UNIVERSITY OF LEEDS

Institute for Transport Studies (ITS)

Research Report **2016**

The opening of the new ITS building, from left Nigel Foster, Director of Arup; Professor Richard Batley, Director of ITS; Professor Lisa Roberts, Deputy Vice-Chancellor for Research and Innovation and Rt Hon Chris Grayling, Secretary of State for Transport.

INTRODUCTION

Professor Richard Batley took over as Director from **Professor Greg Marsden** in September 2016.

Greg can look back upon his 5 years as Director with a fantastic sense of achievement, having secured investment for the Institute building project, over twenty new staff, external partnerships and other initiatives. These developments mean that the Institute stands on strong foundations, as we move forwards to pursue the opportunities, and address the challenges, that will emerge over the coming years.

At the University level, our optimism is further buoyed by Leeds' award of the University of the Year 2017 by The Times and The Sunday Times 'Good University Guide'. Chosen by a distinguished panel, the Guide showcases the excellent student experience at Leeds.

Benefiting from Greg's legacy as Director, the Institute moved back into 36-40 University Road in October 2016, following completion of the £4M building project. Boasting a new three-storey modern extension, the investment also involved extensive remodelling and refurbishment work to upgrade the original building, as well as sensitive restoration of original features. This has resulted in an improved learning environment, and will greatly enhance the quality of interactions between our students, staff and industry partners. The official opening of the building was performed by the **Secretary of State for Transport, Chris Grayling MP** – and this proved to be a highly successful promotional event which further raised the profile of ITS amongst an invited VIP audience of partners (and beyond), and futher galvanised a sense of identity and common purpose amongst staff and students.

In 2016 we conducted a major refresh of our research strategy in order to ensure that the Institute is

best positioned to respond to the emerging research questions, funder opportunities, and industry and policy needs. Among the key initiatives from this refresh is 'Virtuocity', a University-wide Centre for City Simulation led by **Professor Richard Romano**. Building upon the Institute's world-class simulator suite – which is being extended to cover HGVs and pedestrians, as well as cars – Virtuocity will combine simulations from different domains, in order to address the grand challenges that face cities across the world including energy, resources, well-being, health, environment, mobility and place-making.

Staff Changes

As in previous years, 2016 saw a degree of renewal among staff, as we welcome newcomers, bade farewell to leavers, and celebrated promotions. **Professor Natasha Merat** was promoted to a Chair in Human Factors of Transport Systems, **Professor Andrew Smith** to a Chair in Transport Performance and Economics and **Professor Samantha Jamson** to a Chair in Transport and Psychology. **Dr Phill Wheat** and **Dr James Tate** were promoted to Associate Professorships.

We welcomed **Dr Robin Lovelace** and **Dr Kate Pangbourne** as our second wave of University Academic Fellows, joining the first wave of fellows appointed last year. We also welcomed **Professor Jillian Anable**, **Dr Alex Baker-Graham**, **Dr Eleonora Morganti**, **Dr Craig Morton**, **Dr Luigi Pariota**, and **Alex Stead**. In administrative roles we welcomed **Lois Nuttall**, **Zhenya Purves**, **Rachael Thomas** and **Rosie Samuel**. We bade farewell to Dr Jiwei Zheng, Jodie Morrison and Luisa Nanovo.

Awards and Prizes

Emeritus **Professor Tony May** was awarded the Jules Dupuit Prize at the 14th World Conference on Transport Research in Shanghai. The Prize is the highest award made by the WCTRS, and was made in recognition of Tony's contribution to the development of transport research, particularly related to urban transport policy, and of his contribution to the work of the Society, for which he served as President from 2007 to 2013.

PhD student **Haneen Khreis** was awarded the World Conference on Transport Research Society (WCTRS) Innovation Grant.

PhD student **Tyron Louw** won the Best Young Scientist Award at the International Conference on Traffic and Transport Psychology (ICTTP) held in Brisbane, Australia. The award recognises the role that early career researchers play in shaping the next generation of road safety and transportation research and practice.

PhD student **Oluwasegun Aluko** was awarded the prize for best student paper: "A Model for the Evaluation of Transport Safety Policies in Commercial Motorcycle Operation in Nigeria" at the System Dynamics Society's annual conference.

Best paper prizes were awarded to:

Dr Eva Heinen for the Best Randomised Controlled Trial/Natural Experiment Paper in the International Journal of Behavioural Nutrition and Physical Activity, and to

Professor Susan Grant-Muller and **Frances Hodgson** for Distinguished Scientific Papers – Europe Award at the World Congress on Intelligent Transport Systems.

Influencing Government Policy

Professor Andrew Smith gave oral evidence to the House of Commons Transport Committee inquiry into rail franchising, whilst **Professor Natasha Merat** gave oral evidence to the House of Lords Science and Technology Committee inquiry into Autonomous vehicles.

Research conducted by **Professors Greg Marsden** and **Jillian Anable** with colleagues from the University of Glasgow was showcased at the International Transport Forum OECD Council of Ministers conference in Leipzig. The work, drawing on real-time investigations of behavioural responses to major weather events, contributed to background materials for a closed Ministerial Session on responses to disruption.

Bryan Matthews participated in the launch of the House of Lords Report 'The Equality Act 2010: the impact on disabled people', contributing to the discussion on transport issues.

After 4 years of activities led by **Professors Oliver Carsten** and **Samantha Jamson**, the €14.5m 'ecoDriver' project released its final results in Stuttgart. The project trials involved 170 drivers in seven countries, both in controlled and naturalistic environments, testing nine different eco-driving support systems. Overall, the findings showed that eco-driving contributed an average 4.2% fuel saving across all systems, with the highest saving (5.8%) on rural roads. Embedded systems (i.e. more elaborate systems, closely linked to the vehicle) were more effective than nomadic systems, with fuel saving of up to 6%.

International Visitors

In the spirit of International Collaboration, the Institute hosted a number of academic visitors most of whom presented their research to staff, students and the wider community. Seminar presentations are available to view on www.its.leeds.ac.uk/slideshare. Our visitors included:

Dr Matthew Beck from University of Sydney, Australia and **Dr Amanda Stathopoulos** from the Northwestern University, USA were hosted by Professor Stephane Hess. **Mathieu Carrier** of the Institut National de la Recherche Scientifique (INRA), Quebec, Canada, **Dr Eduardo Vasconcellos** of the National Public Transport Association, Brazil and **Dr Alexa Delbosc** from Monash University, Australia were hosted by Professor Karen Lucas. **Dr Giovanni Circella** from the Georgia Institute of Technology, Atlanta, USA, **Dr Michael Poku-Boansi** of The Premier University of Science and Technology in Ghana and West

Africa (KNUST) and **Dr Karel Martens** from Radboud University, Nijmegan, Netherlands were hosted by Professor Greg Marsden. **Dr Susilawati** of Monash University, Malaysia was hosted by Dr Chandra Balijepalli. **Katsuya Sakai** of the Tokyo Institute of Technology, Japan and **Dr Shang Hua-Yan** from the Central University of Business and Economics, Beijing, China were hosted by Dr Ronghui Liu. **Dr Shigeki Ozawa** of Daido University, Nagoya, Japan was hosted by Professors Chris Nash and Andrew Smith. **Dr Tomas Rasmussen** of the Technical University of Denmark, Copenhagen was hosted by Professor Dave Watling. **Professor Mark Nieuwenhuijsen** from the Barcelona Institute for Global Health, Spain was hosted by Dr James Tate.

Are you interested in recruiting ITS graduates?

Each year we hold Employer Visit Days where employers from the transport sector visit the campus to give presentations to, and/or interview current students. This is a unique opportunity for students to gain direct access to employers, and for employers to gain access to ITS graduates.

International students make up 75% of our full-time cohort and are drawn from 35 countries. International job opportunities would be greatly welcomed. Companies based outside the UK, and interested in employing ITS graduates for their international offices, can register their interest to take part in a Virtual Employer Day. This is a format whereby companies can deliver an on-line presentation, with the possibility to interview potential candidates remotely. We also have an ITS LinkedIn page, onto which employers can upload job advertisements. If you would like to register your interest in our virtual employer days, or the visit days, please contact us. Contact details are shown at the end of this page.

PhDs awarded

Postgraduate research degrees were awarded to six of our students in the past year: **Nicholas Herbert** 'Hearing loss and its effect on driving performance'; **Andyka Kusuma** 'A weaving model for general motorways'; **Andrew Naimanye** 'Development of equitable algorithms for distribution of road infrastructure funds in developing countries'; **Munajat Nugroho** 'Stated preference study on mode and port choice for containerised exports from Java'; **Sanna Pampel** 'How can mental models of eco-driving be measured, represented and changed?' and **Doh Shin** 'Explanation of factors influencing cyclists' route choice using actual route data.

ITS PhD theses are available via White Rose eTheses Online.

Postgraduate Research Students

The Institute has a vibrant research culture and our students participate in seminars, international nights (sharing regional foods), field trips and other events throughout the year.

In addition to those who graduated, a further 73 students were engaged in research during 2016.

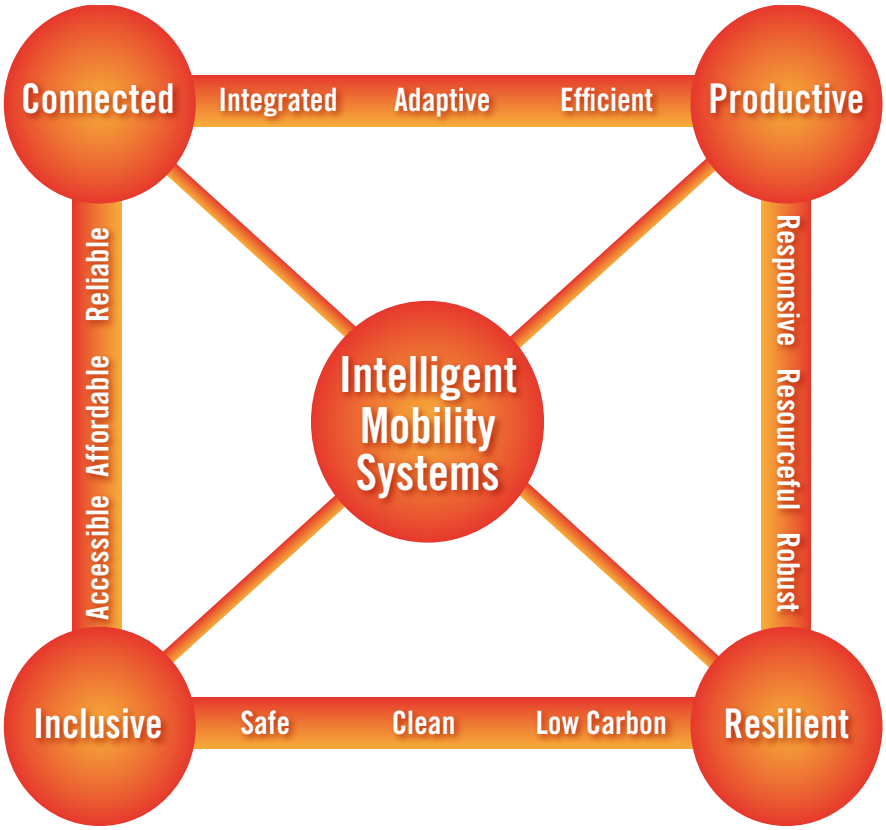
Khaled Abdullah, Samuel Adjei Appiah, Ilyas Alhassan, Al-Amin Al-Hasan, Mahmoud Al-Khazaleh, Izza Anwer, Peter Atkinson, Jeroen Bastiaanssen, Valerio Benedetto, Julian Burkinshaw, Andrew Bwambale, Chiara Calastri, Mauro Capurso, Madga Cepeda-Zorrilla, David Chikwendu, Anna Correa-Pereira, Fiona Crawford, Edmond Daramy-Williams, Louise de Tremerie, John Dixon, Joel Dodsworth, Rafael Dos Reis, Umoh Edemeka, Joanna Elvy, Anderson Etika, Anthony Ezenwa, Fahmi Fahmi, Cristhian Figueroa-Martinez, Andrew Gillies-Smith, Thiago Guimaraes-Rodrigues, Alvaro Guzman-Jaramillo, Thomas Hancock, Stephen Hanley, Md Bashirul Haque, Probo Hardini, Sheriff Idriss-Yahya, Ismaeel Rashed, Haneen Khreis, Alexandros Kontotasios, Qiyang Liu, Tyron Louw, Tahera Mayat, Ioanna Moscholidou, James Musgrave, Tamas Nadudvari, Haruko Nakao, Taufiq Nugroho, Benjamin Olobo, Lamprini Papafoti, Evangelos Paschalidis, Alexander Patrick, David Pierce, Lei Qian, Christopher Rushton, Ehsan Sadraei, Arwa Sayegh, Aswin Siregar, Fangquing Song, Daosadeth Soysouvanh, Panagiotis Spyridakos, Sidi Sun, Tianli Tang, Yvonne Taylor, Lap Kwan Tjiong, Nur Ubaidillah, Chinebuli Uzondu, Ersilia Verlingheri, Conor Walsh, Yin Wang, Yao Yao, Jingyan Yu, Weiming Zhao and **Tatjana Zimasa.**

Collaborating with colleagues across campus, ITS staff co-supervised five students registered in other Schools at the University of Leeds: **Sakarias Bank** (Psychology); **Pablo Guillen** (Computing); **Maha Alsabbagh (**Earth & Environment); **Dr Ashkay Dwarakanath** (Medicine & Health); **Kate Palmer** (Doctoral Training Centre) and **Daisy Thomas** (Engineering).

Alumni Events

During the past year we welcomed return visits to Leeds by alumni **Lea Ruzic** (2012) at the ITS summer BBQ and **Alex Ryan** (2015) at a student induction event. **Michele Dix** CBE (1982), **Ben Stil**l (1997) and **Ian Palmer** (1996) presented seminars at ITS. The University Big Get Together campaign saw five worldwide events hosted by ITS alumni in Ghana, Uganda, UK, Bangladesh and Vietnam. At overseas events we had the opportunity to catch up with alumni in Indonesia, Argentina, India and Chile, and at WCTRS in China we hosted an alumni event where **Jialiang Guo** (2014) gave a keynote speech.

Alumni news, events and over 120 career profiles representing 48 countries can be found at www.its.leeds.ac.uk/alumni.
If you would like to post your profile please get in touch via http://www.its.leeds.ac.uk/contact/.



RESEARCH PROJECTS

Expertise at the Institute ranges from engineering, modelling and econometrics through to psychology and sociology. The quality of our research delivery is underpinned by ISO9001 accreditation which provides those commissioning research from ITS with a high degree of confidence in the quality or the research and the professionalism and ethics of our processes.

The organisation of ITS research is in accordance with a "Research Landscape" that has been restructured to meet the emerging challenges in transport and to enhance opportunities for multi-disciplinary research collaborations both within and beyond the University. Our new research groups, priority themes and centres together make up this Landscape, and are featured on the ITS website.

Our thematic approach is organised to support the development of an intelligent mobility system which is **Connected** (integrated in terms of modes and systems); **Inclusive** (addressing disadvantage and supporting equity); **Productive** (promoting economic and social wellbeing) and **Resilient** (sustainable, flexible and responsive to external pressures).

The range of research carried out at the Institute is demonstrated in the extensive list of projects which are described below and arranged under the four 'cornerstone' themes as shown in the diagram:

Connected Transport

AdaptIVe (Automated Driving)

Grant holder: **Professor Natasha Merat**
Investigators: **Professor Richard Romano, Tyron Louw, Dr Ruth Madigan**
Funded by: **European Commission**
Dates: **April 2014 – June 2017**
Collaborative partners: **28 partners in eight countries (see website for details)**
Website: **www.adaptive-ip.eu**

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

CARTRE (Coordination of Automated Road Transport Deployment for Europe)

Grant holder: **Dr Yvonne Barnard**
Investigators: **Dr Haibo Chen, Dr Dongyao Jia, Professor Natasha Merat**
Funded by: **EU H2020**
Dates: **October 2016 – September 2018**
Coordinating partner: **ERTICO – ITS Europe**
Collaborating partners: **36 European partners (see website for details)**
Website: **http://connectedautomateddriving.eu/about-us/cartre/**

Abstract: CARTRE is a Coordination and Support Action to accelerate development and deployment of automated road transport by increasing market and policy certainties. To achieve this, CARTRE will support the development of clearer and more consistent policies for EU Member States in collaboration with industry players, ensuring that automated road transport systems and services are compatible at EU level and are deployed in a coherent way.

Other objectives include: the creation of a solid knowledgebase of all European activities, to support current activities and structure research outcomes by enablers and thematic areas; to setup a platform for sharing and re-using data and experiences from different automated road transport systems; to actively support Field Operational Tests (FOTs) and pilots carried out at National and European levels; and to work on future visions, potential impacts and research gaps in the deployment of automated road transport.

The CARTRE project will run for two years and aims to establish a joint stakeholders forum in order to coordinate and harmonise automated road transport approaches at European (e.g. strategic alignment of national action plans for automated driving) and international level (in particular with the US and Japan).

Impact: *As an overall impact, CARTRE supports the development of automation in road transport, in view of optimising its contribution to the ambitious EU policy goals in terms of road safety, reduced congestion, energy efficiency and air quality as well as ensuring the leading role of European industry in the global market to boost sustainable growth and create jobs.*

City Mobil 2

Grant holder: **Professor Natasha Merat**
Investigators: **Dr Ruth Madigan, Tyron Louw**
Funded by: **European Commission**
Dates: **September 2013 – August 2016**
Collaborative partners: **45 partners (see website for details)**
Website: **www.citymobil2.eu/en**

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

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: The main objective of EMPOWER is to substantially reduce the use of conventionally-fuelled vehicles in cities, using positive incentives delivered through pervasive information technology 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 IT architecture and templates for business models in a multi-stakeholder context.

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**
Collaborative partners: **VTT (co-ordinator), ERTICO, SAFER, IKA, PTV, CTAG, CEESAR and DAI**
Website: **http://fot-net.eu**

Abstract: Objectives of this project were to: (1) support the efficient sharing and re-use of available Field Operational Test (FOT) 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.

Impact: *The project has updated and promoted the FESTA methodology, maintained the FOT Wiki and reached an agreement on the adoption of data sharing principles.*

This project received an 'excellent' rating in its final review and keeps the momentum of the FOT network, delivering new perspectives with regard to the sharing and re-use of globally available Naturalistic Driving Studies. The sharing of FOTnet 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.

MARS Jakarta

Grant holder: **Professor Simon Shepherd**
Investigator: **Dr Chandra Balijepalli**
Funded by: **Greater Jakarta Transport Authority (GJTA)**
Dates: **August 2016 to April 2017**

Abstract: The capital region of the republic of Indonesia has 10% of population of the nation. It has increased 1.6 fold in 20 years: from 17 million in 1990 to 28 million in 2010. The Jakarta region is the growth center with a share of approximately 30% of Gross Domestic Product and 40% foreign investment. Transportation in Greater Jakarta relies heavily on the road network and the surge in motorized vehicle traffic is tremendous. The worsening congestion in the region is causing huge economic loss. This project aims to develop a strategic Land Use Transport Interaction model based on the system dynamics model MARS. We have collaborated with the GJTA who supplied data and advice on which policy issues and objectives are most relevant to their master plans. The ultimate goal is to use the MARS model in a new environment (i.e. a new continent and cultural situation) and to develop an integrated master plan which helps meet the goals of improving welfare and growth while ensuring a more sustainable transport strategy.

The base model has been developed and training provided in the use of the MARS model to a delegation from Jakarta in November 2016. The final steps of the project are to validate the model and then assess the impact of various transport strategies to see which can provide best value for money and whether any strategy combinations can help obtain the goal of a 60% public transport mode share by 2030.

The Smarter Travel Solution

Grant holder: **Dr Astrid Gühnemann**
Investigators: **Dr Haibo Chen, Jeremy Shires, Professor Simon Shepherd, Dr Ian Philips**
Funded by: **Innovate UK**
Dates: **March 2016 – February 2018**
Coordinating partner: **Telefónica UK**
Collaborating partners: **C3UK, Firstgroup, West Yorkshire Combined Authority, Leeds City Council, Ove Arup & Partners, City Car Club, Forum for the Future and South Yorkshire Passenger Transport Executive.**
Website: **STS**

Abstract: The aim of the project is to develop a new travel app for smart phones that allows users to plan their journey. It's an online, map-based, multi-modal journey planner that incorporates real-time travel and disruption information. It will also provide the option to book and pay for tickets, hire cars, use car club and provide feedback on the journey. The ITS input to this collaborative project is to look at the impact of the travel app in terms of carbon mitigation and what changes it will have on travel decisions in particular for vulnerable user groups.

Vehicle and Road Automation (VRA)

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

Abstract: VRA is a Support Action to create a collaboration network of experts and stakeholders towards the deployment of automated vehicles and related infrastructure. Professor Merat led the tri-lateral working group on human factors.

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: This project collected good practices in the promotion of integrated network management (including multi-modal interchanges), public transport, intelligent infrastructure, clean vehicles, and urban logistics in Europe and beyond. We exchanged experience and knowledge between global cities and produced a 'Virtual Solution Book' showcasing best practices ranging from flexible cycling facilities in Sao Paolo, through bus rapid transit, tram projects and multimodal interchanges across the globe to traffic demand management in Beijing.

Inclusive Transport

ADAPT

Grant holder: **Dr Kate Pangbourne**
Investigators: **Dr Alex Baker-Graham**
Funded by: **EPSRC**
Dates: **June 2016 to May 2021**
Website: **https://adapt.leeds.ac.uk/**

Abstract: ADAPT is leading a new network, Arguments for Behaviour Change (ABC-NET) for researchers and practitioners interested in developing well-structured arguments for behaviour change. The aim is to establish a collaborative community to further research and practice in this area, with a particular emphasis on sustainability, well-being and resilience, and the use of ICT in delivering tailored, persuasive and ethical arguments for travel behaviour change. Over the life of the project, the ABC-NET will be the focal point for two academic colloquia intended to generate productive collaborations and raise the profile of the field.

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 – January 2017**
Coordinating partner: **University of York**
Collaborative partners: **University of Newcastle, University of Northumbria**

Abstract: The project conducted interviews with older people to explore their mobility and wellbeing over time and life changing events. Participants were involved in the research through a series of workshops and co-design sessions to help develop and test innovations such as crowd sourcing about mobility barriers, mobility apps, adaptations to mobility scooters. The aim was to help overcome conflicts between the needs of different people in the urban space.

Impact: *The project has co-created practical tools which can complement or act as alternatives to the redesign of the built environment. Please see the* Co-motion project website *for details.*

Propensity to Cycle Tool (PCT)

Grant holder: **Dr Robin Lovelace**
Funded by: **DfT, ESRC**
Dates: **February to August 2016**
Collaborative partners: **Atkins, London School of Hygiene and Tropical Medicine, University of Cambridge, University of Westminster and Nikolai Berkoff, independent web developer**
Website: **http://www.pct.bike/**

Abstract: The PCT was designed to assist transport planners and policy makers in the prioritisation of investments and interventions to promote cycling. The PCT answers the question: 'Where is cycling currently common and where does cycling have the greatest potential to grow?'

The PCT can be used at different scales – strategic and local.

The PCT is a strategic planning tool. Different visons of the future are represented through various scenarios of change, including the government's draft Cycling Delivery Plan target to double cycling in a decade and the more ambitious 'Go Dutch' scenario, whereby Dutch cycling levels are reached in England (allowing for English hilliness and trip distances). By showing what the rate of cycling could feasibly look like in different parts of cities and regions, and illustrating the associated increase in cycle use on the road network, the PCT should inform policies that seek a wider shift towards sustainable transport.

The PCT can also be used at a smaller scale. The scenario level of commuter cycling along a particular road can be used to estimate future mode share for cycling on that corridor. This can be compared with current allocation of space to different modes, and used to consider re -allocation from less sustainable modes to cater for cycling growth. In other cases, low current or potential flows may indicate a barrier, such as a major road or rail line, causing severance and lengthening trips. This could be addressed through new infrastructure such as a pedestrian and cycle bridge.

Underlying the PCT is open source software development led by Robin Lovelace, who created the R package stplanr to empower people worldwide with accessible tools for reproducible transport planning research.

In summary the PCT is a planning support system to improve cycling provision at many levels from whole regions to specific points on the road network. For further information on the thinking underlying the tool's design, and the methodology used to create it, please see the paper quoted below. To view the underlying source code please visit Github/npct.

Papers:

Lovelace R, Goodman A, Aldred R, Berkoff N, Abbas A, Woodcock J (2016) The Propensity to Cycle Tool: An open source online system for sustainable transport planning, Journal of Transport and Land Use, **10** 505-528.

Shaping London's Air Quality Strategy

Grant holder: **Dr James Tate**
Funded by: **Transport for London (TfL)**
Dates: **October 2013 – May 2016**

Impact: 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 TfL's Environmental Policy and Strategy Team to support the on-going development of the capital's 'Transport and Emissions Action Plan' that can take better account of congested driving conditions. Dr Tate brings the latest research developments and international evidence to enhance the road transport air pollutant evidence base and facilitate the application of emerging research methodologies to the Greater London road transport network.

Transport Equity Assessment (TEA COST)

Grant holder: **Professor Karen Lucas**
Funded by: **EU COST Action**
Dates: **April 2013 to April 2017**
Collaborative partners: **15 partner countries of the TEA COST consortium**
Website: **www.cost.eu/COST_Actions/tud/TU1209**

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 develops 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 impact analysis in line with mainstream welfare economics. TEA COST has three main purposes: i) to develop innovative and comprehensive transport evaluation criteria that account 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.

VENI

Grant holder: **Dr Eva Heinen**
Funded by: **Dutch Research Council**
Dates: **January 2014 – December 2017**

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. 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 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:

1) Heinen E (2016) Identity and travel behaviour: A cross-sectional study on commute mode choice and intention to change, *Transportation Research Part F: Traffic Psychology and Behaviour*, **43**, pp.238-253.

2) Scheiner J; Chatterjee K; Heinen E (2016) Key events and multimodality: A life course approach, *Transportation Research Part A: Policy and Practice*, **91**, pp.148-165.

3) Heinen E; Ogilvie D (2016) Variability in baseline travel behaviour as a predictor of changes in commuting by active travel, car and public transport: A natural experimental study, *Journal of Transport and Health*,**3**, pp.77-85.

XCYCLE

Grant holder: **Professor Oliver Carsten**
Investigators: **Dr Daryl Hibberd, Professor Richard Romano, Michael Daly**
Funded by: **EU H2020**
Dates: **June 2015 – November 2018**
Coordinating partner: **University of Bologna**
Collaborating partners: **Nine 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 has developed an in-vehicle HMI to warn truck drivers of imminent collision risk. The work is being carried out on a new truck simulator, developed with University funding.

Impact: *There will be large impacts on cycling safety by addressing some of the most severe collision scenarios.*

Productive Transport

CQC Efficiency Network

Grant holder: **Dr Phill Wheat**
Investigator: **Alex Stead**
Coordinating partners: **Measure 2 Improve**
Funded by: **Local Authorities**
Dates: **April 2015 – December 2018**
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 Cost of work done, the Quality of the work and the Customer 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 HMEP.

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.*

CTS New Guest Researcher

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

Abstract: This appointment continued from previous visiting arrangements dating back to 2009 and developing new collaborations across CTS, moving beyond previously reported research in rail marginal cost and efficiency (though continuing to develop research and projects in the rail area). The arrangement involved several visits to Stockholm, a presentation of research (empirical and methodological), plus collaboration on key papers.

DITTO

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

Abstract: DITTO (Developing Integrated Tools to Optimise Railway Systems) is a multi-disciplinary project bringing together University-based traffic engineers and transport operations researchers (from Leeds and Southampton) and computer scientists (from Swansea). The project contributes 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 is 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 ERTMS (European Rail Traffic Management System) Levels 2 and 3.

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 estimated the economic impacts of inter-urban land based connectivity between Auckland, Hamilton and Tauranga, particularly around air and sea ports. The project developed a General Equilibrium model capable of responding to the effects of changes in network connectivity.

HS2 Economic Advisory Panel

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

Abstract: The Economic Advisory Panel assisted 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 had focused on appraisal at the national level, in line with WebTAG guidance. In this project we conducted an analysis of sub-national and regional impacts of the HS2 scheme.

Land Value Uplift phase 1

Grant holder: **Dr John Nellthorp**
Investigators: **Dan Johnson, Dr Manuel Ojeda-Cabral, Dr James Laird**
Funded by: **West Yorkshire Combined Authority (WYCA) and University of Leeds**
Dates: **June to December 2016**
Co-ordinating partner: **ITS**

Abstract: The aim of this scoping study was to produce a targeted piece of theoretical and practical research which will advance the understanding of the wider economic impacts of transport – in particular land and property uplift. Key research questions were around: how to treat these impacts in appraisal and policy analysis; the types of models needed; the likely size and pattern of the impacts. The research crosses the agendas of transport, housing and regional economic development, and is of direct interest to the co-sponsor WYCA and to the wider set of organisations who attended the national Workshop at the conclusion of the scoping study.

Papers: Response to the DfT Consultation on Wider Economic Impact Appraisal

Impact: *The National Workshop on Transport and Land Value Uplift was held at the Institute for Transport Studies on 16 Dec 2016 and generated much interest among delegates from DfT; TfL; TfN; WYCA; TfGM; National Infrastructure Commission; JLL; Leeds City Council; Cushman & Wakefield; Leeds Chamber of Commerce.*

It is intended to take the work forward in a second phase, bringing together the needs and requirements of a wider set of authorities and interested parties, and developing further the methods established in phase one.

Liberalisation of Passenger Rail Services

Grant holder: **Professor Chris Nash**
Co-Investigator: **Professor Andrew Smith**
Funded by: **Centre on Regulation in Europe (CERRE)**
Dates: **July to December 2016**
Collaborative partners: **Professor Yves Crozet (France), Dr Heike Link (Germany), Professor Jan-Eric Nilsson (Sweden)**

Abstract: Where it has occurred, liberalisation of passenger rail services in Europe has largely been successful, bringing with it, improved services, increased traffic and reduced support from public finances. This report offers lessons for markets that are yet to be liberalised. It also points to a number of key questions and difficult issues that policy-makers will have to address. In markets, such as France, which have yet to undergo liberalisation, the report identifies a number of trade-offs to be faced by policy-makers. These include:

- Choosing a path to liberalisation – through competitive tendering for public service contracts, or open access for the operation of commercial services, or some combination of the two;
- Deciding which levels of government should be responsible for competitive tendering: devolving this to regional administrations or maintaining central coordination;
- Determining the optimal size and duration of franchises to maximise economies of scale and density;
- Allocating risk-sharing between private operators and the state;
- Dealing with the political and social implications of potentially transferring large numbers of public-sector staff to private companies.

Papers: The report was presented at an executive seminar held by CERRE in Brussels to an audience from the European Commission, the rail industry and policy makers from Member States on 7/12/2016. The final report is available at www.cerre.eu/publications/liberalisation-passenger-rail-services

Impact: *CERRE Director General, Professor Bruno Liebhaberg, says: "Through its wide geographical scope, its robust analyses and its clear policy recommendations, this new CERRE report highlights the benefits of liberalisation, to both users and taxpayers, in the countries where that process has been completed. As such, it should provide a valuable contribution to the current debate around rail transport reform which is currently going on in many Member States."*

NeTIRail

Grant holder: **Professor Andrew Smith**
Investigators: **Dr James Laird, Dr Phill Wheat, Dr Dan Johnson**
Funded by: **EU**
Dates: **June 2015 – May 2018**
Collaborative partners: **University of Sheffield (co-ordinator), University of Leeds, VTI, UIC, ADS Electronic, AFER, TU Delft, IFSTTAR, TCCD, ALU-FR, Intader, SZ, RCCF**
Website: **http://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.

Network Rail Secondment

Grant holder: **Dr Ronghui Liu**
Funded by: **EPSRC Impact Acceleration Account**
Dates: **May 2015 – March 2016**

Abstract: Network Rail's Digital Railway Division (NR-DRV) was formed in 2015 to tackle the specific demand to move the UK railway system to the standards set out for the European Rail Traffic Management Systems (ERTMS).

Impact: *By playing a significant role in supporting and shaping the development of Network Rail's Digital Railway, Dr Liu's secondment laid 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.*

Steel composition and track degradation

Grant holder: **Professor Andrew Smith**
Investigators: **Professor Richard Batley, Dr James Laird, Dr Phill Wheat**
Funded by: **Engineering and Physical Sciences Research Council (EPSRC)**
Dates: **July 2015 – June 2017**
Collaborative partners: **University of Huddersfield (co-ordinator), University of Cambridge, Cranfield University, Tata Steel, involvement also from Network Rail and RSSB.**

Abstract: To reduce costs of the railway system and improve performance 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. 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 research will help establish the design of steel microstructures that provide a step change in the predictability of steel deterioration rates. 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.

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 – February 2017**
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.

Resilient Transport

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 consider how to improve energy efficiency, reduce greenhouse gas emissions and improve 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: A May and H Khreis (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.*

ClimateXChange

Grant holder: **Professor Jillian Anable**
Investigators: **Dr Craig Morton**
Funded by: **Scottish Government**
Dates: **May 2016 to October 2017**
Website: **www.climatexchange.org.uk/**

Abstract: This project delivers timely evidence and recommendations to the Scottish Government concerning its climate change mitigation policies across two principle areas of investigation. Firstly, by charting and understanding the factors that underpin the adoption of low-carbon technologies such as hybrid and electric vehicles. Second, by considering the motivations of citizens to make use of more sustainable modes of transport. These areas of investigation are pursued through the application of spatial regression modelling and psychological modelling in order to uncover new insights on how to shift Scotland's transport sector onto a sustainable trajectory.

Papers:

1) Morton C; Beeton D (2016) The Constrained Governance of Socio-technical Transitions: Evidence from electric mobility in Scotland, In: Hopkins D; Higham J (Ed) Low Carbon Mobility Transitions, Goodfellow Publishers, pp.190-205.

2) Morton C; Caulfield B; Anable J (2016) Customer perceptions of quality of service in public transport: Evidence for bus transit in Scotland, Case Studies on Transport Policy, 4, pp.199-207. doi: 10.1016/j.cstp.2016.03.002.

Impact: *Research associated with this project has been presented to the Scottish Government at a number of conferences, meetings and workshops. In addition, a series of policy notes have been produced and disseminated*

by the ClimateXChange centre *which summarise the key policy relevant findings of the project.*

Crossmodal

Grant holder: **Dr Jeremy Toner**
Funded by: **Norwegian Research Council**
Dates: **October 2015 – June 2018**
Coordinating partner: **The Institute of Transport Economics, Norway (TØI)**
Collaborating partner: **Mark Wardman (SYSTRA)**

Abstract: Mode shift is at the core of sustainable transport planning in all world cities; yet we know comparatively little about it. The Crossmodal project seeks to improve our understanding of demand effects across different transport modes: How and to what extent policies which change demand for one transport mode (e.g. bus) also affect demand for other modes (e.g. car). Crossmodal develops new and policy-relevant understanding of passengers' mode-switching behaviour through improved theoretical understanding, better methodological approaches and new empirical evidence.

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: **University of Lancaster, University of Reading, University of Aberdeen, University of Birmingham, University College London, University of Southampton, EDF Research, Transport for London**
Website: **www.demand.ac.uk**

Abstract: At ITS we lead the majority of the mobility facing research of the Demand Centre's programme. In 2016 we completed 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). The work is culminating in a national Commission on Travel Demand which is reviewing how travel demand is understood, how it is changing and what the key uncertainties are for demand futures.

Impact: *The Commission on Travel Demand has attracted evidence from the DfT, Committee on Climate Change, Civil Aviation Authority and several core cities as well as from consultant practitioners and academics.*

ecoDriver

Grant holder: **Professor Samantha Jamson**
Investigators: **Professor Oliver Carsten, Dr John Nellthorp, Dr Daryl Hibberd, Dr Astrid Guehnemann (and several others in previous years)**
Funded by: **European Commission**
Dates: **October 2011 – March 2016**
Collaborative partners: **11 European partners (see website for details)**
Website: **www.ecodriver-project.eu**

Abstract: Road transport contributes about one-fifth of total CO2 emissions in the EU. Advances have been made in terms of cleaner vehicles, traffic management, efficiency and intermodality, but the final link is the driver. This project aimed to reduce carbon emissions and fuel consumption by encouraging the adoption of green driving behaviour. This was done by developing and extensively testing a range of driver support systems for cars and commercial vehicles.

Impact: *The results from our trials indicate that there are substantial fuel and energy savings to be obtained when drivers are given precisely tailored advice on green speed and gear, as well as given foresight of how to drive when approaching a particular road or traffic situation. The driver support systems can make a real contribution to reducing the carbon impact of road transport as well as saving fuel costs. The systems also deliver important safety benefits by encouraging drivers to reduce their speed. A number of vehicle manufacturers have incorporated ecoDriver concepts into their vehicles: BMW's ecoAssist incorporates a new HMI dashboard and an automated coasting mode when the driver is not using the accelerator pedal. In CRF's system the HMI solutions are both visual & visual combined with a haptic pedal. Daimler has developed a new ecoDriver app consisting of a map-based driving strategy with a visual & haptic (accelerator pedal) HMI. EcoDriver prototype systems bring energy savings of up to 6%. This project received an 'excellent' rating in its final review.*

Emissions Detecting and Reporting (EDAR)

Grant holder: **Dr Karl Ropkins**
Funded by: **Transport Systems Catapult**
Dates: **October 2016 (EDAR phase 1.2)**
Collaborating partners: **University of Birmingham**

Abstract: EDAR is a new-to-market passive passing-vehicle emission measurement system developed and commercialised by US company Hager Environmental and Atmospheric Technologies (HEAT) who claim that EDAR has superior sensitivity by comparison to other similar technologies. Early findings from independent tests implemented by the US Environmental Protection Agency appear to support this claim. The Universities of Birmingham, Leeds and King's College London undertook a demonstration/evaluation study to provide complementary real-world evidence regarding EDAR performance in the UK. The second phase of that

work, provides an analysis of datasets collected as part of the first round EDAR deployments.

Papers: Early US and UK findings are presented in:

1) Ropkins K, Defries TH, Pope F, Green D, Kemper J, Kishan S, Fuller G, Sidebottom J, Li H, Hager JS. (2017). 'Some Observations based on Complementary International Evaluations of EDAR Vehicle Emissions Remote Sensing Technology.' Conference paper presented at CRC 27th Real-world Emissions Workshop, Long Beach and at the 7th International PEMS Conference and Workshop, Riverside, California.

A more detailed discussion of findings has also been submitted for inclusion in the Science of the Total Environment (STOTEN) Special Issue on In-use Testing post 'Dieselgate'.

Energy-related economic stress in the UK

Grant holder: **Professor Greg Marsden**
Investigators: **Dr Giulio Mattioli, Professor Karen Lucas, Professor Jillian Anable**
Funded by: **Engineering and Physical Sciences Research Council (EPSRC)**
Dates: **November 2014 April 2016**
Website: **https://teresproject.wordpress.com/**

Abstract: The outcome of the project is three sets of indicators of 'car-related economic stress' and vulnerability to motor fuel price increases, based on different data sources (Living Costs and Food Survey, EU Income and Living Conditions Survey, MOT tests data and Accessibility Statistics). Our findings suggest that the affordability of motoring costs is an issue affecting a non-negligible number of households – in the range of 2 million in the UK. The working poor and households on the edge of inclusion are particularly at risk. Households with low incomes and high motoring costs have the most inelastic demand for fuel, which means that they have high exposure, high sensitivity and low adaptive capacity to fuel price increases. Car-related economic stress is also associated with economic precarity and material deprivation in other areas of life, as households may cut on domestic heating or incur debt in order to afford motoring costs. Our spatial analysis shows that London and the South East are relatively resilient to increases in fuel prices, while suburban and peri-urban areas in the North of England are rather vulnerable.

Papers:
1) Mattioli, G., Philips, I., Anable, J., & Chatterton, T. (2017) Developing an index of vulnerability to motor fuel price increases in England, 49th Annual UTSG Conference, 4 January 2017, Dublin.

2) Mattioli, G., Lucas, K., & Marsden (2016) The affordability of household transport costs: quantifying the incidence of car-related economic stress in Great Britain, *48th Annual UTSG Conference*, 6 January 2016, Bristol.

Impact:*The research has been presented to non-academic and policy-making audiences in events organized by the Scottish Government, RAC Foundation and the Department for Transport, receiving very positive feedback. The possibility of further funding for follow-up research is currently being discussed. We published a briefing note targeted at a non-academic public on the project website. A special issue of Transport Policy on the themes of the project will be published in 2017, collecting articles from a range of countries and disciplines.*

Forth Road Bridge Closure

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

Abstract: This project 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 previously developed at ITS were put into action. The research provided insights to Transport Scotland and ScotRail on likely behavioural responses from previously assembled data sets. We also conducted 1,500 surveys of households and users of alternative rail and bus services, and 50 business surveys. A major new report on behavioural responses to disruption was commissioned by the OECD International Transport Forum and a workshop held for Transport Scotland.

Papers: Marsden G, Anable J, Shires J, Docherty I (2016) Travel Behavior Response to Major Transport System Disruptions: Implications for Smarter Resilience Planning, International Transport Forum Report

Impact: *The work influenced both the responses of Transport Scotland during the event and their learning following the event.*

Infrastructures for online shopping: integrating supply and demand

Grant holder: **Professor Greg Marsden**
Investigators: **Dr Anthony Whiteing, Dr Ian Jones**
Funded by: **Research Councils UK, EDF R&D, Transport for London (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 demand. 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.

Motoring and vehicle Ownership Trends (MOT)

Grant holder: **Professor Jillian Anable**
Funded by: **EPSRC**
Dates: **October 2013 to March 2017**
Collaborating partners: **Department for Transport, University of Aberdeen, University of Bristol, University of the West of England.**
Website: **www.motproject.net**

Abstract: Efforts to reduce emissions from car travel have so far been hampered by a lack of specific information on car ownership and use. The MOT project seeks to address this by bringing together new sources of data to give a spatially disaggregated diagnosis of car ownership and use in Great Britain and the associated emissions and energy demands.

Data from annual car roadworthiness tests ('MOT tests' in the UK), made available by the Department for Transport, together with additional details of all vehicles registered from the UK Driver Vehicle Licencing Agency is used as a platform upon which to undertake a set of inter-linked modelling and analysis tasks.

Papers:

1) Chatterton T, Anable J, Cairns S, Wilson E. (2017) Financial Implications of Car Ownership and Use: A Social and Spatial Distributional Analysis. Transport Policy.

2) Chatterton T, Barnes J, Anable J, Yeboah G. (2016) Mapping household direct energy consumption to provide a new perspective on energy justice. *Energy Research and Social Science*, 18:71-87.

Impact: *The project has developed the capability to understand spatial differences in car ownership and use and has the potential to transform the way in which energy and emissions are quantified, understood and monitored. This will help refine future research and policy agendas and inform transport and energy infrastructure planning.*

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. Particular emphasis of these models are to capture how stress levels impacts driving decisions and vice versa.

Papers:

1) Papadimitriou S and Choudhury CF (In press) Transferability of Car-Following Models between Driving Simulator and Field Traffic, Transportation Research Record.

2) Paschalidis E, Choudhury CF and Hess S. (2016) Development of an integrated car-following model combining driving simulator and video trajectory data, hEART- 5th Symposium of the European Association for Research in Transportation, Delft.

OptiTruck

Grant holder: **Dr Haibo Chen**
Investigators: **Dr Yvonne Barnard, Dr Dongyao Jia, Dr Richard Connors, Professor David Watling**
Funded by: **EU Horizon2020**
Dates: **September 2016 to August 2019**
Coordinating partner: **ERTICO**
Collaborating partners: **Ten partners in industry and academia (see website for details)**
Website: **http://optitruck.eu/**

Abstract: The automotive industry has developed powertrain technologies to improve the fuel efficiency of Heavy-Duty Vehicles (HDVs). However, due to increasing road freight, total HDV energy use and CO2 emissions are expected to remain undiminished if no policy action is taken. The goal of optiTruck is to combine the most advanced technologies from powertrain control with intelligent transport systems in order to achieve a 20% global reduction of energy consumption, while achieving Euro VI emission standards, for heavy duty road haulage.

Powering the Powerhouse

Grant holder: **Professor Simon Shepherd**
Investigators: **Dr Zia Wadud**
Funded by: **Impact Acceleration Account and Future Cities Catapult**
Dates: **January 2016-September 2016**
Collaborative partners: **Future Cities Catapult, Leeds Sustainability Research Institute**

Abstract: There is huge potential to link electric vehicles, local energy systems, and personal mobility in the city. By doing so we can improve air quality, tackle climate change, support the green economy and grow new business models. Many studies and 'roadmap' projections do not consider the role of business model innovation as critical to the uptake of electric or alternative fuel vehicles. This research is different, in that it takes seriously the role of business model innovation as an enabler of e-mobility futures.

New e-mobility business models can link three important sectors that have previously operated in isolation from one another; the auto industry, energy systems and transport infrastructure. It is vital that new e-mobility business models are investigated, since recent research shows that current city-level policies are having little effect on stimulating electric vehicle uptake. New e-mobility business models have to work across the boundaries of these three large systems. We call this the 'Innovation Interface', where new products, services and commodities are offered by new partnerships between cities, the energy system, and the auto industry.

This research presents ten business models that work at the Innovation Interface. Some offer more benefits to the energy system, some are most positive for the auto industry, and others link together city transport infrastructures more effectively.

The key outcome of this project was a stakeholder facing report on the opportunities for linking electric vehicles, the energy system, and transport infrastructures in cities. The report was publicised via an article in The Conversation. The article and report were well received on social media and by industry. The promotion of the report has led to invitations from the Auto industry, government, and the energy industry to present the findings of the study in person and seek further collaboration.

Papers:

1) Hall S., Shepherd S., Wadud Z and Jonas A, (in review) Urban Infrastructures as Common Pool Resources. Urban Studies.

2) Hall S, Shepherd S and Z Wadud (2017) The Innovation Interface: Business model innovation for electric vehicle futures. University of Leeds report.

Impact: *The Authors have been invited to present their work at the Energy UK working group on electric vehicles. Energy UK is a consortium of the largest energy utilities and this work aims to inform commercial strategies of this group.*

Programme for Simulation Innovation (PSI)

Grant holder: **Dr Gustav Markkula**
Investigators: **Professor Richard Romano, Dr Hamish Jamson, Tony Horrobin, Dr Andrew Tomlinson, Ehsan Sadraei and Panagiotis Spyridakos**
Funded by: **EPSRC, Jaguar Land Rover (JLR)**
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. In a very rare set of experiments, involving engineers and professional test drivers from a number of different groups within JLR, selected vehicle testing tasks have been re-created in the University of Leeds Driving Simulator, scaled to different levels of fidelity. By modelling and comparing driver behaviour and test outcomes obtained in these simulator trials to corresponding results with physical prototypes, a Simulator Functionality Matrix is being established, quantifying the required simulator characteristics per type of vehicle testing. The targeted testing domains have been selected for large potential of savings in time and cost of vehicle development.

Papers:

1) Sadraei, E., Romano, R., Advani, S., Jamson, A.H., Chappell, P., Markkula, G., Bean, A., and Boer, E.R. (2016), Understanding Cue Utility in Controlled Evasive Driving Manoeuvres: Optimizing Vestibular Cues for Simulator & Human Abilities. IFAC-PapersOnLine 49, pp.414-419.

1) Boer, E.R., Spyridakos, P.D., Markkula G.M., and Merat, N. (2016). Cognitive Driver Distraction Improves Straight Lane Keeping: A Cybernetic Control Theoretic Explanation. IFAC-PapersOnLine 49, pp.627-632.

Impact: *The obtained insights on required driving simulator capabilities are being incorporated in JLR guidelines for simulator use. New methods for rapid tuning of simulator motion feedback, developed at Leeds within the project, are also being adopted by JLR simulator engineers.*

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 – observing drivers in their everyday driving routines and behaviours within a fleet of 200 vehicles (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 are to identify measures that improve road safety and to identify ways for reducing vehicle emissions and fuel consumption. At Leeds we are involved in all stages of the project, including study design, field trials, data analysis and dissemination. With the driving simulator facility we are examining how the choices that drivers make second-by-second are linked to risk including the uptake of in-vehicle secondary tasks.

RESEARCH PUBLICATIONS

Increasingly, our research publications are available via Open Access so that the outcomes of publicly funded research are more widely and freely available.

JOURNAL ARTICLES

Ahmed A, Ngoduy D, Watling D (2016) Prediction of traveller information and route choice based on real-time estimated traffic state, Transportmetrica B, **4** 23-47.

Bache I, **Reardon LH**, Anand P (2016) Wellbeing as a wicked problem: navigating the arguments for the role of government, Journal of Happiness Studies, **17** 893-912.

Balijepalli C, Shepherd S (2016) Cordon tolls and competition between cities with symmetric and asymmetric interactions, Transportation, **43** 797-821.

Barnard Y, Utesch F, van Nes N, Eenink R, Baumann M (2016) The study design of UDRIVE: the naturalistic driving study across Europe for cars, trucks and scooters, European Transport Research Review, **8:14.**

Batley R (2016) Income effects, cost damping and the value of time: theoretical properties embedded within practical travel choice models, Online First, Transportation.

Batley R, Hess S (2016) Testing for regularity and stochastic transitivity using the structural parameter of nested logit, Transportation Research Part B: Methodological, **93** 355-376.

Beck MJ, **Hess S** (2016) Willingness to Accept Longer Commutes for Better Salaries: Understanding the Differences Within and Between Couples, Transportation Research Part A: Policy and Practice, **91** 1-16.

Blainey SP, Armstrong J, **Smith ASJ**, Preston JM (2016) New routes on old railways: increasing rail's mode share within the constraints of the existing railway network, Transportation, **43** 425-442.

Cantarella GE, **Watling DP** (2016) A general stochastic process for day-to-day dynamic traffic assignment: Formulation, asymptotic behaviour, and stability analysis, Transportation Research Part B: Methodological, **92** 3-21.

Cantarella GE, **Watling DP** (2016) Modelling road traffic assignment as a day-to-day dynamic, deterministic process: a unified approach to discrete- and continuous-time models, EURO Journal on Transportation and Logistics, **5** 69-98.

Cartení A, **Pariota L,** Henke I (2016) The effects of High Speed Rail on the touristic attractiveness of the main Italian cities, Ingegneria Ferroviaria, **71** 229-245.

Chatterton TJ, **Anable J,** Barnes J, Yeboah G (2016) Mapping household direct energy consumption in the United Kingdom to provide a new perspective on energy justice, Energy Research and Social Science, **18** 71-87.

Chen J, **Liu R, Ngoduy D**, Shi Z (2016) A new multi-anticipative car-following model with consideration of the desired following distance, Nonlinear Dynamics, **85** 2705-2717.

Choudhury CF, Islam MM (2016) Modelling acceleration decisions in traffic streams with weak lane discipline: A latent leader approach, Transportation Research Part C: Emerging Technologies, **67** 214-226.

Connors RD (2016) The Price of Anarchy in Urban Traffic Networks, Mathematics Today, **52** 234-237.

Curl A, **Lucas K** (2016) The transport geography research group at the 2015 RGS-IBG conference, Journal of Transport Geography, 51 227-228.

Daly A, Dekker T, Hess S (2016) Dummy coding vs effects coding for categorical variables: Clarifications and extensions, Journal of Choice Modelling, **21** 36-41.

De Jong GC, Kouwenhoven M, Ruijs K, Van Houwe P, Borremans D (2016) A time-period choice model for road freight transport in Flanders based on stated preference data, Transportation Research Part E: Logistics and Transportation Review, **86** 20-3.

De Jong GC, Tavasszy L, Bates J, Gronland SE, Huber S, Kleven O, Lange P, Ottemoller O, Schmorak N (2016) The issues in modelling freight transport at the national level, Case Studies on Transport Policy, **4** 13-21.

Dekker T (2016) Asymmetric triangular mixing densities for mixed logit models, Journal of Choice Modelling, **21** 48-55.

Dekker T, Hess S, Brouwer R, Hofkes M (2016) Decision uncertainty in multi-attribute stated preference studies, Resource and Energy Economics, **43** 57-73.

Dent CM, Bale CSE, **Wadud Z**, Voss H (2016) Cities, energy and climate change mitigation: An introduction, Cities, **54** 1-3.

Edwards HA, Dixon-Hardy D, **Wadud Z** (2016) Aircraft cost index and the future of carbon emissions from air travel, Applied Energy, **164** 553-562.

Elias D, Nadler F, Cornwell I, **Grant-Muller S,** Heinrich T (2016) UNIETD Assessment of Third Party Data as Information Source for Drivers and Road Operators, Transportation Research Procedia, **14** 2035-2043.

Gillies-Smith A, Wheat P (2016) Do network industries plan to eliminate inefficiencies in response to regulatory pressure? The case of railways in Great Britain, Utilities Policy, **43** 165-173.

Gühnemann A, Koh A, Shepherd S (2016) Optimal Charging Strategies under Conflicting Objectives for the Protection of Sensitive Areas: A Case Study of the Trans-Pennine Corridor, Networks and Spatial Economics, **16** 199-226.

Guo X, Wu J, Sun H, **Liu R,** Gao Z (2016) Timetable coordination of first trains in urban railway network: A case

study of Beijing, Applied Mathematical Modelling, **40** 8048-8066.

Hamersma M, **Heinen E,** Tillema T, Arts J (2016) Residents' responses to proposed highway projects: Exploring the role of governmental information provision, Transport Policy, **49** 56-67.

Hazelton M, **Watling D** (2016, Guest Editors). Editorial, Special Issue: Day-to-day dynamic traffic assignment models, EURO Journal on Transportation and Logistics, **5** 1-3.

Heinen E (2016) Identity and travel behaviour: A cross-sectional study on commute mode choice and intention to change, Transportation Research Part F: Traffic Psychology and Behaviour, **43** 238-253.

Heinen E, Ogilvie D (2016) Variability in baseline travel behaviour as a predictor of changes in commuting by active travel, car and public transport: A natural experimental study, Journal of Transport and Health, **3** 77-85.

Herbert N, Thyer N, Isherwood S, **Merat N** (2016) The effect of a simulated hearing loss on performance of an auditory memory task in driving, Transportation Research Part F: Traffic Psychology and Behaviour, **43** 122-130.

Herbert N, Thyer N, Isherwood S, **Merat N** (2016) The Effect of Auditory Distraction on the Useful Field of View in Hearing Impaired Individuals and its implications for driving, Cognition, Technology and Work, 18 393-402.

Hess S (2016) Editorial: Special issue on standalone technical contributions to choice modelling, Journal of Choice Modelling, **21**.

Hidayati N, **Liu R, Montgomery F** (2016) The development of a prediction model of the Passenger Car Euivalent values at different locations, ARPN Journal of Engineering and Applied Sciences, **11** 3764-3770.

Ibraimovic T**, Hess S** (2016) Changes in the ethnic composition of neighbourhoods: Analysis of household's response and asymmetric preference structures, Papers in Regional Science.

Jamson S, Mrozek M (2016) Is three the magic number? The role of ergonomic principles in cross country comprehension of road traffic signs, Ergonomics, 1-8.

Jephcote C**, Chen H, Ropkins K** (2016) Implementation of the Polluter-Pays Principle (PPP) in local transport policy, Journal of Transport Geography, **55** 58-71.

Jia D, Lu K, **Wang J,** Zhang X, Shen X (2016) A survey on platoon-based vehicular cyber-physical systems, IEEE Communications Surveys and Tutorials, **18** 263-284.

Jia D, Ngoduy D (2016) Enhanced cooperative car-following traffic model with the combination of V2V and V2I communication, Transportation Research Part B: Methodological, **90** 172-191.

Jia D, Ngoduy D (2016) Platoon based cooperative driving model with consideration of realistic inter-vehicle communication, Transportation Research Part C: Emerging Technologies, **68** 245-264.

Jones T, Harms L, **Heinen E** (2016) Motives, perceptions and experiences of electric bicycle owners and implications for health, wellbeing and mobility, Journal of Transport Geography, **53** 41-49.

Kelly C, Hulme C, Farragher T, Clarke G (2016) Are differences in travel time or distance to healthcare for adults in global north countries associated with an impact on health outcomes? A systematic review, BMJ Open, **6**.

Khreis H, Kelly C, Tate J, Parslow R, **Lucas K,** Nieuwenhuijsen M (2016) Exposure to traffic-related air pollution and risk of development of childhood asthma: A systematic review and meta-analysis., Environment International.

Khreis H, Warsow KM, **Verlinghieri E, Guzman A,** Pellecuer L**, Ferreira A, Jones I, Heinen E,** Rojas-Rueda D, Mueller N, Schepers P, **Lucas K,** Nieuwenhuijsen M (2016) The health impacts of traffic-related exposures in urban areas: Understanding real effects, underlying driving forces and co-producing future directions, Journal of Transport and Health, **3** 249-267.

Kolosz B, **Grant-Muller S** (2016) Sustainability assessment approaches for intelligent transport systems: The state of the art, IET Intelligent Transport Systems, **10** 287-297.

Kountouriotis GK, Merat N (2016) Leading to Distraction: Driver distraction, lead car, and road environment, Accident Analysis and Prevention, 89 22-30.

Kountouriotis GK, Mole CD, **Merat N**, Wilkie RM (2016) The need for speed: Global optic flow speed influences steering, Royal Society Open Science, **3**.

Kountouriotis GK, Spyridakos P, Carsten OMJ, Merat N (2016) Identifying cognitive distraction using steering wheel reversal rates, Accident Analysis and Prevention, **96** 39-45.

Lamport DJ, Lawton CL, **Merat N, Jamson H,** Myrissa K, Hofman D, Chadwick HK, Quadt F, Wightman JD, Dye L (2016) Concord grape juice, cognitive function, and driving performance: A 12-wk, placebo-controlled, randomized crossover trial in mothers of preteen children, American Journal of Clinical Nutrition, **103** 775-783.

Leahy C, Batley R, Chen H (2016) Toward an automated methodology for the valuation of reliability, Journal of Intelligent Transportation Systems: Technology, Planning, and Operations, **20** 334-344.

Leong W, Goh K, **Hess S**, Murphy P (2016) Improving bus service reliability: The Singapore experience, Research in Transportation Economics, **59**, 40-49.

Liang XH, Tan KH, **Whiteing A, Nash C, Johnson D** (2016) Parcels and mail by high speed rail-A comparative analysis of Germany, France and China,

Journal of Rail Transport Planning and Management, **6** 77-88.

Link H, **Nash C,** Ricci A, **Shires J** (2016) A generalized approach for measuring the marginal social costs of road transport in Europe, International Journal of Sustainable Transportation, **10** 105-119.

Liu B, Wu L, **Jia D,** Nie L, Ye L**, Wang J** (2016) Data uplink strategy in mobile cloud service based vehicular ad hoc network, Jisuanji Yanjiu yu Fazhan/ Computer Research and Development, 53 811-823.

Lo HK**, Watling DP,** Cantarella GE (2016, Guest Editors) Editorial, Special Issue: Day-to-day dynamics in transportation networks, Transportation Research Part B: Methodological, **92** 1-2.

Louw T, Madigan R, Carsten O, Merat N (2016) Were they in the loop during automated driving? Links between visual attention and crash potential, Injury Prevention.

Lovelace R (2016) BOOK REVIEW David Boyce and Huw Williams Forecasting urban travel: Past, present and future, Environment and Planning B: Planning and Design, **44**.

Lovelace R (2016) Mapping out the future of cycling, Get Britain Cycling, 5 22-24.

Lovelace R (2016) The Data Revolution: Big Data, Open Data, Data Infrastructures and Their Consequences, Journal of Regional Science, **56** 722-723.

Lovelace R, Birkin M, Cross P, Clarke M (2016) From Big Noise to Big Data: Toward the Verification of Large Data sets for Understanding Regional Retail Flows, Geographical Analysis, **48** 59-81.

Lovelace R, Goodman A, Aldred R, Berkoff N, Abbas A, Woodcock J (2016) The Propensity to Cycle Tool: An open source online system for sustainable transport planning, Journal of Transport and Land Use, **10** 505-528.

Lovelace R, Roberts H, Kellar I (2016) Who, where, when: the demographic and geographic distribution of bicycle crashes in West Yorkshire, Transportation Research Part F: Traffic Psychology and Behaviour, **41** 277-293.

Lu H, **Hess S**, **Daly A**, Rohr C (2016) Measuring the impact of alcohol multi-buy promotions on consumers' purchase behaviour, Journal of Choice Modelling.

Lu Y, Stafford T, **Fox C** (2016) Maximum saliency bias in binocular fusion, Connection Science, **28** 258-269.

Lucas K, Bates J, Moore J, Carrasco JA (2016) Modelling the relationship between travel behaviours and social disadvantage, Transportation Research Part A: Policy and Practice, **85** 157-173.

Lucas K, Hamilton J, Mayne R (2016) Building capacity through action research: reflections on working with low-carbon communities in the UK, Local Environment, 1-21.

Lucas K, Mattioli G, Verlinghieri E, Guzman A (2016) Transport poverty and its adverse social consequences, Proceedings of the Institution of Civil Engineers: Transport, **169** 353-365.

Lucas K, Porter G (2016) Mobilities and livelihoods in urban development contexts: Introduction, Journal of Transport Geography, **55** 129-131.

Lucas K, van Wee B, Maat K (2016) A method to evaluate equitable accessibility: combining ethical theories and accessibility-based approaches, Transportation, **43** 473-490.

Madigan R, Golightly D, Madders R (2016) Application of Human Factors Analysis and Classification System (HFACS) to UK rail safety of the line incidents, Accident Analysis and Prevention, **97** 122-131.

Maia ML, **Lucas K,** Marinho G, Santos E, de Lima JH (2016) Access to the Brazilian City—From the perspectives of low-income residents in Recife, Journal of Transport Geography, **55** 32-141.

Markkula G, Engström J, Lodin J, Bärgman J, Victor T (2016) A farewell to brake reaction times? Kinematics-dependent brake response in naturalistic rear-end emergencies, Accident Analysis and Prevention, **95** 209-226.

Marsden G, Groer S (2016) Do institutional structures matter? A comparative analysis of urban carbon management policies in the UK and Germany, Journal of Transport Geography, **51** 170-179.

Mattioli G (2016) Transport needs in a climate-constrained world. A novel framework to reconcile social and environmental sustainability in transport, Energy Research and Social Science, **18** 118-128.

Mattioli G, Anable J, Vrotsou K (2016) Car dependent practices: Findings from a sequence pattern mining study of UK time use data, Transportation Research Part A: Policy and Practice, **89** 56-72.

Morton C, Anable J, Nelson JD (2016) Assessing the importance of car meanings and attitudes in consumer evaluations of electric vehicles, Energy Efficiency, **9** 495-509.

Morton C, Anable J, Nelson JD (2016) Exploring consumer preferences towards electric vehicles: The influence of consumer innovativeness, Research in Transportation Business and Management, **18** *18*-28.

Morton C, Caulfield B, **Anable J** (2016) Customer perceptions of quality of service in public transport: Evidence for bus transit in Scotland, Case Studies on Transport Policy, **4** 199-207.

Mullen C, Marsden G (2016) Mobility justice in low carbon energy transitions, Energy Research & Social Science, **18** 109-117.

Naimanye AG, Whiteing T (2016) Poverty-centred rural road funds

sharing in sub-Saharan Africa, Proceedings of the Institution of Civil Engineers: Transport, **169** 387-396.

Nantes A, **Ngoduy D,** Bhaskar A, Miska M, Chung E (2016) Real-time traffic state estimation in urban corridors from heterogeneous data, Transportation Research Part C: Emerging Technologies, **66** 99-118.

Ngoduy D, Hoang NH, Vu HL, **Watling D** (2016) Optimal queue placement in dynamic system optimum solutions for single origin-destination traffic networks, Transportation Research Part B: Methodological, **92** 148-169.

Ngoduy D, Jia D (2016) Multi anticipative bidirectional macroscopic traffic model considering cooperative driving strategy, Transportmetrica B, **5** 1-15.

Nugroho MT, Whiteing A, de Jong G (2016) Port and inland mode choice from the exporters' and forwarders' perspectives: Case study Java, Indonesia, Research in Transportation Business and Management, **19** 73-82.

Odolinski K, Smith ASJ (2016) 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, **50** 93-112.

O'Hare SJ, **Connors RD, Watling DP** (2016) Mechanisms that govern how the Price of Anarchy varies with travel demand, Transportation Research Part B: Methodological, **84** 55-80.

Ojeda Cabral M, Batley R, Hess S (2016) The value of travel time: random utility versus random valuation, Transportmetrica A: Transport Science, **12** 230-248.

Ojeda Cabral M, Chorus C (2016) Value of travel time changes: theory and simulation to understand the connection between random valuation and random utility methods, Transport Policy, **48** 139-145.

Ojeda-Cabral M, Hess S, Batley R (2016) Understanding valuation of travel time changes: are preferences different under different stated choice design settings? Transportation, 1-21.

Panter J, **Heinen E,** Mackett R, Ogilvie D (2016) Impact of New Transport Infrastructure on Walking, Cycling, and Physical Activity., American Journal of Preventive Medicine, **50** 45-53.

Pariota L, Bifulco GN, Brackstone M (2016) A linear dynamic model for driving behavior in car following, Transportation Science, **50** 1032-1042.

Pariota L, Bifulco GN, Galante F, Montella A, Brackstone M (2016) Longitudinal control behaviour: Analysis and modelling based on experimental surveys in Italy and the UK, Accident Analysis and Prevention, **89** 74-87.

Pariota L, Galante F, Bifulco GN (2016) Heterogeneity of driving behaviors in different car-following conditions, Periodica Polytechnica Transportation Engineering, **44** 105-114.

Parkes SD, Jopson A, Marsden G (2016) Understanding travel behaviour change during mega-events: Lessons from the London 2012 Games, Transportation Research Part A: Policy and Practice, **92** 104-119.

Parry K, **Watling DP,** Hazelton M (2016) A New Class of Doubly Stochastic Day-to-Day Dynamic Traffic Assignment Models, EURO Journal of Transportation and Logistics, **5**, pp.5-23.

Pedersen LB, **Hess S,** Kjær T (2016) Asymmetric information and user orientation in general practice: Exploring the agency relationship in a best–worst scaling study, Journal of Health Economics, **50** 115-130.

Perederieieva O, Ehrgott M, Raith A, **Wang JYT** (2016) Numerical Stability of Path-based Algorithms For Traffic Assignment, Optimization Methods and Software, **31** 53-67.

Prins RG, Panter J, **Heinen E**, Griffin SJ, Ogilvie DB (2016) Causal pathways linking environmental change with health behaviour change: Natural experimental study of new transport infrastructure and cycling to work, Preventive Medicine, **87** 175-182.

Rahman S, **Balijepalli C** (2016) Understanding the determinants of demand for public transport: Evidence from suburban rail operations in five divisions of Indian Railways, Transport Policy, **48** 13-22.

Sayegh A, Tate JE, Ropkins K (2016) Understanding how roadside concentrations of NOx are influenced by the background levels, traffic density, and meteorological conditions using Boosted Regression Trees, Atmospheric Environment, **127** 163-175.

Scheiner J, Chatterjee K, **Heinen E** (2016) Key events and multimodality: A life course approach, Transportation Research Part A: Policy and Practice, **91** 148-165.

Schmöcker J-D, Sun W, Fonzone A, **Liu R** (2016) Bus bunching along a corridor served by two lines, Transportation Research Part B: Methodological, **93** 300-317.

Simcock N, **Mullen C** (2016) Energy demand for everyday mobility and domestic life: Exploring the justice implications, Energy Research and Social Science, **18** 1-6.

Smith MJ, **Watling DP** (2016) A route-swapping dynamical system and Lyapunov function for stochastic user equilibrium, Transportation Research Part B: Methodological, **85** 132-141.

Tomlin AS, Ziehn T, Goodman P, **Tate JE**, **Dixon NS** (2016) The treatment of uncertainties in reactive pollution dispersion models at urban scales, Faraday Discussions, **189** 567-587.

Uttley J, **Lovelace R** (2016) Cycling promotion schemes and long-term behavioural change: A case study from the University of Sheffield, Case Studies on Transport Policy, **4** 133-142.

Veeneman W, **Smith A** (2016) Workshop 2 report: Effective institutional design, regulatory frameworks and contract strategies, Research in Transportation Economics, **59** 60-64.

Vuk G, Bowman JL, **Daly A, Hess S** (2016) Impact of family in-home quality time on person travel demand, Transportation, **43** 705-724.

Wadud Z (2016) Diesel demand in the road freight sector in the UK: Estimates for different vehicle types, Applied Energy, **165** 849-857.

Wadud Z, Huda FY (2016) Fire Safety in the Readymade Garment Sector in Bangladesh: Structural Inadequacy Versus Management Deficiency, Fire Technology, 1-22.

Wadud Z, MacKenzie D, Leiby P (2016) Help or hindrance? The travel, energy and carbon impacts of highly automated vehicles, Transportation Research Part A: Policy and Practice, **86** 1-18.

Wardman M, Chintakayala VPK, De Jong GC (2016) Values of travel time in Europe: Review and meta-analysis, Transportation Research Part A: Policy and Practice, **94** 93-111.

Wardman M, Lyons G (2016) The digital revolution and worthwhile use of travel time: implications for appraisal and forecasting, Transportation, **43** 507-530.

Westin J, Vierth I, **De Jong GC**, Karlsson R, Kruger N, Johansson M (2016) Analyzing model uncertainty and economies of scale of the Swedish national freight model to changes in transport demand, European Journal of Transport and Infrastructure Research, **16** 619-632.

Wilson T, **Lovelace R**, Evans AJ (2016) A Path Toward the Use of Trail Users' Tweets to Assess Effectiveness of the Environmental Stewardship Scheme: An Exploratory Analysis of the Pennine Way National Trail, Applied Spatial Analysis and Policy, 1-29.

Wu W, **Liu R,** Jin W (2016) Designing robust schedule coordination scheme for transit networks with safety control margins, Transportation Research Part B: Methodological, **93** 495-519.

Xiao F, Yang H, **Ye H** (2016) Physics of day-to-day network flow dynamics, Transportation Research Part B: Methodological, **86** 86-103.

Xu M, **Grant-Muller S** (2016) Trip mode and travel pattern impacts of a Tradable Credits Scheme: A case study of Beijing, Transport Policy, **47** 72-83.

Xu M, **Grant-Muller S** (2016) VMT reduction and potential environmental effects with a tradable credits scheme: a simulation case study of Great Britain, International Journal of Sustainable Development and World Ecology, **23** 514-525.

Xu M, Lam WHK, Gao Z, **Grant-Muller S** (2016) An activity-based approach for optimisation of land use and transportation network development, Transportmetrica B, **4** 111-134.

Xu M, Wang G, **Grant-Muller S**, Gao Z (2016) Joint road toll pricing and capacity development in discrete transport network design problem, Transportation, 1-22.

Ye H, Liu R (2016) A multiphase optimal control method for multi-train control and scheduling on railway lines, Transportation Research Part B: Methodological, **93** 377-393.

Zhao F, Sun H, Wu J, Gao Z, **Liu R** (2016) Analysis of road network pattern considering population distribution and central business district, PLoS ONE, **11**.

Zhao F, Wu J, Sun H, Gao Z, **Liu R** (2016) Population-driven Urban Road Evolution Dynamic Model, Networks and Spatial Economics, **16** 997-1018.

Zhong RX, Fu KY, Sumalee A, **Ngoduy D**, Lam WHK (2016) A cross-entropy method and probabilistic sensitivity analysis framework for calibrating microscopic traffic models, Transportation Research Part C: Emerging Technologies, **63** 147-169.

CONFERENCE PAPERS

Barnard Y, Innamaa S, Koskinen S, Gellerman H, Svanberg E, **Chen H** (2016) Methodology for Field Operational Tests of Automated Vehicles, Transport Research Arena TRA2016 In: Transportation Research Procedia, Vol 14.

Barnard YF, Gellerman H, Koskinen S, **Chen H**, Brizzolara **D** (2016) Anonymization of Data from Field Operational Tests, 11th ITS European Congress.

Boer ER, Spyridakos PD, Markkula GM, Merat N (2016) Cognitive Driver Distraction Improves Straight Lane Keeping: A Cybernetic Control Theoretic Explanation, 13th IFAC Symposium on Analysis, Design, and Evaluation ofHuman-Machine Systems HMS 2016.

Elmahroug MH, Tutesigensi A, Smith NJ (2016) A problem solving approach to identifying civil engineering infrastructure projects, Proceedings 32nd Annual ARCOM Conference.

Gellerman H, Svanberg E, **Barnard Y** (2016) Data Sharing of Transport Research Data, Transport Research Arena TRA2016 In: Transportation Research Procedia, Vol 14.

Liu R (2016) Simulation model of speed control for the moving-block systems under ERTMS Level 3, 2016 IEEE International Conference on Intelligent Rail Transportation (ICIRT).

Liu Y, **Fox C**, Hasan M, Hain T (2016) The Sheffield Wargame Corpus day two and day three, Interspeech 2016.

Madigan R, Louw T, Dziennus M, Graindorge T, Ortega E, Graindorge M, **Merat N** (2016) Acceptance of Automated Road Transport Systems (ARTS): An Adaptation of the UTAUT Model, Transport Research Arena

TRA2016 In: Transportation Research Procedia, Vol 14.

Mattioli G, Lucas K, Marsden G (2016) The affordability of household transport costs: quantifying the incidence of car-related economic stress in Great Britain, 48th Annual Universities' Transport Study Group.

Morganti E (2016) Electric vehicles for urban food transport: the case of fruit and vegetables deliveries in Paris, XXVth World Road Congress.

Pariota L, Pastore SR, Timpone F (2016) Modelling components for the fuel consumption investigation in Model in the Loop environment: Parameter tuning for an ecological fully-adaptive cruise control system, EEEIC 2016.

Pierre M, **Morganti E,** Boutueil V (2016) Will fleet managers really help vehicle fleets to become electric?, Demand (Dynamics of Energy, Mobility and Demand).

Rivas Amiassorho E, **Wheat PE, Smith A** (2016) Regional Benchmarking of the British Rail Infrastructure Manager: A Long Panel Approach, International Transportation Economics Association (ITEA).

Romano RA, Park GA, Paul V, Allen RW (2016) Motion Cueing Evaluation of Off-Road Heavy Vehicle Handling, SAE 2016 Commercial Vehicle Engineering Congress.

Sadraei E, Romano R, Advani S**, Jamson AH,** Chappell P**, Markkula G,** Bean A**, Boer ER** (2016) Understanding Cue Utility in Controlled Evasive Driving Manoeuvres: Optimizing Vestibular Cues for Simulator & Human Abilities 13th IFAC Symposium on Analysis, Design, and Evaluation of Human-Machine Systems HMS.

Siulagi A, Antin JF, Molnar LJ, Bai S, Reynolds S, **Carsten O,** Greene-Roesel R (2016) Vulnerable Road Users: How Can Automated Vehicle Systems Help to Keep Them Safe and Mobile? Road Vehicle Automation 3, 277-286.

Wells S, **Pangbourne K** (2016) Using Argumentation within Sustainable Transport Communication, 1st European Conference on Argumentation.

BOOKS AND BOOK CHAPTERS

Bache I, **Reardon L** (2016) The Politics and Policy of Wellbeing: Understanding the Rise and Significance of a New Agenda, Edward Elgar.

Bache I, **Reardon LH** (2016) The 'wicked problem' of wellbeing: theorising the prospects for policy change, In: **Tachibanaki** T ed. Advances in Happiness Research: A Comparative Perspective, In: Creative Economy, Springer, pp.23-38.

Gillespie C, Lovelace R (2016) Efficient R Programming: A Practical Guide to Smarter Programming, O'Reilly Media,

Hodgson FC (2016) Structures of Disadvantage and Acts of Resistance: Remembering, Skilling, History and Gender, In: Divall C, Hine J, Pooley C eds. Transport Policy Learning Lessons from History, Transport and Society, Lund Humphries Publishers.

Lovelace R, Dumont M (2016) Spatial Microsimulation with R, CRC Press.

Morton CL, Beeton D (2016) The Constrained Governance of Socio-technical Transitions: Evidence from electric mobility in Scotland, In: Low Carbon Mobility Transitions, Oxford, Goodfellow Publishers, pp.190-205.

Smith ASJ, Buckell J, **Wheat P,** Longo R (2016) Hierarchical Performance and Unobservable Heterogeneity in Health: A Dual-Level Efficiency Approach Applied to NHS Pathology in England, In: Greene WH, Khalaf L, Sickles R, Veall M, Voia MC eds. Productivity and Efficiency Analysis, In: Springer Proceedings in Business and Economics, Switzerland, Springer International Publishing, pp.119-143.

Vaghi C, **Wheat PE,** Osterle I, Milottia A, **Nellthorp J** (2016) The Role of Human Factors in Rail Freight Innovation, In: Blanquart C, Clausen U, Bernard J eds.Towards Innovative Freight and Logistics, Wiley, pp.245-258.

REPORTS

Carsten O, Campsall D, Christie N, Tunbridge R (2016) Fit to Drive? Parliamentary Advisory Council for Transport Safety.

Lucas K, Philips I, Nellthorp J, Reardon L, Laird J, Verlinghieri E (2016) Social Assessment of Section 3 of the A465 Heads of the Valleys Road: Brynmawr to Tredegar for Welsh Government.

Marsden G, Anable J, Shires J, Docherty I (2016) Travel Behavior Response to Major Transport System Disruptions: Implications for Smarter Resilience Planning, International Transport Forum.

Mullen CA (2016) Freedom of movement and fairness: Transforming transport planning for social and environmental justice: thinkpiece for Friends of the Earth Big Ideas project.

Nash CA (2016) Liberalisation of passenger rail services. CERRE project report.

Hall S, **Shepherd S and Z Wadud** (2016) Business model innovation for electric vehicle futures. Innovation Interface.

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