UNIVERSITY OF LEEDS

Institute for Transport Studies (ITS)

Research Report **2015**

INTRODUCTION

by Professor Karen Lucas, Director of Research and Innovation

It has been another busy year for ITS with several new members of staff joining us, some promotions and a few goodbyes. **Professor Richard Batley** took up the role of interim Faculty Pro-Dean for Research and Innovation. We welcomed two new Professors; **Professor Richard Romano**, who now leads the Driving Simulation Centre and **Professor Jillian Anable**, leading in the area of Energy and the Environment. Promoted to Professor were: **Karen Lucas**, Chair of Transport and Social Analysis and **Susan Grant Muller**, Chair of Technologies and Informatics.

Increasingly, our research is co-ordinated in multidisciplinary and collaborative research centres. The **Demand Centre** led by Professor Greg Marsden is now in its third year. The **Consumer Data Research Centre** opened at the Leeds Institute for Data Analytics with a major work stream on mobilities and social innovation led by Professor Susan Grant-Muller. The **Choice Modelling Centre** began recruiting its core staffing team under the leadership of Professor Stephane Hess. (See p4).

Staff across the Institute have contributed to research excellence resulting in the award of 39 new research projects representing an income of £3.23m. Some notable grant awards included:

The **EMPOWER** project – developing tools for industry to encourage the uptake of more sustainable modes of transport, led by Professor Susan Grant-Muller; **XCYCLE** – a project to make roads safer for cyclists, led by Professor Oliver Carsten; **NeTIRail** – a three year project to optimise European railways, led by Dr Andrew Smith; and the **Value of Travel Time** study – informing the UK Government's transport analysis guidance, led by Professor Richard Batley.

Projects running during 2015 are listed in the index and described under Research Projects starting on page 5.

Staff Changes

Our growing research portfolio has led to the recruitment of 15 new members of research staff, including two Academic Fellows appointed as part of the University's '250 Great Minds' scheme: **Dr Charles Fox** and **Dr Eva Heinen**.

In addition to the above mentioned Professors and Fellows we also welcomed **Dr Romain Crastes dit Sourd, Dr Dongyao Jia, Dr Ian Jones, Dr Ruth Madigan, Dr Gustav Markkula, Dr Louise Reardon, Dr Hongbo Ye** and **Dr Jiwei Zheng**. New support staff were: **Natalie Ainsworth, Jennie Stones, Maria Seijo Richart.**

We celebrated the achievements and long service of **Dr Anthony Fowkes** and **Professor Mark Wardman** (Institute Director 2007 to 2011). We also bade farewell to **Dr Georgios Kountouriotis**.

Influencing Government Policy

Members of the Institute gave evidence to a number of Parliamentary Committees and Boards including:

Professor Richard Batley was appointed to the Department for Transport Joint Analysis Development Panel; **Professor Chris Nash** was appointed to the Scientific Committee of the European research programme Shift2rail; **Professor David Watling** was invited to join the Review Board of the Danish National Model; **Dr James Laird** was appointed to the advisory panels of the Major Projects Association, HS2 and Transport Scotland; **Dr Natasha Merat** was invited to the Department for Transport's (DfT) Science Advisory Council on Horizon Scanning; **Dr James Tate** gave evidence to the House of Commons Transport Committee based on the findings of his research on exhaust emissions; **Bryan Matthews** co-authored the response of the Chartered Institute of Logistics and Transport to the DfT consultation on changes to Tactile Paving Guidance.

International Activity

The Institute is playing a key role in a pioneering new school, being formed between the University of Leeds and China's Southwest Jiaotong University. Based in Chengdu, the joint school will offer a 'BEng Civil Engineering with

Transport' programme led by **Dr Judith Wang**, and is the first overseas school to be set up by the University of Leeds.

Prime Minister David Cameron welcomed the joint school following its formal launch in Chengdu: *"This partnership will cultivate global talent and build strong connections between the UK, China and other parts of the world, addressing future skills requirements and opening up new research opportunities."*

Professor Simon Shepherd and **Dr Chandra Balijepalli** were invited to present the Land Use Transport Interaction Model (MARS) to the Ministry of Transport in Jakarta. This included an international seminar launching a project to develop the Transport Master Plan for Jakarta and surrounding districts. The main objective of the plan is to have a public transport mode share of 60% by 2030. The event was widely reported in the local media e.g. Jakarta-Turns-to-Software-Modeling-to-Avoid-Future-Gridlocks.

From left – 6th Prof Shepherd, 7th Dr Balijepalli at the Ministry of Transport Forum, Jakarta.

International Visitors

Our international horizons were widened by a number of incoming visitors who shared their research with staff and students across campus. (See presentations at www.its.leeds.ac.uk/slideshare).

Our visitors included: **Professor Graham Currie**, Monash University, Victoria, Australia, hosted by Professor Greg Marsden; **Professor Karel Martens**, Radboud University, The Netherlands, hosted by Professor Karen Lucas; **Professor Noreen McDonald**, Fulbright Scholar, University of North Carolina, USA, hosted by Professor Greg Marsden; **David Araneda**, Pontificia Universidad Catolica. Chile, hosted by Professor Stephane Hess; **Alessio Capellaro**, University of Trento, Italy, hosted by Dr Hamish Jamson; **Lucilia Capelli**, University Nacional de San Martin, Argentina, hosted by Frances Hodgson; **Waqas Cheema**, Singapore University of Technology and Design, hosted by Professor Simon Shepherd; **Dr Jianzhong Chen**, Northwestern Polytechnical University, China, hosted by Dr Ronghui Liu; **Dr Angelo Guevara**, Universidad de los Andes, Chile, hosted by Professor Stephane Hess; **Harry Li**, Department of Rail Traffic, Guang Dong Communication Polytechnic, China, hosted by Dr Dong Ngoduy; **Deborah Misfud**, University of Malta, hosted by Professor Karen Lucas; **Luc Pellecuer**, École de Technologie Supérieure, Canada, hosted by Dr Samantha Jamson; **Ko Takakura**, Ritsumeikan University, Japan, hosted by Dr Dong Ngoduy; **Diana Talavera**, University of Chihuahua, Mexico, hosted by Professor Karen Lucas; **Antonino Vitetta**, University of Reggio Calabria, Italy, hosted by Dr Richard Connors; **Shuxia Xu**, BeiHang University, China, hosted by Dr Ronghui Liu; **Dr Hideki Yaginuma & Junji Urata**, University of Tokyo, Japan, hosted by Professor David Watling.

Secondments and Industry Engagement

Professor Simon Shepherd and Dr Chandra Balijepalli completed their secondment to METRO. **Dr Ronghui Liu** commenced a secondment to Network Rail. **Dr Natasha Merat** was invited as an External Advisory Board Member to Autoliv Inc., the worldwide leader in automotive safety systems.

Dr James Tate's secondment to Transport for London was extended, focused on reducing diesel emissions and improving air quality. During the 'dieselgate' scandal Dr Tate was regularly called upon by the national and international media to provide expert insight including The Guardian, The Times and BBC World Service. **Kasia Speakman** completed her part-time secondment from Leeds City Council to collaborate on the project Retrofitting Accessible Highway (see Research Projects below). From **Arup, Anna Vickers** completed her secondment and **Simon Mabey** is working on improving links between Arup and the University of Leeds.

Student Success

The high quality of the postgraduate research students we continue to attract was evident on the global stage.

Tyron Louw received an award from Honda for his research on transitions from automation – work he is conducting as part of the AdaptIVE project: Engaging With Highly Automated Driving: To Be Or Not To Be In The Loop?

Charlotte Kelly received best poster prize at the NIHR trainees conference: *What impact does transport accessibility to healthcare have on health outcomes and how can this inform policies such as centralisation of healthcare treatment?*

PhDs awarded

Postgraduate research degrees were awarded to 14 of our students in 2015. **Afzal Ahmed** Integration of real-time traffic state estimation and dynamic traffic assignment with applications to advanced traveller information systems; **Segun Aluko** Understanding the safety performance of commercial motorcycles in urban transport using a system dynamics approach based on qualitative data; **John Buckell** Empirical essays on the cost efficiency and economic regulation of hospitals in the National Health Service in England; **Rawia El Rashidy** The resilience of road transport networks: Redundancy, vulnerability and mobility characteristics; **James Fox** Temporal transferability of mode-destination choice models; **Qian Fu** Modelling route choice behaviour with incomplete data: An application to the London Underground; **John Haith** Understanding the relationship between capacity utilisation and performance and the implications for the pricing of congested rail networks; **Jie Huang** Growth, Evolution and Scaling of Transport Networks; **Andrew Koh** Toll competition in highway transportation networks; **Chao Lu** A self-learning motorway traffic control system for ramp metering; **Steven O'Hare** The influence of structure in supply and demand on the performance characteristics of road traffic networks: An exploration of how methodological approaches from network science can be implemented for a transportation research problem; **Stephen Parkes** The longevity of behaviour change: A case study of the London 2012 Olympic and Paralympic Games; **Rahman Pilvar** Development of an optimisation model for scheduling of street works schemes; **Padma Seetharaman** Reliability based disaggregate stochastic process models with strict capacity constraints in congested transit networks. These and other ITS PhD theses are available via etheses.whiterose.ac.uk.

Postgraduate Research Students

In addition to those who graduated, a further 64 students were actively engaged in research in 2015. **Khaled Abdullah, Oladele Afuje, Mahmoud Al-Khazaleh, Izza Anwer, Peter Atkinson, Valerio Benedetto, Julian Burkinshaw, Julian Bwambale, Chiara Calastri, Mauro Capurso, Madga Cepeda-Zorrilla, Fiona Crawford, Louise de Tremerie, John Dixon, Joel Dodsworth, Rafael Dos Reis, Umoh Edemeka, Joanna Elvy, Anderson Etika, Cristhian Figueroa-Martinez, Andrew Gillies-Smith, Thiago Guimaraes-Rodrigues, Alvaro Guzman, Stephen Hanley, Md Bashirul Haque, Probo Hardini, Nicholas Herbert, Sheriff Idriss-Yahya, Haneen Khreis, Andyka Kusuma, Christopher Leahy, Qiyang Liu, Tyron Louw, James Musgrave, Tamas Nadudvari, Andrew Naimanye, Munajat Tri Nugroho, Taufiq Nugroho, Benjamin Olobo, Sanna Pampel, Evangelos Paschalidis, Anna Pereira, Lei Qian, Christopher Rushton, Ehsan Sadraei, Arwa Sayegh, Aswin Siregar, Fangquing Song, Daosadeth Soysouvanh, Panagiotis Spyridakos, Sidi Sun, Yvonne Taylor, Jessica Taylor-Ashley, Lap Kwan (Jeff) Tjiong, Nur Zaimah Ubaidillah, Chinebuli Uzondu, Ersilia Verlingheri, Conor Walsh, Yin Wang, Matthew Whittle, Yao Yao, Jingyan Yu, Weiming Zhao and Tatjana Zimasa.**

Collaborating with colleagues across campus, ITS staff co-supervised eight students registered in other University of Leeds Schools: Clare Linton (School of Civil Engineering); Pablo Guillen (School of Computing); Jing Ma (School of Geography); Maha Alsabbagh (School of Earth & Environment); Dr Ashkay Dwarakanath (School of Medicine & Health); Andrew Dixon, Holly Edwards, and Richard Riley (School of Chemical & Process Engineering).

Alumni

The Institute's active alumni network encompasses nearly 2,000 former students across 88 countries. The ITS alumni website has the latest news and an alumni map which showcases over 100 alumni profiles. The highlights of 2015 include:

Dr Michèle Dix (PhD, 1982) received a CBE in the Queen's New Year's Honours list for services to transport in London and received a lifetime achievement award presented at Transport Practitioners Meeting, recognising her outstanding contribution to transport planning in the capital. She is presently Managing Director of Crossrail 2.

Hilary Holden (MSc in Transport Planning, 1999) became Toronto's first sustainable transport director.

Frank Montgomery (MSc Transport Planning & Engineering 1979 & ITS Lecturer 1985-2013) received a Certificate of Merit from the Chartered Institution of Highways & Transportation for his long-standing contribution to the transport sector.

Professor Simon Shepherd and Dr Ronghui Liu attended the 19th International Conference of Hong Kong Society for Transportation Studies and hosted dinner for alumni guests.

Emeritus Professor Tony May, Dr Zia Wadud and PhD student Segun Aluko attended the 16th CODATU conference in Istanbul and hosted dinner for alumni and friends of ITS.

RESEARCH CENTRES

Choice Modelling Centre

Led by Professor Stephane Hess, the Choice Modelling Centre (CMC) is a large cross-disciplinary group of leading academics working in choice modelling. CMC brings together expertise from all key disciplines and creates an environment of collaboration by breaking down traditional barriers. A one stop shop for conducting state-of-the-art theoretical research, the CMC is making a step change in applied work, leading the way in postgraduate study, and providing world class teaching and continuing professional development (CPD). Staff at the Centre are currently involved in thirteen research projects including the **Value of Travel Time** study, **Decisions** in a changing world (see index). The Centre holds regular events and professional training programmes. Read more at www.cmc.leeds.ac.uk.

Consumer Data Research Centre

The Institute plays a key role in the Consumer Data Research Centre (CDRC) which is located in the Leeds Institute for Data Analytics (LiDA) and opened in July 2015. Professor Susan Grant-Muller is leading the research and translational activity in the field of big data and transport. Our research in this area harnesses the big data arising from remote sources such as mobile phones, social media, consumer transactions, smart cards and transport system sensors. This wealth of new data allows us to answer grand challenges for the transport sector, such as how to improve accessibility, reduce congestion and better understand the movements of goods and people. The long term impact will be a more sustainable transport system and improved city planning.

The CDRC at Leeds forms part of the Economic and Social Research Council's Big Data Network and is partnered with University College London and the Universities of Liverpool and Oxford. The Centre has developed a three-tier data service using a secure infrastructure which enables the collection, analysis and dissemination of consumer data for public benefit, whilst protecting privacy. The CDRC's key objectives are to provide researcher access to consumer data, serve as a centre of expertise in consumer analytics and research and to deliver training and capacity building activities to a range of stakeholders. Find out more at www.cdrc.ac.uk.

DEMAND Centre

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. In 2015 the Institute welcomed Professor Noreen McDonald to develop her work on understanding the trends in millennials travel reduction. In April 2016 a major international DEMAND conference will be held (see www.demand.ac.uk).

Driving Simulation Centre

www.uolds.leeds.ac.uk

The University of Leeds Driving Simulator is a virtual prototyping facility providing a flexible tool for research into driver behaviour and road safety. 2015 saw the appointment of two leading academics in the field of driver behaviour and driving simulation. Professor Richard Romano and Dr Gustav Markkula contribute to the research direction and activities of the Driving Simulation Centre and lead the work on the **Programme for Simulation Innovation** project, one of the Institute's largest research programmes. The centre is due to expand with a proposed new truck simulator funded jointly by the University of Leeds and the XCYCLE project.

The Driving Simulator featured in a demonstration of hands-free driving in an automated vehicle on BBC Building Cars Live www.youtube.com/watch?v=DT7FMs9L_vM.

RESEARCH PROJECTS

Relevance to Societal Grand Challenges

Mobility is fundamental to economic growth and societal well-being. Yet it is also understood that the impacts of transport on public space, on environmental quality and public health are substantial. The Institute is at the heart of global grand challenges around issues, including climate resilience, energy use, technological adaptation and resource efficiency. The Institute's research has strong connections with the University of Leeds' strategic themes in Cities, Energy and Health. This provides a context in which to develop and deliver ambitious long-term programmes of research.

Expertise of staff at the Institute ranges from engineering, modelling and economics through to psychology and sociology. The quality of our research delivery is supported by ISO9001 accreditation. The range of research carried out at the Institute is demonstrated in the following sixty-five projects grouped under ten thematic headings.

Theme: Active Travel

VENI

Grant holder: **Dr Eva Heinen**
Funded by: **Dutch Research Council**
Dates: **October 2014 – December 2017 (commenced January 2014 at Delft University of Technology)**

Abstract: Reducing car use and encouraging people to walk, cycle or use public transport seems almost impossible to achieve despite extensive academic and policy attention. Change may be effected, but calls for a different methodological approach to the complexity of behaviour, and a focus that goes beyond the current emphasis on theories concerning rational choice. Current research seeks to explain differences in behaviour between individuals and ignores differences in behaviour *within* individuals (intrapersonal variability), such as variation in destination and variation in transport mode use. Moreover, conventional transport research assumes that choices are based on the evaluation of costs and time needed for alternatives. The conventional approach fails to explain why individuals in similar situations and with corresponding socioeconomic characteristics make different decisions. This project aims to tackle the problem using a novel methodological approach and focussing on differences in behaviour from journey to journey within individuals. It is conceptualized that people using multiple transportation modes for different journeys as opposed to only one are more likely to change their travel behaviour. Furthermore, it is recognised that identities could prevent behavioural change, as a threat to one's identity causes resistance to change. This research will make a major contribution towards effective strategies to achieve more sustainable transport.

Papers: Heinen E, Chatterjee K (2015) The same mode again? An exploration of mode choice variability in Great Britain using the National Travel Survey, *Transportation Research Part A: Policy and Practice*, 78, pp.266-282.

WHISPER (Wearable Haptic Information Signals – Evidence and Research)

Grant holder: **Bryan Matthews**
Funded by: **Department For Transport (DfT)**
Dates: **December 2015 – March 2016**

Abstract: We are exploring the usefulness of a wearable device to provide visually impaired people with haptic feedback about the street environment, so as to assist their mobility. Haptic feedback is the conveying of information via the sense of touch in the form of vibration signals and/or the application of mild pressure to the skin; and the idea that the device is wearable means that it could be used by anyone including visually distracted pedestrians. We investigate whether haptic feedback provides useful information about obstacles and wayfinding points in the environment and supplements a person's useful vision, or the white cane or guide dog if they use these. We will conduct focus groups and laboratory tests of prototype devices by potential beneficiaries.

XCYCLE

Grant holder: **Professor Oliver Carsten**
Investigators: **Professor Richard Romano, Dr John Nellthorp, Jeremy Shires**
Funded by: **EU H2020**
Dates: **June 2015 – November 2018**
Coordinating partner: **University of Bologna**
Collaborating partners: **9 European industry and academic partners (see website for details)**
Website: **www.xcycle-h2020.eu**

Abstract: This project aims to find the means to equalise the treatment of cyclists in traffic and thus both encourage cycling and make cycling safer. The project will contribute to innovative and efficient advanced safety measures to reduce the number of accidents involving cyclists in interaction with motorised vehicles. The project will develop technologies aimed at improving active and passive detection of cyclists, systems informing both drivers and cyclists of hazards at junctions, effective methods of presenting information in vehicles and on-site and cooperation systems aimed at reducing collisions with cyclists. To this end, the University of Leeds will develop an in-vehicle HMI to warn truck drivers of imminent collision risk. The work will be carried out on a new truck simulator, developed with University funding.
Impact: *There will be significant impacts on cycling safety by addressing some of the most severe collision scenarios.*

Theme: Choice Modelling

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

Grant holder: **Professor Stephane Hess**
Investigators: **Professor Andrew Daly, Professor Richard Batley, Professor David Watling**
Funded by: **Danish Strategic Research Council**
Dates: **January 2011 – December 2015**
Coordinating partner: **Danish Technical University**

Abstract: The objective was to develop a new decision support methodology for transport policy evaluation. We designed 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 explored 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. We also identified how improved accessibility generates positive effects in terms of labour market changes and working hours. Such effects were overlooked in the existing decision support methodologies in Denmark. The project develops a decision support methodology which can address a broad spectrum of transport policies more realistically than existing methods. It will improve the chances to find a sustainable balance between mobility and negative effects from transport to the benefit of the Danish society.

Papers:

1) Vuk G, Bowman J, Daly AJ & Hess S (2015) Impact of family in-home quality time on person travel demand, *Transportation*.
2) Watling DP, Rasmussen TK, Prato CG, Nielsen OA (2015) Stochastic user equilibrium with equilibrated choice sets: Part I – Model formulations under alternative distributions and restrictions, *Transportation Research Part B: Methodological*, 77, pp.166-181.
3) Rasmussen TK, Watling DP, Prato CG, Nielsen OA (2015) Stochastic user equilibrium with equilibrated choice sets: Part II – Solving the restricted SUE for the logit family, *Transportation Research Part B: Methodological*, 77, pp.146-165
4) Rasmussen TK, Watling DP, Prato CG, Nielsen OA (2015) Stochastic user equilibrium with Threshold RSUET – Model formulation, solution methods and large-scale test. *hEART 2015: 4th symposium of the European Association for Research in Transportation*.

Next Generation Driving Behaviour Models

Grant holder: **Dr Charisma Choudhury**
Investigators: **Dr Daryl Hibberd, Michael Daly, Evangelos Paschalidis**
Funded by: **EU-Marie Curie**
Dates: **May 2015 – January 2019**

Abstract: We aim to develop dynamic driving behaviour models that explicitly account for the effects of driver characteristics in driver decisions alongside the effects of path-plan, network topography and traffic conditions. In a novel approach, the project will calibrate our driving behaviour models by combining experimental data collected from the University of Leeds Driving Simulator and actual traffic data collected using video recordings.

Values of Travel Time Savings and Reliability

Grant holder: **Professor Richard Batley**
Investigators: **Professor Stephane Hess, Professor Mark Wardman, Dr Anthony Fowkes, Dan Johnson, Dr James Laird, Dr Phill Wheat, Dr Charisma Choudhury, Professor Andrew Daly, Dr Thijs Dekker, Dr Manuel Ojeda-Cabral**
Funded by: **DfT**
Dates: **May 2014 – April 2017**
Collaborative partners: **Arup, Accent**

Abstract: The value of travel time (VTT) is an important concept in policy making and investment decisions for the transport sector, since savings in travel time typically account for a large proportion of the benefits of major transport infrastructure. Current DfT values for non-work travel date back to research from 2003, and the data supporting them is over two decades old, whilst the values used for business travel have come under increasing scrutiny for their underlying assumptions. Over the past five years, the DfT has undertaken a programme of work including scoping studies to better understand the uncertainties around the current values. The DfT concluded that it would be appropriate to undertake fresh primary research, to ensure that the values continue to reflect changes in society and people's travel behaviour.
Impact: *The overall objective of this study was to recommend up-to-date national average values for in-vehicle (car and public transport) travel time (in-vehicle refers to the time spent travelling on the specific mode of transport). With regards to non-work, the project recommendations entail an increase of around 50% in values for commute, but a reduction of around 25% for other non-work – relative to current DfT WebTAG guidance. With regards to business, our recommendations are based on willingness-to-pay (WTP), and thus represent a methodological shift away from the cost saving approach traditionally used in WebTAG. The WTP-based business values show*

marked variation by distance; for trips of less than 20 miles, values are around 75% lower than current WebTAG values; for trips of around 100 miles, WTP-based values are comparable to WebTAG; and for longer trips still, WTP-based values exceed those currently in WebTAG. The study outputs are gathered in the Final Report published by DfT gov.uk/government/publications/values-of-travel-time-savings-and-reliability-final-reports.

Theme: Climate Change

CH4LLENGE

Grant holder: **Dr Caroline Mullen**
Investigators: **Professor Tony May, Professor Simon Shepherd, Dr Astrid Gühnemann**
Funded by: **European Commission – Intelligent Energy Europe Programme**
Dates: **March 2013 – March 2016**
Collaborative partners: **16 partners across the EU (see website for details)**
Website: **www.sump-challenges.eu**

Abstract: Planning for urban transport must increasingly contribute to improving energy efficiency, reducing greenhouse gas emissions and improving local economies and quality of life for residents. A Sustainable Urban Mobility Plan (SUMP) is designed to contribute to these ambitions for urban transport and its impacts on social inclusion, economy and environmental targets. In this project we have extended knowledge to support cities in planning, implementing and evaluating SUMPs. Working with cities has provided new insights and knowledge drawn from their experiences and pilots such as pedestrianisation, and evaluation of participation in the City Connect project.

Papers: May A and Khreis H (2015) Option generation for policy measures and packages: the role of the KonSULT knowledgebase, presented at the WCTRS SIG G3 conference on climate change and urban transport policy in Valetta.

Impact: *Pilot projects in each of the eight partner cities will have tangible impacts for significant aspects of sustainable urban mobility planning. The project has contributed to major development of the KonSULT option generator plus freely available manuals and online resources to support learning and professional development for planners across Europe and beyond.*

ecoDriver

Grant holder: **Professor Oliver Carsten**
Investigators: **Dr Samantha Jamson, Dr James Tate, Dr Zia Wadud, Dr John Nellthorp, Dr Frank Lai, Dr Daryl Hibberd, Dr Astrid Guehnemann**
Funded by: **European Commission**
Dates: **October 2011 – March 2016**
Collaborative partners: **11 European partners (see website for details)**
Website: **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 CO2 emissions and fuel consumption in road transport by delivering effective advice and feedback to the driver. This fourth year of the project has seen extensive activity. On-road trials with over 160 participants have provided 18,000 km of data. Analysis of the data and its subsequent use in a scaling up exercise has also been completed. We will showcase the ecoDriver vehicles and present project results at the ecoDriver Final Event,16th and 17th March 2016 at the Mercedes-Benz Museum in Stuttgart.

Papers:

1) Jamson SL, Hibberd D, Jamson AH (2015) Drivers' ability to learn eco-driving skills; effects on fuel efficient and safe driving behaviour. *Transportation Research Part C: Emerging Technologies*, 58 657-668.
2) Hibberd DL, Jamson AH and Jamson SL (2015) The design of an in-vehicle assistance system to support eco-driving. *Transportation Research Part C: Emerging Technologies*, 58 732-748
3) Pampel SM, Jamson SL, Hibberd DL and Barnard Y. (2015) How I reduce fuel consumption: An experimental study on mental models of eco-driving, *Transportation Research Part C: Emerging Technologies*, 58 669-680

Impact: *A number of vehicle manufacturers have incorporated ecoDriver concepts into their vehicles. BMW's ecoAssist incorporates a new HMI using dashboard & HUD plus an automated coasting mode when the driver is not using the accelerator pedal. In CRF's system prototypes the HMI solutions are both visual & visual combined with a haptic pedal. The system suggestions for an improved eco driving style are tailored to subjective drivers' style. Daimler has developed a new ecoDriver app consisting of a map-based driving strategy calculation with a visual & haptic (accelerator pedal) HMI.*

EMPOWER

Grant holder: **Professor Susan Grant-Muller**
Investigator: **Frances Hodgson**
Funded by: **EU H2020**
Dates: **May 2015 – April 2018**
Collaborative partners: **11 European partners (see website for details)**
Website: **http://empowerproject.eu**

Abstract: One of the first research projects to be awarded under the new H2020 framework, EMPOWER is the fifth project in a programme of research into transport and big data at the Institute, supported by over £12m of funding.
The main objective of EMPOWER is to substantially reduce the use of conventionally fuelled vehicles in cities using positive incentives delivered through pervasive ICT such as smartphone, as part of a behavioural approach to demand management. To achieve this objective EMPOWER will create a set of tools for industry, policy makers and employers. These will empower them beyond the lifespan of this project to understand, help choose and successfully implement positive evidence-based and cost-effective policy interventions, based on new and innovative mobility services, and in the context of already existing infrastructure, policy and measures. EMPOWER is working with over 40 stakeholders including cities, transport sector suppliers and incentive providers, and will demonstrate large scale implementation in four 'living labs': Manchester, Helsinki, Gothenburg and Enschede, plus a further seven take-up cities across Europe. The positive incentives being designed, trialled and implemented include: financial incentives, points and digital currencies, tangible rewards (such as prizes and vouchers), upgraded service offers and social incentives. Early deliverables include design features for the ICT architecture and templates for business models in the multi-stakeholder context. The key performance indicators of the project will include reductions in the distances travelled by conventionally fuelled vehicles and impacts on vulnerable groups.

Emission Factors from Road Vehicles by Remote Sensing Device

Grant holder: **Dr James Tate**
Investigator: **Christopher Rushton**
Funded by: **European Commission – Joint Research Centre**
Dates: **January 2014 – April 2015**

Abstract: There is a pressing need to better understand the emissions from vehicles on the road. Remote sensing devices measure the tailpipe emissions of vehicles as they drive through a monitoring site. The technology scans the exhaust plumes from thousands of vehicles per day. The measurements are combined with vehicle registration information. This allows the emissions to be characterized by vehicle type (car, van, light and heavy commercial vehicle, bus), age, fuel type and emission standard (e.g. Euro 0 – 6).
Impact: *This project reviewed the capability of vehicle emission remote sensing instrumentation, and we have established 'emission factors' for different vehicle classes and powertrain types.*

Hybrid Taxis – Developing the Business and Environmental Case

Grant holder: **Dr James Tate**
Investigators: **David Wyatt, Richard Riley**
Funded by: **Leeds City Council (LCC), Department for Environment, Food and Rural Affairs (DEFRA)**
Dates: **October 2014 – September 2015**

Abstract: Annual mean nitrogen dioxide concentrations in towns often fail to achieve the objectives set in the UK Air Quality Regulations and the limit values within the EU Directive PM2.5. Particles from diesel emissions have serious health consequences. The taxi fleet forms a significant proportion of vehicles operating in the urban area throughout the day and night. By gaining a better understanding of the composition and operation of the taxi and private hire fleet in Leeds (over 4000 vehicles), we have assessed the environmental benefits that could be achieved through the use of alternative vehicles (notably petrol-hybrids) and analysed the costs to operators.
Impact: *We have developed a business case, looking into the feasibility and implications of the use of hybrids as the vehicles of choice for taxi operators in Leeds.*

Modelling Wakefield Air Quality Action Plan Measures

Grant holder: **Dr James Tate**
Investigator: **Arwa Sayegh**
Funded by: **Wakefield Council, DEFRA**
Dates: **October 2014 – March 2015**
Collaborative partner: **Fore Consulting Limited**

Abstract: We have evaluated the environmental benefits of a range of potential junction improvements in several Air Quality Management Areas (AQMAs) in Wakefield. Traffic microsimulation and instantaneous emission modelling provides accurate estimates of vehicle emissions, critically including robust predictions of oxides of nitrogen from modern diesel engines, which are likely to be the principle cause of air quality exceedances in the AQMAs under consideration. The modelling compared vehicle and fuel types and considered the contribution from Euro 6 vehicles, some of which are now in operation.

Shaping London's Air Quality Strategy

Grant holder: **Dr James Tate**
Funded by: **Transport for London (TfL)**

Abstract: Dr Tate's extensive vehicle emissions measurements on behalf of Local Authorities across the UK, and in particular his report that diesel vehicles are more polluting within cities than manufacturer's specifications would have us believe, resulted in his secondment to TfL. Dr Tate is working with the TfL environmental policy and strategy team, to support the on-going development of London's transport and

emissions action plan; low emission vehicle strategy; and design of the Ultra-Low Emission Zone. This extended secondment brings the latest research developments and international evidence to the TfL air quality team. Dr Tate is working to enhance the robustness of the road transport carbon and air quality pollutant emission evidence base. The secondment is facilitating the application of emerging research methodologies to the Greater London road transport network that can take better account of congested driving conditions.

Speed Emission/Energy Curves for Ultra Low Emission Vehicles

Grant holder: **Dr James Tate**
Investigator: **Dr Richard Connors, Richard Riley**
Funded by: **DfT**
Dates: **September 2014 – March 2015**
Collaborative partner: **Ricardo-AEA**

Abstract: We have developed fuel/energy consumption and emission speed curves for a range of low emission vehicles (petrol hybrid, diesel hybrid, petrol or diesel plug-in hybrid and battery electric vehicles). The performance of low emission powertrains on cars, light-goods vehicles, rigid- and articulated heavy-goods vehicles were evaluated. Experimental data was used if available. Extrapolation methods and mathematical models of powertrains were used if empirical data was unavailable. We hypothesized that the energy curves should be consistent with the existing curves used for conventional vehicles by the National Transport Model (NTM) and WebTAG.

Theme: Dynamic Modelling

Advanced Traffic Flow – Theory and Control

Grant holder: **Dr Dong Ngoduy**
Funded by: **EPSRC**
Dates: September 2011 – September 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.

DITTO (Developing Integrated Tools to Optimise Railway Systems)

Grant holder: **Dr Ronghui Liu**
Investigators: **Dr Anthony Whiteing, Dr Hongbo Ye**
Funded by: **Railway Safety & Standards Board (RSSB)**
Dates: **September 2014 – August 2017**
Coordinating partner: **University of Southampton**

Abstract: This multi-disciplinary project brings together University-based traffic engineers and transport operations researchers (from Leeds and Southampton) and computer scientists (from Swansea). The project will contribute to the Future Traffic Regulation Optimisation (FuTRO) programme by establishing relevant basic principles and proofs of concept for the optimisation of rail operations. Our objective is to develop the formulations, algorithms and processes that will deliver a step change in rail system performance and meet future customer needs. This will be done by taking into account developments in human and automatic control on trains and in control centres and by making better use of data, particularly with respect to the time and position of trains. The Leeds team is developing network simulation models to design and test real-time operations of FuTRO systems, in particular train control algorithms for the new European Rail Traffic Management System (ERTMS) Levels 2 and 3.

Papers: Liu R, Ye H and Whiteing W (2015) Dynamic Simulation for Real-Time Operations of ERTMS Level 3. *DITTO Project Deliverable 3.1.*

Network Rail Secondment

Grant holder: **Dr Ronghui Liu**
Funded by: **Engineering and Physical Sciences Research Council (EPSRC), Impact Acceleration Account**
Dates: **May 2015 – March 2016**

Abstract: Network Rail's Digital Railway Division was formed in spring 2015 to tackle the specific demand on moving the UK railway system to the standards set out for the European Rail Traffic Management System. By playing a significant role in supporting and shaping the development of Network Rail's Digital Railway, Dr Liu's secondment lays the foundations for substantive and ongoing relationships between Network Rail and the University of Leeds which will precipitate further collaborative opportunities over the coming years.

Papers: Dr Ngoduy has produced 21 papers arising from this research including 4 published during 2015:

1) Nantes A, Ngoduy D, Miska M, Chung E (2015) Probabilistic Travel Time Progression and its Application to AVI Data, *Transportation Research Part B: Methodological,* 81, 131-145.
2) Ngoduy D (2015) Linear stability of a generalized multi-anticipative car following model with time delays, *Communications in Nonlinear Science and Numerical Simulation*, 22, 420-426.
3) Ngoduy D (2015) Effect of the car-following combinations on the instability of heterogeneous traffic flow, *Transportmetrica B*, 3, 44-58.
4) Nantes A, Ngoduy D, Miska M and Chung E (2015) Real time traffic state estimation in urban corridors from heterogeneous data, *Transportation Research Part C: Emerging Technologies*, doi 10.101b/j.trc.2015.07.005.

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

Grant holder: **Professor David Watling**
Investigators: **Dr Paul Timms, Dr Richard Connors, Dr David Milne**
Funded by: **EPSRC**
Dates: **April 2012 – June 2016**
Collaborative partners: **University of Manchester, University of Birmingham, London School of Economics**
Website: **www.changing-mobilities.org.uk**

Abstract: STEP-CHANGE is a multi-centered multi-stranded project. We have collaborated across all strands of the project and our chief contributions during 2015 have been concerned with the strand on new modelling paradigms, especially those concerned with developing narratives of transport change. In one body of work (Paper 1) we have analysed 19 papers that narrate historical change of real transport system, distinguishing between the historical aspects of the papers (the events that are recounted by the narratives) and their historiographical aspects (how the histories are written). The paper aims to highlight how thinking about transport futures can be aided by such an historical analysis, by drawing analogies with past periods of political and societal change. In the second work (Paper 2), we focus specifically on the narratology of ten academic papers, with the aim to develop more imaginative approaches for thinking about the future. The papers each combine an authorial voice with a phenomenological element which describes, using quotes, the perspectives of various actors (from the past) involved in the transport system. The paper analyses these ten narratives in terms of: periodisation of the narratives; significant factors (internal and external) driving the narratives along; the types of actors being considered; and the sources of evidence for their perspectives. Finally (Paper 3), we have further developed the link from planning to visioning of futures, by analysing historical views of urban transport futures.

Papers:

1) Timms PM and Watling DP (2015) Using urban transport histories to help construct narratives of the future. Presented at T2M Conference The Future of Mobilities: Flows, Transport and Communication, Caserta, Italy.
2) Timms PM and Watling DP (2015) What might be learnt from the narratology of historical transport behaviour for constructing narratives of the future? Presented at the 14th International Conference on Travel Behaviour Research, Windsor, UK.
3) Timms PM, Tight MR and F Rajé (2015) Visions from the past: an exploration of historical views of urban transport futures. Presentation at RGS-IBG Annual International Conference, Exeter, UK.

Towards Autonomic Road Transport Support Systems

Grant holder: **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 well recognised societal problem is the frequent failure of road networks resulting from traffic incidents, capacity overload 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 configuration, maintenance, and infrastructure, while potentially improving network efficiency and reducing the chances of human error.

Understanding New and Improving Existing Traffic Data

Grant holder: **Professor Susan Grant-Muller**
Investigators: **Frances Hodgson, Jeremy Shires**
Funded by: **Conference of European Directors of Roads**
Dates: **April 2014 – August 2015**
Co-ordinating partner: **Mott McDonald**
Collaborative partners: **NAST consulting ZT GmbH (AT), TRANSVER (DE)**

Abstract: The primary objective was to guide the national road administrations' use of third party data such as crowd sourced / social media and floating vehicle data in place of traditional infrastructure-based techniques. The more detailed objectives of the project were (1) to develop, implement and test methods for quality assessment of traffic data and services based on mobile devices, (2) to understand the potential of social media analysis for traffic management and (3) to understand the implications of these new data sources to support traffic management decision-making.
Impact: *The project has investigated the potential of social media data as a source of useful information for traffic management purposes. The business models around the use of such data have also been proposed. Primary research has been undertaken to assess the willingness of individuals to contribute user generated content via social media and their attitudes towards the governance of that data. The project has also produced benchmarking criteria for the quality of alternative sources of new data.*

Theme: Economic Appraisal

Our expertise in economic appraisal provides a number of CPD courses for industry professionals (see www.its.leeds.ac.uk/courses/cpd).

Business Case Development Manual (BCDM) review

Grant holder: **Professor Mark Wardman**
Investigators: **Dr John Nellthorp, Professor Chris Nash, Dr James Laird**
Funded by: **TfL**
Dates: **September 2014 – March 2015**

Abstract: Transport for London's Business Case Development Manual was in need of an upgrade having evolved in an organic manner over many years. It required a development focus particularly in important areas such as urban realm and regeneration. The review carried out by the ITS team provided the basis for significant improvements and enabled TfL to link up with the academic community to help steer on aspects that had previously been overlooked.
Impact: *The results of this work will help TfL make the case for a range of interventions that previously were hard to appraise. Urban Transport Authorities are increasingly asked to solve real world problems. The appraisal environment must evolve to enable urban authorities to quantify the benefits of their schemes. TfL have praised this review: "It required deep thought that only the academic community can provide … people who care about the robustness of the output and who were genuinely interested in moving the appraisal world forward."*

CQC Efficiency Network

Grant holder: **Dr Phill Wheat**
Investigator: **Alex Stead**
Coordinating partners: **Measure 2 Improve**
Funded by: **Local Authorities**
Dates: **April 2015 onwards**
Website: **http://nhtnetwork.org/cqc-efficiency-network/home**

Abstract: The CQC Efficiency Network (Cost, Quality, Customer) is an offering to local authorities throughout Britain to enable them to quantify the scope for cost savings in the delivery of highway services and to identify better practices. Importantly the analysis recognises the interplay between the **C**ost of work done, the **Q**uality of the work and the **C**ustomer perception of the highway service. The CQC Efficiency Network is a joint venture between the National Highways & Transport Network (NHT) and the University of Leeds. Both partners worked successfully together in two pilot studies of this approach funded by the Highways Maintenance Efficiency Programme.

Papers: Wheat P (2015) Cost Quality Customer: Statistical Benchmarking, report to stakeholders.
Impact: *The network is helping local authorities improve their cost performance, whilst at the same time maintaining the quality of their offering. The work has identified substantial opportunities for savings. The CQC network provides evidence to support enhanced central government funding as a reward to local authorities who adopt efficient practices*

Crossrail Evaluation

Grant holder: **Dr James Laird**
Investigator: **Dr John Nellthorp**
Funded by: **Mott McDonald**
Dates: **February 2015 – August 2015**

Abstract: The aim of this study was to develop an evaluation framework for Crossrail. This includes the specification of the data to be collected for the baseline and post-scheme opening. The different

elements of the evaluation need to be separately identified and costed to allow Transport for London and the Department for Transport to choose the evaluation strategy most relevant to them.

Cycling – Scoping Study

Grant holder: **Dr James Laird**
Investigator: **Jeremy Shires**
Funded by: **DfT, Technopolis**
Dates: **May 2015 – July 2015**

Abstract: The aim of this study was to develop a framework for the evaluation of different types of cycling investments. The framework accommodates a range area types: a town, a City Region such as Sheffield, Manchester or Leeds (these are Cycling Ambition Cities and have received significant cycling funding to date); an outer London Borough; and a low density Local Enterprise Partnership. The study was led by Technopolis with ITS providing specialist input. Cycling investments can be area wide or localised. We set out the methods and data that could be used to evaluate each of a number of outcomes of cycling investments in order to obtain robust data on the different social and economic impacts of cycling. The study focused on the impacts to: local residents, consumers, retail and leisure, accessibility to labour markets, health, the environment, air pollution, wellbeing of employees and private sector development.

Economics of Connectivity

Grant holder: **Dr James Laird**
Funded by: **ECPC Ltd New Zealand**
Dates: **November 2015 – April 2016**
Collaborating partners: **Infometrics Ltd**

Abstract: The concept of network connectivity and its role in providing for economies of scale for individuals and firms across nodes (locations) has recently been identified. However, there is little research on understanding the value of network connectivity and its role in productivity, in particular through the provision of transport links between nodes. This research will estimate the economic impacts of inter-urban land based connectivity between Auckland, Hamilton and Tauranga, particularly around air and sea ports. We are developing a General Equilibrium model capable of responding to the effects of changes in network connectivity.

Efficiency analysis coding

Grant holder: **Dr Phill Wheat**
Funded by: **Office of Rail and Road (ORR)**
Dates: **February – March 2015**

Abstract: This was a small piece of work to translate code previously developed for the LIMDEP/NLOGIT platform into code for the STATA platform. The work involved refinements to the original code in collaboration with one of the authors of the original method paper (Professor Robin Sickles). The work facilitates ORR to develop their efficiency analysis of Network Rail for the current regulatory control period using the STATA platform.

Gatwick Airport Peer Review

Grant holder: **Dr James Laird**
Funded by: **Airport Commission**
Dates: **January 2015 – February 2015**

Abstract: The Price Waterhouse Cooper report to the Airports Commission concerned the application of a Spatial Computable General Equilibrium (S-CGE) model to estimate the GDP effects of proposed airport capacity increases at Gatwick (1 runway option) and Heathrow (2 runway options). Dr Laird has produced an in-depth peer review of the PWC report.
Papers: Laird JJ and A Stroombergen (2015) *Airports Commission. 2. Economy: Wider Impacts Assessment*.

Greener Journeys Phase 3

Grant holder: **Daniel Johnson**
Investigators: **Professor Karen Lucas, Dr Ian Philips**
Funded by: **Greener Journeys**
Dates: **October 2015 – December 2015**
Collaborative partner: **KPMG**
Website: **www.greenerjourneys.com**

Abstract: We reported our recent work on the economic and environmental value of local bus services (see Buses and the Economy II). The current project articulates and quantifies the important social impacts of local bus services, which when combined with the economic and environmental impacts will demonstrate the 'true value' of local bus services. Our contribution is to apply an econometric approach to modelling the link between social outcomes and public transport accessibility.

Highways benchmarking 2

Grant holder: **Dr Phill Wheat**
Investigator: **Dr Andrew Smith**
Funded by: **ORR**
Collaborative partner KPMG LLP
Dates: **September – October 2015**

Abstract: This work informed the potential benchmarking opportunities for Highways England. This is important work given that Highways England has only recently been formed (previously Highways Agency) and so a new economic benchmarking framework is currently being developed to ensure Highways England provides value for money.

HS2 Economic Advisory Panel

Grant holder: **Dr James Laird**
Funded by: **HS2 Ltd**
Dates: **November 2015 – September 2016**

Abstract: The Economic Advisory Panel assists HS2 Ltd in scoping and designing a programme of work to deliver robust and credible analysis on

the potential impact of HS2 on the economy, particularly at a sub-national or regional level. The existing methodology used to assess the economic case for HS2 focuses on appraisal at the national level, in line with WebTAG guidance. Analysis of sub-national impacts of the scheme are limited. Employment and regeneration effects may extend beyond the benefits quantified within the economic case. At present there is no widely accepted methodology to fully capture the sub-national economic impacts of high speed rail projects. Given this and the importance of producing robust and credible analysis, HS2 Ltd has convened the Economic Advisory Panel, which is expected to meet 4 times a year, to provide advice on the methods adopted and results found by HS2.

Rail Demand Forecasting

Grant holder: **Professor Mark Wardman**
Funded by: **DfT**
Dates: **May 2015 – April 2016**
Collaborative partners: **Leigh Fisher and RAND Europe**

Abstract: In recent years, the recommendations of the railway industry's Passenger Demand Forecasting Handbook (PDFH) have struggled to explain changes in rail demand, particularly the strong growth in the context of difficult financial conditions. A number of recent studies have failed to provide improved insights into these rail demand trends. The aim of this study is to better explain recent rail demand growth. It has made use of National Travel Survey (NTS) data to enhance rail demand models estimated to rail ticket sales data. In particular, the analysis of NTS data has provided estimates of variations in rail trip rates according to age group, employment status, occupation, car ownership and income. Parameters obtained from this analysis of trip rates are being used in econometric models of rail demand where the routinely collected exogenous data has been supplemented with district level data on the variables used in the NTS models.

Impact: *The enhanced rail demand models can account for the impact of changes in socio-economic and demographic factors in a way not previously possible. Mark Wardman has delivered annually two CPD courses on Passenger Demand Forecasting for industry professionals.*

Transport Investment and Economic Performance

Grant holder: **Dr James Laird**
Funded by: **DfT**
Dates: **January 2014 – May 2015**
Collaborative partners: **Oxford University, London School of Economics**

Abstract: The aim of this project was to boost the quality of public debate around transport infrastructure, by providing an up-to-date, comprehensive and authoritative summary of the impact of transport investment on economic performance. We identified to what extent these impacts are captured by the current appraisal framework and modelling methods and gave broad quantification of the relative scale of any impacts not captured.

Uncertainty and Real Options

Grant holder: **Dr James Laird**
Funded by: **New Zealand Transport Authority**
Dates: **November 2015**
Collaborative partners: **ECPC Ltd New Zealand, Motu Economic and Public Policy Research.**

Abstract: Provision of transport systems requires investments that are on many occasions huge, irreversible, and risky with long economic return periods. The underlying factors are dynamic in nature and in many cases volatile. Planning transport infrastructure systems to satisfy short-term and long-term demand conditions requires decision makers to take into account uncertainty and irreversibility and there is a need to explicitly deal with uncertainty within the analysis. One of the key sources of uncertainty is travel demand and its relationship with uncertainty in economic growth. The purposes of the research are to examine and understand the time series properties of travel demand, to analyse the impact of stochastic properties of travel demand and to develop methodologies and techniques of how travel demand uncertainties can be incorporated in real option valuation framework.

What Works Centre for Local Economic Growth: Transport

Grant holder: **Professor Karen Lucas**
Funded by: **Economic and Social Research Council (ESRC), London School of Economics**
Dates: **September 2013 – August 2016**
Website: **www.whatworksgrowth.org**

Abstract: The What Works Centre for Local Economic Growth was set up to provide solutions for local and national policymakers through the systematic review of the evidence base on policies for local economic growth, as well as to improve that evidence base. Transport can have a positive impact on the local economy, although the role of transport in stimulating growth is not as clear-cut as assumed by many decision makers. The impact of transport investment on employment is mixed (for road) or unknown (for rail, bus, tram, and cycling). However, there are good reasons to invest in transport infrastructure beyond the impact on local growth. Many of the findings depend on a small number of studies. They are, however, consistent with other research on the economic impact of transport improvements.
Impact: *A report of the initial evidence review can be found at www.whatworksgrowth.org/policy-reviews/transport*
The next stage of the study will be to develop a toolkit of interventions that will help to guide local transport authorities and other investors on what works for economic growth in the local transport sector.

Theme: Energy

DEMAND Centre

Grant holder: **Professor Greg Marsden**
Investigators: **Dr Caroline Mullen, Dr Anthony Whiteing, Dr Giulio Mattioli, Professor Jillian Anable**
Funded by: **Research Councils UK (RCUK) Energy Programme**
Dates: **May 2013 – May 2018**
Collaborative partners: **Universities of Lancaster, Reading, Aberdeen, Birmingham, Southampton, University College London, EDF Research, TfL**
Website: **www.demand.ac.uk**

Abstract: At ITS we lead the majority of the mobility facing research of the Demand Centre's programme. In 2016 we will complete a study examining the extent to which technology is reconfiguring business practices and associated travel and beginning a new study on the future of retail and the evolution of on-line shopping in combination with different supply side options (described below). In parallel there is a strong emphasis on understanding need and justice in future mobility transitions through in-depth qualitative investigations in parallel with a quantitative exploration of economic stress across housing and transport in the linked (t)ERES study (described below).
Impact: *The work is already having impact with Transport for London around demand projections and using new data to understand evolving travel patterns.*

Energy-related economic stress in the UK; t(ERES)

Grant holder: **Professor Greg Marsden**
Investigators: **Professor Karen Lucas, Professor Jillian Anable, Dr Giulio Mattioli**
Funded by: **EPSRC**
Dates: **November 2014 – April 2016**

Abstract: This project is attached to the DEMAND Research Centre as part of the End Use Energy Demand programme, and is related to other on-going work at ITS on qualitative understandings of transport needs and affordability. At present, home energy issues are framed in terms of reducing energy consumption and emissions while at the same time taking into account fuel poverty – an established area of interest for British policy and research. The same is not true for transport poverty and economic stress, which are currently under-researched, despite increasing concerns for transport costs. The project is developing the concept of transport poverty, exploring its relationships with housing and fuel poverty, its systematic patterns and implications for energy demand reduction and social justice. We are developing connections between the British academic and policy debate and similar debates abroad. The project consists of 5 interdependent work packages, mostly comprising secondary quantitative analyses: (1) Conceptualising the relationships between transport, housing and fuel poverty in an interdisciplinary and international perspective; (2) Exploring patterns of transport spending and its relationship with spending on housing and domestic energy in the UK by analysing family expenditure data; (3) Explore material deprivation and economic stress in low-income car owning households in the UK and the EU; (4) Exploring more geographically detailed patterns of transport poverty with the Merseyside Travel Poverty Survey; (5) Exploiting MOT Testing data to produce UK-wide maps of the fuel-related economic stress and oil vulnerability of car users.

Papers: Mattioli G (2015) Energy-related economic stress at the interface between transport, housing and fuel poverty: a multinational study, *2nd International Days of Sociology of Energy*, pp.254-257.

Infrastructures for online shopping: integrating supply and demand

Grant holder: **Professor Greg Marsden**
Investigators: **Dr Tony Whiteing, Dr Ian Jones**
Funded by: **RCUK, EDF R&D, TfL**
Dates: **September 2015 – August 2017**

Abstract: The trend towards online shopping will result in changes to transport demand, for both personal travel and freight movement. This will have important implications for future energy demands. We will collect data from consumer focus groups and household surveys as well as from retailers and logistics service providers. The data will be analysed to gain insights into how households expect to shop in the future, particularly for non-grocery items, and how logistics systems will respond to such changes. The analysis will inform how energy use both in households and industry will change as a result of online shopping.

Moderated Policy

Grant holder: **Dr Zia Wadud**
Funded by: **Marie Curie Career Integration Grant**
Dates: **February 2012- September 2016**

Abstract: Energy consumption in the domestic sector is responsible for more than 50% of UK carbon emissions (and between one-thirds to one-half in most EU countries) and presents a significant challenge to reducing greenhouse gas emissions from the EU. The overall goal of this project is to understand the impact and distributional burden of downstream policies, especially carbon trading at the personal or household level, in order to mitigate carbon emissions from the domestic sector of the economy. The project will make contributions to modelling in-house and transportation energy demand

through developing an econometric demand model allowing for substitution between household energy consumptions and the transportation needs of the households. Special focus will be on personal carbon trading as a policy to reduce emissions, and incorporation of an additional carbon budget in the theoretical microeconomic demand model. In addition, intermediate to long term trade-offs in energy saving/carbon saving behaviour will be investigated and incorporated in the model. Since there is no existing 'real' world example of carbon capped behaviour, the project will also seek to understand potential behavioural responses through comparable real world examples (e.g. vehicle lease for a given cap in km per month). Ultimately, the distribution of burden will be analysed for a carbon tax and a personal carbon trading policy.
Impact: *The results will significantly contribute to the current debate on the potential of downstream policies to help reduce carbon emissions from households and thus reduce overall carbon emissions.*

Theme: Rail

Argentinian Railways

Grant holder: **Dr Andrew Smith**
Investigator: **Professor Chris Nash**
Collaborating partner: Michigan **State University**
Dates: **October 2014 – July 2015**

Abstract: The project was to advise the Argentinian government and railways on European experience of rail reform. Argentina had recently taken rail infrastructure back into government hands having previously leased it to train operators, but with continued access to private operators, so issues such as allocation of paths and track access charges were of key interest. The project culminated in Prof Nash giving a one week short course to senior figures in the rail sector in Buenos Aires.

Belgian Rail Charges

Grant holder: **Dr Andrew Smith**
Investigator: **Professor Chris Nash**
Funded by: **Belgian Ministry of Transport**
Dates: **January – May 2015**
Collaborative partner: **Stratec**

Abstract: We were commissioned to advise on alternative approaches to infrastructure charges for Belgium. Specifically we advised on evidence on the variability of infrastructure costs with traffic volume and on how to implement an efficient mark-up regime. We provided advice to the Belgian Ministry of Transport on the setting of its access charges in line with economic principles and with EU legislation. Our role was mainly focused around the economic principles and the underlying empirical evidence.
Impact: *The work has informed the Belgian Ministry of Transport's policy with respect to rail access charges.*

Centre for Transport Studies (CTS) New Guest Researcher

Grant holder: **Dr Andrew Smith**
Funded by: **Centre for Transport Studies at the Royal Institute of Technology (KTH, Sweden), Swedish National Road and Transport Research Institute (VTI, Stockholm)**
Dates: **December 2015 – November 2016**

Abstract: This appointment follows on from an existing visiting arrangement dating back to 2009. The aim is to develop new collaborations across CTS, moving beyond previous research in rail marginal cost and efficiency (though continuing to develop research and projects in the rail area). The arrangement involves several visits to Stockholm each year, a presentation of research (empirical and methodological), plus collaboration on key papers.

Papers: Dr Smith has submitted a paper to the North American Productivity Workshop IX: A Stochastic Frontier Analysis of Cost Efficiency in Road Maintenance.

European Rail Access Charging (Guest Researcher Programme)

Grant holder: **Dr Andrew Smith**
Investigators: **Dr Phill Wheat, Professor Chris Nash**
Funded by: **KTH, VTI**
Dates: **August 2011 – March 2016**

Abstract: This project is an extension of a previous visiting researcher arrangement with Sweden. European rail legislation on enhancing competition and ensuring economically efficient and fair access to the common infrastructure focuses 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. In particular the research is seeking to better understand renewal costs, through corner solution panel models and exploring dynamic approaches. Second, 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.

Papers: Odolinski, K and Smith, ASJ (2015) Assessing the cost impact of competitive tendering in rail infrastructure maintenance services: *evidence from the Swedish Reforms* (1999 to 2011). Journal of Transport Economics and Policy, 1-32.
Impact: *In the above paper we have shown that tendering of rail maintenance has reduced costs by around 11% in the paper:*

Korean Rail

Grant holder: **Dr Andrew Smith**
Investigator: **Professor Chris Nash**
Funded by: **Korean Development Institute**
Dates: **September 2015 – August 2016**

Abstract: Drawing on European experience, we were asked to advise on a project examining rail reform in South Korea, where the rail infrastructure has been separated from operations but so far the government owned train operator still has a monopoly. A key issue is therefore whether, and if so how, to introduce competition between different train operators.
Impact: *The work included hosting a one day seminar for staff of the Korean Development Institute and the University of Seoul, including Prof Eyon Shon, who studied for his PhD at ITS.*

Marginal Cost Research

Grant holder: **Dr Andrew Smith**
Investigators: **Professor Chris Nash, Dr Phill Wheat**
Funded by: **SNCF**
Dates: **April 2015 – March 2016**
Collaborative partners: **Stratec, Ecoplan**

Abstract: This project saw the development of new econometric models to understand the marginal wear and tear cost of different aspects of rail maintenance for the purpose of developing track access charges for different types of vehicle on the network. The work involved a dataset of over 1000 track sections and a rich set of factors explaining variation in rail costs as well as data on the different types of traffic running on different parts of the network. We led the development of the econometric framework and acted in an advisory capacity, overseeing the econometric implementation and reviewing the outputs and drawing conclusions on behalf of SNCF. Several methodological issues were explored as part of the research, interacting with the Scientific Committee.
Impact: *The results have been shared with the French Rail Regulator for consideration for use as the basis for setting track access charges in France.*

MOCHA

Grant holder: **Academic Unit of Health Economics, University of Leeds**
Investigator: **Dr Andrew Smith**
Funded by: **National Institute for Health Research (NIHR)**
Dates: **August 2015 – July 2018**
Collaborative partners: **NHS Benchmarking Network, University of Sheffield, University of Nottingham, Patients Association, Community Hospitals Association**

Abstract: To understand the variation in performance between UK community hospitals, our objectives are: to measure the relative cost efficiency of rehabilitation services in community hospitals; to identify the characteristics of community hospital rehabilitation that optimise performance; to investigate the current impact of community hospital in-patient rehabilitation for older people on secondary care and the potential impact if community hospital rehabilitation was optimised to best practice nationally; to examine the relationship between the configuration of intermediate care and secondary care bed use; and to develop toolkits for commissioners and community hospital providers to optimise performance. Dr Smith's role was to conduct efficiency analysis based on a sample of community hospitals using the most up-to-date techniques.

Papers: The project proposal was submitted to BMJ Open: Understanding the Models of Community Hospital rehabilitation Activity (MoCHA): a mixed method study.
Impact: *This project is but one example of cross-disciplinary collaboration undertaken by the Institute and the translation of research across disciplines.*

NeTIRail

Grant holder: **Dr Andrew Smith**
Investigators: **Dr James Laird, Dr Phill Wheat, Dan Johnson**
Funded by: **EU**
Dates: **June 2015 – May 2018**
Co-ordinating partner: **University of Sheffield**
Collaborative partners: **12 European partners (see website for details)**
Website: **www.netirail.eu**

Abstract: The main purpose is to develop and demonstrate technologies and best practice tailored to the needs of different categories of rail systems including busy capacity limited passenger lines, under-utilised rural or secondary "low density" lines and routes dominated by freight. The consortium will deliver innovative concepts of new technologies for railway operation and analyse current best practice to identify optimal solutions to be applied to different line categories across Europe. Moreover, it will also assess the societal impact of railway and the business case for each alternative asset management strategy and the applications of the technologies developed, including consideration of the incentives and regulatory/ financial frameworks across the EU member states. Our contribution to this large project involves establishing the business case and associated cost, demand modelling and undertaking research on incentives and regulatory aspects.

Steel composition and track degradation

Grant holder: **Dr Andrew Smith**
Investigators: **Professor Richard Batley, Dr James Laird, Dr Phill Wheat**
Funded by: **EPSRC**
Dates: **July 2015 – June 2017**
Co-ordinating partner: **University of Huddersfield**
Collaborative partners: **University of Cambridge, Cranfield University, Tata Steel, with contribution from Network Rail and RSSB.**

Abstract: To reduce whole-life costs of the railway system, through increased asset life and reduced maintenance,

and to improve performance, such as increased service availability and reliability, it is important to select the optimum materials for railway components. There are many conflicting requirements when selecting the materials for wheels and rails including a range of failure mechanisms, operating and loading conditions, and the associated financial implications. This research will establish a comprehensive understanding of the metallurgical characteristics of rail and wheel steels to enable scientifically-informed choices. It will take account of both the specific requirements arising from the peculiarities of wheel to rail contact and the economic trade-offs at a system-wide level. Recent development of high performance rail steel by Tata has shown that improvements in the resistance to both wear and rolling contact fatigue can be achieved through judicious choice of alloying elements to alter the microstructural characteristic of the steel. However, understanding the success of such steels requires further research to establish how steel microstructures react to the forces imposed at the wheel-rail interface. The project combines the skills of an interdisciplinary team from four Universities necessary to deal with the complexity of the phenomena. Our contribution at Leeds is to establish the business case and associated cost and demand modelling, and to undertake research on incentives and regulatory aspects. New research on econometric and engineering based cost modelling is also envisaged.

SUSTRAIL (The SUSTainable freight RAILway)

Grant holder: **Dr Phill Wheat**
Investigators: **Dr John Nellthorp, Daniel Johnson, Dr Anthony Whiteing, Dr Andrew Smith**
Funded by: **European Commission**
Dates: **June 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**

Abstract: 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. The SUSTRAIL project was focussed on allowing the rail freight system to regain position and market by a combination of improvement in both freight vehicles and track components. At ITS we led three 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.

Papers: The final report is published on the project website.

Theme: Resilience

ATOC-Disruptions

Grant holder: **Professor Mark Wardman**
Investigators: **Jeremy Shires, Greg Marsden**
Funded by: **Association of Train Operating Companies (ATOC)**
Dates: **March 2015 – September 2015**

Abstract: The aim of this project was to determine the impact of engineering based disruptions on rail passenger demand. It was conducted for the Railway Industry's Passenger Demand Forecasting Council, set against a background of perceived weaknesses in the Passenger Demand Forecasting Handbook's treatment of this issue. A series of surveys was conducted, achieving a sample of over 7500 rail travellers, that covered: behavioural intentions in the event of a hypothetical disruption; actual responses to experienced previous disruptions; awareness levels; preferences amongst different types of service in the event of a disruption; and impacts on future planned behaviour. Models were estimated to explain how rail travellers respond to different types of engineering disruption, alongside analysis of how aware they were of planned disruptions and the effects on future travel.

Disruption

Grant holder: **Professor Greg Marsden**
Investigators: **Jeremy Shires, Dr Caroline Mullen**
Funded by: **Research Councils UK, Energy Programme**
Dates: **October 2011 – May 2015**
Collaborative partners: **Universities of Aberdeen, Brighton, Glasgow, Lancaster, Open University, University of the West of England**
Website: **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 and individual lifestyles that are needed to inspire conversions to lower carbon travel. The project thus seeks to move beyond the purely individualistic view of behaviour change. The project has developed a number of streams of on-going research. First, the project worked collaboratively with the ATOC-Disruptions project (above) to shape research on how the rail industry responds during temporary disruptions and second the project created a set of tools which have been applied to a rapid response investigation around the Forth Road Bridge Closure (see below).
Impact: *The project has developed a Green Paper on travel behaviour change (www.fleximobility.solutions) which pulls together all of the findings and suggests new ways in which we should approach travel behaviour and transport policy. On-going impact acceleration studies with JMP Consulting are exploring deployment options in two cities.*

Forth Road Bridge Closure

Grant holder: **Professor Greg Marsden**
Investigator: **Jeremy Shires**
Funded by: **EPSRC – Impact Acceleration Account**
Dates: **December 2015 – May 2016**
Collaborative partner: **Glasgow University**

Abstract: This research follows on from the Disruption project (above). When the Forth Road Bridge in Edinburgh suffered an unexpected structural failure, closing it to all traffic, the tools and insights we have developed were put into action. As well as providing insights to Transport Scotland and ScotRail on likely behavioural responses from previously assembled data sets, we have collected over 1,500 surveys of households and users of alternative rail and bus services, and over 50 business surveys. In early 2016 this data will be shared with the affected agencies and a major new report on behavioural responses to disruption will be released.

Future Resilience in Urban Transport

Grant holder: **Dr Nik Lomax (School of Geography)**
Investigators: **Dr Ian Philips, Ersilia Verlinghieri**
Funded by: **EPSRC, Impact Acceleration Account**
Dates: **July – September 2015**

Abstract: Resilience is now firmly established as a transport policy buzzword, but what does it mean in practice? A great deal of academic work has established a range of conceptualisations of the term. However, there is no multi-level definition of transport resilience nor is there a matrix summarising the zones of consensus and contention in different stakeholder's views of resilience. It is important to understand the range of views because there are many threats to resilience requiring a response or vision, and because poor understanding leads to poor policy outcomes (as with the definition gap in 'sustainability'). This project is developing methods to form an iterative process of engagement with local stakeholders in the urban transport planning process.
Impact: *Further insights were presented at the Royal Geographical Society conference http://conference.rgs.org/AC2015/71.*

RUSSELL (Resilient Urban Systems: Optimising Land Use with Multiple Objectives)

Investigator: **Dr Chandra Balijepalli**
Funded by: **EPSRC – Impact Acceleration Account**
Dates: **April – July 2015**
Collaborating partners at the University of Leeds: **Water@Leeds, Sustainability Research Institute, Institute for Resilient Infrastructure**

Abstract: This project investigated the interdependencies between various systems such as water and transport to improve their overall resilience.

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

Grant holder: **Dr Haibo Chen**
Investigator: **Dr Paul Timms**
Funded by: **European Commission FP7**
Dates: **May 2013 – April 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. We are involved in studying such practices, identifying needs for implementation and developing executive plans for different scenarios. We are also exchanging experience and knowledge with global cities via showcases, site visits, workshops and learning materials with the final objective of producing a 'Virtual Solution Book'.

Theme: Social Equality

Co-Motion (Co-design of the built environment for mobility in later life)

Grant holder: **Bryan Matthews**
Investigator: **Frances Hodgson**
Funded by: **Research Councils UK (RCUK)**
Dates: **September 2013 – August 2016**
Coordinating partner: **University of York**
Collaborative partners: **University of Newcastle, University of Northumbria**

Abstract: The project is working with approximately 120 older people across three sites in Northern England. Focusing on life transitions which affect well-being and mobility – such as losing a driving licence, losing a partner, sight deterioration or becoming a carer. We are conducting interviews with older people to explore their mobility and wellbeing over time. Smaller groups will participate actively in the research through a series of workshops, interviews and co-design sessions, helping to develop and test innovations such as crowd sourcing about mobility barriers, mobility apps, adaptations to mobility scooters, and means to overcome conflicts between the needs of different users of urban space. The project will co-create practical tools which can act as complements or alternatives to the redesign of the built environment.

Retrofitting Accessible Highways

Grant holder: **Bryan Matthews**
Investigator: **Kasia Speakman**
Funded by: **EPSRC, LCC**
Dates: **June 2014 – September 2015**
Collaborative partner: **Leeds City Council**

Abstract: The importance of accessible street environments to people with mobility impairment was addressed. We researched the impact of demand-responsive retrofitting of the highway with accessible features on the mobility and wellbeing of disabled residents. Through a series of interviews with disabled people across the Leeds district we sought to understand the problems encountered by those with mobility impairment. The three main strands were; 1) Economic (explore how local spending by older and disabled people may be influenced by the accessibility of shopping parades); 2) Personal (scope how a more accessible street environment may contribute to independence, wellbeing and a reduced reliance on care delivery) and 3) Social (greater participation of disabled people in Town Planning and Highways decision making processes).

Papers: Speakman K and Matthews B (2014) Retrofitting an accessible highway: a user-led approach, *Proceedings of the ICE – Municipal Engineer,* ***167****(4) 207-213.*
Impact: *Interim findings were presented at TRANSED 2015, the 14th International Conference on Mobility and Transport for Elderly and Disabled Persons held in Lisbon, and a dedicated final dissemination event was held in Leeds.*

Social Assessment of the A465 scheme in South Wales

Grant holder: **Professor Karen Lucas**
Investigators: **Dr Ian Philips, Dr Louise Reardon, Ersilia Verlinghieri**
Funded by: **Welsh Government**
Dates: **April – December 2015**

Abstract: The Welsh Government is widening the entire length of the A465 in South Wales to dual carriageway standard. The A465, or Heads of the Valleys road, is a key corridor and international gateway for the South Wales economy connecting the M4 at Neath to Abergavenny and Hereford. It provides a strategic link between West Wales and the Midlands, and also links up the northern valleys, supporting regeneration in the local communities. The focus of this social assessment study is Section 3 of the A465, between Brynmawr and Tredegar. The section contains a stretch of replacement road on a new alignment along which several low-income communities are located.
Impact: *Our study is the first of its kind in the UK. It uses a combination of quantitative and qualitative analyses to identify the local social impacts arising from the Scheme after opening in summer 2015. The study is designed to act as an exemplar for future evaluations of the social impacts of road projects in Wales and will also be used to feed in evidence to the development of WelTAG.*

Transport Equity Assessment (TEA COST)

Grant holder: **Professor Karen Lucas**
Funded by: **EU COST Action**
Collaborative partners: **15 partner countries of the TEA COST consortium**
Website: **www.teacost.eu**

Abstract: Understanding the equity implications of transport policies and investments is becoming increasingly important, as underscored by social movements around the world. A major challenge in the assessment and appraisal of transport projects and policies is that equity issues are currently hardly addressed. The TEA COST Action brings together new

approaches that incorporate equity consideration in transport project evaluation and decision making. This includes the measurement of accessibility combined with the literature on social justice, travel behaviour models and socio-economic impacts analysis in line with mainstream welfare economics. TEA COST has three main purposes: i) to develop innovative and comprehensive transport evaluation criteria accounting for distributional effects and accessibility; ii) to include social and spatial factors in social welfare assessment; iii) to devise a common European methodology that links equity indicators and social welfare maximization in order to promote equity considerations in transport decision making. It will achieve this by promoting a series of knowledge exchange workshops between academics and policymakers in the 15 partner countries that form the TEA COST Consortium.

Theme: Technology and Human Factors

AdaptIVe (Automated Driving)

Grant holder: **Dr Natasha Merat**
Investigators: **Professor Richard Romano, Tyron Louw, Dr Ruth Madigan**
Funded by: **European Commission**
Dates: **April 2014 – June 2017**
Collaborative partners: **the project includes 45 partners (see website for details)**
Website: **www.adaptive-ip.eu**

Abstract: AdaptIVe develops various automated driving functions for daily traffic by dynamically adapting the level of automation to situation and driver status. The focus of ITS Leeds partners is to investigate how drivers' intentions and actions should be taken into account in the design of automated systems.

Papers: The work was presented at two conferences:

1) Merat N, Kountouriortis G, Louw T (2015) Driver inattention during vehicle automation: how does driver engagement affect resumption of control? *Proceedings of the Fourth International conference on Driver Distraction and Inattention, Sydney, Australia.*
2) Louw T, Merat N, Jamson AH (2015) Engaging with highly automated driving: to be or not to be in the loop. *Proceedings of the Seventh International Driving Symposium on Human Factors in Driver Assessment, Training and Vehicle Design, Park City, Utah, USA.*

City Mobil 2

Grant holder: **Dr Natasha Merat**
Investigators: **Dr Ruth Madigan, Tyron Louw**
Funded by: **European Commission**
Dates: **September 2013 – August 2016**
Collaborative partners: **the project includes 45 partners, see website for further details**
Website: **www.citymobil2.eu**

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.

Papers: The work was presented at two conferences including: Merat N & Louw T (2015) Pedestrian and cyclists' interactions with automated road transport systems in La Rochelle, France: Results from the CityMobil2 Project. Proceedings of the Transportation Research Board Workshop, Anna Arbor, USA.

FORWARN

Grant holder: **Dr Natasha Merat**
Investigators: **Panagiotis Spyridakos, Dr Gustav Markkula**
Funded by: **EPSRC**
Dates: **November 2012 – August 2016**

Abstract: FORWARN aims to create a Forward Collision Warning (FCW) system that is able to consider driver distraction when making decisions on the appropriateness and timing of automated warnings. To achieve this, drivers will be asked to engage in a variety of distracting tasks in simulated driving scenarios. As driving is a multi-faceted activity, assessing the effects of distraction on driving performance depends on the metrics being observed as well as the nature of the distracting task itself. Since identifying non-visual distraction is particularly problematic, the project will focus specifically on identifying the best metrics for this type of activity. This project builds upon work already conducted by the Institute's Safety and Technology group during previous projects such as AIDE (Adaptive Integrated Driver-vehicle interfacE) and HASTE (Human machine interface And the Safety of Traffic in Europe) and EASY (Effects of Automated Systems on safetY).

Papers: This work has resulted in 5 outputs to date including the following published or presented during 2015:

1) Kountouriotis GK, Wilkie RM, Gardner PH, Merat N (2015) Looking and thinking when driving: The impact of gaze and cognitive load on steering, *Transportation Research Part F: Traffic Psychology and Behaviour*, 34 108-121.
2) Carsten O & Merat N (2015) Protective or Not? *Proceedings of the Fourth International conference on Driver Distraction and Inattention, Sydney, Australia*.
3) Merat N, Kountouriortis G, Tomlinson A & Carsten O (2015) Visual and Non-Visual Distractions: Are they all that different? *Proceedings of the Fourth International conference on Driver Distraction and Inattention, Sydney, Australia.*
4) Merat N, Kountouriotis G, Carsten O, Engstrom J (2015) Performance on the Detection Response Task during driving: Separating the manual and cognitive element of the secondary task, *4th International Driver Distraction and Inattention Conference*.

FOT-Net Data (Field Operational Test Networking and Data Sharing Support)

Grant holders: **Dr Haibo Chen**
Investigators: **Professor Oliver Carsten, Dr Yvonne Barnard**
Funded by: **European Commission FP7**
Dates: **January 2014 – December 2016**
Co-ordinating partner: **VTT**
Collaborative partners: **seven European collaborating partners (see website for details)**
Website: **http://fot-net.eu**

Abstract: Objectives of this project are to (1) support the efficient sharing and re-use of available Field Operational Tests (FOTs) datasets, (2) develop and promote a framework for data sharing and data re-use, (3) build a detailed catalogue of available data and tools and (4) operate an international networking platform for FOT activities. The project keeps the momentum of the FOT network and delivers new perspectives with regard to the sharing and re-usage of globally available FOT/Naturalistic Driving Studies datasets. The sharing of these datasets will yield further research results, create new collaborative options, generate financial and time savings in transport research, support education at high levels and contribute to the market introduction of improved vehicle ICT. The project will also update and promote the FESTA methodology, maintain the FOT Wiki and reach an agreement on the adoption of data sharing principles.

Programme for Simulation Innovation (PSI)

Grant holder: **Dr Gustav Markkula**
Investigators: **Professor Richard Romano, Dr Hamish Jamson, Tony Horrobin, Dr Andrew Tomlinson, Lei Qian, Ehsan Sadraei, Panagiotis Spyridakos, Jessica Taylor-Ashley**
Funded by: **EPSRC, Jaguar Land Rover**
Dates: **April 2013 – December 2017**
Collaborative partners: **Dr Erwin Boer-independent researcher; Universities of Loughborough, Warwick, Cambridge, Sheffield and Manchester**

Abstract: PSI is developing capabilities in advanced simulation to support a virtual vehicle design process and to 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. Hence, an emerging lynch-pin in PSI is an increasingly complex driver model. This is being developed in a number of sub-projects in PSI which characterise how visual, vestibular, auditory, tactile and haptic cues are perceived, integrated and used to produce resulting vehicle control actions. This driver model will ultimately allow us to develop an objective Simulator Functionality Matrix which aims to quantify, at a task-based level, the capability of a specific simulator to undertake a specific vehicle evaluation task. Within the scope of the project this ranges from high-quality Human-Machine Interface design to the development of a human-like co-driver to underpin well-accepted and reliable vehicle automation.

UDRIVE

Grant holder: **Professor Oliver Carsten**
Investigators: **Dr Daryl Hibberd, Dr Frank Lai**
Funded by: **European Commission**
Dates: **October 2012 – June 2017**
Collaborative partners: **19 partners across 11 countries (see website for details)**
Website: **www.udrive.eu**

Abstract: UDRIVE is the first large-scale European Naturalistic Driving Study, with a fleet of 200 vehicles across cars, trucks and powered-two wheelers. It aims at enhancing in-depth understanding of actual road user behaviour by means of field observations. The objectives of the project are to identify measures to improve road safety and to identify approaches for reducing vehicle emissions and fuel consumption in order to make road transport more sustainable. ITS is involved in all stages of the project, including study design, field trials, data analysis and dissemination. ITS has particular responsibility for the analysis of everyday driving, i.e. examining how the choices that drivers make second-by-second on aspects of driving such as speed choice and car following are linked to risk, and the uptake of in-vehicle secondary tasks. The field trials are currently underway and the data analysis is due to take place from April 2016 onwards.

Vehicle and Road Automation (VRA)

Grant holder: **Dr Natasha Merat**
Funded by: **European Commission**
Dates: **November 2013 – December 2016**
Collaborative partners: **over 30 partners and associates (see website for details)**
Website: **http://vra-net.eu**

Abstract: VRA is a support action funded by the European Union to create a collaboration network of experts and stakeholders working on deployment of automated vehicles and related infrastructure. The VRA project is the cooperation interface between EC funded projects, international relations and national activities on the topic of vehicle and road automation. Dr Natasha Merat is leading the tri-lateral working group that is focussing on human factors.

JOURNAL ARTICLES

Increasingly, our research publications are available via Open Access, so that the outcomes of publicly funded research are more widely available to those outside of academia. Authors affiliated with ITS are shown in bold.

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