lx based on PMHS testing. FID EC project report	
	FID Deliverable 8/10: Requirements for a frontal impact dummy. Contribution to a FID EC project report	
	FID Deliverable 9: Biofidelity impact response requirements for an advanced mid-sized male crash test dummy. Contribution to a FID EC project report	
	FID Deliverable 11/12: Performance of existing dummies – final summary report. FID EC project report	

	Final report on the lower leg biomechanical and THOR-LX testing conducted for the IIC project THOR-alpha seat-belt, submarining and face sensitivity evaluation. FID THOR evaluation summary report. Biofidelity evaluation of the THOR-Lx. Injury mechanism review. Project report IMR case-by-case.	PR/SE/784/2003 PR/SE/799/2003 PR/SE/831/2004 PR/SE/832/2003 UPR/SE/210/2005 UPR/SE/211/2005
Papers	Title	
	Biofidelity of dummy legs for use in legislative crash testing. Paper presented at IMechE Vehicle Safety 2000 conference Ankle and hindfoot injury in frontal collisions. Paper presented at Stapp 2000 conference Requirements for the evaluation of the risk of injury to the ankle in car impact tests. Paper presented at 17th ESV conference, 2001 The development of an injury criterion for axial loading to the THOR-Lx based on PMHS testing. Paper presented at the 18th ESV conference, 2003 Biofidelity impact response requirements for and advanced mid-sized male crash test dummy. Contribution to an EEVC WG12 paper presented at the 18th ESV conference, 2003 Evaluation of the performance of the THOR-alpha dummy. Contribution to a FID EC project paper presented at the Stapp 2003 conference Upper extremity injury study: recommendations for injury prevention priorities. Paper presented at the 20th ESV Conference, 2007	
Completion Date	March 2006	
Contact	Enquiries at TRL: Enquiries at TTS:	01344 770310 020 7944 5026

S0218/ VC The Co-operative Crash Injury Study - Phase 7

Background

In-depth accident studies provide a vital insight into how people are injured in crashes. In these studies, an examination of a crashed vehicle is correlated with injuries to the crash victims which is then used to determine how people are injured.

One of the world's largest studies of car occupant injury causation is the UK's Co-operative Crash Injury Study (CCIS), which is a programme of research that started in 1983 and continues to investigate real life car accidents.

The objective of the Co-operative Crash Injury Study is to improve car crash performance by:

- developing the understanding of how car occupants are injured in crashes;
- providing information on current vehicle crash-worthiness; and
- identifying the needs for future improved vehicle safety as changes take place.

Examinations of accident-damaged cars where an occupant was injured are undertaken to determine the nature and severity of the damage to the vehicle, and the role of seat belts, airbags and other safety devices. The associated occupant injuries are then matched to the vehicle data and documented in an anonymised electronic database.

Detailed analysis of the CCIS database helps ensure that future cars will be designed to perform better in real life crashes. A better understanding of how people are injured will lead to safer cars, better restraints, better crash test dummies and improved laboratory crash test techniques.

The database can be analysed to allow the types, frequency and nature of injuries and their causes to be correlated with the vehicle damage and safety devices. Good safety features, which are preventing or reducing injuries can be identified or developed.

Summary

Phase 7 of this ongoing research project began in December 2002 and ran, with a two month extension, until January 2006. The project was managed, on behalf of the DfT, by TRL Ltd who oversaw all aspects of the project including the contracts for all except VOSA. Investigation teams from Birmingham University, Loughborough University provided vehicle investigations in their areas with additional resources provided by VOSA teams. VOSA, under the guidance of TRL Ltd, cover 5 additional areas of Manchester, Staffordshire, Warwickshire, Bristol and Hampshire. These 7 teams between them investigated over the life of the project 2,665 case accidents, 3,548 examinations of vehicles which contained 5,483 occupants.

For an accident to be eligible for the study it must contain AT LEAST ONE VEHICLE, which fulfils the following conditions:

- The vehicle must have crashed within the investigation team's area;
- The vehicle is a car or car derivative (car derived van etc.);
- The vehicle must have been less than **SEVEN** years old at the time of the accident;
- The vehicle must have at least **ONE** occupant who is injured (according to the police). It should be noted that this does not necessarily mean the person has had to visit hospital;
- The vehicle should have been towed away from the scene of the accident.

The maximum severity (as recorded by the police) in the case vehicle or case vehicles then dictates whether or not an accident is selected for examination using the following selection table:

Severity of case vehicle (as specified by the police)	Inspection Selection
FATAL	All accidents
SERIOUS	All accidents
Slight	A random sample of accidents, from vehicles with a maximum age of 7 years

Once an accident has been selected, all available cars (and car derived vehicles) involved in that accident must be examined, regardless of whether or not they meet the other selection criteria. It is important to gain the impact dynamics of both vehicles in a car-to-car impact.

Contractors	TRL Limited	
Reports	Title	Reference
	Phase 7 – End of Phase Project Report	TRL658
	Behaviour of SUV and MPV-type Vehicles in Collisions with Roadside Safety Barriers	
	An Estimation of the Costs and Benefits of Improved Car to Car Compatibility on a National and European Scale	
	Identification of Casualty Reduction Priority for the Occupants of Recent Model Cars Based on the UK Real World Crash and Injury Data Traffic Injury Prevention	
	Development of EuroNCAP Tests and Rating Based on Real Crashes	
	Airbags and Driver Seating Position – A finite Element Modelling Approach	
	An Assessment of Cars for Small Drivers	PPAD 9/33/85
Papers	Title	
IMechE	Initial Observations on Side Airbag Deployments in the UK Journal of Automotive Engineering	
Ashgate Publishing Co.	Woman Drivers, Passengers and the Road	
IRCOBI 2004	Comparison of Vehicle Compatibility Issues in US and UK Fleets	
Trauma 2004	Thoracic Aortic Injury in Motor Vehicle Crashes – The effect of Impact Direction, Side of Body Struck and Seat Belt Use	
AAAM 2004	Factors Related to Serious Injury in Post NCAP European Cars Involved in Frontal Crashes	
IMechE 2004	An Assessment of Airbag Deployment for Small Drivers	
IMechE 2004	BOSCOS Bone Scanning for Occupant Safety	
ICRASH 2004	Injury Outcome in Pole/Tree Crashes	
Road Safety Seminar 2004	Mechanistic Approach to Road Traffic Accident Investigation	
Traffic Accident Investigators	The Benefits of Intrusion Resistance Glazing	

IRCOBI 2003	Initial Field Experience of Side Airbag Protection Systems in the UK	
IRCOBI 2003	Real-World Crash Performance of Recent Model Cars – Next Steps in Injury Prevention	
IRCOBI 2003	Requirements for the Crash Protection of Older Vehicle Occupants	
IRCOBI 2003	The application of Injury Scaling to Vehicle Crash Research	
AAAM 2003	Requirements for the Crash Protection of Older Vehicle Passengers	
Great Britain Statistics 2003	Improvement of Rollover Safety for Passenger Vehicles	
AAAM 2003	The Effect of Height on Injury Outcome for Drivers of European Passenger Cars	
ESV 2003	Crash Testing for Real-World Safety – What are the Priorities for Casualty Reduction	
ESV 2003	Multiple Two-Impact Crashes – Implications for Occupant Protection Technologies	
Traffic Injury Prevention	A preliminary Analysis of Aortic Injuries in Lateral Impacts	
ITAI Paper 2003	The Risk of Car Occupant Spinal Injury for Crash Type and Severity	
Completion Date	January 2006	
Contact	Enquiries at TRL: Enquiries at TTS:	01344 770178 020 7944 5026

S0220/ VF Development of Harmonised Side Impact Test Procedures

Background

Research into the development of enhanced side impact test procedures has been supported by the Department for Transport for a number of years. Much of this support was channelled into research coordinated by the European Enhanced Vehicle Safety Committee (EEVC) Working Group 13 (WG13), which researchs side impact protection. WG13 was tasked with supporting the International Harmonisation of Research Activities (IHRA) Side Impact Working Group (SIWG) in developing a suite of test procedures for advanced side impact protection. This research programme was undertaken to continue the support provided by DfT in the development of global harmonised side impact test procedures. In particular, the programme investigated the development of a full scale side impact mobile deformable barrier test procedure and a sub-system interior surface test procedure.

Phase 1 in the development of side impact test procedures was concluded and reported at the Enhanced Safety of Vehicles (ESV) conference held in Nagoya, Japan in May 2003, where it was presented on behalf of EEVC WG13. The Phase II programme covered the period between the ESV conferences of 2003 and that held in Washington DC, USA during June 2005 where two status reports combining Phases I and II of the research were presented on behalf of EEVC WG13. In addition to the research conducted under this project, the ESV 2005 reports included information submitted by the other members of the side impact working group. This report concluded the research performed under Phase II, which built upon the knowledge and recommendations from Phase I. TRL, through EEVC WG13, also contributed to the IHRA SIWG status report, which was presented at the 2005 ESV conference.

Summary

AE-MDB development

A specification for an Advanced European Mobile Deformable Barrier face (AE-MDB) was developed under Phase 1 and termed the AE-MDB specification version 1 (v1). The AE-MDB was further refined to specification version 2 (v2) so that it mirrored the build changes that had been included in the revised version of the UN-ECE Regulation No. 95 (R95) barrier face. In addition to this, Phase II testing utilised the updated anthropomorphic test device (ES-2 dummy) for the evaluation of the test procedure and barrier face.

The cell stiffness profiles of the AE-MDB v1 were based upon test data obtained from car to rigid load cell wall (LCW) tests supplied by the Japan Automobile Research Institute (JARI). Similar tests were performed by EEVC WG13 using popular European vehicle models to provide additional support to the barrier stiffness profiles. This project evaluated the Toyota Corolla and Land Rover Freelander. The results of the JARI and EEVC WG13 data sets gave a good comparison with each other and the stiffness corridors of the AE-MDB v1 and v2. A final rigid LCW test was performed using an AE-MDB v2 barrier in order to confirm that the correct specification of barrier could be built prior to its use in the validation programme. The results showed a good comparison between both specifications of the AE-MDB.

Baseline car to car full scale crash tests were performed in Phase 1, to provide an indication as to the real world side impact situation and the impact severity that a barrier based test procedure should replicate. Additional baseline vehicle tests were performed in this programme, to expand upon the information available from Phase I. A Toyota Corolla was chosen as the target vehicle for use in this project and the results were compared to those of the previous baseline tests to the Renault Megane and Toyota Camry.

A final series of AE-MDB v2 to car tests were performed to allow for an assessment of the barrier design specification to be made. Tests to a Toyota Corolla, Renault Megane and Toyota Camry were performed under this project and compared with the results of other tests performed by EEVC WG13 members. The results showed that the AE-MDB v2 barrier face gave greater levels of differential loading than the baseline vehicles. This was indicated by higher levels of post test intrusion either side of the target vehicle B-pillar, and a lower level of B-pillar deformation.

Interior surface test procedure development

EEVC WG13 presented an update of the latest developments in the production of a European interior surface test procedure at ESV 2003. Prior to the Phase I status report, evaluations of the procedure were undertaken by the UK and other members of the working group and improvements / updates were incorporated into the existing procedure. At the time of the ESV 2003, the procedure was at an advanced stage and only a small amount of

testing was performed as part of this project. A finalised procedure was submitted to the EEVC Steering Committee at the end of 2004 for them to consider and to take forward as appropriate.

The work undertaken for Phase II largely consisted of textual modifications in the headform orientation and the development of limitation angles. A small series of testing was undertaken within this programme to investigate further a definition of 'worst case' impact points, which are specifically targeted within the procedure. The procedure was also extended to take into account vehicles equipped with active head protection devices such as curtain airbags. EEVC WG13 agreed that the interior surface test procedure should not penalise or prevent the addition of such systems.

The EEVC WG13 procedure was extended to include the assessment of deployed head airbags as proposed by the German Federal Highway Research Institute (BASt) and the EEVC Steering Committee suggested some alternative approaches to certain elements of the procedure, which were also included.

EEVC WG13 is continuing development of these procedures for regulation.

Contractor	**TRL Limited**	
Reports	Title	Reference
	Initial regulatory impact assessment: European interior surface test procedure.	UPR/SE/044/04
	Partial regulatory impact assessment: European interior surface test procedure.	UPR/SE/066/04
	Partial regulatory impact assessment: Lateral impact mobile deformable barrier test procedure.	PR SE/067/04
	Initial regulatory impact assessment: Lateral impact mobile deformable barrier test procedure.	PR SE/774/03
	Development of Improved Global Harmonised Side Impact Test Procedures.	UPR SE/245/05 Final Report
Papers	Title	Reference
	Progress on The Development of an Advanced European Mobile Deformable Barrier Face (AE-MDB).	A Roberts - Paper 126 ESV 2003
	The Development of an Advanced European Mobile Deformable Barrier Face (AE-MDB).	J Ellway - Paper 05-0239 ESV 2005
Completion Date	March 2007	
Contact	Enquiries at TRL:	01344 770852
	Enquiries at TTS:	020 7944 5026

S0223/ VF & S0231/ VF Proposed Reduction of Car Crash Injuries Through Improved Smart Restraint Development Technologies (PRISM)

Background

Car secondary safety has improved markedly over recent decades as a result of both improved car design and improved occupant restraint systems (seat belt pre-tensioners and airbags). However, there are still incentives to improve the level of protection provided by the occupant restraint system. The effectiveness of the restraint system depends on many factors, such as the severity of the crash, the type of crash and the characteristics of the occupant. Adaptive or "Smart" systems, are those which are capable of adjusting the response of the restraint system to these variables in order to provide a greater level of protection to a wider range of occupants in a greater range of crash types.

The PRISM project (Proposed Reduction of car crash Injuries through SMart restraint development technologies) was part funded by the EC under the 5th Framework research programme and consortium members included a vehicle manufacturer, tier 1 suppliers of restraint systems, Research Organisations and two academic partners (see the official website www.prismproject.com for further details). Together, the consortium members have a presence in at least nine member states. The project developed computer models for specific injury mechanisms noted from real world accident data which will assist manufacturers in designing and developing effective adaptive or "smart" restraint systems. The department supported two research organisations for this work; TRL and MIRA.

Summary

The objectives of the project were to investigate the likely future societal and financial benefits of implementing "smart" restraint system technologies and to develop guidelines on how to assess and validate the performance of these systems. Current legislative and consumer automotive impact tests typically assess the injury risk to a 50th percentile dummy in a standard posture under a limited range of impact conditions. However, the potential variables influencing a real occupant's injury risk are far greater and include variations in the impact conditions (speed and direction) in addition to the physical characteristics and posture of the occupant. In order to cope with the wider circumstances influencing an occupant's injury risk "smart" restraint systems are required which adapt to the specific impact conditions and react to different occupant types, positioning and biomechanical tolerances to injury.

The project identified specific occupant cases which, when used as a product specification, would assist manufacturers in designing and developing "smart" restraint systems, which offer improved performance over a wide range of occupant and impact scenarios.

The project delivered the following:

- a review of current "state of the art" restraint systems and patent search to examine future technologies;
- a review of current restraint features fit in European cars and associated crash test data relating to performance in regulatory and consumer testing;
- data analysis of European accident databases to determine the important accident types which result in occupant injury;

- photographic studies of "real-world" occupant positioning from five European countries to determine how occupants sit in cars, and the identification of the types and frequency of occupant "out-of-position" cases;
- a simulator study to assess pre-impact occupant kinematics, for use in determining performance requirements of smart restraint sensor and control systems;
- identification of the important injury types categorised into "injury scenarios". These injury mechanisms were then used to assess how "smart" restraint systems might be developed to mitigate these injuries;
- three MADYMO compartment models, representing the confines of a generic super-mini, small family and midi-MPV vehicles;
- numerical simulations to estimate the potential benefits that advanced restraint systems might have in reducing occupant injury risk in the identified "injury scenarios". A range of driver and front seat passenger postures (as identified in the photo study and pre-impact studies) were assessed. A restraint adaptation study was also carried out in order to improve the response of the restraint system to a range of occupant sizes and suggested that considerable reductions in predicted occupant injury risk were possible (65% were achieved for the 95th percentile human body model);
- a comparison of the critical injury scenarios identified with existing (global) legislation and standards in order to formulate improved guidelines for defining and assessing the functional requirements of "smart" restraint systems;
- assessment of the potential benefits which might be realised from "smart" restraint systems; and
- a series of data sheets on each of the ten identified injury scenarios, providing information on injury mechanisms, injury causation, frequency of injury, as well as recommendations for test and evaluation strategies.

Contractors	**MIRA Limited TRL Limited**	
Reports	Title	Reference
MIRA	Occupant Behaviour During Pre-Impact Braking - Car Passengers.	04115024
TRL	Proposed Reduction of car crash Injuries through improved SMart restraint development technologies (PRISM) Final Report.	UPR/VE/010/05
	Proposed Reduction of car crash Injuries through improved SMart restraint development technologies (PRISM) A Summary of the DfT Contribution (January 2003 to August 2004).	UPR/SE/105/04
Completion Date	January 2006	
Contact	Enquiries at TRL:	01344 770199
	Enquiries at MIRA:	024 7635 5127
	Enquiries at TTS:	020 7944 5026

S0225/ VF New Programme for the Assessment of Child restraint Systems (NPACS)

Background

Child Restraint Systems (CRS's) can essentially be of three types; those intended for use in specific vehicles, those that can be used in a range of identified vehicle models and those intended for universal use. The universal category CRS is almost unique as a safety device in that the fit and safety performance is dependant on the local environment into which it is fitted i.e. the car. However, the ability to transfer this safety device from vehicle to vehicle is seen as an essential characteristic. Thus it is seen as important to be able to assess how well the CRS performs when fitted to a range of vehicle seats and other test environments.

In Europe, CRS's are evaluated for crash safety by testing to European Regulation 44. This ensures a minimum safety performance in a single impact test condition. Since this is a universal minimum safety level, all products sold must comply with these requirements. Regulation 44 provides very little assessment of the ease of use and misuse of child restraint systems, which is seen as a role for consumer groups. Consequently, the tests included within this Regulation cannot be used to provide guidance to parents on the relative performance of child restraints.

There are currently at least three different assessment methods being used within Europe to provide consumers with advice on the selection of a CRS and they produce differing results and hence conflicting advice. This is seen as confusing and it is considered that a single well-founded assessment method would have considerable advantages.

The objectives of NPACS were therefore to provide independent published guidance to consumers on the relative protection afforded by CRSs which can be used in a wide range of road vehicles. This is through reliable methods of dynamic testing, assessment of their ease of use and regular European evaluation of the performance of these products.

Summary

This research programme was undertaken by a consortium funded by a number of different bodies including; National Governments within Europe, the European Commission, European Consumer Groups, European Motoring Clubs, the FIA Foundation and the Insurance Industry.

The contractor took part in the following activities:

- Usability and Misuse. The contractor collated all known current methods for the assessment of usability and misuse of child restraints, drew comparisons and identified the relative advantages and disadvantages of each method. A candidate assessment method was evaluated and, based on these results, the preferred test method chosen;
- Dynamic Performance. The contractor collated all known current methods for the assessment of dynamic performance of child restraints both within Europe, the UK and outside Europe, and draw up comparison tables. These were submitted for comparison with other partner's findings and assessed to identify the relative advantages and disadvantages of each method. The candidate assessment method and selected vehicle seats was evaluated and, based on these results, a test and calibration protocol developed;
- Front Impact. Based on the findings of the above activities, two test benches were developed to cover the range of variables observed. Test conditions were selected based upon the evidence available and through technical working group discussions;

- Side Impact. The contractor performed sled tests, which were compared to other partner tests. The preferred test procedures were selected based upon the evidence available and through technical working group discussions; and
- Rating Scheme. The contractor reviewed all known rating schemes for child restraints in Europe, the UK and outside of Europe. These were submitted for comparison with other partner's findings and assessed to identify the relative advantages and disadvantages of each rating scheme. The preferred rating scheme was selected through Technical Working Group discussions.

This collaborative research worked towards a set of protocols for testing and rating child restraints for universal use, or for use across a wide range of vehicles. It was designed to provide the information needed to develop a modern rating scheme, based on the most recent and relevant data. The UK contribution to finalising these protocols was carried out under S0447/V8.

Contractor	TRL Limited	
Reports	Title	Reference
	NPACS (New programme for the Assessment of Child restraint Systems) Phase 1 Final Report. Initial Regulatory Impact Assessment – New Programme for the Assessment of Child restraint Systems (NPACS).	PPR145 UPR SE/153/05
Papers and presentations	Title	Reference
	"Progress on the Development of the Procedures for the Consumer Testing of Child Restraints – NPACS", Protection of Children in Cars International Conference, Cologne, Germany, September 14-15, 2004. "Aims of the New Programme for the Assessment of Child restraint Systems" Protection of Children in Cars, International Conference, Cologne, Germany, July 2003.	
Completion Date	April 2006	
Contact	Enquiries at TRL: Enquiries at TTS:	01344 770980 020 7944 5026

S0414/ V8 'A' Pillar Obscuration: An On the Spot Study to Quantify the Problem

Background

In recent years the introduction of improved vehicle safety legislation and the enhanced role of consumer testing in car design have had a significant effect in reducing the injuries to car occupants in crashes. This has promoted a number of design changes to the structures of

cars. A consequence of these structural improvements is that car design, in relation to the windscreen, forward roof supports and front door frames, has changed significantly, with an increase in width and size of the pillars on either side of the windscreen, commonly called 'A' pillars.

Summary

The scope of this study was to assess if there is a problem caused by car 'A' pillar obscuration preventing drivers seeing other road users in the real world, and to start to quantify the size of that problem. This was achieved by using real world crash data to construct 3-D visualisations to provide a graphical illustration of the obscuration caused by the car 'A' pillar. The real world crash data used in the study was obtained from the On The Spot (OTS) crash study (VOSA Accident Database, project reference S0053/VC) from cases where the 'A' pillar could have been a contributory or causative factor.

Ten in-depth reconstructions were undertaken and 3-D simulations produced. Interrogation of these ten crashes showed that six of them potentially involved 'A' pillar obscuration as a contributory factor. Further evaluation of the accidents resulted in the research team identifying that four of the cases may have been caused, at least in part, by 'A' pillar obscuration. The cases were discussed within the report and visually highlight that 'A' pillar obscuration could be a crash causation mechanism.

In addition to the 3-D modelling work, a detailed literature review of current legislation and research regarding 'A' pillar obscuration was carried out.

The OTS Phase 1 database contains 1,513 collisions and these were analysed to investigate the incidence of car driver 'A' pillar obscuration. Collisions selected as potentially being associated with 'A' pillar obscuration were more likely to occur at T-junctions and are more likely to involve car drivers failing to see vulnerable road users (motorcyclists, pedal cyclists and pedestrians). However, it was not possible from the information contained within the OTS Phase 1 database to routinely identify if the selected "Looked but Did Not See" accidents were specifically caused by the 'A' pillar rather than observational failures on the part of a driver, or other external environmental factors.

The work to date highlights that car 'A' pillar obscuration could be a contributory factor in some road traffic crashes. However, there is rarely only one factor that contributes to an accident.

The report found there is not enough evidence at this stage to suggest changes to the current legislation. However, the EC legislation currently assesses cars based on a 50th percentile male and the visualisations have suggested consideration could be given to smaller and larger drivers.

Figures 1 & 2: The view from the perspective of a car driver as he manoeuvred from a junction

Contractors	TRL Limited	
Reports	Title	Reference
	A-pillar study: An 'On The Spot' study to quantify the size of the problem – Literature Review A-pillar study: An 'On The Spot' study to quantify the size of the problem – Final Report	UPR/SE/212/05 PPR159
Completion Date	August 2006	
Contact	Enquiries at TRL: Enquiries at TTS:	01344 770179 020 7944 5026

S0447/ V8 Additional Work to Deliver NPACS Protocols

Background

The New Programme for the Assessment of Child restraint Systems (NPACS) Phase 1 project included the development of a complete set of testing protocols and rating schemes for a consumer information programme. The UK contribution to the original NPACS Phase 1 project was completed under DfT contract: SO225/VF (PPAD 9/033/128). The front impact, side impact, usability and rating protocols were partially developed based on research conducted in the NPACS Phase 1 research programme. In order to ensure that the protocols were completed and available on schedule, the DfT, along with TRL, led the NPACS European consortium in the development of the final NPACS protocols by taking responsibility for developing the front impact, side impact, and rating protocols. The complete set of test and rating protocols is available in the final report (PPR146)

Summary

This Project finalised the test and rating protocols that were partially developed for the original NPACS Phase 1 project. The assessment includes aspects of usability and the performance in frontal and side impacts. A rating scheme has been proposed which will convert the results of the separate assessments into a performance rating in five levels. The testing and rating protocols conclude the NPACS Phase 1 research programme.

While this research has been directed at the development of assessment techniques to provide consumers with reliable rating of child restraints, where appropriate the research results have fed into EEVC WG18 (www.eevc.org) on child restraints and the EC CHILD (www.childincarsafety.org) project.

Contractors	TRL Limited	
Reports	Title	Reference
TRL	Additional Work to Deliver NPACS Protocols – Final Report	PPR146
Completion Date	April 2006	
Contact	Enquiries at TRL: Enquiries at TTS:	01344 770980 020 7944 5026

S222C/ VF Pedestrian Protection - Test Procedures and Design

Background

Pedestrian injury is a major area for improvement in tackling road safety because pedestrians represent a significant proportion of all road user casualties. In 2003 the European Parliament and Council approved a Directive (2003/102/EC), which requires new cars to provide pedestrian protection. The Directive has two main stages, the first stage came into effect from October 2005 and a second, higher level of protection will be required from 2010. It requires new car types to undergo a series of tests using instrumented dummy body parts impacted against the sections of the car they would be likely to strike in the event of an actual pedestrian accident. The test procedures in the Directive reflect test methods that were developed by the European Enhanced Vehicle-safety Committee (EEVC), by the EEVC working groups WG10 followed by WG17.

TRL had been involved in these working groups throughout, funded by the UK Department for Transport, and this project provided support for the continuing UK contribution to the EEVC WG17. The project also supported the work of the International Harmonization of Research Activities Pedestrian Safety Working Group (IHRA PSWG) by providing part of the European (EEVC WG17) contribution. The aim of the IHRA PSWG was to build on the work of EEVC and others to produce improved harmonised pedestrian test methods and tools suitable for a wider range of vehicle shapes that covered all parts of the vehicle front likely to seriously injure pedestrians (as a first step, the EEVC procedures and the Directive are only for the front of the vehicle up to the base of the windscreen).

Summary

Following on from the work of earlier DfT pedestrian protection projects, this project has been primarily focused on supporting the second, more demanding stage of the EC Directive and the harmonised research activities of the IHRA PSWG. The main tasks of this project were:

With regards to the EC Directive, to:

- determine the effect of humidity on the performance of the flesh of the lower legform impactor in the certification test, and to propose humidity tolerances and revised certification corridors;

- produce a revised upper legform test velocity look-up graph, with suitable adjustments to maintain a minimum impactor mass of 9.5 kg when used in conjunction with the new energy look-up graph;

- adapt the 4.8kg head certification method for a 4.5kg headform and propose pass/fail corridors; and
- assist in integrating the proposed changes in the test methods.

With regards to the IHRA test methods to:

- carry out an accident study to support further research to extend test procedures to cover the windscreen frame;
- participate in the development of a mathematical pedestrian model with good bio-fidelity by developing an improved representation of the human shoulder. This model is initially intended to obtain appropriate head impact conditions, but with further development may be used for other tests; and
- participate in the development of IHRA test methods.

Contractor	**TRL Limited**	
Reports	Title	Reference
	Development of a biofidelic shoulder for the IHRA (JARI) pedestrian model.	UPR/SE/041/04
	Evaluation of the leaf spring certification test for the EEVC WG17 legform impactor.	PR/SE/900/04
	The effect of humidity on legform impactor certification results.	PPR048
	Assessment of the FTSS 4.5 kg aluminium headform as a possible alternative for EEVC WG17.	PPR052
	TRL component tests for the EEVC WG17 pedestrian legform impactor.	EEVC WG17/ Doc 230
	Windscreen frame benefit study.	EEVC WG17/ Doc 265
Papers	The next steps for pedestrian protection test methods (19th ESZ Conference 2005).	Paper 05-0379
	Development and evaluation of a biofidelic shoulder for the IHRA (JARI) pedestrian model (19th ESV Conference 2005)	Paper 05-0096
Completion Date	January 2006	
Contact	Enquiries at TRL:	01344 770675
	Enquiries at TTS:	020 7944 5026

S240C/ VA EEVC and IHRA Web Site Management

Background

The EEVC steering committee co-ordinates vehicle-safety research activities in a number of areas and has Working Groups in the following areas:

- crash test dummy development;
- side impact test procedures;
- under-run;
- compatibility;
- pedestrian safety;
- child safety;
- primary and secondary safety interaction;
- rear impact;
- accident studies; and
- virtual testing.

Summary

This small project was set up to develop and administer a web site (www.eevc.org) to support the activities of the EEVC.

The web site provides a forum for planning, documenting and publishing the activities of the EEVC Working Groups as well as communication within and between the Groups. The web site has proved to be an invaluable medium for enabling communication within the EEVC.

During the project, the scope was extended to provide similar technical support for the International Harmonised Research Activities (IHRA) collaboration, an international group whose mission is to provide the automobile and light truck community (governments, industry, academia, and consumers) with harmonised research from throughout the world. IHRA is an off shoot of the Enhanced Safety of Vehicles Conference.

The IHRA web site (www.ihragroups.org) was set up to service the needs of the five working groups:

- Biomechanics;
- Compatibility & Frontal Impact;
- Pedestrian Safety;
- Side Impact; and
- Intelligent Transport Systems.

IHRA research activities ceased in 2005 as did the web site.

Contractor	TRL Limited	
Completion Date	March 2006	
Contact	Enquiries at TRL: Enquiries at TTS:	01344 770310 020 7944 5026

Ongoing Projects

European New Car Assessment Programme

Euro NCAP, the New Car Assessment Procedure, was set up to evaluate the safety performance of vehicles currently on sale using full scale testing and supplying the results to the public in the form of consumer information.

Established in 1997 following an initiative by the former Department of Transport, Euro NCAP is now an independent organisation backed by seven European Governments and various European motoring, insurance and consumer organisations. It has also been funded by the European Commission. Following its inception, Euro NCAP rapidly became a catalyst for encouraging significant safety improvements to new car design and continues to be highly effective in driving safety improvements as car manufacturers continue to strive for better results.

Since its inception, Euro NCAP has continued to reward vehicle manufacturers meeting more demanding requirements. In 2000, a new optional test was offered to recognise the increased use of head protection airbags across manufacturer model ranges. This new test meant a greater potential score was possible and a fifth star was added to the rating. Further changes have included rewarding manufacturers for equipping vehicles with systems to remind occupants to buckle-up their safety belts – the seat belt remaining the cars most effective safety feature. The crash tests have always incorporated child crash test dummies, representing a 1½ and a 3 year old child restrained in manufacturer recommended child restraints on the rear seats. Recently, a specific star rating for child protection was introduced; this incorporates assessments of the fitting instructions for the child seats, a car's ability to accommodate them securely and the performance of the chosen child restraint in the front and side impact tests.

S0046/ VC Euro NCAP car purchases

Summary

Prior to each phase of testing, the Euro NCAP secretariat presents a list of car models (existing and new) from which the department will select its preferred test models. In preparing the list, the contractor will consider which new models have been released and the version chosen for evaluation will be based on the actual or anticipated sales volume.

Actual test vehicles are then randomly selected by the Euro NCAP secretariat. They are a representative sample of the build standard generally available to the consumer at the time when test results are launched to the public. The Euro NCAP Secretariat arranges the purchase of cars and the logistics from the supplier to the test house.

This project provides the funding for the Department's contribution of vehicles (one each for frontal and side impact testing) and the relevant components to be purchased for use in the Euro NCAP (S0048/VC).

Contractor	Euro NCAP Secretariat	
Contact	Euro NCAP Secretariat (Belgium):	022 868040
	Enquiries at TTS:	020 7944 5026

S0047/ VC Provision of Expert Support for Euro NCAP

Summary

The test protocols and assessment criteria used by Euro NCAP are continuously developed to reflect and encourage the progression of occupant and pedestrian protection. This project provides expert scientific and technical advice for the Department's input into the future development of test procedures and assessment protocols on a call-off basis.

It involves support for the Department as requested at meetings of the Euro NCAP Board of Directors, Technical Working Group and its technical sub-groups.

Contractor	TRL Limited	
Completion Date	Ongoing	
Contact	Enquiries at TRL: Enquiries at TTS:	01344 770310 020 7944 5026

S0048/ VC Euro NCAP New Car Assessment Procedure Testing

This contract provides for the testing of vehicles in Euro NCAP accredited facilities. Once the testing is complete, the data is analysed and assessed according to the latest Euro NCAP assessment protocol and biomechanical criteria and a star rating assigned. The results of tested models are grouped and disseminated through official Euro NCAP launches.

The Department funded vehicles are as follows:

Phase 13:	Mazda 2	Audi A3			
Phase 14:	Honda Jazz				
Phase 15:	BMW 5 Series	Skoda Octavia			
Phase 16:	Fiat Stilo				
Phase 17:	Seat Leon				
Phase 18:	Honda Civic				
Phase 19:	Peugeot 207cc				

All vehicles achieved a four star adult occupant protection rating, except the Peugeot 207cc which achieved the maximum five stars. The MG TF, Honda Jazz, Seat Leon and the Honda Civic all achieved a three star rating (out of a maximum of four) for pedestrian protection with the Peugeot 207cc achieving one. The BMW 5-Series, Skoda Octavia, Seat Leon and Honda Civic achieved four star ratings (out of a maximum of five) for child occupant protection with the Audi A3, Mazda 2 and Honda Jazz scoring three stars. The Peugeot

207cc was exempted from the child protection rating due to insufficient room to fit a child seat in the rear passenger seats.

Contractor	TRL Limited	
Completion date	ongoing	
Reports	Reports available from Euro NCAP website: www.euroncap.com	
Contact	Enquiries at TRL: Enquiries at TTS:	01344 770852 020 7944 5026

S0126/ VF CHILD: Advanced Methods for Improved Child Safety

Background

Each year, approximately 1,000 children are killed on European roads and 80,000 are injured. This produces an unacceptably high burden on Europe's society and economy. Despite a high rate of ECE Regulation 44 compliant child restraint system (CRS) use, these figures demonstrate the need for the European Commission supported CHILD project. It is only through an increase of the basic scientific knowledge of child biomechanics that major steps can be made towards improved standards and more efficient design of CRSs.

The prevention of injuries that result in major permanent disability has important social implications. Furthermore, the reduction of injury severity leads to lower costs of medical care and hence lower costs to society. A European-wide effort is needed in order to produce an effective reduction in these areas. As such, the EC CHILD project will endeavour to meet this challenge and, at the same time, safeguard the employment of European based automotive related industry.

The overall CHILD project aims to enhance the development of designs, methods, tests and tools that will reduce the risk of injuries to children. Without this research, information would not be fed into the CRS manufacturers and organisations such as ISO, IHRA, EEVC and regulatory bodies which could lead directly to an increase in safety for child occupants travelling in vehicles.

Summary

The Department is funding TRL to participate in this European consortium project in the following areas:

- investigation into the misuse, inappropriate use and non-use of CRSs in vehicles;
- selection and analysis of accident cases for reconstruction;
- experimental full-scale reconstruction of accidents;
- evaluation of the quality of the tests performed, and
- development of injury criteria and standards.

These activities will contribute to the following scientific objectives:

Sled test

- to gain a better understanding of real world crashes and the associated injury outcomes experienced by child occupants, through real world crash investigations and full scale reconstruction of a selection of these cases;
- to evaluate the kinematics of children in different types of impacts for different ages of children and for different types of child restraint systems;
- to consider the consequences of interactions of restrained children with "new smart restraint systems" designed for the adult population, such as pre-tensioners, frontal and lateral airbags etc;
- to obtain data necessary to consolidate further, or establish child injury criteria and child injury risk curves; and
- to disseminate the research into other EC and national projects and associated networks.

The technical investigations within this project are complete and the project team is in the process of writing these up into the project final report.

This project also included technical support to the Department for its participation within the EEVC Working Group 18 – Child Safety.

Further information on the CHILD project as well as reports and publications, is obtainable from: http://www.childincarsafety.com.

Contractor	TRL Limited	
Completion Date	April 2008	
Contact	Enquiries at TRL: Enquiries at TTS:	01344 770980 020 7944 5026

S0316/ VF Review of Secondary Safety Priorities - Selected Option

Background

Upon completion of the main project requirements for SO316/VF Review of Secondary Safety Priorities (project report available at http://hdl.handle.net/2134/2333) a further selected option is being undertaken.

Main Objective

To analyse detailed road accident data to determine the evidence base for improvements in side impact protections, in support of the Department's policies on improving vehicle occupant protections and better regulation.

Picture of Crash test with AEMDB version 3.9 (50 km/h)

The data analysis is being carried out collaboratively with other European countries within the European Enhanced Vehicle Safety Committee (EEVC) Working Group 21 (Accident data) in support of the EEVC Working Group 13 (Side Impacts) activities,

specifically the modification of the current European side impact regulation and the development of a new regulatory pole impact test.

The purpose of the EEVC Working Groups is to provide the EEVC Steering Committee (of which the Department is a member) with impartial advice, based upon scientific evidence, in order to support the development and enhancement of European safety standards and legislation. The specific activities of the Working Groups will be as directed by the Steering Committee from time to time.

EEVC Working Group 13s general remit is to provide advice concerning measures to reduce the risk of injury to road vehicle occupants in the event of a side impact.

EEVC Working Group 21 is tasked with providing analytical data to support the general activities in EEVC Working Groups. In this instance to assist Working Group 13 to understand more about specific issues in side impact crashes within the European Union.

The Department is providing funding to support this collaborative project.

Summary

Data analysis is being undertaken in 6 work packages relating to car side impacts.

WP1 Overview Analysis: Placing side impacts in the context of all car impacts. Determining the relative importance of car to car and car to pole side impacts among all side impacts.

WP2 Car-to-car Side Impacts: Reviewing the nature and consequences of car to car side impacts with a focus on newer post UN-ECE Regulation 95 vehicles and struck side occupants. Examining real world crash characteristics in relation to the current regulatory test conditions and MDB (Mobile Deformable Barrier). Examining real world crash characteristics in relation to those of the proposed AEMDB (Advanced European Mobile Deformable Barrier) and revised test conditions.

WP3 Car-to-pole Side Impacts: reviewing the nature and consequences of car to pole side impacts with a focus on newer vehicles.

WP4 Non-struck Side Occupants: an overview of the consequences for non struck side car occupants in side impacts.

WP5 Advanced Technologies: a review of the potential benefits that advanced technologies might present to reduce the number of side impacts or to mitigate the consequences.

WP6 Head Injury Causation: a review of contact points by the head in side impacts and the level of associated injuries.

The analyses are being carried out using both National and in-depth data sets with the UK, Germany, France and Sweden making contributions.

Contractor	Ergonomics and Safety Research Institute (ESRI) Loughborough University	
Completion Date	March 2008	
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S0419/ V8 Advanced PROtection SYStems (APROSYS) (TRL)

Background

As part of its strategy for achieving reductions in road traffic accidents, the EC has part funded a major project called Advanced Protection Systems (APROSYS) on vehicle passive (secondary) safety. APROSYS aims to offer a significant contribution to the reduction of road victims in Europe. The general objective of this Integrated Project is the development and introduction of critical technologies that improve passive safety for all European road users in all relevant accident types and accident severities.

It consists of seven sub-projects. The Department is funding TRL Limited to contribute specialist passive safety work within the topic areas of Car Accidents (SP1), Heavy Vehicle Accidents (SP2), Pedestrian/ Pedal Cyclist Accidents (SP3) and Biomechanics (SP5) and Cranfield Impact Centre in Pedestrian/ Pedal Cyclist Accidents (SP3) and Virtual Testing (SP7).

Summary

Car Accidents (SP1)

For side impact, the development and evaluation of the draft test procedure proposed by IHRA is nearly complete. One of the main achievements of this work was the development of a new Mobile Deformable Barrier with a bumper beam element to better represent current European vehicles. The European Enhanced Vehicle safety Committee (EEVC) Working Group 13 are continuing this work with the aim of recommending new regulations to improve car safety further.

For frontal impact, the specification of an Advanced European Full Width (AE-FW) test has begun. Analysis is ongoing using the UK CCIS and the German GIDAS accident databases to help specify test configuration parameters. The suitability of the THOR dummy for inclusion in this test is being evaluated using sled testing to assess its robustness and compare its performance to the HYBRID III dummy for different loading conditions. This work will lead to the specification of a draft test protocol.

The increasing development and market launch of adaptive safety systems offer new potential for advanced safety systems to improve the primary and secondary safety of vehicles. This Sub-Project is developing a generic methodology to evaluate the performance of advanced safety systems. This methodology is currently being applied to assess a pre-crash pedestrian protection system in order to assess its applicability. Using the experiences gained from this work, the generic evaluation methodology will be updated.

Heavy Vehicle Accidents (SP2)

The overall objective of SP2 is to investigate advanced protection systems for heavy vehicles. SP2 is divided into 2 main work packages.

WP2.1 focuses on vulnerable road users. The two central objectives are to:

- develop an integral assessment method for evaluation of the safety potential of heavy vehicle fronts in accidents with vulnerable road users; and
- demonstrate improvements achievable by innovative safety concepts based on this assessment method.

To date WP2.1 has focused on the development of principal test procedures, which form the "Heavy Vehicle Aggressivity-Index". A benefit analysis was conducted on the most promising concepts and the top three were modelled using computer modelling techniques.

The final aim is the demonstration of the "Aggressivity Index" and safety improvement potential for heavy vehicles based on prototypes derived from the three concepts identified.

WP2.2 concentrates on passenger cars colliding with the side of heavy vehicles. Two major scenarios were identified:

- passenger car colliding with the side of trucks or trailer perpendicularly at up to 50 km/h, in urban areas; and
- passenger car approaching the truck or trailer at acute angles of up to 120 km/h, in rural areas (not only on national roads but also on motorways).

Numerical simulation tools are being used to develop appropriate evaluation criteria for improved truck or trailer side structures. The results are being benchmarked against actual full scale crash tests.

Pedestrian and Pedal Cyclist Accidents (SP3)

The overall objective of SP3 is the development and validation of methods and advanced protection systems for injury reduction of pedestrians and pedal cyclists impacted by passenger cars.

Real world pedestrian and cyclist impact data were examined using two approaches. First, national accident statistics were reviewed to identify the primary accident scenarios concerned in serious and fatal accidents. Second, an "In Depth Database (IDD)" of accident cases conforming to these primary scenarios was constructed to provide more detailed accident scene information. The national statistics highlighted the many similarities and several differences, regarding pedestrian and cyclist accidents, in the different countries.

An objective of the project is to develop new and/or improved vehicle test methods with which to assess vehicle pedestrian impact safety. These will reflect the real world scenarios identified earlier, to address the range of injury mechanisms sustained by pedestrians/pedal cyclists and provide the means of evaluating the potential of a vehicle to inflict these injuries. The aim is to develop testing methods based mainly on the sub-system tests developed by the European Enhanced Vehicle-safety Committee (EEVC). It is hoped the procedures developed will lead to reduced injuries for pedestrians and cyclists of any age and stature in collisions with cars (including MPVs and SUVs).

Biomechanics (SP5)

SP5 aims to investigate human tolerance to impacts and the criteria used to quantify it. It also aims at the development of simulation tools; crash test dummies and human body numerical models. SP5 is organised into three work packages.

The first work package defines injury criteria for the various body segments and establishes injury risk curves for use with simulation tools. A comparative review of existing finite element models of the head has been completed.

Complementary experiments have been conducted in order to collect data to consolidate certain injury criteria. A review of statistical methods applicable to the computation of injury risk curves from small data samples has been realised as well as a review of scaling methods allowing the derivation of mechanical properties for biological materials for subjects of different age. Injury criteria and injury risk curves are expected to be proposed for WorldSID average male and small female dummies. Curves for the THOR frontal crash dummy have been reviewed.

The second work package develops a small female version of the WorldSID side impact dummy. A specification document defining the dimensional and the functional characteristics was established; the design derived from the average male dummy mainly by down scaling. The prototype shows an initial biofidelity rating of 6.7 out of 10 (according to ISO TR 9790) and modifications have been proposed in order to further improve biofidelity, as well as durability and handling. A new method to measure the thorax deformation is under development in order to take into account the distortion sustained in case of an oblique impact. These modifications will be integrated in an updated version of the prototype and will be evaluated in the next period.

The third work package deals with the development of human numerical models, enabling the simulation of impact responses and the prediction of the injury risk. From a generic model based on the geometry of a sitting (close to) average male, the HUMOS2 project produced models with different sizes, including small female and tall male, using scaling tools.

The on-going work is aiming to transform these research tools into true industrial tools usable for design and safety performance evaluation. During this project several human models have been developed in different codes. Although they have been extensively validated it has become clear that the validation process should be standardised. The next step will be to define precise validation procedures with strictly defined response corridors.

Contractor	**TRL Limited**	
Reports/Papers	Title	Reference
	Versmissen T, Van Schijndel M, Edwards M, Langner, T (2007) Development and Evaluation of the Side Impact Test Procedure proposed by IHRA - 20th ESV, Lyon, June 2007	
Further outputs	www.aprosys.com	
Completion Date	March 2009	
Contacts	Enquiries at TRL: Enquiries at TTS:	01344 773131 020 7944 5026

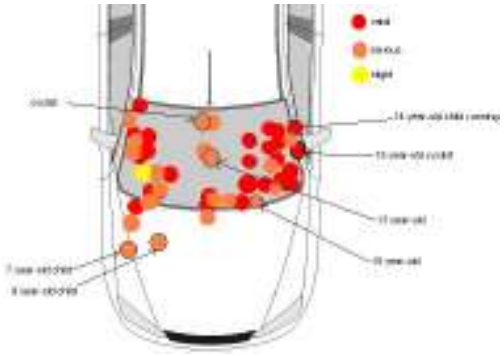
S0419/ V8 Advanced PROtection SYStems (APROSYS) (CIC)

Sub-project 3: Pedestrian/ pedal cyclist accidents

The goal of the project is to pave the way for the introduction of advanced protection systems for the reduction of the number and severity of injuries to pedestrians and pedal cyclists in all relevant accident scenarios involving cars, MPVs and SUV's. The testing processes for evaluating vehicle front ends will also be optimised to reflect real world accident scenarios and the injuries sustained by all vulnerable road users.

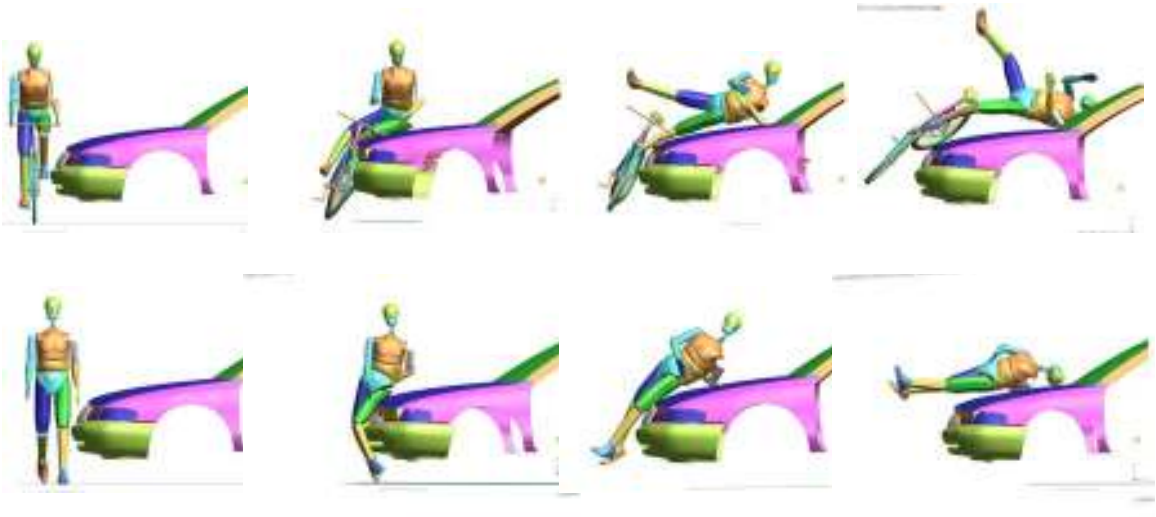
Accident data analysis activities at the start of the project identified the location of vulnerable road user head impacts on the impacting vehicle. These were predominantly on the windscreen region, both in the centre portions and around the edges. This was true for pedestrians and cyclists and children and adults, see figure below where the primary head impact locations are shown on a schematic vehicle.

The windscreen is a region of the vehicle where computer modelling could be improved by developing realistic models of laminated glass to represent the fracture mechanisms. Therefore, CIC conducted a programme of pendulum impactor testing to produce data that could be utilised for developing computer models of laminated glass.



A range of impact locations across a windscreen were selected based on the accident data and tests were conducted with a rigid headform impactor at an impact speed of 6m/s. Both radial and circular cracks were observed during testing and in addition the separate contributions of the glass (first) and PVB interlayer (second) to the time history characteristics. An example for impacts at the centre of a windscreen is shown, where 3 tests were conducted.

In the current EuroNCAP and legislative vehicle testing programmes cyclists are assumed to benefit from the measures introduced by vehicle manufacturers to protect pedestrians. A series of computer simulations was conducted to examine this situation by investigating the interaction of a cyclist and a pedestrian with the same vehicle model. For a large family car the simulations showed that for some body segments the interactions with the vehicle were significantly different. In particular the leg interactions were not the same due to the different leg positions for a cyclist, the torso slid more easily onto the bonnet and the chest and head impact locations were much further back – as illustrated by the cyclist and pedestrian kinematics sequences below.



Therefore, the initial conclusions from the simulations with the large family car model are that cyclists and pedestrians should be considered separately and additional vehicle testing may be required. However, further simulations with three other vehicle shapes representing a super-mini, an MPV and an SUV are being conducted, which may modify this conclusion.

Additionally, CIC are examining measures to reduce the injuries sustained by vulnerable road users when they strike the windscreen and the A-pillar region of a vehicle. Whilst there are significant design constraints on this region of the vehicle for a number of crash safety scenarios and forward visibility requirements there is scope for acceptable design changes.

Sub-project 7: Virtual testing

Simulation techniques have been used extensively over the last 20 years to improve occupant safety in the field of vehicle crashworthiness for various forms of transportation. However, for regulation purposes physical crash tests are used to monitor and type approve vehicle structures for their use on the roads. An example of such physical tests are the EuroNCAP test procedures which have highlighted the safety issues of vehicles to a wider audience. There is a case to be made for simulations to be used in regulations as they will offer many opportunities for regulators and vehicle manufacturers to improve the type approval process. Lack of regulated procedures for evaluations and current computer models is still a challenging obstacle and the Virtual Testing project aims to address these obstacles.

The goal is to contribute to a drastic reduction of injuries and fatal accidents which occur everyday on the roads across Europe. By introducing Virtual Testing to complement the current physical testing, a greater range of accident scenarios can be considered by legislators to ensure that vehicle manufacturers can design their vehicles to cover many different accident types. With vehicles better designed to cope with different range of speeds vehicle occupants and vulnerable road users such as pedestrians and cyclists will be exposed with less risk of serious injury or even fatal injuries. From the manufacturers point of view the costs to type approve their vehicles by Virtual Testing are reduced as computer systems have already been extensively used and currently aid the design process.

To implement Virtual Testing their needs to be a set of implementation rules and a confidence gained in the Virtual Testing process. This project tackles that issue by addressing the following Work Packages. CIC have been involved in a number of work activities covering the four work packages itemised below.

- ***Improvement of predictive capabilities of numerical models (completed).*** CIC have developed improved barrier modelling techniques to be used in side and frontal impact tests. The modelling technique focused on the behaviour of aluminium honeycomb as it came into contact with protruding impactors such as the B-Pillar of a vehicle in a side impact scenario. The model was able to predict the collapse mechanism and the test results were validated from physical tests.

- ***Analysis of real world scenarios via exploratory techniques and dispersion analysis.*** This work package investigated the robustness checks which can be carried out on computer models which can show that they capture accurately the real world. An advantage of the Virtual Testing technique is that you can easily perform a scatter analysis by changing various parameters of the model to create a range of results. The variation of results would be similar to performing repeat physical tests.

- ***Development of new simulation related technologies and user friendly tools.*** To aid the comparison of physical tests and computer models a software package (ADVISER) has been developed to check the validity of models and to provide an objective method of scoring the accuracy of models. Interface software has been developed to translate results from a finite element (FE) software package to the ADVISER program.

- ***Integration of Virtual Testing in Regulatory test Procedures (on going).***

  To aid the integration of Virtual Testing (VT) into regulations a number of demonstrators are being developed in the project to show the capabilities and limitations of VT. These will investigate pedestrian head impacts onto vehicle bonnets across various software codes and very simple computer models to understand the process of exchanging FE models between manufacturers and legislators.

Contractor	Cranfield Impact Centre (CIC)	
Completion date	31 March 2009	
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S0433/ V8 Child Seat Consumer Information: Protocol Validation

Background

The overall objective of the Child Seat Consumer Information (CSCI) project is to provide technical expertise and advice concerning the ability and suitability of the NPACS testing and rating protocols to discriminate between child seats of different perceived safety and usability. The Department will be consulting with other European institutes and any other relevant stakeholders.

The project aims are to:

- validate test protocols and rating schemes developed within the NPACS research phase;
- identify improvements, where necessary, such that valid, objective, unambiguous and independent guidance can be published; and

Side impact test

- rate a range of child seats through testing to the validated NPACS protocols.

Summary

There are three main phases of testing in this project; Tasks 1 and 2 have been completed and the third and largest phase of testing is underway. Testing involves dynamic assessment of child seats to replicate front and side vehicle impact scenarios and an assessment of the usability of the seat.

The first main task was to validate the NPACS protocols for child seats in the mass range 9 - 18kg and establish the level of repeatability (if a test was repeated would it yield similar results) and reproducibility (can the same test conditions be repeated at a different test house) provided by the assessment. This work has been reported on in a Task 1 report. The next task was to validate the NPACS protocols for child seats in the mass ranges 0 – 13kg and 15 - 36kg and, in particular, establish the level of repeatability and reproducibility (subject to consortium data availability) provided by the assessment. In addition, advice on the appropriateness of the NPACS protocols and the application for use in a consumer child seat information scheme as well as dummy robustness were also assessed. This work has been reported on in a Task 2 report.

During the investigation the child seats were assessed according to the published NPACS front impact, side impact and usability protocols and an overall rating determined using the published NPACS rating protocol. During Task 1 the data contributed to a larger data set using data generated in other international laboratories and was analysed. This was not possible for Task 2 because at the time TRL's report was produced, data and test results were not available from other laboratories.

TRL's findings with respect to the suitability of the front impact protocol were positive for the front impact testing programme. For Task 1, the test results show good reproducibility and although there were small inconsistencies in results between the laboratories, it was felt that the recommendations made to improve set-up conditions, along with dummy part upgrades, would provide an improvement in reproducibility for the next phase of testing. This opinion was shared by the international technical representatives, who were also optimistic that the suggestions for improvement to the protocol would provide even greater reproducibility. The Task 2 results confirmed the repeatability of the procedure within one laboratory (TRL) when examining seat types different to those tested in Task 1.

Regarding the side impact protocol, the results for Task 1 side impact testing programme were encouraging. Overall, the primary areas of interest in the dummy produced reproducible results. This was an excellent starting position particularly when previous research identified these regions most in need of protection. Improvements in set-up conditions were identified to improve reproducibility and repeatability further. The Task 2 results confirmed an improvement in the repeatability of the procedure when examining seat types different to those tested in Task 1.

An assessment of the usability protocol found that it required further modification and recommendations were made for changes that would make it easier to use by different assessors.

During this work programme, consideration has been given to the provision of a cost-effective rating for child seats. This has been partially reported in the Task 2 report.

Current and future work includes Task 3 testing which will assess and rate 10 child seats. Following this a cost benefit exercise will be carried out, which will include input from child seat manufacturers. The aim of the cost benefit assessment is to measure the effect a child

rating system will have on child seat designs which would ultimately mean more children will be protected through improved child seat design. The final report will combine all the findings of the whole project and it is the Department for Transport's aim to publish these findings which will include a rating for the child seats tested.

Contractor	TRL	
Reports (unpublished)	Title	Reference
	Child seat consumer information project: Task 1 – Group 1 CRS validation testing. Child seat consumer information project: Task 2 – Group 0+ and group II/III CRS validation testing	UPR VE/071/07 UPR VE/072/07
Completion date	December 2007	
Contact	Enquiries at TRL: Enquiries at TTS:	01344 770980 020 7944 5026

S0437/ V8 Rear Impact Dummy Evaluation

Background

This project forms part of the UK contribution to a collaborative research programme being completed by the European Enhanced Vehicle Safety Committee (EEVC) Working Group 12 'Biomechanics', in conjunction with EEVC Working Group 20 'Rear Impact'. WG12 is reviewing the suitability of three candidate crash test dummies; the Hybrid III, RID3D and BioRID-2, for low-speed rear impact seat testing. The suitability assessment is based on biofidelity (the ability of the dummy to mimic the response of a human in the same impact conditions), repeatability and reproducibility. This project is comprised of two parts:

- rear impact sled testing; and
- co-ordinating the reporting of the results from all of the WG12 partners.

Pre-impact position of the rear impact dummy in the volunteer seating position

Summary

Rear Impact Sled Testing

In a previous project for the DfT (TRR 20/25A/0062), TRL performed low-speed rear impact sled tests with 10 volunteers in order to define response requirements for crash test dummies to be used in rear impact seat testing. The response requirements included head and neck displacements and accelerations. Within the current project, these volunteer tests have been successfully reproduced with the Hybrid III, RID3D and BioRID-2 dummies.

It was found that the BioRID-2 head and neck motion was the most biofidelic of the three dummies at the test speed used, although the RID3D response was also good. The BioRID-2 had the most human-like seat back interaction of the three dummies, as assessed using a pressure sensitive mat placed between the dummy and the seat back. The Hybrid III biofidelity was not as good as the other dummies and the head restraint and seat back interaction was not human-like. It was recommended that the Hybrid III dummy should not be used in any possible future regulatory test to assess seats for rear impact injury protection.

Co-ordinating the WG12 Report

TRL is responsible for co-ordinating the analysis and reporting of the dummy evaluation results from all six laboratories conducting biofidelity and repeatability/reproducibility tests within WG12. Biofidelity reporting has been completed, with repeatability and reproducibility testing and reporting ongoing.

This work will result in a recommendation for a dummy to be used in the low-speed rear impact test procedures being developed by EEVC WG20, which are targeted at the mitigation of 'whiplash' type neck injuries.

Contractor	TRL Limited	
Reports	Title	Reference
	Low Energy Rear Impact Tests using RID3D, BioRID II and Hybrid III for EEVC Working Group 12. Review of Recommendations Regarding the use of Hybrid III in Low-speed Rear Impact 'Whiplash' Tests.	PPR211 PPR 263
Completion Date		
Contact	Enquiries at TRL: Enquiries at TTS:	0344 770310 020 7944 5026

S0445/ V8 Biomechanics – EEVC WG20 Rear Impact - Chair

Background

The purpose of the European Enhanced Vehicle Safety Committee (EEVC) Working Groups (WGs) is to provide the EEVC Steering Committee with impartial advice based upon scientific evidence, in order to support the development and enhancement of European safety standards and legislation. The specific activities of the Working Groups will be as directed by the Steering Committee from time to time.

EEVC Working Group 20's general remit is to develop test procedures for rear-end collisions, with a prime focus on neck injury reduction (Whiplash).

Summary

This project supports the role of Chair of EEVC Working Group 20. The specific activities of the WG are to:

- develop and validate a static test of head restraint geometry, and provide a cost-benefit study from which recommendations for limits on head restraint height and backset can be made;
- recommend to the EEVC Steering Committee whether the option of a dynamic test of head restraint geometry should be pursued further and, if so, to develop a suitable test procedure;
- develop and validate a dynamic injury assessment test procedure, collaborating with EEVC WG12 which is tasked with recommending a suitable dummy and biomechanically-based injury criteria and injury risk functions to be used with the dummy; and
- provide the EEVC contribution to the GRSP Global Technical Regulation Informal Working Group on Head Restraints.

This project has also supported specific work items in support of the UK contribution to EEVC WG20. This includes:

- testing and analysis to evaluate the repeatability and reproducibility of the draft EEVC WG20 static head restraint geometry test procedure. This included analysis of the effect of the test team, test tool, torso angle, and seat on repeatability and reproducibility of head restraint height and backset measurements using the 3-D H machine and HRMD;
- finalising the updated WG20 *ad hoc* report;
- preparation of WG20 position papers on specific issues relating to the development of rear impact test procedures;
- maintenance of the EEVC WG20 web site;
- presentation of EEVC WG20 and WG12 progress at GRSP; and
- co-ordinating reporting of WG20 progress, and of the test procedures as they are developed, to the EEVC Steering Committee.

3-D H machine and HRMD used to measure head restraint height and backseat in version 1 of the WG20 test procedure

Contractor	TRL Limited	
Reports	Title	Reference
	EEVC WG20 Report – Document Number 123: Geometric test Procedure Evaluation	
Completion date	Ongoing	
Contact	Enquiries at TRL: Enquiries at TTS:	01344 770310 020 7944 5026

S0522/ V8 - Co-operative Crash Injury Study - Phase 8

Background

In-depth accident studies provide a vital insight into how people are injured in crashes. In these studies, an examination of a crashed vehicle is correlated with injuries to the crash victims which are then used to determine how people are injured.

One of the world's largest studies of car occupant injury causation is the UK's Co-operative Crash Injury Study (CCIS), which is a programme of research that started in 1983 and continues to investigate real life car accidents and is now into its 8th Phase.

The objective of the Co-operative Crash Injury Study is to improve car crash performance by:

- Developing the understanding of how car occupants are injured in crashes;
- Providing information on current vehicle crash-worthiness; and
- Identifying the needs for future improved vehicle safety as changes take place.

Examinations of accident-damaged cars where an occupant was injured are undertaken to determine the nature and severity of the damage to the vehicle, and the role of seat belts, airbags and other safety devices. The associated occupant injuries are then matched to the vehicle data and documented in an anonymous electronic database.

Detailed analysis of the CCIS database helps ensure that future cars will be designed to perform better in real life crashes. A better understanding of how people are injured will lead to safer cars, better restraints, better crash test dummies and improved laboratory crash test techniques.

The database can be analysed to allow the types, frequency and nature of injuries and their causes to be correlated with the vehicle damage and safety devices. Good safety features, which are preventing or reducing injuries can be identified or developed.

Summary

Phase 8 of this ongoing research (described in more detail under recently completed projects S0218/VC) began in February 2006, with an expected end date of January 2009. The project is currently managed by TRL Ltd who provide both project management and technical management for the project. Investigation teams from Birmingham University, Loughborough University provide vehicle investigations in their local areas with additional

resources provided by VOSA teams. VOSA cover 5 additional areas of Manchester, Staffordshire, Warwickshire, Bristol and Hampshire. These 7 teams between them will investigate 1176 vehicles involved in accidents per year.

The CCIS has introduced new data analysis and routine reporting elements for Phase 8. These are disseminated through the new CCIS website and analysis to date has considered the following topics: the effectiveness of seat belts, whiplash in rear impacts and the influence of stature on car occupant injury outcome following frontal crashes.

Contractor	**TRL Limited**	
Reports	Title	Reference
	Reports available from: http://www.ukccis.org Topic Report 1 – Seat belt effectiveness Topic Report 2 – Rear seat characteristics Topic Report 3 – Population characteristics Topic Report 4 – Frontal impacts Topic Report 5 – Whiplash injuries Topic Report 6 – Influence of stature	
Completion date	January 2009	
Contact	Enquiries at TRL: Enquiries at TTS:	01344 770310 020 7944 5026

THEME 3

Commercial Vehicles and Regulation

Research under this theme focuses on large passenger, goods and agricultural vehicle safety. These vehicles make up a relatively small proportion of the total number of vehicles on UK roads and in general terms they have a good occupant safety record. However, they are involved in more accidents than the numbers of vehicles registered would suggest, and due to their size and weight there is the potential for a significant number of casualties and a higher risk of fatal injury for the occupants of other vehicles. Nevertheless, they have made a positive contribution to the national casualty reduction targets, and research is ongoing to help identify how best they can be improved to achieve further reductions.

Recently Completed Projects

S0016/ VF Seatbelts: Requirements for Minibus and Coaches

Background

Buses and coaches are a widely used form of transport for relatively large numbers of people on the European road network. Despite there being relatively few accidents in relation to cars, when accidents do occur, they involve large numbers of casualties and hence are high profile events. As a result, attempts have been made to increase the level of protection provided for passengers in these vehicles. This includes the mandatory provision of seatbelts in all minibuses and coaches used for the carriage of children and the mandatory wearing of seatbelts for all passengers over 3 years of age. While this development is welcome, it creates two potential problems:

- because it is impractical to carry a range of purpose-built child restraints in coaches and minibuses, an increased number of children will be wearing adult seat belts. We need to be sure that this does not create additional risk; and

- the established method of type-approving seat belt anchorages is destructive (i.e. requires a complete vehicle or representative portion to be crash tested). This poses no problem for high-volume car manufacturers but may be disproportionately expensive for low-volume manufacturers of larger passenger carrying vehicles.

In order to resolve the above issues, the Department instigated a programme of research in the form of the two modules described below.

Summary

Module 1 was in two phases. The aim of phase 1 was to determine: how often children travel in minibuses, buses and coaches, how often they are being injured and in what circumstances. Phase 2 follows on from phase 1 and was aimed to recommend and develop cost effective measures for improving child protection to reduce the injuries identified in phase 1.

Phase 1 identified that:

- the fit of adult belts is unacceptable for the majority of young children up to age of about 8 and for some up to the age of 11;
- poor fit is very likely to induce seatbelt induced injuries in accidents by loading the neck and or soft abdomen;
- appropriate supplementary child restraint systems (CRS) such as booster seats or cushions should be provided in minibuses and coaches or an adult seatbelt or seat that can be adjusted to match the needs of children should be provided;
- both the use of these vehicles by children and the numbers of fatal and seriously injured child casualties in these vehicles are comparatively low; and
- rollover accidents have a higher rate of serious and fatal injuries which is thought to be linked to ejection; therefore retaining occupants in their seats, through compulsory use of well fitting belts will be beneficial. The occupant loads are likely to be lower in roll over accidents; therefore anchorage strength and seatbelt loading to less appropriate parts of a child's body (due to poor fit) are likely to be less critical. However, for small children poor fit is likely to increase the risk of slipping out of the seatbelt and subsequent ejection, etc.

Phase 2 aimed to develop cost effective measures for improving child protection in coaches/buses and minibuses by improving the fit of the seatbelt. The proposed solutions were mathematically modelled and tested in a series of dynamic sled tests. The research identified that:

- car type child restraint systems (CRSs) are used in coaches and minibuses (and in buses where seatbelts are provided). If this is not considered to be feasible then the permitted exemption from compulsory seatbelt wearing, under the EU Directive, for children of less than three years old, should be taken up;
- Public Service Vehicles (PSVs) that carry children should be fitted permanently with an adequate number of seats that can be adjusted to fit any size of occupant from about three years old up to an adult (a universal seat); and
- consideration should be given to introducing a rollover seat strength test for seats with integral seatbelt anchorages intended for use in minibuses, buses and coaches.

Module 2 was to investigate and develop a potential low cost method or methods that would give confidence that seat belt anchorages in vehicles produced in low volumes would meet the destructive regulatory strength tests, if tested. As already noted vehicles that are produced in low volumes are predominantly minibuses, buses or coaches. This module has been completed and a number of conclusions and proposals have been made. The study found that casualties for users of minibuses, buses or coaches are a relatively small proportion of all road user casualties. This low rate supports the use of low-cost approval methods for these vehicles. It was also concluded that a number of different low-cost approval options were needed to reflect the range of vehicles and design solutions found. However, this conflicts with the need for a simple easy to administer low-cost approval method.

Some of the approval methods identified as being suitable for a multi-path approval method were considered to be fundamental. It was also important to make use of existing practices or adaptations of them, which are not thought to need validation to show that they will provide suitable anchorages. It was decided to carry out limited validation of two of the methods identified, where there were some doubts about their suitability. Therefore a series of regulatory pull tests were carried out to a converted delivery van and a TRL designed coachbuilt floor. The results of the delivery van tests showed that it exceeded the strength requirements by a large margin when fitted with a conversion kit intended for a family of similar vans, despite never having been tested on that model of van. Instead the kit had been shown to work, by testing just the two vans thought to be weakest in the family. The coach-built floor was made following design rules intended to allow savings in weight through the use of high strength materials and beams with their cross-sections (shape) selected to give a high strength to weight ratio. The results showed that a lightweight strong structure can be designed to these rules, achieving the anchorage strength requirements. Therefore, there would be confidence that manufacturers using these two construction methods would produce vehicles with seatbelt anchorages that meet the strength requirements, thus removing the need to carry out destructive testing. However, before any of the proposed methods are used in an approval procedure it is recommended that they are refined and that the options are discussed with all the stakeholders concerned.

Contractor	TRL Limited	
Reports	Title	Reference
	Seatbelts: Requirements for Minibuses and Coaches - Module 1 Phase 1 Final Report	CON: 05700
	Development of measures for improving child protection in minibuses, buses and coaches	PPR076
	A low-cost method of evaluating seatbelt anchorages for low-volume vehicles (M1, M2 and M3) - Final report	PPR050
Completion Date	May 2006	
Contact	Enquiries at TRL Enquiries at TTS	01344 770980 020 7944 5026

S0131/ VE Integrated Safety Guards and Spray Suppression for HGVs

Background

Regulations exist to require spray suppression, sideguards, rear underrun and, recently, front underrun protection to be fitted to HGVs. Until now these have all been considered as discrete and separate issues. However, it is possible that developing an integrated structure all of the way around the lower part of an HGV all of the problems these regulations are intended to address could be improved. In terms of safety guards the strength of all of the guards could be increased by tying the structures together to better increase protection for car occupants in collision with an HGV. If an integrated side skirt was fitted it would cover more of the gaps and protrusions typically found at the side of HGVs and could, therefore, offer better protection for vulnerable road users. If the lower part of the vehicle was smooth and integrated it could potentially improve the airflow around the HGV in a way that could reduce the generation of spray in wet conditions and allow improved fuel economy. Currently, regulation does not allow aerodynamic devices to be used as spray suppression systems.

Summary

This project is intended to consider these individual issues and how they interact with one another. The objectives of the project are to:

- Review the various exemptions from fitting side and rear guards in the current directives/regulations.
- Examine current Construction and Use Regulations, EC Directives and UNECE Regulations for front/rear underrun and sideguards, recognise any conflicts that may exist between the requirements and identify the benefits of vehicles being fitted with integrated side/front/rear guards.
- Identify the safety and cost (fuel) saving benefits of vehicles being fitted with "smooth" sideguards rather than the two-rail designs that are currently fitted.
- To investigate and propose remedial solutions to the sideguard height problem with UK and continental truck/trailer compatibility
- Develop a test method that would effectively measure the performance of aerodynamic spray suppression systems and allow a comparison to the types that are currently fitted to HGVs.

The work was completed in June 2006. It was found that in the region of about 20% of UK HGVs was likely to be exempt from at least some of the safety guards regulations and that safety guards could be fitted to a substantial proportion of these exempt vehicles without excessively compromising their operational performance. The various regulations were not found to be in conflict, although there was some inconsistencies between the various standards and they offered nothing to encourage an integrated approach. It was also found that some vehicle types were not adequately covered by the regulations. It was estimated that ending exemptions could prevent up to a maximum of 11 fatalities per year. However, only a proportion of this saving would be achievable because some exemptions are justified and would remain in place. Requiring all safety guards to be smooth integrated designs could prevent up to another 4 or 5 fatalities per year. The reduced aerodynamic drag expected from such designs could reduce by approximately 2.5%, depending on driving cycles and load characteristics. It was also found that improved aerodynamics could greatly reduce the quantity of spray emitted by trucks in wet conditions. However, estimates of the contribution of spray to the cause of accidents were highly variable and strongly influenced the cost benefit analyses. The test method developed to measure spray was sufficiently accurate in identical ambient weather conditions but was strongly influenced by variable light levels.

Contractor	**TRL Limited**	
Reports	Title	Reference
	Integrated safety guards and spray suppression – a literature review	PR SE/755/03
	Measuring vehicle spray using digital cameras	PR SE/819/03
	Review of side and underrun guard regulations and exemptions	PR SE/057/04
	Spray suppression - Initial regulatory impact assessment	UPR/SE/034/04
	Integrated safety guards: Initial regulatory impact	UPR/SE/033/04
	Identifying the safety benefits of "smooth" sideguards and ending exemptions	UPR/SE/032/04
	The use of alternative materials for sideguards	UPR SE/084/04
	Investigation of the effect of tractor and trailer height compatibility on the ground clearance of sideguards	UPR/SE/122/04
	Integrated safety guards and spray suppression – Wind tunnel model testing	UPR SE/014/04
Completion Date	May 2006	
Contact	Enquiries at TRL Enquiries at TTS	01344 770980 020 7944 5026

S0320/ VE Preventing Passenger Ejection from Buses, Coaches and Minibuses

Background

This project is concerned with the protection of bus, coach and minibus passengers from ejection (or partial ejection) in the event of a rollover accident. In particular, the situation where a vehicle overturns whilst moving forwards (as in the case of a vehicle running and rolling off a highway embankment), presents a challenge to the retention of occupants within the vehicle. In the UK, the strength of coach roof structures with regard to rollover protection is specified in UN-ECE Regulation 66. Additionally, since October 2001, seat belt installation has been mandatory for new buses (excluding those for urban use with provision for standing passengers) as well as coaches and minibuses carrying eight or more passengers. Notwithstanding these and other requirements, previous reviews of accident data have suggested that there is the potential for passengers, whether belted or not, to be ejected or partially ejected, once the side windows have become broken or detached.

Summary

In the first phase of this study, a review was conducted of national and other European accident data. In the second phase, use was made of Finite Element simulation to understand the mechanism of passenger ejection during a rollover accident. A generic model of both a coach and a minibus were developed which represented the structural properties of typical vehicles (Figure 1). These were fitted with single-glazed toughened glass, as this represents the most commonly used form of side glazing and was assessed using various sizes and combinations of crash dummies - this included unrestrained dummies as well as those restrained by lap-belt and lap-and-shoulder belt systems. The final phase used the coach model to simulate the behaviour of laminated glass under the same conditions.

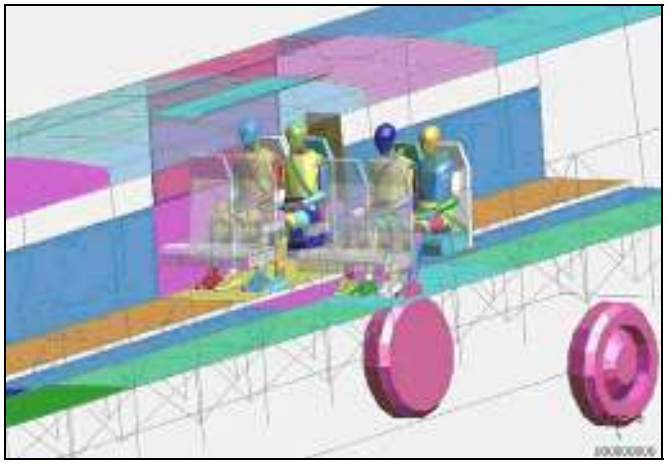


Figure 1 – Overview of FE Coach Model

The findings of the research are as follows:

- For Great Britain, for the 11-year period 1994 to 2004 inclusive, it can be calculated that bus and coach occupants accounted for:
  - 0.49% of all 'killed';
  - 1.45% of all 'killed or seriously injured'; and
  - 3.07% of 'all severities' (killed, seriously injured and slightly injured)

- It was estimated that, for Great Britain, a maximum of some 3 fatalities and 184 serious injuries per year are due to full or partial ejection from coaches and minibuses. It is not

possible to distinguish the individual contribution of coaches and minibuses to this total of ejection related casualties from the available sources.

- The literature search indicated various technologies that have been considered for reducing passenger ejection from car side windows. Of these, the use of seat belts and bonded laminated side glazing was of most relevance to this study in that these fulfilled the projects' mandate to identify practical and cost-effective means for limiting passenger ejection.

- Finite Element analyses indicated that:
  - For the coach model:
    - Toughened glass was unable to offer any retentive capability for the unrestrained occupant;
    - 3-point seat belts were more effective than 2-point belts during the selected rollover condition
    - Installation and routing of the shoulder belt on the seats nearest to windows should be considered, as outboard installations may be vulnerable to damage from the ground or other intrusion during rollover;
    - The use of a seat side bolster, as a form of compartmentalisation for an unrestrained occupant, restricted the occupant from possible ejection, but redirected the occupant into a severe head impact with the overhead luggage rack;
    - Laminated glass bonded to the vehicle rather than toughened glass mounted in a flexible gasket demonstrated that the strength limits of the adhesive bond were always exceeded and this caused the window to be released from the structure. It was concluded that standard laminated glass which was adhesively bonded to the structure was insufficient to retain an unbelted occupant within the vehicle under the accident conditions simulated here.
    - A series of modifications to improve the fixing strength of the window to the vehicle proved unsuccessful. This was believed to be due to the deflection of the structure around the window during the impact. Ultimately, the inclusion of a bolting system as well as adhesive bonding preserved the bond, but transferred the failure into the laminated glass around the bolts. On this basis, the use of standard laminated glass as a mandatory recommendation was not put forward.
    - However, the results indicated that the voluntary use of laminated glass may be beneficial over toughened glass in rollover (and other) accidents where the impact severity was not as high as that used in the simulations conducted here.
    - The parametric study also indicated that the reduced height of current window designs may also have some benefit in retaining an unrestrained occupant although it is likely that they will be redirected to an impact with some other object within the vehicle.
  - For the minibus model:
    - The occupants were not ejected but were subject to impacts with the interior of the vehicle.

- It was concluded that 3-point inertia reel seat belts remain the best option for preventing ejection and partial ejection.

- With the introduction in 2006 of compulsory seat belt wearing in the UK on coaches and minibuses for all occupants over 3 years, the project concluded with the two following recommendations:
    - That future coach and minibus accident data should be monitored following the introduction of compulsory seat belts wearing to measure the effect that this has on rollover ejection casualty numbers
    - As part of the above, current ECE R-66 technical requirements should be reviewed with regard to the increased energy that passengers wearing seat belts will impart to a vehicle's structure during a rollover accident. If excessive roof crush is observed from accidents involving R-66 compliant vehicles (and where passengers wore their seat belts), it may be necessary to increase the energy and strength requirements of roof structures to resist increased roof loading from belted passengers.

Contractor	Cranfield Impact Centre	
Reports	Title	Reference
	Preventing Passenger Ejection from Buses, Coaches and Minibuses - Initial Regulatory Impact Assessment Preventing Passenger Ejection from Buses, Coaches and Minibuses - Partial Regulatory Impact Assessment (31/01/06) Preventing Passenger Ejection from Buses, Coaches and Minibuses – Final Report (31/01/06)	
Completion Date	January 2006	
Contact	Enquiries at CIC: Enquiries at TTS:	01234 754196 020 7944 5026

S0516/ V7 Longer and/ or longer and heavier goods vehicles – a study of the effects if they were to be permitted in the UK

Background

In December 2005, the then Minister of State decided to refuse applications from two hauliers each wishing to trial a goods vehicle longer and heavier than those currently permitted. However, some in industry remained interested in these vehicles, trials were underway in a few Member States, and the European Commission began to consider them as part of the EU Logistics Action Plan to improve the efficiency of transport and logistics by 2010.

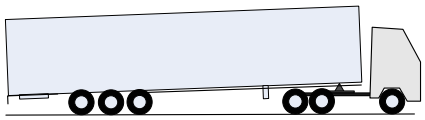
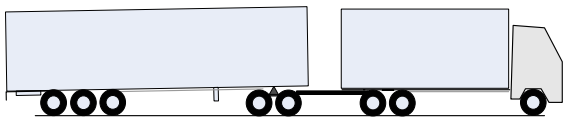
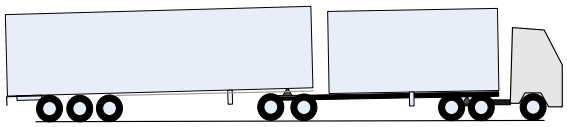
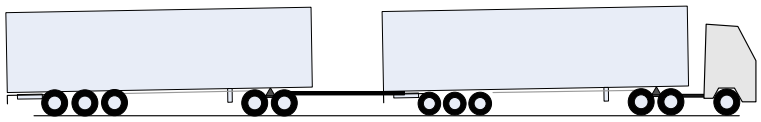
The Department commissioned a study with the Transport Research Laboratory and Heriot Watt University in October 2006 to assess what the effects might be if different types of longer and/or longer and heavier goods vehicles (LHVs) were to be permitted in the UK.

The purpose of the study was not to advise on whether to allow trials, but to better inform any future decisions on LHVs. This includes how they might contribute to the Better Regulation initiative, to the responses to the Eddington and Stern reports and proposals

from the European Commission planned for summer 2008 to amend the rules on goods vehicle weights and dimensions.

Summary

The research took the form of a desk study, which included reviews of relevant scientific literature, analysis of freight data, information gathering from a wide range of stakeholders, modelling of existing road freight flows, and computer simulation of some vehicle performance characteristics. The different types of LHV assessed were as follows:

	
1 Articulated vehicle with a long semi-trailer	Semi-trailer up to 16 metres long compared with the current maximum of 13.6 metres (overall length less than or equal to 18.75m)
	
2 Rigid vehicle towing a semi-trailer (with the front of the semi-trailer supported on a dolly)	Up to 25.25 metres long and 60 tonnes
	
3 "B-double" – articulated vehicle towing a semi-trailer with the second semi-trailer resting on the first	Up to 25.25 metres long and 60 tonnes
	
4 "C-train" – articulated vehicle towing a semi-trailer (with the front of the second semi-trailer supported on a dolly)	Up to 33.5 metres long and 84 tonnes

Eight different scenarios were assessed as follows:

A. business as usual;
B. an increase in the length of an articulated lorry from 16.5 to 18.75m - equal to that currently permitted for a drawbar combination (a rigid lorry towing a trailer);
C. as B but with the maximum weight increased from 44 to 46 tonnes to preserve payload capacity;
D. an increase in length from 18.75 to 25.25m, and an increase in the number of axles from 6 to 8;
E. as D but with the maximum weight increased from 44 to 50 tonnes to preserve payload capacity;
F. as D but with the maximum weight increased to 60 tonnes;

G. an increase in length to 34m together with an increase in the number of axles to 11 and the maximum weight increased to 63 tonnes, giving the same payload capacity as F; and
H. as G but with the maximum weight increased to 82 tonnes.

For each scenario, the study selected the relevant LHV(s) and estimated the combined effects on road safety, the atmospheric and built environment, and the efficiency of freight transport arising from the changes that could occur in each of the following parameters if such vehicles were to be permitted:

- carbon, noise and pollutant emissions;
- fatal, serious and slight injuries in road accidents;
- modal shift to road from rail and water;
- vehicle movements and congestion;
- road wear and transport infrastructure; and
- induced freight demand.

The report concludes that recent increases in the sizes of goods vehicles have helped to reduce emissions of carbon dioxide, vehicle kms and the cost of freight transport relative to what it otherwise would have been. Further increases might, therefore, be expected to deliver additional worthwhile reductions, but the findings of the study show that if goods vehicles significantly larger than 18.75m and 44 tonnes were to be allowed they would be likely to have serious adverse effects unless:

- investment was made in improved parking facilities to provide for statutory rest periods, which could be substantial if a new nationwide network of dedicated facilities are deemed to be necessary;
- investment was made in network infrastructure to establish suitable routes and procedures to manage diversions and enforce restrictions, and/or vehicles conformed with certain weight limits and manoeuvrability characteristics that reduce risk to the infrastructure. However, for such vehicles it does not currently appear to be possible to mandate standard manoeuvrability requirements on account of European trade rules.
- the speed limits for combinations with more than one trailer were increased (currently these are 40 mile/h on motorways and 20 mile/h on other roads).

A blanket decision to permit 60 tonne vehicles with more than one trailer for general haulage would present a substantial risk of adverse environmental effects mainly because of likely mode shift from rail to road, especially in the deep sea container market. If such multi-trailer vehicles were restricted to around 50 tonnes, or less, the likely magnitude of mode shift would be much reduced and largely confined to the deep sea container market. The risk of adverse environmental affects would, therefore, be much lower.

Vehicles significantly larger than 18.75m and 44 tonnes would be likely to increase safety risks per vehicle km, but decrease safety risks per unit of goods moved. If such vehicles were to be allowed, it would be advantageous for certain safety features to be fitted in order to minimise the risks and maximise the casualty reduction potential. However, once again, requiring this does not appear to be possible within the current European regulatory framework.

Although an analysis of the internal and external costs of freight transport suggests that such vehicles offer substantial ongoing benefits, the potentially large but unknown capital investment cost means that it is not certain as to whether the benefit cost ratio would exceed one. Further work would therefore be needed to determine whether addressing the above issues would deliver worthwhile net benefits.

However, in the case of 18.75m 44 tonne articulated goods vehicles with semi trailers longer than those currently permitted, few of the problems or additional risks identified above would apply. The reductions such vehicles would offer in terms of the internal and external costs are likely to be smaller than those offered by vehicles with significantly higher capacity but the minimal investments required mean that a benefit cost ratio substantially in excess of one would be likely, with the model predicting annual savings of around:

- 45 thousand to 66 thousand tonnes of carbon dioxide,
- 57 million to 85 million vehicle kms,
- 276 thousand to 682 thousand goods vehicle movements,
- one or two fatalities, and
- £23 million to £37 million in net internal and external freight transport costs.

If the net present value of the benefits for 18.75m 44 tonne articulated goods vehicles with longer semi-trailers are evaluated over 5 years, they would be expected to be between approximately £110 million and £176 million. If the evaluation period was extended to 15 years the net present value of the benefits would be expected to be between £224 million and £359 million and over 60 years would be approximately £241 million to £386 million. Additional worthwhile benefits would be likely if the weight of such vehicles were to be increased to approximately 46 tonnes to compensate for the increase in unladen weight (a payload neutral weight increase).

If further consideration is given to permitting these longer articulated vehicles then more detailed study may be necessary in order to:

- validate the costs and benefits with respect to uptake by the industry, the effects of small (payload neutral) weight increases, legal issues, safety, manoeuvrability, and the effects on current and future rail markets; and
- assess whether additional worthwhile benefits could be achieved, relative to existing vehicles, by variations to the length, height and configuration of the longer semi-trailer.

Contractor	**TRL Limited / Heriot-Watt University**	
Completion Date	Spring 2008	
Contact	Enquiries at TRL: Enquiries at TTS:	lhv@trl.co.uk TTS.Enquiries@dft.gsi.gov.uk

Ongoing Projects

S0601/ V7 The Heavy Vehicle Crash Injury Study Phase 2

Background

Following on from Phase 1 (S0211/VE), the Heavy Vehicle Crash Injury Study (HVCIS) Phase 2 provides information to the DfT in order to promote safer commercial vehicle design. The data collected in this study over the three years from March 2006, will aid research into the causes and consequences of personal injury accidents involving commercial vehicles. This data can then be used to identify countermeasures which would achieve accident and injury reductions.

Phase 2 of the Heavy Vehicle Crash Injury Study (HVCIS) exists to determine the likely causes and personal injury consequences of accidents involving case vehicles, which are classed as heavy goods vehicles, buses, coaches, minibuses, light vans and agricultural vehicles.

Summary

To achieve the aims of the project there are three core work programmes:

1. Truck Crash Injury Study (TCIS)

The TCIS collects in-depth information regarding fatal and non-fatal accidents involving heavy and light goods vehicles, buses, coaches and minibuses. Detailed vehicle investigations are undertaken by the Vehicle and Operator Services Agency (VOSA) who supply their findings to TRL. The forms are completed by VOSA teams operating in the TCIS sample areas (which are harmonised with the Co-operative Crash Injury Study sample areas as far practicable). TRL process and store the data collected in the TCIS database and release the data on a quarterly basis to the Department.

2. Police Fatal Road Accident Reports

Police Fatal accident reports are one of the main sources of data for the HVCIS project. Retrospective analysis of police fatal accident reports where case vehicles were involved, is undertaken by means of coded forms completed by experienced accident researchers. This provides data which highlights specific accident mechanisms and identifies specific countermeasures that could prevent similar accidents reoccurring. The coded sheets which form the output of the analysis of the fatal files are released on a quarterly basis to the Department.

Citroen Relay which swerved to avoid an animal

3. Press Cuttings relating to Agricultural Vehicle Accidents

The collection of additional information regarding agricultural vehicle accidents is contracted to Richard Gard Associates. This information is obtained through the collection of press cuttings and workshops on the safety issues surrounding the on-road use of agricultural vehicles.

For the TCIS and Police Fatal Road Accident Reports databases, a browser and basic data input system has been produced. This provides a method for viewing and analysing the data from the project databases and also simplifies the entry of the data into the research databases. There are quarterly data releases and a summary analysis of the data collected is reported in the last quarter of the project. In addition to this summary analysis, the data has been analysed in detail in order to support a wide range of separate research projects providing more detailed analysis of specific issues. Recent examples include:

- investigation of how to protect pedestrians in collisions with Heavy Vehicles – EC funded 6th Framework project APROSYS;
- investigation of trends in pedestrian accidents – DfT Road Safety Division;
- a review of safety priorities for commercial vehicles – DfT VTS division;
- Heavy Vehicle Wheel Detachment – DfT VTS division;
- technical requirements, costs and benefits of automated emergency braking systems – EC DG Enterprise and Industry;
- assessing the costs and benefits of improved car to truck crash compatibility – EC funded 5th Framework project VC_COMPAT;
- development of a revised EC Directive relating to the braking systems of agricultural vehicles – EC DG Enterprise and Industry;
- assessing the potential effects of Integrated safety guards and spray suppression fitted to HGVs – DfT VTS division; and
- assessing the effects of proposed changes to the EU Directive relating to the field of view from vehicles – DfT VTS division.

Contractor	TRL Limited	
Completion Date	March 2009	
Contact	Enquiries at TRL: Enquiries at TTS:	01344 770425 020 7944 5026

S0415-V7 Development of the Vehicle and Operator Services Agency (VOSA) Accident Database - Phase 3

Background

As part of its work, the Vehicle and Operator Services Agency (VOSA) is responsible for running the accident defects and recall programme that operates in the UK. This requires the detailed inspection of vehicles involved in accidents where a defect is alleged to have contributed to an accident happening. When appropriate, VOSA works with vehicle and component manufacturers to rectify safety critical faults with vehicles.

VOSA vehicle examiners become involved in an investigation at the request of the Police. They may attend accidents of any severity, but their involvement is more frequently requested for fatal and serious accidents. The Police often have their own vehicle examiners qualified to inspect passenger cars and therefore VOSA focus on accidents involving Heavy Goods Vehicles (HGVs), both rigid and articulated, and Public Service Vehicles (PSVs).

A frontal damage to HGV

The nature of the accidents that the examiners are called to is reflected in biases within the resulting database.

Summary

This project follows on from previous phases (S0053-VC) and involves processing the collision forms that are completed by VOSA vehicle examiners.

Data is collected by the Vehicle examiners and entered onto a Common Reporting Format (CRF) form, which was created to ensure that all vehicle examiners record similar information in a standard way, as it may be used as evidence should a VOSA examiner be required to go to Court. TRL receive paper copies of the VOSA collision forms which they validate and process.

The information from the forms is entered on a multi-table relational database that both addresses the needs of the project stakeholders and promotes linking of the data to other DfT accident databases. The design of the database, the creation of which was recommended from phase 1 of this project, enables analysis of the stored data to identify where vehicle defects may have an influence on road safety, and to understand better their specific role in accidents. This can be used to guide research and development of accident countermeasures for specific accident types. Data is released to the project sponsor on a quarterly basis.

The database has been routinely analysed to answer specific questions raised by VOSA and the Department. It has also been used in some research projects. Examples of some of the topics investigated are:

- lightweight trailer safety;
- road tanker accidents;
- a review of safety priorities for commercial vehicles;
- wheels becoming detached from heavy goods vehicles; and
- accidents occurring due to insecure HGV loads.

Contractor	TRL Limited	
Completion Date	Summer 2008	
Contact	Enquiries at TRL: Enquiries at TTS:	01344 770425 020 7944 5026

S0515/ V7 Large passenger, goods and agricultural vehicle safety - effectiveness of existing measures and ranking of future priorities in the UK

Background

The UK has a target for casualty reduction on its roads which is to be achieved by the year 2010. This project is intended to contribute to a wider assessment of how the UK is performing against this target and where further reductions can best be achieved after 2010.

Large passenger, goods and agricultural vehicles make up a relatively small number of the vehicles on the roads in the UK. However, in general they are involved in greater numbers

of accidents than the numbers of vehicles registered would suggest and, due to their size and weight, those accidents are more frequently fatal or result in more congestion and/or property damage than those involving other vehicle types. Large vehicles may, therefore, represent an important area for future casualty reduction efforts in relation to the 2010 casualty reduction targets and beyond. To help identify and prioritise the potential for further worthwhile reductions, DfT commissioned TRL to review previous and current research and regulatory activity, and to establish the most cost-effective means of improving the safety of these vehicles. The project focusses on issues related to the construction of large vehicles, but has also considered other areas relevant to their use.

Summary

The aims of the project are:

- to determine how previous research and resulting measures have performed;
- to identify and prioritise current issues; and
- to propose where best to target resources to deliver further worthwhile casualty savings.

The vehicles of interest for the purpose of this research are defined as:

- heavy goods vehicles (HGVs) – goods vehicles with a GVW >3.5 tonnes;
- light commercial vehicles (LCVs) – goods vehicles with a GVW ≤ 3.5 tonnes inclusive;
- large passenger vehicles (LPVs) – passenger vehicles with 17 or more passenger seats;
- minibuses – passenger vehicles with more than 8 and less than 17 passenger seats;
- agricultural vehicles; and
- other motor vehicles (OMVs) – commercial vehicles not fitting other definitions e.g. refuse lorries, mobile cranes, fire engines etc.

The project involves extensive reviews of literature and analysis of a wide variety of accident data sources including:

STATS 19	HVCIS fatal	CCIS
CARE	TCIS	OTS

The project has been peer reviewed at two stages by representatives of DfT, other research agencies and the commercial vehicle industry. A final report is being written that can be used to help inform future policy and decision making in the field of commercial vehicle safety.

Contractor	**TRL Limited**	
Completion Date	Summer 2008	
Contact	Enquiries at DfT: Enquiries at TRL:	020 7944 2082 020 7944 5026

THEME 4

Motorcycle Safety

Motorcyclists represent only 1% of the traffic population but account for 18% of the fatalities. In 2007 there were 588 motorcyclist fatalities on our roads.. Against this background it is important for the Department to investigate measures to reduce the risk by ensuring new machines are safe and that machines in use are well maintained and serviceable. Exposure of riders to risk should also be reduced to a minimum by improved equipment such as helmets, clothing, the provision of better conspicuity and vision.

The Government's Motorcycle Strategy was published in February 2005 and updated and re-issued in June 2008. Nine specific actions for TTS division were included within the "motorcycle and rider equipment" section covering issues on diesel spills, lighting, vision (mirrors and visor) and tyres. Several projects have been commissioned to meet our obligation; an analysis of the potential benefits of "safety features" is underway and following an extensive research programme, the SHARP helmet test/rider information initiative has been launched.

SHARP – the Safety Helmet assessment and Rating Programme – was set up in 2007. SHARP provides an independent assessment of how much protection a helmet can offer in an impact. Helmets are rated from 1 to 5 stars; the more SHARP stars a helmet has the better protection it can give. The first ratings for 60 full face helmets were published in spring 2008 with further ratings to be published on a rolling basis.

Recently Completed Projects

S0232/ VF Motorcyclists Helmets and Visors - Test Methods and New Technologies

Background

Between 1980 and 1995, the annual numbers of motorcyclist fatalities and serious injuries in Great Britain fell from 1,018 to 416 and 19,341 to 5,672 respectively (during the same period, the numbers of motorcyclists fell from 1.372 to 0.594 million). By the year 2000, these figures had risen to 573 deaths and 6,312 serious injuries and the number of motorcyclists had risen to 0.825 million. Fatal and serious injuries to motorcyclists have therefore become an increasingly significant contributor to road accident casualties.

Based on a study of injuries sustained by motorcyclists in the Strathclyde region, it has been estimated that, if test methods could be strengthened, improvements in helmet design could save up to 100 lives a year in Great Britain. This is one of the key deliverables to better motorcycle safety as set out in the Governments' Road Safety Strategy. Given this potential, the Department funded a research programme with TRL which had overall objectives to improve helmet and visor test methods, evaluate new helmet concepts and devise a consumer information scheme.

Summary

The involvement of industry was perceived to be an essential part of delivering safer helmets to the market and the project was initiated with a workshop to facilitate an open exchange of views on how best to deliver better helmets capable of saving around 100 lives per year in the UK. The potential for the activities discussed to be taken forward within the EC 6th Framework Programme was also explored.

A review of current test methods was completed to determine their suitability for evaluation of alternative helmet designs. A number of deficiencies in the current UN ECE Regulation 22.05 were identified and improved test methods and performance criteria were proposed that were suitable for the evaluation of enhanced helmet concepts. These methods were developed to form the basis of a consumer information scheme (CIS) that was complementary to the recommendations of COST 327 European Research action and previous Departmental work (S100L/VF) but could rate and compare helmet safety performance. A range of helmets were tested in accordance with the protocols and the scheme was shown to provide a mechanism to deliver safer helmets to the market, thus helping the Government to achieve published safety targets.

A partial Regulatory Impact Assessment (RIA) validated the potential benefits of safer helmets and assessed the impact on major helmet industry stakeholders. The RIA concluded that Regulatory change could achieve up to 100% usage of enhanced safety helmets over a period of 5 years, with the potential to improve the injury outcome for up to 20% of motorcyclists who currently suffer serious or fatal injuries. It was estimated that as a minimum a consumer information scheme could encourage approximately 10% usage of enhanced safety helmets over 5 years, delivering a pro-rata safety improvement. A CIS was considered the most effective option for rapid delivery of enhanced safety motorcycle helmets to the market, by providing consumer choice. Furthermore, the CIS could lead manufacturers in a positive direction and may ease the transition to Regulatory change.

Contractor	TRL Limited	
Report	Title	Reference
	S0232/VF Motorcyclists Helmets and Visors - Test Methods and New Technologies – FINAL REPORT	TRL PPR 186
Completion Date	November 2005	
Contact	Enquiries at TRL: Enquiries at TTS:	01344 770605 020 7944 5026

S0602/ V6 Summary of Project to Assess Test Procedures for Evaluating the Performance of Motorcycle Anti-Lock Braking Systems

Background

UNECE's Working Party on Brakes and Running Gear (GRRF) was asked to recommend test procedures that could form the basis of a Global Technical Regulation (GTR) on motorcycle braking. The Department agreed to participate in the evaluation, and commissioned MIRA to conduct the necessary testing, using a BMW 650C motorcycle.

Summary

The evaluation involved two different tests:

- measuring the Peak Braking Force Coefficient of the test surface, using an adaptation of the ASTM1337 "chirp" test. In this, the braking force on a towed wheel is gradually increased until lock-up occurs, and the peak braking force that occurs (usually just before lock-up) is measured; and
- measuring the deceleration of a motorcycle fitted with a valve that pre-sets the maximum braking force available (k-measurement). The ABS system is turned off and the limiting braking effort increased until one or both wheels are on the point of locking. The deceleration achieved in this condition is then compared with what can be achieved with the ABS system active.

Both tests proved to be a practical form of assessment, and produced consistent results. At 50km/h, average deceleration on the high-friction surface was 76% of that recorded in the k-measurement tests, and on the low-friction surface 83% of the k-measurement result. However, in tests at 60km/h, these effects were reversed, with the high-friction 93% of the

k-measurement and the low-friction 70%. Measurements were also taken of the response of the ABS system during the transition from a low-friction surface to a high-friction one. In all but one case, these times were less than 1 second.

Contractor	MIRA Limited	
Report	Title	Reference
	Assessment of procedures to evaluating the performance of Motorcycle Anti-Lock Braking Systems (S0602/V6)	MIRA 06-1012440-02
Completion Date	July 2006	
Contact	Enquiries at MIRA: Enquiries at TTS:	02476 355000 020 7944 5026

S0614/ V8 Motorcycle Helmets Test Assessment Protocol Prove Out

Summary

This project involved subjecting five UN ECE 22.05 approved motorcycle helmet models to a series of linear and oblique dynamic impact tests specified by the Department for Transport (DfT). The objective was to ensure that the test and assessment protocols proposed for the basis of a consumer information programme are robust and suitable for implementation. The protocols are based on the findings and recommendations made by the DfT project SO232/VF (Motorcyclists' Helmets and Visors - Test Methods and New Technologies) and a collaborative European project (European Co-operation in the Field of Scientific and Technical Research, Action 327), known as COST 327. TRL was commissioned to complete a series of linear and oblique impacts at 6m/s, 8.5m/s and 9.5m/s and to provide technical comment on their appropriateness and suitability for implementation.

Impact tests were shown to be repeatable and appropriate for purpose. Results showed that the assessment methodology distinguished between the injury protection offered by five motorcycle helmets approved to UN-ECE Regulation 22.05 in impacts up to 8.5m/s. There was a large range of performance between the helmets tested. Based upon the assessment it was estimated that up to 47 lives per year could be saved if all wearers used the best performing helmet model rather than the worst.

Contractor	TRL Limited	
Report	Title	Reference
	S0614/V8 Motorcycle Helmets Test Assessment Protocol Prove Out	TRL PPR 212
Completion Date	November 2005	
Contact	Enquiries at TRL: Enquiries at TTS:	01344 770605 020 7944 5026

Ongoing Projects

S0607/ V6 Powered Two Wheeler Integrated Safety (PISa)

Background

In Great Britain, Powered Two Wheelers (PTWs) currently account for approximately 1% of annual vehicle kilometres travelled, but account for around 20% of fatal and serious casualties (Road Casualties Great Britain:2005, DfT, 2006). When the distances travelled by PTWs are taken into account, the rate of motorcyclists killed and seriously injured has declined over recent years. However, the rate of PTW users killed or seriously injured is still approximately 30 times greater than for cars. The increasing popularity of motorcycles and improved safety of other vehicles, suggests that motorcyclists may continue to become a greater percentage of the road traffic fatality distribution in the future.

Summary

The principal objective of the European PISa project is to identify and develop an effective integrated system that will include active technologies for application to a range of PTWs. The system will be focused on vehicle technology rather than infrastructure or personal protective equipment solutions, with an emphasis on accident avoidance. The integrated system developed in the project may improve primary safety, but also allow links to secondary safety systems, such that injury severity can be mitigated in those accidents that the technology cannot completely avoid.

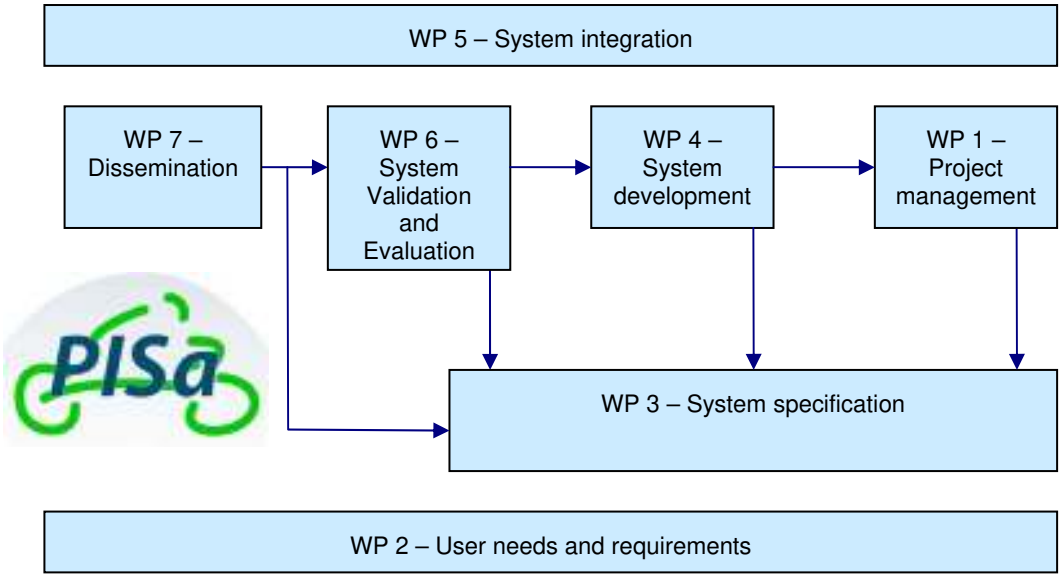


Diagram of PISa project structure

The collaborative PISa project involves 11 partners from 4 EU countries and India, including universities, research institutes and 4 OEM's. TRL is involved primarily in work packages 2, 3 and 6. The main activities within these work packages are:

- to define the main accident types applicable to PTWs and to assess a sample of in-depth cases in order to make predictive assessments of the effectiveness of a range of active systems. This includes detailed accident analysis using data from accident data sources such as STATS19, the On-The-Spot project and a UK Fatals database;
- to determine and prioritise the most effective strategies for mitigating or avoiding PTW accidents by derivation of functional requirements for active systems in specific accident types;

- understanding user acceptance of active system technologies through survey data;
- assessment of pre-crash manoeuvres to enhance understanding of the rider and vehicle interaction, essential for determining the potential benefits that may be offered to PTW rider's safety, particularly when considering primary safety systems;
- definition of the specification for potential PTW safety systems, achieved by identifying a range of sensor and actuator systems which could potentially deliver the countermeasures required;
- identifying, using existing data and computer modelling activities, which types of sensor and actuators are feasible and provide the most effective way to deliver the functional requirements of the system to the PTW rider;
- the selected integrated safety system will be developed into two working prototypes to allow full system evaluation in real-world conditions. This will allow an objective assessment of the system in terms of technical performance and user acceptance, which, when related to accident information, will be used to estimate potential costs and benefits of the system.

A sample of in-depth accidents from the UK OTS and COST 327 databases have been reconstructed to assess the types of active safety system predicted to avoid or mitigate the accident outcome. In parallel, the UK Fatals database was analysed to identify the most effective countermeasures for PTW fatalities. A list of 43 functional requirements developed by the PISa consortium was matched to active systems, and these were assessed for each in-depth accident case reviewed. A series of inter-team workshops were used to co-ordinate and validate the predictive assessments made by the participants of the consortium. The systems were ranked and the systems proposed to be taken forward by the project and fitted to two PTW models were:

- Automatically stop PTW without input from rider - Stop PTW (continuous braking);
- Detect and warn PTW that vehicle travelling from left, right or oncoming is crossing the PTW's path - PTW to detect other vehicle and warn rider;
- Avoid locking of wheels – ABS;
- Balance front to rear braking force – CBS (combined braking system/linked brakes);
- Reduce closing speed – ACC (adaptive cruise control);
- Amplify braking force – Brake Assist, EBS (enhanced braking system);
- Improve PTW conspicuity – Special fairings/PTW conspicuity.

Questionnaire investigation of user needs and acceptance of different active safety systems has been completed for PTW riders in The Netherlands and Great Britain. An initial benefit assessment has been carried out to provide an estimate of the magnitude of the casualty saving attributable to each safety system. This confirmed the proposed PISa system functionality has significant target population benefits. A specification for the sensors and actuators required for the PISa system has been developed from modelling and other data, and the development of the system for later performance evaluation has commenced.

Contractors	**TRL Limited**	
Reports	http://www.pisa-project.eu	
Completion Date	December 2009	
Contact	Enquiries at TRL: Enquiries at TTS:	01344 770199 020 7944 5026

Motorcycle Helmets: Consumer Safety Information

S0707/ V8 Performance Testing

S0708/ V8 Test Equipment

S0709/ V8 Helmet Supply

S0710/ V8 Technical Support

Background

A commitment to review current standards and the minimum levels of protection offered by motorcycle helmets was made in the Government's Motorcycling Strategy published in 2005. The Government has invested heavily in motorcycle helmet research over a number of years and this indicated the potential to improve the safety protection given by motorcycle helmets. Laboratory tests have demonstrated the real differences in the safety performance of motorcycle helmets available in the market. While they all satisfy the minimum legal requirements, providing objective advice concerning the level of protection a safety helmet provides will assist riders when making this very important buying decision.

Summary

In 2007, the Government launched a new helmet safety scheme. SHARP (The Safety Helmet Assessment and Rating Programme) aims to provide consumers with an independent assessment of the safety performance of motorcycle helmets sold in the UK. The rating is based upon a series of laboratory tests, which assess helmet performance above the level currently required by UN ECE Regulation 22.05 or BS 6658:1985 and rates helmets from 1-5 stars.

Scientific analysis has shown that up to 50 motorcyclists' lives could be saved on UK roads each year if all riders wore helmets scoring highly in SHARP. Moving forward, the evidence gained from the SHARP initiative will be used to underpin UK approach to developing improvements to international standards for motorcycle helmets if necessary.

We launched the first ratings for 60 full face helmets in **Spring 2008**. More information about this initiative is available at: www.direct.gov.uk/sharp

Contractor S0707 - V8 S0708 - V8	INSPEC International	
Reports	None	
Completion Date	May 2011	
Contact	Enquiries at TTS:	020 7944 4558

Contractor S0709 - V8		
Reports	None	
Completion Date	July 2008	
Contact	Enquiries at TTS:	020 7944 4558

Contractor S0710 - V8	TRL Limited	
Reports	Title	
	SHARP – Development of the Performance Evaluation Protocol	CPR 005
Completion Date	April 2008	
Contact	Enquiries at TTS:	020 7944 4558

S0801/ V6 Comparison of Safety Requirements in QUADS and Cars

Background

Type approval of motorcycles, motorised tricycles and motorised quadricycles manufactured for the UK market are currently covered by 21 European Motorcycle Directives. Cars must meet more stringent regulations, outlined in 47 European Directives. However, the distinction between some of the heavier, bodied trikes/quads and cars is now becoming blurred with members of the public likely to be unaware that they are purchasing/using a vehicle with a lower relative safety performance.

Non-safety aspects, such as environmental performance or ease of movement and parking in urban areas, are leading to an increased number of "car-like" quads/trikes on UK roads. As a result there is a need to determine the risk posed by the lower safety standards in place for these vehicles.

Summary

The Department has initiated a desktop study to compare and contrast safety Directives for these different types of vehicle, and to quantify the technical challenges for "car-like" quads/trikes to meet the requirements of the car safety Directives. A full list of these Directives can be found in Annex IV of the Framework Directive for motor vehicles: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CONSLEG:1970L0156:20060704:EN:PDF.

Contractor	TRL Limited	
Completion date	ongoing	
Contacts	Enquiries at TRL: Enquiries at TTS:	01344 770852 020 7944 5026

THEME 5

Intelligent Transport Systems

Intelligent Transport Systems (ITS) offer a range of technology solutions to support delivery of the Government's future transport vision, helping to improve safety, reduce congestion and to bring environmental, economic and social benefits. The White Paper 'The Future of Transport - a network for 2030' highlights a commitment to encourage and enable greater adoption of technology. Specifically it talks about the development and deployment of Intelligent Transport Systems as playing an important role in supporting delivery of road safety, congestion and other policy objectives. Four ongoing projects are reported on under this theme.

Electronic Vehicle Identification (EVI): Standards project is working to develop an international standard for Electronic Vehicle Identification, with the primary aim of ensuring that, if and when developed, systems from different manufacturers are fully interoperable.

A toolkit' to understand the benefits and costs of ITS has been produced and will help guide key decision makers within the transport planning process to make informed decisions on considering investment in ITS as an alternative or an enhancement to more conventional measures.

We have also embarked on the first phase of a programme to develop and maintain the ITS Technical Framework for the road sector in the UK. The work to date comprises Phase 1 of the development of the Technical Framework. Under this phase, we have been working with key stakeholders to discuss the high level aspirations and to define objectives and the scope for the Technical Framework. A plan is being prepared for implementing the approach in Phase 2 and maintaining the Framework through sound governance.

Research on Co-operative Vehicle Highway Systems (CVHS) has looked at the many benefits that have been predicted or claimed for systems that closely couple a vehicle and infrastructure. The project's aims were to investigate whether or not the benefits being claimed for CVHS were realistic, and to consider how far these benefits could help the Department deliver on it objectives and targets, and if so, to devise a strategy to take this forward.

Ongoing Projects

S0233/ V2 Electronic Vehicle Identification: Standards (UG503A)

Background

A number of countries and manufacturers are investigating the possibility of Electronic Vehicle Identification (EVI). As vehicles are marketed as global products and have to be able to operate across boarders it is important that EVI systems, if and when they are deployed, are interoperable. Therefore, international standards should be developed to establish standards for performance and functionality.

Summary

The object of this project has been to take an active role in the development of an international standard for EVI, with the aim of ensuring future interoperability of manufacturers' systems.

TRL, on behalf of the Department, played a prominent role in establishing EVI as a work item for the development of a CEN/ISO standard by the AVI/AEI working group CEN TC278 WG12.

The working group is currently developing several standards for EVI applications;

Fully Featured (24534)

This standard comprises 5-parts, of which parts 1-4 are relevant to the UK. This standard (parts 1-5) has been successfully balloted for Technical Specification (TS) status, with parts 1-4 on a fast track for ballot as a full CEN/ISO standard.

For continuation, the contractor will continue to represent the Department at technical groups, in the required role of reviewing, responding to technical questions, and generally monitoring the development path of the Fully Featured EVI draft standard.

Basic (24535)

This was included as a work item at the request of the USA members, after starting the development of the Fully Featured standard. Now completed and published as an ISO standard. This Basic EVI standard developed by the working group references the Fully Featured 24534, and provides a limited specification for EVI applications.

Application interface definition (17264)

The development of the EVI standard required an application interface definition. The development of 17264 has been based on a revised version of an existing standard (14906). This will be published initially as a Technical Specification and is also on the path for CEN/ISO standard status.

Contractor	TRL Limited	
Reports	None	
Completion date	March 2009	
Contact	Enquiries at TRL: Enquiries at TTS:	01344 770541 020 7944 5026

S0446/ V1 Understanding the Benefits and Costs of Intelligent Transport Systems (ITS) – A toolkit approach

Background

As transport networks become more congested, and new highway construction recedes as a sustainable long-term solution, there is a growing need to adopt policies that manage demand and make full use of existing assets. Advances in information technology are now such that "Intelligent Transport Systems" (ITS) offer real possibilities for authorities to meet this challenge; by monitoring what is going on, predicting what might happen in the future and providing the means to manage transport proactively on an area-wide basis.

Summary

The Toolkit, originally in CD format, has now been updated and extended to be available to those who wish to use it via the Web. The new version of the Toolkit also includes new case study material and further advice and guidance in the area of monitoring, evaluation and reporting of ITS related schemes. This will enable further enhancement of the guidance through direct feedback from practitioners and provides specific advice on:

- the selection of ITS tools to meet policy objectives;
- the benefits and costs of ITS deployment; and
- what others have done to incorporate ITS within transport plans and lessons learnt from their experience.

The website is aimed at two groups:

- decision makers – to identify strategic goals to help achieve local and national transport objectives, and
- transport planners – who undertake the more technical aspects of a project, fulfilling the strategic requirements of decision makers.

Users of the toolkit are guided through the various modules, with instructions on how the material should be used. Distinct topics are used to assist in the decision making process. The toolkit approach enables the user to assess the relative merits of a range of tools, both ITS and, to a lesser extent, conventional measures. Detailed information on these tools is accessed via a decision tree, which requires the user to link policy objectives to the tools to deliver those objectives.

Contractor	Faber Maunsell	
Toolkit:	Understanding the Benefits and Costs of ITS - A toolkit approach	www.dft.gov.uk/itstoolkit
Completion Date	Ongoing	
Contact	Enquires at Faber: Enquires at TTS:	0121 262 1904 020 7944 5026

S0524/ V1 PPRO 4/ 12/ 27 Development of an ITS Technical Framework for the UK

Background

The UK Government published an ITS policy framework for the roads sector in November 2005. The document introduced the need for coordination of an ITS Technical Framework at a national level, so that individually procured solutions can interface effectively, sharing data and information in a way that ensures seamless service delivery. The Department of has since embarked on the first phase of a programme intended to develop and maintain the ITS Technical Framework for the road sector in the UK.

Summary

The project brief for managing the development of the UK ITS Technical Framework had six main tasks. These were:

- identify, refine and confirm DfT's high level aspirations;
- identify and manage stakeholders;
- appoint contractor;
- manage the delivery;
- provide client-side expert and quality assurance; and
- develop demonstration projects.

Developing the aspirations for the Technical Framework

A Steering Group comprising potential key DfT stakeholders was formed and met several times to discuss the high level aspirations and to define objectives and the scope for the Technical Framework.

Conclusions from the initial analysis

The initial approach implied a high commitment to ownership of the Technical Framework by DfT. The initial analysis revealed the fact that the stakeholder community was much broader than that represented by the Steering Group and that the stakeholders have quite a variety of different aspirations. The initial approach required a significant financial commitment from DfT and thus a strong business case. Despite significant interest from local authorities and the private sector in the development of the Technical Framework over a long period of time, it was concluded that there was not sufficient confidence in the business case to justify investment in the development of an "end-state" Technical Framework.

It was decided that the initial approach did not reflect adequately the need for wider ownership and governance of the Technical Framework. It was decided therefore to explore an alternative, more pragmatic approach.

Developing an alternative approach

It was decided that the alternative approach needed to:

- acknowledge the reality that there are many ITS stakeholders;
- allow and encourage devolved ownership of the Technical Framework;
- acknowledge the need to ensure proper long-term governance;
- acknowledge the role of public sector stakeholders at national and local level; and
- acknowledge the need to accommodate the aspirations of both public and private sectors.

The team investigated possible "tools" for the development of such an alternative approach. The "Zachman Framework" was selected, being highly relevant, academically sound and used widely. This is basically an approach to "Enterprise Architecture".

The Zachman Framework provides a systematic method of defining all the elements required for an enterprise architecture. There are six main headings (answering the questions Why, What, Where, Who, When and How), and six levels dealing with increasing detail (contextual, conceptual, logical, physical, as built and operational). The contents of the resulting 6x6 matrix provides the basis of an Enterprise Architecture.

The approach is described in the main report and further details are given in an Annex.

Testing the approach with public authorities

It was decided to test the approach on public authorities, as they currently are significant purchasers of ITS systems, encounter directly the problems of compatibility and interoperability and have experience of developing integrated ITS systems.

Five public authorities assisted in undertaking case studies;

- TfL – as the road authority for London;
- Romanse (Hampshire, Southampton and Portsmouth) – as an example of cooperation on ITS between authorities;
- Kent – as an authority linking urban and inter-urban traffic management;
- West Midlands – as an example of a conurbation; and
- Highways Agency – as a strategic road authority.

The case studies were limited in scope to the more contextual and conceptual layers of the Zachman Framework. They addressed the Why, What, Where, Who and How questions for each authority.

Consultation with the private sector

A workshop was arranged in conjunction with ITS(UK). The approach was presented and comments received. As a result of that workshop two further elements were included in the work.

The first element was to undertake a joint exercise with InnovITS to consider the development of an architecture for in-vehicle applications. The interest of the ITS supply industry is to develop generic "products" which can support a wide range of ITS applications. This implies a physical architecture, such as that using various technologies (e.g. satellite positioning, mobile communications and dedicated short-range communications) installed in a vehicle. The case study approach was followed with a team selected to represent different sectors of the ITS industry who might work together to provide the in-vehicle architecture by which many future ITS could potentially be supported.

Experience in other countries

The second element of the work initiated following the ITS(UK) workshop was a study of the relevance of work undertaken in other countries, particularly US, France and Italy on national approaches to ITS architecture development.

A Plan for Phase 2 of the development of the Technical Framework

The work to date comprises Phase 1 of the development of the Technical Framework. It has proposed and tested an approach with some of the stakeholders. A plan has been prepared for implementing this approach in Phase 2. A list of tasks, timeline and budget to develop

and maintain the Framework over a five year period are contained in the main interim report.

Contractor	Rapp Trans	
Reports	Title	
	Interim Project Management Report	
Completion Date	Ongoing	
Contact	Enquiries at Rapp: Enquiries at TTS:	07966 584748 020 7944 5026

S0706/ V1 Co-operative Vehicle Infrastructure Systems (CVIS) – A Policy Perspective

Background

The future concept of communication between individual vehicles and the roadside infrastructure has the potential to bring about significant road safety and network efficiency benefits. Running alongside the DfT's earlier CVHS feasibility study to identify and quantify the extent of policy delivery benefit and to consider potential barriers, pitfalls and dis-benefits, we also committed to take part in the co-funded European Co-operative Vehicle Infrastructure Systems project (CVIS).

One of the objectives of CVIS is to define and test new systems for cooperative traffic and network monitoring for use both in vehicle and roadside equipment, to detect incidents instantly and anywhere. In the framework of the CVIS, the Deployment Enablers sub-project tasks are to look into the non-technical barriers to cooperative systems deployment. DfT is leading a Work Package looking at the policy impacts and opportunities for CVIS and is continuing to explore the legal, administrative, technical, institutional, implementation and public acceptance issues so that a balanced view is reached.

Summary

With CVIS, drivers can influence the traffic control system directly and get individual guidance with the quickest route to their destination. Speed limits and other road sign information, as well as warnings of approaching emergency vehicles and similar urgent messages will be sent wirelessly to the vehicle and displayed to the driver. To validate the project's results, CVIS technologies and applications will be tested at one or more test sites in seven European countries including the UK.

In order to mitigate the barriers for any future CVIS deployment strategy, there will need to be co-ordination of policy initiatives across a wide range of stakeholders, including the policy owners responsible for road infrastructure, vehicle manufacturing, system design and telecommunications to name but a few. This involvement provides a good opportunity to see what others, particularly industry, are doing and want to do.

Contractor	Bittern Consulting Ltd	
Consortium Coordinator	ERTICO – ITS Europe	
Completion Date	January 2010	
Contact	Enquiries at Bittern: Enquiries at TTS:	01295 713916 020 7944 5026

THEME 6

Smart Cards and Ticketing

Research in this area has built on previous work on development of the ITSO specification for an interoperable ticketing interface. The specification covers all aspects of the ticketing life cycle, including the back office functions. It will enable the customer to use one smart card (or other smart media) to travel across any ITSO scheme. The specification is Crown Copyright and available free of charge.

This research programme has looked at the potential of smart cards and other smart media such as mobile phones for ticketing to enable seamless travel across transport modes. We have considered the opportunities and limitations offered by new technologies and emerging solutions and managed three desk research studies looking at Existing Smart Cards schemes (wider than just transport), e-Money in Public Transport and the potential for Be-in Be-out payment systems (where a passenger's presence is automatically detected).

Current research is also looking at wider ITSO implementation issues. The potential use of so-called "Low Cost" smart cards is being investigated in the Cheshire smart card scheme and the potential for multi-modal citizen services smart cards is being investigated in the wider Yorcard scheme.

New research which began at the start of 2008 is investigating the applicability and commercial benefits of Near Field Communications for smart ticketing on mobile phones.

Recently Completed Projects

S0530/ V3 Review of Existing Smartcard Schemes

Background

The aim of this project was to gain an understanding of the extent of existing smart card schemes, wider than just transport, to gather views of potential future smart card operation spanning transport and associated applications, and synthesise the results.

Summary

Questionnaires, interviews and workshops were used to collect information from other Government departments, Local Authorities, bus/train operators, banking, retail/loyalty cards and telecommunication/network providers. From this, it was possible to draw a number of conclusions.

The potential for multi-application smart cards and ticketing interoperability with ITSO was generally well understood. However, more could be done to communicate how ITSO transport ticketing could co-exist with non-transport applications, particularly to the non-ITSO schemes.

In terms of opportunities and constraints, the constraints were seen as non smart-card specific ones relating to budgetary issues, institutional arrangements (between authorities or across functions within authorities) and the need for strong project management skills. A bus operators' workshop highlighted the need for project managers to make more realistic estimates of implementation timescales. No 'fresh' opportunities were identified, although authorities and operators both underlined the need to make the most of platforms already in place.

The key lesson learnt from the impetus for national roll-out of smart cards was the recognition of potential benefits of scale. However, there was concern among those already rolling out schemes that their local needs would be ignored or that previous efforts would be rendered nugatory.

Under-resourced suppliers and their failure to meet their own delivery timescales was a common complaint. Instability in the ITSO specification was also given as a contributory factor delaying project delivery, but this was recognised as inevitable as the specification matured through real-life deployment and debugging.

The additional cost of 'doing ITSO' was highlighted as the reason why, for some pilot schemes, they had not trialled ITSO when the purpose of the pilots was a 'proof of concept' for some other key aspect (e.g. 'multi-application', stored travel etc). This barrier for small-scale pilots was considered likely to get worse because of the cost of setting up the required back-office, unless a lower-priced entry mechanism can be created.

A number of specific examples were given of technology failure in the early stages of some projects – some specific card supply problems, deficiencies with Electronic Ticket Machines on buses – or incomplete project delivery. However, contactless smart cards worked and delivered good management data, and stakeholders were still confident of ITSO deliverability.

A few authorities without smart card schemes still raised technology risk as a concern. The perception that the Oyster/ITSO debate was unresolved continued to cause uncertainty on the London-fringes, particularly for the neighbouring authorities as well as customers and transport services travelling cross-boundary.

Future plans of existing schemes, particularly transport schemes, were at a hiatus awaiting the outcome of decisions on the 2008 National Concessions programme, the evolution of the re-franchising programme on rail with ITSO and Oyster smart card commitments for Train Operating Companies and how this will play-out in the delivery of a national infrastructure.

The availability of future funding was seen as a possible major constraint to new smart card schemes. There was also concern that schemes created and funded on the basis of grants and special pots of capital funding might struggle to meet future running costs.

There were some concerns over the high costs of ITSO generally (including certification costs for suppliers) and the lengthened deployment times. However, it was recognised that these costs could be reduced by the greater economies of scale, and better value for money that larger partnership schemes could provide.

There was a general belief that the key ingredients of the technology, i.e. the ITSO specification and provision of ITSO services, were stabilising. There were also recent signs that some suppliers were advocating a more packaged ITSO product, with increasing emphasis on a generic configuration and a standard pricelist for some associated services, including elements of the back office as a managed service.

Examples of smart card schemes using old and new models of partnership were emerging and other schemes could consider the relevance of these models and potentially follow them.

The report concludes with a series of specific recommendations to address some of the issues raised.

Contractor	**MVA Consultancy**	
Reports	Title	Reference:
	Review of Existing Smart Card Schemes	Pending
Completion Date	June 2007	
Contact	Enquiries at TTS: Enquiries at MVA:	020 7944 5026 020 7529 6500

Ongoing Projects

S0444/ V3 Low-Cost Smartcard Investigation

Background

Conventional plastic contactless smartcards are used almost universally by transport smartcard schemes in the UK, but the ITSO specification supports a variety of card media, including 'low-cost' or disposable paper-based smartcards, which are already established in some applications (such as 'visitor' cards) in many countries. The objective of this project is to research the potential for such card media in UK public transport, from technical, general usage and public acceptance perspectives.

Non-personalised smartcard products with a given validity or travel entitlement present different production, marketing and distribution opportunities to conventional, personalised smartcards. It is envisaged that the potential to add flexible travel entitlement to other products, such as visitor or loyalty-type entitlements, or vice versa, will promote use of public transport, as well as generating wider benefits such as tourism and economic development.

Summary

The investigation is based on the existing Cheshire Travelcard scheme which was introduced and is maintained by Cheshire County Council. Its commercial interoperability, whereby passengers can use their smartcard products interchangeably between participating commercial bus operators, provides the platform for the trials associated with the investigation.

The Low Cost trial deployments rely on the ITSO development programme of the Cheshire scheme. Trials include multiple journey products for use on bus-based transport applications such as park and ride services, and to replace existing paper-based schemes for visitor entitlements, staff travel and home-to-school travel. Two commercially available low-cost smartcard types are included in the investigation.

Although the focus of the Investigation is on the technical characteristics and customer acceptability of low-cost smartcard technology, account is also being taken of the wider potential in marketing and distribution opportunities presented by the use of non-personalised smartcards.

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Reports	None	
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S0526/ V3 Trial of a Multi-Mode "Citizen Services" Smart Card

Background

South and West Yorkshire Passenger Transport Executives (PTE) are conducting a pilot of an ITSO compliant smartcard system – "Yorcard". If fully implemented the project would provide an ITSO compliant smartcard ticketing system for public transport throughout West and South Yorkshire on bus, train and tram. It would deliver a fully managed 'back office' service and offer a platform to provide multi-application smartcards or Citizen Cards in the future. The pilot includes a bus pilot scheme in Sheffield and a rail pilot on the Sheffield to Doncaster route.

The Trial of a Multi-Mode "Citizen Services" Smart Card research will augment the core Yorcard work by further considering new transport applications and the overlap with emerging Local Authority Citizen Cards.

Summary

The objective of this research project is to provide information from both before and during the Yorcard pilot. In addition a thorough analysis and evaluation will be carried out, including requirements for all types of user. Moreover, this project will provide information to deliver best practice and provide advice to other existing, or potential, smartcard schemes including a log of lessons learned.

The project will provide for a number of 'before pilot' and 'during pilot' reports over four phases including:

- bus boarding times;
- bus driver perceptions;
- travel centre staff perceptions; and
- consumer perceptions.

Additionally, the project will provide:

- an evaluation of the operations of Citizen Card schemes from a practical and political viewpoint;
- the findings of a simple technological trial involving the Sheffield Citizen Card and Yorcard;
- generic management information about the use of transport products within the Yorcard pilot; and
- a best practice final report aimed at providing an optimum solution to implementing transport and Citizen Card smartcard schemes.

Work aimed at collecting the initial baseline data is currently underway. The full suite of reports for this project is to be completed by March 2009.

Contractor	South Yorkshire Passenger Transport Executive	
Reports	None	
Completion Date	March 2009	
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S0527/ V3 E-Money in Public Transport

Background

The ITSO specification includes the potential for stored value products, ie loading a smartcard with money or other forms of credit. ITSO security is understood to be fit for purpose for a stored value scheme limited to transport applications. However, before using it as a general e-money solution, consideration needs to be given to possible vulnerabilities and their counter measures.

As a stored value scheme moves from a constrained environment to become more generalised, liability gravitates to the issuer of stored value, who is not generally in direct control of the environments in which the stored value is used. The issuer's level of control and influence over the ITSO specification, and the business rules associated with a compliant stored value scheme also need to be considered.

Summary

This study investigated the potential impact of developments in mobile telecommunications, e-ticketing and e-money on transportation and addressed the question of how they can add value to transport services and retail ticketing.

The research adopted the following methodologies:

- desk research of existing e-Money developments and schemes in the UK, across Europe and the rest of the world;
- discussion with key stakeholders to understand the potential of new services to improve public transport ticketing and related services, and how they might interface with ITSO; and
- guidance to DfT on e-Money issues including any potential conflicts which may occur when e-Money services are used within the transportation arena.

The Final Report documents the current status of e-money in legislative terms and considers the emergence of e-money schemes in various commercial sectors.

The key conclusion with relevance to transport policy and e-money is that the low take-up of e-Money in UK transport is for three specific, and separate, reasons:

- there is no 'champion' of e-Money in the fragmented and mostly competitive UK transport industry;
- 'on the road' bus competition, where operators compete to sell their own-brand discounted products to 'buy' loyalty is not amenable to an interoperable purse; and
- there is, as yet, no emerging market-winner for e-Money provision in the non-transport market which could have a catalytic effect in developing the transport market with a low-

cost infrastructure to support e-money (e.g. transaction 'clearing'). Furthermore, transport providers were concerned about adopting one approach only to find that it is the long-term market loser.

The study also concludes that, as a minimum, the following platforms are likely to evolve (interoperating just on transport or more widely, as the market dictates):

- ITSO stored value in its current form as a transport-only solution on either a local or, perhaps eventually, national scale;
- ITSO/non-transport stored value under a different security regime defined by the banking/retailing world, but acceptable to the transport world could be permitted and evolve; and
- proprietary solutions for payment cards can be expected to evolve as the market dictates.

Contractor	MVA Consultancy	
Report	Pending	
Completion date	Spring 2008	
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S0613/ V3 Be-In-Be-Out Payment Systems for Public Transport

Background

Well functioning and convenient ticketing schemes on public transport networks are of interest to the transport operators, users and Government in promoting accessibility and facilitating innovative solutions to demand and revenue management. Integrated transport networks and non-gated environments such as bus and light rail networks need solutions that do not require user actions while boarding or alighting. There have been several approaches, developments, trials and pilot projects to introduce Be-In-Be-Out (BIBO) solutions across Europe with different levels of success in recent years.

BIBO ticketing is a method by which the presence of the passenger is automatically detected at or just after entry to the transport system and his or her entitlement to travel is automatically validated, and later the passenger's exit from the transport system is also automatically detected or at least inferred. BIBO acts as a front end to a complete ticketing system.

BIBO systems, in conjunction with the generated electronic data on the public transport usage, may help to better manage the transport infrastructure and to improve public transport services by providing more detailed information on route utilisation.

BIBO user device: The ALLFA-Ticket as a smartcard (source: GWT-TUD)

Summary

This desk study investigates the relevance and the potential applicability of BIBO systems to payments and ticketing in UK public transport.

The analysis is based on the following major steps:

- analysis of the status of development of BIBO technologies;
- evaluation of BIBO technologies;
- analysis of standardisation of BIBO technologies for both International and European level as well as on national level in the UK; and
- analysis of the UK Public transport market and the potential of BIBO for the UK.

Theoretical concepts of the BIBO approach are being considered in the context of electronic fare management. Two of the conceptual approaches to BIBO, Walk-in Walk-out and Check-in Be-out, which are at a more promising level of development, have been selected for a more detailed comparison in the study. The ongoing and foreseeable technological trends for long-term sustainability of BIBO-based fare collection systems are also being investigated.

The study covers a comprehensive assessment of BIBO technologies, in particular:

- benefits for the different parties;
- technical risk, reliability and potential for fraud and resistance to fraud as well as data security and integrity and privacy and safety issues;
- commercial risk for operators; and
- dissemination potential.

A comparison of existing BIBO approaches and the relevant standards (such as EN 1545, ISO/IEC 15693 or EN 15320) is being carried out. Of equal importance are the components that work together in a BIBO-based ticketing system and that may be affected by BIBO technology such as user media and the vehicles' on-board systems. The extent to which ITSO provides the necessary preconditions for an implementation of BIBO technology is also analysed.

The study addresses the potential impacts on current UK ticketing regulations by the introduction of BIBO and also the reverse – some of the required potential changes to BIBO. An assessment is made regarding the potential stakeholders involved in BIBO, in particular possible new entrants and implications for existing stakeholders. Potential conflicts of interest between stakeholders, operators and government policies are also being considered.

The conclusions and recommendations include the contribution which BIBO systems in the UK could have to the Department's strategy in terms of delivering improvements to the accessibility, punctuality and reliability of local and regional public transport, and making it more efficient, cost-effective and competitive.

Contractor	**GWT-TUD GmbH**	
Reports	Title	Reference
	Be-In-Be-Out Payment Systems for Public Transport – Final Report	work in progress
Completion Date	Summer 2008	
Contact	Enquiries at GWT-TUD: Enquiries at TTS:	+49 351 8734 1560 020 7944 5026

S0610/ V3 The use of Near Field Communication (NFC) technology in mobile phones for public transport ticketing

Background

As technologies such as Near Field Communications (NFC) develop, the Department is keen to understand their possible impact on transport ticketing and to identify any areas of potential conflict with the ITSO national ticketing standard. This research project will assess the applicability and commercial benefits of NFC for public transport.

Summary

The main objective of the project is a trial of NFC enabled phones acting in three modes: as a carrier of public transport tickets compliant to the ITSO environment, as a retail device, and as a validator device.

This research involves the development of additional functionality within ITSO which the trial will demonstrate. The additional functionality will be in two areas. First, the use of an NFC device as a certified ITSO customer media, i.e acting as a smart card. Second, enabling an NFC device to perform the ITSO Product Retailer functions. This would enable a suitably certified NFC device to be used to retail public transport ticketing products via the mobile network, and to validate public transport ticketing products stored on other customer media via the NFC interface.

A trial using NFC as Customer Media is being carried out in a live ITSO environment. It will run for a period of six months to obtain sufficient passenger transactions to provide a robust analysis of the NFC device. The analysis will establish the operational impact of the NFC device on all stakeholders involved, and include an assessment of their reliability and durability.

The project is also developing a specification for remote retail and validation and will carry out a bench test demonstration. Trials of NFC devices as validators and remote retail devices may then be carried out to demonstrate their ability to operate in an ITSO environment.

The project will report on issues relating to:

- standards, regulatory, privacy and safety issues, data security and integrity, and technical risks

- the commercial drivers in public transport that would need to be met for the introduction of NFC devices
- current UK fares and ticketing regulations
- conflicts which may occur when NFC devices are used within for public transport ticketing and validation
- future opportunities for NFC in transport following the results of the trial

Contractor	**Consult Hyperion Limited**	
Report	Title	Reference
	The use of Near Field Communication (NFC) technology in mobile phones for public transport ticketing	Work in progress
Completion Date	Spring 2009	
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