

# Institute for Transport Studies

FACULTY OF ENVIRONMENT



UNIVERSITY OF LEEDS

## Research Report 2012 and 2013



[www.its.leeds.ac.uk/research](http://www.its.leeds.ac.uk/research)



## INTRODUCTION Dr Richard Batley, Director of Research and Innovation

An important focus of the past year has been the completion and delivery of our submission to the Research Excellence Framework (REF 2014). The scope of the previous exercise by the Higher Education Funding Council (RAE 2008) – was extended to include the assessment of not only our research outputs, but also the impacts of these outputs on industry, economy and society. The latter focus plays to one of our strengths as a provider of high-level independent research and consultancy to government and regulators. For our research activities we have held ISO9001 accreditation continuously since 1995. During 2012 and 2013, our research impacts have included the following:

- Path-breaking research has exposed the inadequacy of NO<sub>x</sub> emission controls on diesel vehicles and shaped European legislation on low emission zones (Dr James Tate see page 6 “Surveying Vehicle Emissions”).
- Valuations of travel time savings and forecasts of the demand response to travel time savings have formed key inputs to the economic case for High Speed 2 (Dr James Laird and Professor Peter Mackie see page 8 “Economic Appraisal and Evaluation”; Professor Mark Wardman, Dr Tony Fowkes and Dr Richard Batley see pages 10 and 12 “Modelling and Valuing Reliability and Punctuality” and “Passenger Demand for Rail Travel”).
- Long-standing research on the effectiveness of Intelligent Speed Adaptation (ISA) has been translated into changes to the Euro NCAP accreditation scheme (Professor Oliver Carsten, Dr Samantha Jamson) Publications covering our ISA research are listed on pages 22 – 25 under authors Carsten; Chorlton; Jamson and Lai.

Research activities at ITS cover a diverse set of themes and have engaged a vast array of sponsors and stakeholders. On pages 3 – 21 our research projects are listed alphabetically under theme headings. Research highlights of 2012 and 2013 include:

- A major new project with expert partners and cities across Europe, CH4ALLENGE expands understanding, transfers knowledge, and supports implementation of schemes in sustainable urban mobility planning (Dr Caroline Mullen see page 4).
- In 2013, the Department for Transport published five reports (amounting to some 500 pages of output) on the valuation of journey time savings produced by Professor Mark Wardman, Dr Richard Batley, Dr James Laird, Professor Peter Mackie and Phill Wheat (the reports can be found on our [website](#)).
- ITS researchers submitted evidence to the House of Commons Transport Select Committee Inquiry on winter resilience. In their submission, Professor Greg Marsden and Jeremy Shires drew on key issues from the Disruption project (see page 15), which included a large scale survey of UK regions affected by snow, storms and flooding during January 2013.
- Dr Susan Grant-Muller is a co-investigator on a Big Data centre recently funded by the Economic and Social Research Council, a collaborative venture with other academic schools at Leeds and University College London. The grant will help to establish a new Master’s course in Geography and Business and will fund a Consumer Data Research Centre (CDRC).

Staff achievements during 2012 and 2013 include the following highlights:

- Greg Marsden, Stephane Hess and Simon Shepherd were promoted to Professor.
- [Charlotte Kelly](#) was awarded a 3-year fellowship by the National Institute for Clinical Excellence (NICE).
- PhD student [Rawia El Rashidy](#) is one of ten women at the University of Leeds to be honoured as a ‘Woman of Achievement’. This was in recognition of her being awarded a gold medal in the ‘Young Researchers in Europe’ competition 2012.
- [Professor Peter Mackie](#) was appointed to the Airports Commission, which is examining the need for additional UK airport capacity and recommending to government how this can be met in the short, medium and long term.

## Transport Systems Hub

With the help of resources from The Higher Education Infrastructure Fund, the [Transport Systems Hub](#) was set up in 2011 to allow better coordination between academics at the University of Leeds and industrial partners interested in Transport Systems research. The strategic priorities of the cross-disciplinary hub are directed by [Dr Natasha Merat](#), with input from steering group members from across the University of Leeds. Relationship building with external contacts is co-ordinated by business development manager [Dr Erik Thomasson](#). In a bid to respond to both current and future transport and mobility challenges in the UK, our workshops, training events, industry placements and communications initiatives have extended the reach of cutting-edge research beyond the academic community. Activities particularly supported by the hub include:

- accelerating research impact by encouraging links with local, national and international non-academic organisations
- helping academics to disseminate their research to a wider audience using new technologies and social media
- identifying secondment opportunities for academics in industry and for industrial contacts at the University of Leeds

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- increasing the number of industrially sponsored, iCASE, studentships.

To get involved in any of the above activities, please contact our [Business Development Manager](#).

The Transport Systems Hub has strengthened or created new relationships with partners such as ARUP, M&S and JLR as well as with York and Leeds City Councils, First Group, O<sub>2</sub> and Telephonica, amongst others. The hub also aims to provide expert advice and secondment opportunities to the newly established Transport Systems Catapult. “*Reducing the Impact of Transport on the Environment*” was the first TEDx event at the University of Leeds, organised by the Transport Systems Hub to promote the impact of academic research to the wider world. Videos from this event can be seen here: <http://tsh.leeds.ac.uk/watch-listen/videos-and-podcasts/videos/>. Follow us on Twitter @TransportSH\_UoL

## The University of Leeds Driving Simulator

The simulator has received much press attention recently. In June 2013, the Programme for Simulation Innovation project (PSI), funded by both EPSRC and Jaguar Land Rover, was launched by Dr Vince Cable, Secretary of State for Business, Innovation and Skills. [Dr Hamish Jamson](#), UoLDS Facility Manager and Principal Investigator on PSI, was on hand to meet Dr Cable, highlighting the project’s significant academic and industrial impact. PSI is examining the extent to which simulation can support JLR’s virtual vehicle design process (and is further described on page 17) In July 2013, Dr Jamson took part in the BBC World Service Radio programme Click, taking a desktop version of the simulator to London’s Broadcasting House in a demonstration and debate on the role of automation in future vehicle design. During Road Safety Week in November 2013, [Professor Oliver Carsten](#) and [Dr Daryl Hibberd](#) were interviewed by BBC Breakfast and BBC Radio 5Live on BRAKE’s campaign encouraging drivers to turn off their mobile phones whilst in the car. Dr Hibberd also appeared on ITV’s Daybreak with live link-ups to the simulator demonstrating the hazards of driving when fatigued and of early morning driving following a night’s steady drinking. The simulator featured in the University’s 2013 e-Christmas card, showcasing some of our new visual effects developed by technician [Tony Horrobin](#): a night-time, snowy, driving landscape scene.

## STAFF CHANGES

New academic and research staff joining the Institute during 2012 and 2013 were: **Dr Charisma Choudhury**, **Dr Antonio Ferreira**, **Dr Daryl Hibberd**, **Tyron Louw**, **Dr Karen Lucas**, **Dr Reto Tanner**, **Dr Nikolaos Thomopoulos**, **Dr Zia Wadud** and **Dr Judith Wang**. New support staff included **Paul Adams**, **Zoe Clough**, **Kirsten McCaskill**, **Jodie Morrison** and **Erik Thomasson**.

**Professor Peter Mackie**, **Professor Mike Maher** and **Frank Montgomery** retired, and **Dr Thijs Dekker** left to take up a post at TU Delft.

## ACADEMIC VISITORS

During 2012 and 2013, the following visitors were hosted: **Professor Sanjay Gupta**, of the School of Planning and Architecture, Delhi, hosted by Professor Greg Marsden; **Professor Bashirul Haque** of Shahjalal University of Science and Technology, Bangladesh, hosted by Dr Charisma Choudhury; **Professor Akio Kishi** of the University of Shizuoka, Japan, hosted by Dr John Nellthorp; **Professor Janny Leung** of the Chinese University of Hong Kong, hosted by Professor Michael Maher; **Professor Michael Patriksson** of Chalmers University, Sweden, hosted by Professor David Watling; **Professor Nobuhiro Sanko** of Kobe University, Japan, hosted by Professor Stephane Hess; **Dr Michal Wolanski** of the Warsaw School of Economics, Poland, hosted by Professor Chris Nash; **Professor Meng Xu** of Beijing Jiaotong University, China, hosted by Dr Susan Grant-Muller.

## RESEARCH INTERNS

Research interns during the period were: **Holly-Anne Barber**, working with Jeremy Shires on the DISRUPTION research project; **Daniel Gillett**, working with Dr Yvonne Barnard on the BRIDGE and STEP-CHANGE research projects; **Syed Rahman** working with Dr Dan Johnson on rail and bus research projects; **Nikos Thomopoulos** working with Dr Susan Grant-Muller on the SUNSET project.

## POSTGRADUATE RESEARCH VISITORS

International research students hosted during 2012 and 2013 included: **Lingling Xiao** of BeiHang University, China hosted by Dr Ronghui Liu; **Matteo Agresta** of the University of Genoa hosted by Dr Dan Johnson; **Montsant Jornet-**

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**Gibert** from University of Barcelona, Spain, hosted by Dr Sam Jamson and Dr Ronghui Liu; **Cassiano Isler** of University of São Paulo, Brazil, hosted by Professors Chris Nash and Mark Wardman; **Elena Zucchini** of Universidad Polytechnica Madrid, Spain, hosted by Frances Hodgson; **Thomas Rasmussen** of Technical University Denmark and **Maria Luisa De Maio** of University of Reggio Calabria, Italy, both hosted by Professor David Watling; **Portnep Puangprakhon** of Mahanakorn University of Technology, Thailand, hosted by Dr Dong Ngoduy.

## PhDs AWARDED

Nine postgraduate research degrees were awarded to ITS students during 2012 and 2013: **Erica Ballantyne** 'How is urban freight logistics affected by transport demand management measures and policies?'; **Daryl Hibberd** 'In-vehicle systems - developing a multiple warnings strategy'; **Nurul Hidayati** 'Modelling the effects of the physical facilities 'school safety zones' on passenger car equivalent values on urban roads.'; **Calvin Jephcote** 'Spatio-temporal correlative analysis of the health effects of urban air pollutants from traffic'; **Fatimah Kamal** 'Understanding the governance of reforms to urban transport in developing cities.'; **Ben Kolosz** 'Assessing the sustainable performance of inter-urban intelligent transport'; **George Kountouriotis** 'Vision, attention and steering.'; **Said Munir** 'An investigation into new trends in air pollutant concentration (particularly ozone and nitrogen oxides).'; **Martin Rivas-Perez** 'The dynamics of access: a study of social inclusion, job opportunities, travel mobilities and developing the Gateshead Metro Centre'.

## RESEARCH STUDENTS

A total of sixty one students were registered at ITS during 2012 and 2013. In addition to those who graduated, the following students undertook postgraduate research study : **Khaled Abdullah; Afzal Ahmed; Segun Aluko; Izza Anwer; Valerio Benedetto; Anzir Boodoo; John Buckell; Julian Burkinshaw; Fiona Crawford; Joel Dodsworth; Rawia El Rashidy; Joanna Elvy; Fahmi Fahmi; James Fox; Qian Fu; Andrew Gillies-Smith; Alvaro Guzman; John Haith; Stephen Hanley; Probo Hardini; Nick Herbert; Jie Huang; Sheriff Idriss-Yahya; Christopher Kelsey; Haneen Khreis; Andrew Koh; Andyka Kusuma; Peter Lawson; Christopher Leahy; Chao Lu; Mojtaba Moharrer; Helen Muir; James Musgrave; Andrew Naimanye; Munajat Nugroho; Steven O'Hare; Sanna Pampel; Stephen Parkes; Ian Philips; Rahman Pilvar; Shafiq Rahman; Christopher Rushton; Padma Seetharaman; Doh Shin; Aswin Siregar; Daosadeth Soysouvanh; Yvonne Taylor; Evona Teh; Andrew Tomlinson; Ersilia Verlingheri; Phillip Wheat; Zhitao Xiong; Noor Yahaya and Jingyan Yu.**

The co-supervision of students registered in other University of Leeds Schools included: **Manuel Cabral** and **Cheryl Roberts** (Business School); **Gillian Harrison** and **Claire Linton** (School of Civil Engineering); **Pablo Guillen** and **Rob Smith** (School of Computing); **Jing Ma** (School of Geography); **Ashkay Dwarakanath** (School of Medicine & Health); **Laura Campbell, Andrew Dixon, Holly Edwards, Richard Riley** and **David Wyatt** (School of Process, Environmental and Materials Engineering).

## Research theme: ACTIVE TRAVEL

### VISIONS of the role of walking and cycling in 2030

Grant holder: [Dr Paul Timms](#)

Investigators: Dr Paul Timms, Dr Astrid Gühnemann, Prof David Watling, Dr Dong Ngoduy, Dr Caroline Mullen, Dr James Laird

Funded by: Engineering and Physical Sciences Research Council

Dates: Oct 2008 - Mar 2012

Collaborative partners: University of Oxford; University of Salford; University of East Anglia; University of Manchester

Website: [www.visions2030.org.uk](http://www.visions2030.org.uk)

**Abstract:** This project created three visions of the future for walking and cycling in UK cities. These visions were accompanied by a large number of visualizations of street scenes (which can be seen on the [Visions2030](#) website). The visions were used in three city workshops (Leeds, Norwich and Kirkcaldy), that devised city-specific visions and pathways for achieving these visions, and in one national workshop (organised by the Department for Transport). A number of theoretical issues arising from the creation of such visions and their transfer to other locations (e.g. in Latin America) are being taken up by the EPSRC-funded STEP CHANGE project. The project led to a large number of publications and conference/workshop presentations, including:

- Tight (2011) et.al. [Visions for a walking and cycling focussed urban transport system](#) Journal of Transport Geography 19(6):1580-1589
- Timms and Tight (2010) [Aesthetic Aspects of Walking and Cycling](#) Built Environment, 36(4):487-503
- Timms et al (2011) [Pathways to Achieving Radically Different Urban Walking and Cycling Futures in the UK by 2030](#). Institute for Transport Studies working paper

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- Ngoduy et al (2013) [Dynamic Bayesian Belief Network to Model the Development of Walking and Cycling Schemes](#), International Journal of Sustainable Transportation, 7(5):366-388

## Research theme: CHOICE MODELLING AND NON-MARKET VALUATION

### **ACTUM (Analysis of activity-based travel chains and sustainable mobility)**

Grant holder: [Professor Stephane Hess](#)

Investigators: Professor Stephane Hess, Professor Andrew Daly, Dr Richard Batley, Professor David Watling

Funded by: Danish Strategic Research Council

Dates: Jan 2011 - Dec 2015

Coordinating partner: Danish Technical University

**Abstract:** The objective is to develop a new decision support methodology for transport policy evaluation. We aim to design an instrument able to evaluate sustainable transport policies that need a balance between guaranteeing mobility and reducing transport externalities (e.g., CO2 emissions). The methodology is a novel disaggregate person- and household-based, activity-based framework. We will explore new techniques for the efficient collection of data about activity (and hence travel) patterns through the use of individual GPS data loggers and in-depth interviews to provide a better understanding and prediction of how restrictions within daily activity patterns influence the travel pattern. It is also an ambition to identify how changes in the transport system may influence the activity pattern, for example how improved accessibility may generate positive effects in terms of labour market changes and working hours. Such effects are overlooked in the existing decision support methodologies in Denmark.

### **Global Positioning System (GPS)**

Grant holder: [Professor Stephane Hess](#)

Investigators: Professor Stephane Hess, Professor Andrew Daly

Funded by: Department for Transport

Dates: Apr 2011 - Sep 2013

**Abstract:** The efficient movement of freight around the road network is essential to the UK economy. Any policy or infrastructure decisions that have an impact on this movement should thus be based on a solid understanding of such movements, and especially the factors influencing the choice of a specific route. This project made use of existing GPS data on the movement of around 600 HGVs over a period of one month. We processed this data into individual trips and, thus identified the actual route chosen by a specific truck driver for a specific journey. Next, we constructed a database of alternative routes that the driver could have used. The resulting dataset was used in choice modelling which allowed us to understand the relative sensitivities to travel time, cost, type of road, and other factors that influence route choice.

### **Federal Highways Agency Modelling**

Grant holder: [Professor Stephane Hess](#)

Investigators: Professor Stephane Hess, Professor Andrew Daly

Funded by: Federal Highway Administration, USA

Dates: Aug 2011 - Jul 2014

Collaborative partners: Resource Systems Group (RSG)

Research Group: Economics and Discrete Choice

**Abstract:** This project works on methods to improve long-distance passenger modelling in the U.S. The research will involve exploration of long-distance travel behaviour to establish a model structure and model components that are sensitive to policy variables and also representative of the population. The aim is to develop a long-distance passenger travel demand forecasting model framework for use in transport planning applications using micro-simulation data and surveys.

## Research theme: CLIMATE CHANGE; TRANSPORT AND LOW CARBON FUTURES

### **CHALLENGE**

Grant holder: [Dr Caroline Mullen](#)

Investigators: Professor Tony May, Professor Simon Shepherd, Dr Astrid Günemann

Funded by: European Commission - Intelligent Energy Europe Programme

Dates: Mar 2013 - Mar 2016

Collaborative partners: Rupprecht Consult; University of Timisoara; Urban Institute of the Republic of Slovenia; The Association for Urban Transition; Promotion of Operational Links with Integrated Services; Union of the Baltic cities Commission on Environment; FGM Amor; City of Amiens; City of Dresden; City of Gent; West Yorkshire Integrated Transport Authority and Executive; City of Brno; Centre for Budapest Transport; City of Krakow; City of Timisoara; City of Zagreb.

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Website: [www.sump-challenges.eu](http://www.sump-challenges.eu)

**Abstract:** Cities play a crucial role in contributing to EU2020 targets which aim to improve energy efficiency and reduce greenhouse gas emissions. Urban transport is one of the main contributors to energy consumption and emissions. A Sustainable Urban Mobility Plan (SUMP) is a strategic document designed to contribute to meeting EU2020 targets, building on existing planning practices and taking due consideration of the four key challenges: Public and Stakeholder Participation; Institutional Cooperation; Measure Selection; Monitoring and Evaluation. In collaboration with expert partners and cities across Europe we are working on these challenges, developing knowledge and practitioner learning, and supporting the partner cities in development, implementation and evaluation of sustainable urban mobility plans.

## COMPASS (Optimised Co-Modal Transport for Reducing Carbon Emissions)

Grant holder: [Bryan Matthews](#)

Investigators: Bryan Matthews, Dr Narasimha Balijepalli, Professor Simon Shepherd, Professor Stephane Hess, Dr Haibo Chen

Funded by: European Commission FP7

Dates: Nov 2011 - Nov 2013

Coordinating partner: Transport Research Institute, Edinburgh Napier University

Collaborative partners: Istituto di Studi per l'Integrazione dei Sistemi; Mcrit SL; MKmetric Gesellschaft für Systemplanung mbH; TRT Trasporti e Territorio; TTS Italia; Technical University of Vienna; Uniwersytet Gdanski.

Website: [www.fp7-compass.eu](http://www.fp7-compass.eu)

**Abstract:** This project addressed the challenges arising from the key European socio-economic trends, from environmental concerns and from technological change. The general objectives were 1) to provide an overall picture of future travellers' needs in the light of the key socio-economic trends, 2) to analyse how ICT and Intelligent Transport Systems applications can meet future travel and access demands, favouring the integration of multi-modal transport solutions and 3) to assess how these solutions can contribute to the de-carbonisation of transport activities. The key inputs of the Institute for Transport Studies analysed behavioural data to improve travel surveys and data collection. We also analysed the potential contribution of ICT solutions to European transport goals – in particular the de-carbonisation of transport. For project results please view the [compass](#) website.

## ecoDriver

Grant holder: [Dr Samantha Jamson](#)

Investigators: Professor Oliver Carsten, Dr Samantha Jamson, Dr Hamish Jamson, Dr Natasha Merat, Dr James Tate, Dr Richard Batley, Dr John Nellthorp, Dr Frank Lai, Dr Ann Jopson, Dr Daryl Hibberd, Dr Reto Tanner, Dr Karl Ropkins

Funded by: European Commission

Dates: Oct 2011 - Sep 2015

Collaborative partners: TNO; VTI; BMW; CTAG; TOMTOM; IKA; IFSTTAR; ERTICO; CRF; DAIMLER; SIMOTION.

Website: [www.ecodriver-project.eu](http://www.ecodriver-project.eu)

**Abstract:** Environmentally friendly driving, or ecodriving, is becoming an increasingly important topic among the intelligent transport systems community because carbon emissions need to be curbed in the context of climate change mitigation policies. In general, drivers are not aware that certain behaviours elevate fuel consumption and result in unnecessary emissions. Ecodriving interventions try to modify such behaviour in order to maximise energy efficiency and improve traffic flows – without compromising safety. The ecoDriver project aims to achieve a 20% reduction of CO<sub>2</sub> emissions and fuel consumption in road transport by delivering effective ecodriving advice and feedback. This will be achieved by maximising the effectiveness and acceptance of ecodriving interfaces (using graphical interfaces, haptic feedback or auditory messages). Driving style, traffic conditions, powertrain type and vehicle type will be studied independently using a common methodology to test and compare the effectiveness of nomadic and built-in ecodriving systems. The field trials, using passenger cars, light and heavy commercial vehicles and buses will be carried out in seven European countries. The results from the field trials will be scaled-up and social cost-benefit analyses will be carried out to assess the economic feasibility of a potential market deployment of the ecoDriver system.

## EVALOC (Evaluating Low Carbon Communities)

Grant holder & Investigator: [Dr Karen Lucas](#)

Funded by: Research Councils UK

Dates: Jan 2011 - Jul 2014

Collaborative partners: University of Oxford and Oxford Brookes University

Website: [www.evaloc.org.uk](http://www.evaloc.org.uk)

**Abstract:** The project seeks to assess, explain and communicate the changes in energy use due to community activities within six selected case study projects under the Department of Energy and Climate Change. The 'Low Carbon Communities Challenge' is a government-supported initiative to transform the way communities use and produce energy, and build new ways of supporting more sustainable living.

## Low Emission Zones - York feasibility study

Grant holder & Investigator: [Dr James Tate](#)

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Funded by: York City Council

Dates: Apr - Jun 2012

Collaborative partner: Halcrow Group

**Abstract:** We are delivering improved assessments of Low Emission Zone policies in the City of York using the next generation of vehicle emission information and models. The simulations across the city are highly detailed, down to individual vehicle level, and are a step towards a second-by-second virtual representation of the traffic network and the emissions generated. The modelling allows researchers to analyse the impact of congestion using a detailed breakdown of the local fleet and the emissions profile, such as grams per second for distance travelled, for different ages and types of vehicle. The results from the modelling can then be compared to recent on-road vehicle emission remote sensing measurements. This feasibility study forms part of our wider analysis of vehicle emissions (see below – Surveying Vehicle Emissions).

## MOPED

Grant holder: [Dr Susan Grant-Muller](#)

Investigators: Professor Meng Xu

Funded by: FP7 Marie Curie Actions (International Incoming Fellowship)

Dates: Apr 2013 - Mar 2015

**Abstract:** Congestion results in lost and more unpredictable travel time, increases fuel consumption and increased driver stress. Tradable Permits cover a variety of instruments that range from the introduction of flexibility into traditional regulation to the organization of competitive markets for permits. The aim of this project is to investigate the use of permits for emissions from driving. The main approach will be to establish road traffic network models to investigate alternative Tradable Permit schemes, their impacts, the advantages of different types of schemes, the socio-economic implications and to develop efficient algorithms for the proposed models.

## Multi-Level Governance and Carbon Management

Grant holder: [Professor Greg Marsden](#)

Investigators: Dr Antonio Ferreira, Dr Caroline Mullen

Funded by: Economic and Social Research Council

Dates: May 2011 - May 2013

Collaborative partners: University of Sheffield; University of Glasgow; Lund University

Website: [www.its.leeds.ac.uk/transport-carbon](http://www.its.leeds.ac.uk/transport-carbon)

**Abstract:** The UK, through the Climate Change Act 2008 has committed to a radical 80 per cent reduction in carbon dioxide emissions by 2050. Domestic transport emissions account for almost one quarter of these emissions and is the sector making least progress with a reduction of just 1.4% since 1990. The primary goal of this research has been to examine whether governance structures make a difference to policy effectiveness (design and delivery) and accountability within the field of carbon emissions management and the transport sector. The research has been theoretically-informed and examined through the analytical lens of multi-level governance. Case studies of two cities in England (Leeds and Manchester) and Scotland (Edinburgh and Glasgow) were developed through desktop research and interviews with fifty one stakeholders and five stakeholder workshops. The findings suggest that top level climate target commitment has yet to lead to a clear understanding amongst the many actors in the public and private sector about who should do what and when. This uncertainty has been further compounded by the economic downturn which is dominating local and national politics and spending priorities. Theoretically, the study has advanced our understanding of how complex cross-sectoral policies are steered, how narratives of credit claiming and blame avoidance are deployed and how incremental decision-making might be made more effective in the different governance settings. Practically, the project identifies the key barriers which appear to be limiting progress in carbon reduction and offers options to overcome these barriers such as enhanced city level experimentation.

## Surveying Vehicle Emissions

Grant holder & Investigator: [Dr James Tate](#)

Funded by: DEFRA Air Quality grant scheme

Dates: 2011 - 2013

**Abstract:** We have been measuring the tail-pipe emissions of road vehicles at drive-through monitoring sites in Bradford, Cambridge, Kirklees, Leeds, Sheffield and York. When combined with Vehicle Registration Information these measurements allow vehicle emissions to be broken down by vehicle type, age and fuel type against emission standards (e.g. Euro 0 - 5). This has provided a rare opportunity to: 1) study the composition of the on road fleet in detail; 2) study the emission characteristics of each fuel type and Euro standard on the road. This information provides an improved evidence base for Local Authorities to better calibrate their emission models and design more effective management strategies. We have found that the established EU methodology was over optimistic and unreliable for diesel cars and vans: [Road schemes at risk from persistently dirty diesels](#) and Carslaw et al (2011) [Recent evidence concerning higher NOx emissions from passenger cars and light duty vehicles](#). *Atmospheric Environment* 45(39):7053-7063.

## University of Leeds Travel Survey

Grant holder: [Jeremy Shires](#)

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Investigators: Dr Anthony Whiteing, Jeremy Shires

Funded by: University of Leeds

Dates: Annually in spring

**Abstract:** This annual travel survey collects data on travel behaviour from UoL staff and students to assist with the University's travel planning and to enable the calculation of Scope 3 travel emissions in accordance with new local authority environmental planning controls. This involves looking at both commuting and business travel for staff and travel between term-time residences and the University sites for students.

## DYNAMIC MODELLING: FROM MICRO-SIMULATION TO SYSTEM DYNAMICS

### Competitive Cities

Principal Investigator: [Professor Simon Shepherd](#)

Co-Investigators: Professor Greg Marsden, Professor David Watling

Funded by: Engineering and Physical Sciences Research Council

Dates: May 2010 - Sep 2013

Collaborative partners: Vienna University of Technology; Department for Transport; University of Amsterdam; Hong Kong Polytechnic University; Gateshead Metropolitan Borough Council.

Website: <http://qtr.rcuk.ac.uk/project/ECAE12B8-B9B5-408A-93AC-85637657EBB2>

**Abstract:** This project set out to answer the following research questions:

- In what ways do and could cities compete using fiscal demand management policies?
- How should cities design their policies to achieve individual and collective 'best' outcomes?
- Should cities consider sharing revenue streams – should they compete or co-operate?
- How significant are these policies to the redistribution of business and residents between cities?

Our interviews with local authorities confirmed that cities do compete, but they consider different cities as competitors for different aspects. For example, when competing for investment from creative industries to locate jobs, then cities from further afield will be considered as competitors. When competing for regional funds from government, cities will team with neighbouring cities but, when it comes to charges for transport such as parking, they will view neighbouring cities as competitors. When it comes to road user charging (which is not yet common in the UK), the cities suggested that there would be a hierarchy of charges to consider akin to the parking charges and so some form of competition may well evolve. Our modelling work set up games between cities which were assumed to be implementing cordon tolls. In general we found that cities who consider themselves in isolation may be missing out from the benefits of tax exporting behaviour. However from a system point of view, this ability to charge non-residents and retain the revenues could lead to a sub-optimal outcome when considering the whole population. Whilst regulation of cities was seen to bring about the greatest welfare gain in both the symmetric and asymmetric cases, the introduction of competition was seen to reduce welfare and increase tolls for all users. Using a static model, these competitive cases often resulted in a classic prisoner's dilemma or Nash Trap whereby both cities are worse off than in the no toll case. This supports the view that cities should be regulated. To explore the potential of collaboration further, a dynamic model was used in gaming mode where players (representing city planners) were able to update their toll strategies in response to changes in welfare and the toll set by the opposing player. Within this dynamic setting we found that players still tended to the Nash Trap or high toll solutions. However, once given information about the optimal regulated low toll solution, the players changed their strategy and a co-operative equilibrium evolved. This demonstrated how the sharing of information helps cities collaborate without the need for regulation. Further research is required into whether similar collaborative strategies would emerge where cities differ in size and amenity. In terms of business and resident location, it was shown that a smaller city would in general lose residents and jobs to a larger city (which may charge more).

### ORIGAMI (Optimal Regulation and Infrastructure for Ground, Air and Maritime Interfaces)

Grant holder: [Professor Simon Shepherd](#)

Investigators: Prof Simon Shepherd, Professor Stephane Hess, Jeremy Shires, Bryan Matthews, Dr Thijs Dekker, Dr Haibo Chen

Funded by: European Commission

Dates: Feb 2011 - Jan 2013

Coordinating partner: Transport Research Institute Edinburgh Napier University

Collaborative partners: Mcrit SL; MKmetric; Istituto di Studi per l'Integrazione dei Sistemi; Technical University of Vienna; Uniwersytet Gdanski, Emeritus Professor Peter Bonsall

Website: [www.origami-project.eu](http://www.origami-project.eu)

**Abstract:** The ORIGAMI project was concerned with improvements in long-distance door-to-door passenger transport chains through both improved co-modality and inter-modality. It started from the premise that, with the continuing increase in trip length in interregional travel, effective use of the available transport modes as well as the interconnection between trip legs would become increasingly important for a growing proportion of passenger journeys, particularly of journeys which contribute to regional and national economies. Effective co- and inter-modality requires the provision of integrated networks and services which are attractive to potential users and this is likely to require co-operation between

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a range of authorities and providers in the public and private sectors and may necessitate a wider vision than might otherwise prevail. On the other side of the coin are the users of the transport system, their demand for travel, their expectations and their reaction to the transport supply. The profile of users varies across European countries and regions and so will their actual and future travel behaviour. The general focus of ORIGAMI was on all those long-distance journeys which might benefit from more effective co-operation and/or interconnection between modes and services, and on those situations where this is currently hampered by institutional barriers, lack of investment, or failure to innovate and which could benefit from a more enlightened approach. Technical solutions to improved co-modality and, in particular, inter-modality were a particular focus of the project which has shown examples of how good solutions found in one mode can be transferred to other modes. Our contribution was through the delivery and analysis of an EU-wide survey on long distance transport including revealed and stated preference analyses. We contributed to the development of a long distance travel model (LUNA) for the whole of Europe.

## Secondment to West Yorkshire METRO – long-term issues in land use and transport planning

Grant holder: [Professor Simon Shepherd](#)

Investigators: Dr Narasimha Balijepalli

Funded by: Engineering and Physical Sciences Research Council; University of Leeds Impact Acceleration Account

Dates: Nov 2013 - Oct 2014

**Abstract:** The aim of this secondment is threefold: 1) To upgrade the current [MARS](#) model allowing it to be extended over the 6 local authorities of the Leeds city region partnership and to be updated with latest data from METRO ensuring compatibility with their other modelling tools. 2) The updated model will be adapted to investigate the benefits of longer-term land use development options in terms of location and phasing, alongside transport policies to maximise the potential for growth in the region whilst minimising other impacts such as greenhouse gas emissions. 3) A critical link analysis is to be developed to investigate how to prioritise transport schemes which can best unlock growth in jobs within the region.

## Train Control (Challenging Established Rules for Train Control through a Fault Tolerance Approach)

Grant holder: [Dr Ronghui Liu](#)

Investigators: Dr Ronghui Liu, Andrew Koh, Professor Malachy Carey, Dr Anthony Whiteing

Funded by: Engineering and Physical Sciences Research Council /Rail Safety and Standards Board

Dates: Mar 2011 - Feb 2014

Collaborative partner: Engineering 2050 Research Centre at the University of Salford

Website: <http://spark.rssb.co.uk/Lists/Records/DispForm.aspx?ID=3566>

**Abstract:** The aim of this project is to develop a new integrated approach for train control and rail network design to enable a more optimised use of capacities at stations and junctions. The operation of rail networks is safe-guarded through the use of train control and protection systems which follow strict rules. Rules such as conservative speed profiles on approaching signal blocks have a knock-on effect and can cause a network to operate at considerably less than its full achievable capacity. To overcome this we are developing a fault-tolerant approach to the design and operation of the rail network by integrating track design with dynamic routing and scheduling. The project uses novel evolutionary computational approaches particularly suited for combining multi-objective optimisation with risk management. Outcomes of the project were presented at the 1<sup>st</sup> European Symposium on Quantitative Methods in Transportation Systems, 4-7 Sept 2012, Lausanne, and published in the following journal articles:

- Liu R, Whiteing AE and Koh A. (2013) [Challenging established rules for train control through a fault tolerance approach: Applications at a Classic Railway Junction](#). *Proceedings of the Institution of Mechanical Engineers, Part F: Journal of Rail and Rapid Transit*. **227**(6):685-692.
- Ursani Z, Mei TX, Whiteing AE. (2013) [A Fault Tolerance Approach for Railway Scheduling and Train Control](#). *Transportation Research Part B: Methodological*. **56**:161-173.

## Research theme: [ECONOMIC APPRAISAL AND EVALUATION](#)

### Buses and the Economy

Grant holder: [Daniel Johnson](#)

Investigators: Daniel Johnson, Jeremy Shires, Professor Peter Mackie

Funded by: Greener Journeys; Department for Transport

Dates: Dec 2011 - Apr 2014

Collaborative partner: Marco Ercolani, University of Birmingham

Website: [www.greenerjourneys.com](http://www.greenerjourneys.com)

**Abstract:** This project has met the following objectives: 1) quantify the relationship between public transport accessibility, employment and gross value added; 2) show how this relationship might be implemented in line with Department for Transport guidance; 3) understand the role buses play in helping the unemployed and in re-vitalising town centres and 4) quantify the value of bus services in rural areas. Thus far, the project has reported on [the link](#)

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[between unemployment and bus use](#) and the [use of buses to access urban centres](#). Our findings have been highlighted in the [Daily Mirror](#) and the Financial Times. We have secured further funding for additional study and surveying in 2014.

## **Bundesverkehrswegeplanung (BVWP) – Scientific Advice**

Grant holder & Investigator: [Dr Astrid Günemann](#)

Funded by: German Federal Ministry of Transport, Building and Urban Development

Dates: Oct 2011 - Sep 2013

**Abstract:** The project provided scientific advice and research support for the development of an appraisal methodology for the German Federal Transport Infrastructure Plan to support their fulfilment of the research contract 'Grundsätzliche Überprüfung und Weiterentwicklung der Nutzen-Kosten-Analyse im Bewertungsverfahren der Bundesverkehrswegeplanung' for the German Ministry of Transport.

## **Economic Productivity and Transportation Investment Priorities (EPATIS)**

Grant holder: [Dr James Laird](#)

Investigators: Dr Daniel Johnson, Professor Peter Mackie

Funded by: National Cooperative Highway Research Program (NCHRP); Transportation Research Board

Dates: Jan 2012 - Mar 2014

Collaborative partners: EDR Group (lead); System Metrics Group; David Simmonds Consultancy; Prime Focus LLC; David Gillen; Roger Vickerman

**Abstract:** The objective of this research is to develop a methodology and guide for incorporating productivity gains in analysis and prioritization of transportation investments. The methodology and guide will encourage Departments of Transport and other agencies to apply consistent analysis methods and produce results that facilitate public decision making about transportation improvement priorities within a state or other large region.

## **Improving the Evidence Base on Journey Time Reliability on the Trunk Road Network in Scotland**

Grant holder: [Dr Anthony Fowkes](#)

Investigators: Professor Gerard de Jong, Jeremy Shires, Dr Haibo Chen, Dr James Laird, Dr Richard Batley

Funded by: Transport Scotland

Dates: Nov 2013 - Apr 2015

**Abstract:** The project aims (i) to generate evidence on journey time reliability from users of Scottish trunk roads; (ii) to bring together latest evidence and understanding worldwide on current patterns of journey times along with common causes of unreliability and the impact this has on businesses; (iii) to review currently held data on journey time reliability for the trunk road network in Scotland; (iv) to review international evidence on the values placed on journey time reliability; and (v) consider the implications of the foregoing for appraisal guidance.

## **Transformational Infrastructure**

Grant holder: [Professor Chris Nash](#)

Investigators: Dr James Laird, Professor Peter Mackie

Funded by: N8 partnership of universities

Dates: July - Dec 2012

Collaborative partners: University of Manchester; Liverpool University; Sheffield University; Durham University

**Abstract:** This project was concerned with the impact of infrastructure investment with a particular interest on transformational impacts on the northern regional economies of England. We contributed a chapter in the report on cost benefit analysis challenges with transformational transport infrastructure.

**Research theme:** [ENERGY AND ENERGY SECURITY](#)

## **DEMAND Centre**

Grant holder: [Professor Greg Marsden](#)

Investigators: Dr Anthony Whiteing, Dr Caroline Mullen

Funded by: Research Councils UK Energy Programme

Dates: May 2013 - May 2018

Collaborative partners: University of Lancaster; University of Reading; University of Aberdeen; University of Birmingham; University College London; University of Southampton; EDF Research; Transport for London

Website: [www.demand.ac.uk](http://www.demand.ac.uk)

**Abstract:** The DEMAND Centre is a five year collaborative research centre developing new ways to cut energy use in the UK. While greater energy efficiency is important, the trend is often towards more resource intensive standards of comfort, convenience and speed. The problem is that we lack a sophisticated understanding of how these trends take hold and of the underlying dynamics of demand itself. The DEMAND Centre takes this problem as its central challenge, contributing directly to the objectives of the call by focusing on what energy is for. If we are to understand the fundamental dynamics of demand and engage with related issues of justice, need and entitlement we have to develop a

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more thoroughly integrated account of the relation between technological provision and social practice, and of the spatial and temporal ordering of end uses. For example, knowing how end use practices vary, when and where they occur, and how and why they change over time is crucial if carbon reduction policies involving real time management or the decentralisation of supply are to have any chance of success. In taking this approach we move into new territory, redefining the problem of energy demand and the range of possible solutions. The DEMAND Centre's programme therefore represents a step-change in how problems of end use and energy demand are conceptualised and tackled. The research being undertaken at Leeds addresses issues of the dynamics of energy demand, the future of business travel, retail and on-line shopping trends and issues of fairness in fuel prices in the transport sector.

## Research theme: FREIGHT AND LOGISTICS

### Guest Researcher Programme 1

Grant holder & Investigator: [Professor Gerard de Jong](#)

Funded by: Swedish National Road and Transport Research Institute (VTI, Stockholm)

Collaborating partner: Centre for Transport Studies at the Royal Institute of Technology (KTH, Sweden)

Dates: 2009-2013

**Abstract:** Our collaborative research has focused mainly on validating, updating and extending the [Swedish national freight transport forecasting model](#) Samgods.

### SUSTRAIL

Grant holder: [Phill Wheat](#)

Investigators: Dr John Nellthorp, Daniel Johnson, Dr Anthony Whiteing, Dr Andrew Smith

Funded by: European Commission

Dates: Jun 2011 - May 2015

Coordinating partners: TRAIN (Ital) and Network Rail (GB)

Collaborative partners: 29 academic and industry partners across the EU

Website: [www.sustrail.eu](http://www.sustrail.eu)

**Abstract:** The SUSTainable freight RAILway: Designing the freight vehicle – track system for higher delivered tonnage with improved availability at reduced cost. EU freight transport is expected to grow by some 50% in tonne-kilometres by 2020. In many areas rail has been displaced from a dominant position by road transport services. The latter have grown and developed in capability and levels of sophistication that have not been matched by rail service providers. SUSTRAIL aims to contribute to the rail freight system to allow it to regain position and market, and the proposed solution is based on a combined improvement in both freight vehicles and track components. ITS is leading several work packages: 1) Development of the business case within SUSTRAIL, in collaboration with university and rail industry partners from 13 countries. 2) Specialist work on infrastructure capacity benefits: Faster rail freight services running closer to line speed can free up paths for passenger and freight traffic. 3) Examining cost-reflective charges, which can play a key role in minimising whole system cost by aligning operator incentives with the track damage costs caused by a particular vehicle type.

## Research theme: HEALTH, TRAVEL AND POPULATION CHANGE

### Travel to the GP

Grant holder & Investigator: [Charlotte Kelly](#)

Funded by: Bradford and Airedale Primary Care Trust

Dates: Oct 2011 - May 2012

Coordinating partner: Leeds Institute of Health Sciences

Collaborative partner: Derek Pearson

**Abstract:** This project calculated and compared the carbon footprint of patient journeys to and from a GP practice in West Leeds (following a travel survey implemented at the practice) using three methods including GIS mapping. It then explored, through focus groups with patients and clinicians, methods for identifying and reducing avoidable trips.

## Research theme: MODELLING AND VALUING RELIABILITY AND PUNCTUALITY

### Recovery time

Grant holder: [Professor Mark Wardman](#)

Investigators: Professor Mark Wardman, Jeremy Shires

Funded by: Passenger Demand Forecasting Council

Start and end dates: Jan - July 2012

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Collaborative partner: MVA Consultancy

**Abstract:** Recovery time is the amount of slack time that train operators include in timetables to help to ensure trains arrive at their destinations on time. We conducted a large scale stated preference study of rail travellers to determine their preferences amongst train in-vehicle time, delay time and recovery time. It was found that rail travellers find recovery time itself to be annoying, with a premium of 50% over and above in-vehicle time attached to it. The findings of the research were presented at the [2012 European Transport Conference](#).

## Value of Time meta analysis

Grant holder: [Professor Mark Wardman](#)

Investigators: Professor Mark Wardman, Phani Chintakayala, Professor Gerard de Jong

Funded by: European Investment Bank

Dates: Aug 2011- Jan 2013

**Abstract:** This research extended our recent meta-analyses of valuations of time and time related attributes to cover European wide evidence. It is the largest meta-analysis of values of time yet undertaken, covering 3109 monetary values from 390 studies and 26 countries that reported between 1960 and 2011. The values covered were in-vehicle time, walk and wait time, service headway, displacement time, congested time, parking search time and various aspects of reliability. The meta-model found the GDP elasticity to be around 0.8 and valuations varied with a wide range of other factors such as distance, journey purpose, mode, data type and type of travel time. The study findings were presented at the 2012 IATBR conference in Toronto.

## Values of Travel Time Savings: Analysis of Non-Work Values since 1994

Grant holder: [Professor Mark Wardman](#)

Investigators: Professor Mark Wardman, Phill Wheat

Funded by: Department for Transport

Dates: Dec 2012 - Mar 2013

Collaborative partners: ARUP; URS

**Abstract:** This study was undertaken for the Department for Transport to help it determine its future strategy regarding the values of non-work travel time and the need for further research. It was based on the investigation of a large data set of UK value of time evidence. Comparison of study values and the Department's appraisal values suggested the latter to be too large although there was no evidence to suggest that the variation over time was inappropriate. A meta-model estimated in a previous study supported the Department's appraisal values provided that the values implied by Revealed Preference data were taken as more appropriate than those obtained from Stated Preference data. Our [report](#) supported a return to a GDP elasticity of one and this change has subsequently been made by the Department.

## Values of Travel Time Savings for Business Travellers

Grant holder: [Professor Mark Wardman](#)

Investigators: Professor Mark Wardman, Dr Richard Batley, Dr James Laird, Professor Peter Mackie, Dr Tony Fowkes

Funded by: Department for Transport

Dates: Aug 2012 - Apr 2013

Collaborative partners: Glenn Lyons (University of the West of England); John Bates

**Abstract:** The purpose of this study was to provide the Department for Transport with an evidence base which could be used to inform its decisions going forward regarding the value of time savings for business travellers. It undertook a review of international appraisal practice and derived the Hensher equation approach to valuing business travel time savings from first principles. A major international review of the parameters that underpin the Hensher equation was conducted and the implications of this approach relative to the traditional wage rate approach were considered. The study also undertook an extensive review of European willingness to pay evidence for business travel time savings. Our [report](#) recommended various future research scenarios and also that the then current official values be re-based using more up-to-date income data and this was subsequently done. The research has been reported at international conferences.

**Research theme:** [OPTIMAL DESIGN AND PRICING](#)

## Pricing Competition in Transport Networks

Grant holder: Professor Erik Verhoef (VU/Amsterdam & Visiting Professor at ITS)

Investigator: [Andrew Koh](#)

Dates: Oct 2013 – Apr 2014

Funded by: NWO (Royal Netherlands Organisation for Scientific Research)

**Abstract:** As part of the i-PriSM programme (Innovative Pricing for Sustainable Mobility) we extend and develop a model in which both public transport and private operators engage in policies to maximize their profit objectives. In many research problems the city is considered in isolation from neighbouring regions. It is usually assumed in most conventional modelling frameworks that a benevolent regulator sets out to devise policies and strategies that maximise

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welfare for the entire transportation network. In reality, transportation authorities are organized according to geographical boundaries, but policies implemented by one jurisdiction have an impact on the welfare of another. Using a variety of techniques that will be gathered from literature reviews as well as research that we have carried out elsewhere, we propose a methodology for the study of such problems. This project has UK parallels in the Competitive Cities project (page 7).

## Research theme: PASSENGER DEMAND FOR RAIL TRAVEL

### PDFH update

Grant holder: [Professor Mark Wardman](#)

Investigators: Professor Mark Wardman, Dr Richard Batley

Funded by: Passenger Demand Forecasting Council

Dates: Dec 2012 - May 2013

Collaborative partner: MVA Consultancy

**Abstract:** As part of the PDFH 5.1 update, a review was undertaken of GJT elasticities, late time valuations and late time elasticities. An original aspect of this work was a comparison of the recently emerged evidence on directly estimated elasticities with PDFH's standard approach. This has led to a revision of late time valuations, impacting directly on financial flows within the industry and incentivising good performance. The results of the review were presented as a keynote speech at the ITEA (Khumo-Nectar) conference in Chicago and were published: Wardman M (2012) [Review and meta-analysis of UK time elasticities of travel demand](#). *Transportation* 39 (3):465-490. Another outcome was that greater clarity and significant amendment was given to the GJT elasticities recommended by PDFH. The Department for Transport is auditing the work for possible inclusion of its recommendations in webTAG.

### Schedule 8

Grant holder: [Professor Mark Wardman](#)

Investigators: Professor Mark Wardman, Dr Richard Batley

Funded by: Office of Rail Regulation

Dates: Nov 2012 - May 2013

Collaborative partners: ch2m hill

**Abstract:** This work was undertaken alongside the PDFH 5.1 update. The method underpinning the schedule 8 regime, which is used as an incentivisation and compensation mechanism in the regulation of rail industry service performance, was undertaken and new valuations were recommended for use in the formulation used.

### Seating Layout

Grant holder & Investigator: [Professor Mark Wardman](#)

Funded by: Passenger Demand Forecasting Council

Dates: Sep 2012 - May 2013

Collaborative partner: AECOM

**Abstract:** This project examined rail passengers' preferences amongst different seating layouts, seating positions and occupancies. The layout of seating within train carriages, of which there are numerous possibilities, and also the occupancy of that seating can be expected to impact on passengers' experiences of a train journey. However, there is very little evidence on how rail passengers value different seating experiences. Informed by exploratory research, and including attitudinal evidence, this study provided significant and original insights into rail passengers' preferences in this area. The primary evidence base was a Stated Preference experiment of over 2000 rail passengers, complemented by a novel Revealed Preference exercise that used CCTV footage to observe where rail passengers prefer to sit. The valuations, expressed as travel time multipliers, obtained from the Stated Preference exercise were generally plausible and exhibited a wide range according to the precise seating configuration, the occupancy level and the seating position within a layout. The innovative Revealed Preference analysis provides an encouraging degree of support to the Stated Preference results which, reassuringly, can themselves be reconciled with related valuations widely used in the railway industry in Britain and also the findings of the exploratory and attitudinal research. The findings of the research were presented at the [2013 European Transport Conference](#).

### Station Security

Grant holder: [Dr Richard Batley](#)

Investigators: Dr Richard Batley, Dr John Nellthorp, Professor Mark Wardman, Jeremy Shires, Daniel Johnson

Funded by: Rail Safety and Standards Board (RSSB)

Dates: Apr 2011 - May 2012

**Abstract:** Recent national passenger surveys have shown that satisfaction associated with personal security on the railways in Great Britain has been consistently lower than the overall satisfaction level of rail passengers. To address these concerns, and to improve personal security on the railways, the industry has implemented various security measures and schemes. However, in the absence of a value or a set of values to robustly quantify such measures,

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making a case for investment becomes very difficult. The Rail Personal Security Group asked RSSB to address this knowledge gap. To this end, the project has evaluated the Secure Station and Park Mark schemes implemented by the industry to improve personal security. The aims of the research, which have been fulfilled, were to establish whether the schemes are meeting their objectives and to estimate the value of the benefits accrued from their introduction. The project has quantified the schemes' benefits through increased patronage and crime reduction, as well as identifying wider social and economic benefits. Additionally, the research has delivered a well-developed and informed framework to assess the societal and economic benefits of investing in personal security, as well as recommendations on the effectiveness of the schemes. The knowledge gained through this work may be used in the Passenger Demand Forecasting Handbook, the New Approach to Appraisal guidelines; and individual train operator and Network Rail business case frameworks. The outputs will help make better investment and deployment decisions associated with personal security on the railways.

## Research theme: PRICING TRANSPORT SERVICES

### Revenue Management Review

Grant holder & Investigator: [Dr Jeremy Toner](#)

Funded by: First Group plc

Dates: May 2011 - Jun 2012

**Abstract:** First Group sought further understanding of the range of techniques available for Revenue Management including forecasting and optimisation. Our review of the principles and practice of price discrimination and yield management in transport and other sectors enabled our clients to establish the potential applicability to the various business arms of First Group.

## Research theme: RAILWAY COSTS AND EFFICIENCY

### Foster Rail

Grant holder: [Professor Chris Nash](#)

Investigators: Professor Chris Nash, Professor Mark Wardman, Dr Andrew Smith

Funded by: European Commission

Dates: Jul 2013 - Jun 2016

Collaborative partner: EURNEX

**Abstract:** The Foster rail project is being undertaken under the leadership of the European Rail Research Advisory Council and its overall aim is to identify long term research needs for the European rail industry. We are particularly involved in developing long run scenarios for the rail industry to 2050.

### Guest Researcher Programme

Grant holder: [Dr Andrew Smith](#)

Investigators: Dr Andrew Smith, Phill Wheat, Professor Chris Nash

Funded by: Centre for Transport Studies at the Royal Institute of Technology (KTH, Sweden); Swedish National Road and Transport Research Institute (VTI, Stockholm).

Dates: Apr 2011 - Mar 2013

**Abstract:** This project is an extension of a previous two year visiting researcher arrangement. The research is focussing on three main areas. First, developing our research on estimating marginal (wear and tear) rail infrastructure costs, which is important information needed to set track access charges, given European legislation on enhancing competition and ensuring economically efficient and fair access to the common infrastructure. In particular the research is seeking to better understand renewal costs, through corner solution panel models and exploring dynamic approaches. Secondly, the research aims to quantify the impact of contracting out of rail maintenance activity in Sweden on costs and efficiency using stochastic frontier analysis techniques. Third, the research will explore how to better model heterogeneity between decision making units, including modelling the impact of climate variables and quality measures.

### Half Cost Train

Grant holder: [Dr Andrew Smith](#)

Investigators: Dr Andrew Smith, Professor Chris Nash

Funded by: Rail Safety and Standards Board (RSSB)

Dates: 2013-2014

Collaborative partners: Loughborough University; Imperial College

**Abstract:** The 'half cost train' is an initiative to develop radically lower-cost railway rolling stock. The basic premise is the assertion that the aerospace industry has proved much more dynamic and successful in delivering better, cheaper aircraft than the rail industry has been in respect of rolling stock. We are comparing the rail and civil aircraft industries to see how their incentives to deliver innovative stock solutions differ, and what changes are needed to enable innovation

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in the rail industry. The research will also study trends in costs (and innovation) for both industries to challenge or verify the assertion that the civil aircraft has performed better than rail.

## ORR secondment

Grant holder: [Dr Andrew Smith](#)

Investigators: Dr Andrew Smith, Phill Wheat

Funded by: Office for Rail Regulation (ORR)

Dates: 2011-2014 and ongoing

**Abstract:** This project continues our long involvement in developing econometric, efficiency benchmarking approaches that underpin the cost efficiency assessment made by ORR. This in turn sets funding levels and efficiency targets for Britain's rail infrastructure manager, Network Rail. Using data collected directly from participating railways in Europe, the research has further developed the Leeds dual level efficiency model approach (Smith, A.S.J. and Wheat, P.E. (2012) [Estimation of cost inefficiency in panel data models with firm specific and sub-company specific effects](#). Journal of Productivity Analysis 37:27-40). Further work has also been undertaken on applying state of the art time varying efficiency modelling techniques for panel data, using railway data, and has been undertaken on the question of how to deal with uncertainty in efficiency estimates produced by stochastic frontier models. Our contribution is acknowledged in the [ORR Periodic Review](#) (see p331).

## Railway cost and efficiency modelling

Grant holder & Investigator: [Dr Andrew Smith](#)

Funded by: OFWAT

Dates: 2012-2014 and ongoing

Collaborative partner: Cambridge Economic Policy Associates (CEPA)

**Abstract:** This project developed new econometric models and advised on how they could be used to set a 'corridor' for allowed cost levels, whilst complying with OFWAT's aim to achieve a "light touch" approach to regulation. The preliminary report sets out the approach developed by ITS (with CEPA) which has fed directly into OFWAT's 2014 [regulatory review](#). OFWAT has adopted the ITS approach to econometric modelling. Dr Smith was appointed (from August 2013) as the regulator's academic advisor on cost assessment.

## Surface Transport Costs

Grant holder: [Jeremy Shires](#)

Investigators: Jeremy Shires, Professor Chris Nash, Dr Andrew Smith

Funded by: The Community of European Railway and Infrastructure Companies (CER)

Dates: Oct 2011 - Jan 2012

Collaborative partner: CE Delft

**Abstract:** The objective of this study was to provide an overview of all the main transfers between the government sector and the land transport sector, separately for road and rail, as well as the external costs of both modes for four selected European countries (UK, Germany, The Netherlands and Poland). Differences between countries and trends over time are identified and explained (if possible). Based on the results a comparison of the social costs of road and rail transport and revenues/expenditures from/to taxes, charges and subsidies for these modes are made. The results have been fed into the policy making of the Community of European Railway and Infrastructure Companies.

## Vertical Separation (Study on Railway Unbundling)

Grant holder: [Dr Andrew Smith](#)

Investigators: Dr Andrew Smith, Professor Chris Nash

Funded by: Community of European Railways and Infrastructure Companies (CER)

Dates: 2012

Collaborative partners: Delft University of Technology; Kobe University; Osaka City University; Civity (Consultants); University of Amsterdam.

**Abstract:** Working with partners in Japan and The Netherlands, we led key aspects of the important and influential EVES-Rail Study. We examined the cost and wider impacts of vertical separation (and alternative structural reforms) in the case of Europe's railways. The European Commission was proposing new railway legislation which may have mandated specific institutional forms (particularly vertical separation), and the purpose of our study was to determine the costs and other effects of such a policy. The [work has been presented and disseminated widely](#) and was referred to in the impact assessment of the European Commission's final regulatory proposals.



## Research theme: RESILIENCE IN TRANSPORT AND MOBILITY

### Disruption

Grant holder: [Professor Greg Marsden](#)

Investigators: Dr Antonio Ferreira, Jeremy Shires and Dr Caroline Mullen

Funded by: Research Councils UK Energy Programme

Dates: October 2011 to May 2015

Collaborative partners: University of Aberdeen; University of Brighton; Glasgow University; University of Lancaster; Open University; University of the West of England

Website: [www.disruptionproject.net](http://www.disruptionproject.net)

**Abstract:** When, for whatever reason, an otherwise stable context is disrupted, habits associated with that context are also broken. This suggests that analysis of unplanned disruptions presents a window of opportunity to capture the maintenance, substitution, abandonment and protection of travel practices during disruption, something which can provide insights into the main factors shaping an individual's travel practices. In turn these insights can help reveal the kinds of changes, to transport systems, social systems, individual lifestyles etc. that are needed to inspire conversions to lower carbon travel. The project thus seeks to move beyond the purely individualistic view of behaviour change. Leeds is responsible for leading the project, the work package on data collection from planned and unplanned disruptions and the deliberative policy design workshops. The project has already generated some unique insights into travel behaviour under disruption.

### Viajeo Plus (International Coordination for implementation of innovative and efficient urban mobility solutions)

Grant holder: [Dr Haibo Chen](#)

Investigators: Dr Haibo Chen, Dr Paul Timms, Dr Anthony Whiteing, Dr Astrid Günemann, Andrew Koh

Funded by: European Commission FP7

Dates: May 2013 - Apr 2016

Website: <http://viajeoplus.eu>

**Abstract:** Viajeo+ collects good practices in promotion of integrated network management (including multi-modal interchanges), public transport, intelligent infrastructure, clean vehicles, and urban logistics in Europe and beyond. ITS is involved in studying such practices and identifying needs for implementations and develops executive plans for different scenarios. We will also exchange experience and knowledge with global cities through showcases, site visits, workshops and dissemination learning materials with the final objective of producing a 'Virtual Solution Book'.

## Research theme: ROAD SAFETY

### Accident Models (Continuously updating predictive accident models using modern data sources)

Grant holder: [Professor Mike Maher](#)

Investigators: Dr Richard Connors, Dr Karl Ropkins

Funded by: Engineering and Physical Sciences Research Council

Dates: 2010 - 2013

Collaborative partner: University of Liverpool

**Abstract:** Predictive accident models (PAMs) are derived by fitting statistical models to data from road sections and junctions. There is no accepted theory to indicate how accident frequency increases with traffic flow and road characteristics, nor how to include changes over time. The temporal transferability of PAMs is questionable; PAMs derived using data from some 20 to 30 years ago seem to over-estimate expected accidents now. This project developed methods to readily and reliably update PAMs, which are described in the following three papers:

- Connors RD, Maher M, Ropkins K, Wood A, Mountain L. (2013) [Methodology for fitting and updating predictive accident models with trend](#). Accident Analysis and Prevention 56:82-94.
- Connors RD, Maher MJ, Mountain L, Wood A, Ropkins K. (2013) [Updating Outdated Predictive Accident Models](#). Accident Analysis and Prevention 55:54-66.
- Wood AG, Mountain LJ, Connors RD, Maher MJ. (2013) [Updating predictive accident models of modern rural single carriageway A-roads](#). Transportation Planning and Technology 36(1):93-108.

### Managed Motorways – All Lanes Running (MM-ALR): Alternative Temporary Traffic Management Simulation Studies

Grant holder: [Dr Samantha Jamson](#)

Investigators: Dr Daryl Hibberd, Dr Samantha Jamson

Funded by: Highways Agency

Dates: Aug 2013 - Feb 2014

Collaborative partner: ARUP URS Consortium

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**Abstract:** Nine temporary traffic management scenarios were designed for implementation in the Driving Simulator. Each scenario involved a lane closure on an All Lane Running (ALR) motorway (a motorway where the hard shoulder has been transformed into an active driving lane). The scenarios used various current and potential future signage methods to signal these lanes closures. The output of the project will be an assessment of driver comprehension and performance around these different signage methods, primarily the timeliness of their lane changes. This work will inform the selection of future traffic management techniques on ALR motorways. This project involves substantial improvements in the simulation of night-time driving in the [University of Leeds Driving Simulator](#).

## TTM signs

Grant holder: [Dr Samantha Jamson](#)

Investigators: Dr Hamish Jamson, Dr Daryl Hibberd

Funded by: Highways Agency

Dates: Aug 2012- July 2013

**Abstract:** This project investigated whether current signing at roadworks could be improved both in terms of its comprehension by drivers and from the perspective of a road operative. For the latter, the size of a sign to be placed at road works sites dictates manual handling procedures, including the number of live traffic crossings they have to make. Reducing the size of signs, without compromising driver comprehension was the ultimate goal of this project, achieved via a driving simulator study carried out on the [University of Leeds Driving Simulator](#). For a range of signs, alternative layouts were trialled and compared to the current Chapter 8 configurations. It was concluded that some significant savings could be made, both in terms of sign manufacture costs and sign size, without any observed changes in driver behaviour.

## UDRIVE

Grant holder: [Professor Oliver Carsten](#)

Investigators: Professor Oliver Carsten, Dr Frank Lai, Dr Natasha Merat

Funded by: European Commission

Dates: Oct 2012 - Sep 2016

Collaborative partners: 19 partners across 11 countries

Website: [www.udrive.eu](http://www.udrive.eu)

**Abstract:** UDRIVE is the first large-scale European Naturalistic Driving Study, with a plan to instrument 210 cars, trucks and motorbikes. We aim to enhance the understanding of actual road-user behaviour by means of field observations and thereby to identify ways to improve road safety, and to reduce vehicle emissions and fuel consumption. Our involvement in this project covers all stages of the collaboration, including study design, field trials, data analysis and dissemination.

## Undertaking secondary tasks while driving (two hands better than one)

Grant holder and Investigator: [Dr Samantha Jamson](#)

Funded by: esure car insurance

Dates: 2012

**Abstract:** This study revealed that reaction times increase by 50% when motorists eat whilst driving. This study used the [University of Leeds Driving Simulator](#) to evaluate motorists' ability to drive with only one hand on the steering wheel. Drivers were asked to complete a number of tasks while driving with one hand on the wheel, such as eating, drinking and talking on a hand-held mobile phone (only the latter is illegal in the UK). Driving with two hands on the wheel was compared to driving with just one hand. The study found that lane position varied more whilst driving with one hand. In a car-following task, where drivers were asked to maintain a safe and constant gap to the vehicle in front, performance also degraded when eating or drinking. When driving with one hand without undertaking a secondary task, drivers were able to maintain the same level of performance as when driving with two hands. It is possible that the poorer performance exhibited when eating or drinking while driving with one hand is the result of increased visual demand.

## Variable Message Signs

Grant holder: [Dr Frank Lai](#)

Investigators: Dr Frank Lai, Charlotte Kelly, Dr Ann Jopson

Funded by: Birmingham Primary Care Trust

Dates: Mar 2012 - Mar 2013

**Abstract:** Variable Message Signs (VMS) have been in use for traffic management since the 1970s. Their primary use is for warning drivers of incidents ahead or to offer routing information. VMS are most often used for delivering real-time traffic messages and are turned off when the situation has cleared. The possibility for using VMS to display non-driving-related information was investigated in this study. Survey results suggest that the vast majority of drivers do notice what is displayed but support for non-traffic-related information on VMS was luke-warm although most respondents were in favour of full use of VMS (i.e. not leaving them blank). Potential distraction by VMS was not a strong concern.



## Research theme: SHAPING FUTURE VEHICLE DESIGN

### Programme for Simulation Innovation (PSI)

Grant holder: [Dr Hamish Jamson](#)

Investigators: Dr Hamish Jamson, Anthony Horrobin

Funded by: Engineering and Physical Sciences Research Council; Jaguar Land Rover

Dates: Apr 2013 - Dec 2017

Collaborative partners: University of Loughborough; University of Warwick; University of Cambridge

**Abstract:** PSI is a five year strategic research collaboration to develop capabilities in advanced simulation to support the vehicle design process and reduce the reliance on physical prototypes. If a vision of zero physical prototypes is ever to be realised, then the process of digital design and verification needs to encompass not just the physical dimensions of component and system functionality, but also the driver's perceptual experience. Our principal focus is the development of a test driving experience which is as realistic as possible in a purely virtual environment. The challenge is for driving simulators to realistically represent driver behaviour across all driving tasks. It is necessary to understand how visual, vestibular, auditory, tactile and haptic cue rendering techniques impact on driver behaviour. Driver models are needed to explicitly quantify how cues are perceived, integrated and used to produce vehicle control actions. We are currently developing such models, and identifying their coefficients for basic driving tasks such as slalom, obstacle avoidance, lane-change and controlled stopping. The data will be used to map from cues (perceptions in the simulator) to control (handling of the vehicle). Analysis of our data will quantify the degree to which a simulator is able to reproduce real world driving behaviour in basic driving tasks.

## Research theme: SOCIAL MEDIA, SOCIAL INNOVATION AND MOBILITIES

### BRIDGE (Building Relationships with the 'Invisible' in the Digital Global Economy)

Grant holder: [Dr Yvonne Barnard](#)

Investigators: Dr Yvonne Barnard, Frances Hodgson

Funded by: Engineering and Physical Sciences Research Council

Dates: May 2009 - Oct 2012

Collaborative partners: University of Edinburgh; Middlesex University

Website: <http://bridge-relate.org>

**Abstract:** The aim of this project was to better understand the needs of digitally excluded people, as well as to search for common requirements across the globe and define new segments large enough to be economically feasible, reducing both social and economic barriers to inclusion. We investigated the use of digital technologies for older people. This was completed using walking interviews and an internet-enabled tablet with Google maps and other relevant applications such as Skype. New understandings of the development of skills and social organization are described by Barnard Y, Bradley M, Hodgson F and Lloyd AD (2013) [Learning to use new technologies by older adults: Perceived difficulties, experimentation behaviour and usability](#). Computers in Human Behavior 29 (4):1715–1724.

### SUNSET (Sustainable Social Networking Services for Transport)

Grant holder: [Dr Susan Grant-Muller](#)

Investigators: Dr Susan Grant-Muller, Frances Hodgson, Dr Nikolaos Thomopoulos

Funded by: European Commission

Dates: Feb 2011 - Jan 2014

Coordinating partner: Stichting Novay (NL)

Collaborative partners: Novay (NL); DOCOMO (DE); Queen Mary College University of London; Eco2Win (SE);

LocatieNet (NL); Universiteit Twente (NL); Gemeente Enschede (NL); Viktoria Institute (SE)

Website: <http://sunset-project.eu>

**Abstract:** Continued growth in personal mobility has consequences in terms of safety, economic efficiency and the environment. The SUNSET project aims to address these issues by taking a new approach to urban mobility management using the latest ICT technologies. This is based on a user-centred mobility paradigm involving cooperation by information sharing and provision of positive incentives between travellers, road authorities and other parties. The information is targeted on individual travel behaviour, and thus allows road authorities to fine-tune their transport policies and allows individuals to meet their personal objectives. The personalized approach can also help to alleviate other societal problems such as safety, social exclusion and health. ITS is leading the evaluation methodology for the impacts of the concept (Susan Grant-Muller) and the development of incentives to be implemented in a Leeds Living Lab (Frances Hodgson). The Living lab experiments ended December 2013. The final phase of the project will be devoted to analysis and evaluation of the results and dissemination.

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## The Forge

Grant holder: [Professor Greg Marsden](#)

Funded by: Economic and Social Research Council

Dates: May 2011 - Oct 2013

Collaborative partner: University of Lancaster

Website: [www.its.leeds.ac.uk/theforge](http://www.its.leeds.ac.uk/theforge)

**Abstract:** The Forge is a network of social science researchers interested in novel ways of conceptualising and analysing transport and travel. Its key objectives are to 1) integrate transport researchers – often isolated in areas of applied research – in wider communities of social science/social theory; 2) promote substantive and critical discussion around topics relating to transport, travel and mobility from a range of social scientific perspectives; 3) develop a self-sustaining network of researchers in transport, travel and mobilities research that will provide a step-change in the research capacity of the community. The network provides a means for research students, researchers and early career policy makers to meet, collaborate, publish and exchange ideas and has developed to 166 members over the three year period. Members of the network have set up profiles and can search for colleagues with common interests. The Forge has also provided small quantities of funding to allow participants to set up and support meetings and workshops on 'history of mobility systems', 'disused infrastructures' and 'well-being'. The annual Summer School has been a focal point for the network and its activities. These events were open to research students from all areas of social science. Over the three years 101 people from 39 higher education institutes in the UK and 13 other countries participated PhD and early career research training focussed on 'Crises'; 'Time, Travel and Everyday Life' and 'The Dynamics of Mobility'.

**Research theme: TECHNOLOGY AND HUMAN FACTORS**

## City Mobil 2

Grant holder: [Dr Natasha Merat](#)

Investigator: Tyron Louw

Funded by: European Commission

Dates: 2012-2016

Collaborative partners: the project includes 45 partners, please see website for further details

Website: [www.citymobil2.eu/en](http://www.citymobil2.eu/en)

**Abstract:** CityMobil2 is setting up a pilot platform for automated road transport systems, which will be implemented in several urban environments across Europe. Automated transport systems are made up of vehicles operating without a driver in collective mode. They are deemed to play a useful role in the transport mix as they can supply a good transport service complementing the main public transport network. Five sites in Europe will host a 6-month demonstration. Vehicles for the demonstrations will be supplied by selected manufacturers within the project. In addition to the pilot activities, research will be undertaken into the technical, financial, cultural, and behavioural aspects and effects on land use policies and how new systems can fit into existing infrastructure in different cities. The legal issues surrounding automated transport will also be addressed leading to a proposed framework for certifying automated transport systems. In this major collaboration our role at ITS is to study road users' (particularly pedestrians' and cyclists') interactions with driverless vehicles, using both questionnaire-based and quantitative video analysis.

## FORWARN

Grant holder: [Dr Natasha Merat](#)

Investigators: Dr Natasha Merat, Professor Oliver Carsten, George Kountouriotis

Funded by: Engineering and Physical Sciences Research Council (EPSRC)

Dates: Sep 2012 - Aug 2016

**Abstract:** FORWARN aims to create a Forward Collision Warning system (FCW) that is able to consider driver distraction when making decisions on the appropriateness and timing of warnings. To achieve this, drivers will be asked to engage in a variety of distracting tasks in simulated driving scenarios that might trigger a forward collision warning. The FCW will be 'trained' to ascertain driver distraction using vehicle- and driver-related metrics. The distracting effects of non-visual tasks, such as hands free mobile phone conversations, will be a particular focus of this research. Systems which have permanently fixed criteria will be viewed by drivers as presenting too many false warnings. Previous studies have found that drivers in Field Operational Tests in the US were keen to be able to tune the system to their personal preferences. Therefore, we use eye tracking and vehicle related performance measures to identify the information that is needed by a FCW. Upon approach to a hazardous condition, this intelligent FCW will only be triggered after it has ascertained that the driver is truly distracted and unable to respond to the hazard in good time. This project will build upon the work already conducted by the group during previous European projects such as AIDE (Adaptive Integrated Driver-vehicle interface) and HASTE (Human machine interface And the Safety of Traffic in Europe) and a recently completed EPSRC-funded project, EASY (Effects of Automated Systems on safety).

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## FOT-Net 2

Grant holders: Dr Yvonne Barnard, [Dr Haibo Chen](#)

Investigators: Dr Yvonne Barnard, Professor Oliver Carsten, Dr Haibo Chen, Erik Thomasson

Funded by: European Commission FP7

Dates: Jan 2011 - Mar 2014

**Abstract:** Field Operational Tests (FOTs) are large-scale testing programmes aimed at a comprehensive assessment of the efficiency, quality, robustness and acceptance of ICT solutions used for smarter, safer, cleaner and more comfortable transport solutions, such as navigation and traffic information, advanced driver assistance and cooperative systems. The prime goal of FOT-Net 2 is to increase the momentum achieved in the FOT-Net 1 project of 2008-2010. The project gathered European and international stakeholders in a strategic networking platform to present results of FOTs, to identify and discuss common working items and promote a unified approach for FOTs. The ITS role was particularly oriented at conducting seminars on FOT evaluation issues, and coordinating groups working on extending the Field Operational Test support Action (FESTA) methodology.

**Research theme:** [TRAFFIC FLOW THEORY AND REAL-TIME TRAFFIC MANAGEMENT](#)

## Advanced Traffic Flow - Theory and Control

Grant holder & Investigator: [Dr Dong Ngoduy](#)

Funded by: Engineering and Physical Sciences Research Council

Dates: Sep 2011 - Sep 2016

**Abstract:** Active Traffic Management (ATM) is a scheme for improving traffic flow and reducing congestion on motorways. It makes use of automatic systems and human intervention to manage traffic flow and ensure the safety of road users. Information and communication technologies (ICT) are now in the early stages of transforming transportation systems by integrating sensors, control units and automatic technologies with microchips to enable them to communicate with each other through wireless technologies. In Japan and South Korea, the deployment of ICT in ATM programs has led to significant improvement of traffic network performance. In the coming decade ICT will considerably progress worldwide so that intelligent equipped vehicles, in which the driving tasks are shifted from the driver to the vehicle will make up a significant share of the traffic flow. Networks containing a mixed composition of manual and equipped vehicles are defined as heterogeneous intelligent traffic systems. This project seeks solutions for an improved ATM program to monitor and control intelligent traffic networks. The complex issues in real-life data collected from multiple sources will be tackled using a new real-time model-based intelligent traffic control framework to predict the transitions between free-flow, congestion and stop-and-go jams, and to investigate the true causes of such congestion. A sequence of immediate control actions will be established in order to reduce congestion, travel time and air pollution.

## Lanes and lane changing in dynamic modelling of congested road traffic

Grant holder: [Professor Malachy Carey](#)

Investigators: Professor Malachy Carey, Professor David Watling, Dr Narasimha Balijepalli

Funded by: Engineering and Physical Sciences Research Council

Dates: Oct 2009 - July 2012

**Abstract:** In macroscopic (flow based) modelling for dynamic traffic assignment (DTA), lanes and traffic movement between lanes have generally been ignored. As a result, these models can yield inaccurate or misleading results and cannot be used to investigate some important traffic issues. In view of that, for each of the main types of traffic flow models that have been used or proposed for DTA we (a) considered how to introduce lanes and lane-changing and (b) the advantage and disadvantages of each of the resulting models. The cell-transmission model (CTM) was found to have the strongest advantage, hence in the rest of the work and experiments we focussed on the CTM. Unlike other proposed models it handles queue formation and dissipation, spillback, merges, diverges, etc., in an intuitive and widely accepted manner, and all of these are essential in modelling lane-changing. We also made significant (published) contributions to each of the following closely related topics: 'route swapping' methods, analysis and comparison of the flow-density functions, methods for ensuring FIFO in the CTM, marginal costs, externalities, and optimal congestion tolls for the CTM. The results are reported in journal papers and conference proceedings, including the following.

- Carey, M. and Y.E. Ge (2012). [Comparison of methods for path flow reassignment for dynamic user equilibrium](#). *Networks and Spatial Economics* 12(3), 337-376.
- Carey, M. and M. Bowers (2012). [A review of properties of flow-density functions](#). *Transport Reviews* 32(1), 49-73.
- Carey, M. and D.P. Watling (2012). [Dynamic traffic assignment approximating the kinematic wave model: system optimum, marginal costs, externalities and tolls](#). *Transportation Research Part B* 46(5), 634-648.
- Carey, M., N.C. Balijepalli and D.P. Watling (2013). [Extending the cell transmission model to multiple lanes and lane-changing](#). *Networks and Spatial Economics*.
- Liu, Ronghui and Geoff Hyman (2012). [Modelling motorway merge: The current practice in the UK and towards establishing general principles](#). *Transport Policy* 24, 199-210.

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## Towards Autonomic Road Transport Support Systems

Grant holder & Investigator: [Dr Haibo Chen](#)

Funded by: European Cooperation in Science and Technology (COST Action TU1102)

Dates: 2011 - 2015

Website: <http://helios.hud.ac.uk/cost>

**Abstract:** A current, well recognised societal problem is the frequent failure of road transportation networks, resulting from traffic incidents, system overloading and lack of optimised support systems. The aim of this Action is to unite and align groups across Europe from computer science, engineering and transport studies into a world leading research community that will develop new ways of designing road transportation support (RTS) systems based on the ideas of autonomic systems. If used as a platform on which to implement leading edge RTS technologies, such systems have the potential to deliver savings in the cost of system configuration, maintenance, and infrastructure, while potentially improving network efficiency and reducing the chances of human error.

**Research theme:** [TRAVEL BEHAVIOUR AND SOCIAL INEQUALITIES](#)

## Modelling the relationship between transport poverty and social disadvantage

Grant holder & Investigator: [Dr Karen Lucas](#)

Funded by: Economic and Social Research Council

Start and end dates: Jan 2011 - July 2014

Collaborative partners: John Bates

URL: [www.tsu.ox.ac.uk/research/mrtpsd](http://www.tsu.ox.ac.uk/research/mrtpsd)

**Abstract:** This fellowship funds a programme of advanced research to explore and develop the use of socially disaggregate transport models within policy decision-making. It builds on Dr Lucas' extensive previous research with socially disadvantaged groups in different geographical contexts. It examines the value of applying socio-theoretical perspectives of transport poverty within current transport modelling approaches.

## TranSENDaNC: Transport and Social Exclusion New Dimensions and National Comparisons

Grant holder & Investigator: [Dr Karen Lucas](#)

Funded by: EU Marie Curie; IRSES

Dates: Jan 2011 - Dec 2014

Collaborative partners: University of Oxford and Oxford Brookes University

Website: [www.tsu.ox.ac.uk/research/TranSENDaNC](http://www.tsu.ox.ac.uk/research/TranSENDaNC)

**Abstract:** This four-year project facilitates international exchanges between senior researchers in the UK, Belgium and Chile. Sharing ideas and skills, about the theoretical concepts and methodological approaches which abound in the analysis of transport and social disadvantage, the researchers will seek to identify new theories and methods for the development of future transport policy and systems delivery more widely.

## Transport Equity Assessment

Grant holder & Investigator: [Dr Karen Lucas](#)

Funded by: EU COST

Dates: Sept 2013 - July 2017

Collaborative partners: TRANSyT Polytechnica De Madrid; IFFSTAR France

Website: [www.teacost.eu](http://www.teacost.eu)

**Abstract:** This four-year programme of researcher and policymaker exchanges contributes to the body of research on transport and social equity by bringing together new approaches to incorporate equity consideration in transport project evaluation and decision making. The approaches consist of the measurement of accessibility with the literature on social justice, travel behaviour models and socio-economic impacts analysis in line with mainstream welfare economics.

**Research theme:** [VISIONING TRANSPORT FUTURES](#)

## STEP-CHANGE (Sustainable Transport Evidence and modelling Paradigms: Cohort Household Analysis to support New Goals in Engineering Design)

Grant holder: [Professor David Watling](#)

Investigators: Professor David Watling, Dr Paul Timms, Dr Richard Connors

Funded by: Engineering and Physical Sciences Research Council

Dates: Apr 2012 - Jan 2016

Collaborative partners: University of Manchester

**Abstract:** There is an accepted need to promote step-changes towards more sustainable urban environments. While many model-based desk-studies have aimed to simulate such environments as part of a decision support tool, they adopt many un-validated, hypothetical assumptions, particularly in the way that major transport-focused interventions

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might impact on both behaviour and the effectiveness of the infrastructure. There is very little real evidence of what works and what can be used to promote such changes, deriving from the physical nature and make-up of urban environments and in the way that people choose to act and behave. Our research aims to fill this evidence gap, providing an empirically grounded frame for the modelling of transformational futures. The proposed research is ambitious and novel. We are undertaking the first largely qualitative longitudinal panel study of households which focuses on their transport activity, in particular delving into questions of why they do certain things and how change might be brought about. This work is complemented by the study of historical databases, coupled with testimony from planners and others who have experienced changes first hand. While bringing these diverse data sources together we will explore innovative ways of integrating these materials in ways which recognise the complexity of decisions and practices around transport and allow us to draw some understanding of why step-changes occur. We will use the results of these analyses to feed into more theoretical work which will consider firstly the potential for new planning procedures and practice and secondly new modelling tools which provide the means to help achieve the step-changes necessary in transport for sustainable and resilient urban futures by 2050.

## Transport Policy Making

Grant holder: [Professor Peter Mackie](#)

Investigators: Professor Peter Mackie, [Tom Worsley](#)

Funded by: Rees Jeffrey Road Fund

Dates: Oct 2011 - Mar 2013

**Abstract:** Recent history has been notable for the profusion of transport policy documents. A number of academic books have been written which adopt the working hypothesis that these documents are an expression of implementable policy and comment, usually with disappointment, on the failure to deliver of the last fifteen years. The proposition underlying this project is that policy statements are rarely more than aspirational in nature and pay inadequate attention to financial, deliverability and public acceptability constraints. This is not to belittle the worth of writing down from time to time what the aspirations are. But the real content of transport policy is best deconstructed from the decisions which Government takes faced with a range of engineering, economic and planning advice mixed with advocacy from lobby groups, the pressure of public opinion and political considerations and in the face of budget, deliverability and other constraints. Our thesis is that transport decisions are the outcome of three overlapping spheres of influence or 'world views'—technocratic, public/social and political. The way in which these are blended together in the crucible which produces the decision is something we seek to study. So too is the role of the project champion. Who is it who really believes in the project and is able to make it happen? We shall see that projects and policies lacking powerful champions are at a clear disadvantage. To illustrate this, we have chosen eight case studies of transport policy in action and give an accurate description as it relates to the political economy. Lessons are brought together in a closing synthesis in which we consider the implications for future transport policy and policy-making.

## What Works Centre

Grant holder & Investigator: [Dr Karen Lucas](#)

Funded by: Economic and Social Research Council

Start and end dates: Sept 2013 - Jul 2016

Collaborative partners: London School of Economics; Arup; Centre for Cities

Website: <http://whatworksgrowth.org/>

**Abstract:** This project asks whether transport investment can stimulate local economic growth and aims to identify the most effective interventions.

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