

# ITS RESEARCH REPORT 2018

## DEEP ACADEMIC ALLIANCE WITH THE TRANSPORT SYSTEMS CATAPULT



The Transport Systems Catapult (TSC) and the University of Leeds have signed a 'Deep Academic Alliance'

agreement. Dr Erik Thomasson (pictured) our Business Development Manager has been made a Business Fellow of the TSC. This initiative – aligned with the opening of the University's Nexus centre for innovation and enterprise in 2019, will help us to further accelerate innovation and deepen the impact of our research.



Ronghui Liu has something to smile about as she celebrates her promotion to Chair of Networks and Transport Operations. Here Professor Liu is flanked by colleagues at the Beijing Metro during a field trial of their project 'Energy-efficient Automatic Train Operation'.



A driverless pod was showcased at ITS during the Leeds Digital Festival. The pod was used in a 5G testbed at Leeds in collaboration with AQL, LCC, Westfield Motors, citiPark, and others.



Is Leeds ready for driverless vehicles? Woodhouse Street and Leeds University's iconic Parkinson tower.

## Highlights of 2018

On many fronts academics and researchers at the Institute for Transport Studies have been actively meeting today's challenges in transportation.

**Professor Greg Marsden's** 5-year DEMAND centre funded by Research Councils UK has produced the Commission on Travel Demand Report. It contains a series of thought provoking presentations: [www.demand.ac.uk/events/event/commission-on-travel-report-launch](http://www.demand.ac.uk/events/event/commission-on-travel-report-launch). In addition the Centre has produced a Dictionary of DEMAND Phrase and Fable which is highly engaging.

**Dr Zia Wadud's** paper '[Help or hindrance? The travel, energy and carbon impacts of highly automated vehicles](#)' was an instant hit becoming the most downloaded article of the journal Transportation Research Part A (TRA). It received media attention from 20 countries, including prestigious outlets such as The Times, Boston Globe, Popular Science, Discovery, World Economic Forum and others. The article remains among the top 3 most downloaded and has the highest altmetric of any paper published in the history of TRA. Dr Wadud's paper has received professional and government attention internationally. Dr Wadud said his 'work went against the 'hype' that

driverless vehicles will reduce energy use and carbon emissions, and warned about their unintended consequences'.

The prize-winning publication by **Kate Palmer, Dr James Tate, Dr Zia Wadud and Dr John Nellthorp** in [Applied Energy, Jan 2018](#) shows that battery electric vehicles are now cheaper to own than combustion engine cars. The research was widely covered by the media internationally including a feature in The Guardian, adding further evidence and impetus to encourage more consumers to buy electric vehicles. With over 25,000 downloads the article maintained its position among the top 3 most downloaded articles of the Applied Energy journal.

In celebration of women in science, **Professor Ronghui Liu** was elected to represent women in the International Advisory Committee (IAC) for the International Symposium on Transportation and Traffic Theory. Professor Liu was one of the first women elected to the IAC. The appointment has also strengthened the UK presence in the IAC as Ronghui is one of just two IAC members representing the UK. Professor Liu was also appointed as an International Evaluator to the University of Tokyo to review their research programs and advise on research directions for their Centre for Spatial Information Sciences.

**Professor Jillian Anable** joined the steering group for the Government's new Electric Vehicle Energy Taskforce as part of the 'Road to Zero' strategy to tackle energy sector opportunities and impacts associated with the rise of electric vehicles. Jillian is the only academic member of the Taskforce in recognition of her important research on transport and energy demand. Professor Anable is leading the Transport and Mobility theme at the new UK Centre for Research on Energy Demand Solutions (UK-CREDS) and has taken on programme leader and co-director role within the Research Councils UK (RCUK) Energy Research Centre (pages 22-23).

**Professor Natasha Merat** is leading the Leeds team of the 'Human Drive' project that will culminate in the most complex journey yet attempted across the UK in a driverless car (page 13). Professor Merat gave her first keynote speech to the Driving Simulation Conference in Antibes providing a talk on "Human-in-the-Loop Simulation for Human Factors Challenges and Opportunities of Automated Vehicles". Professor Merat contributed to the London Assembly report '[Future Transport: How is London responding to technological innovation](#)', which argues that London has been "caught unaware" by the influx of new transport technology. The advent of driverless cars could therefore be delayed until the 2030s at the earliest.

**Professor Simon Shepherd** has joined the debate on driverless cars by producing mathematical models that estimate the most likely scenarios for the adoption of autonomous vehicles. The introduction of driverless cars to Leeds could potentially cause a 50 per cent increase in overall car travel by 2050, an increase in the average distance that people travel and a significant drop in the use of public transport and active travel. The findings were presented at the World Conference on Transport Research Society (WCTRS) in Beijing. Co-author **Emeritus Professor Anthony May** said "We have a limited time in which to respond to these new technologies, and governments need to be thinking now about the regulatory framework as well as promoting the technology."

**Dr Phill Wheat** was appointed as Advisor to the Department for Transport (DfT) on Airport Demand Econometrics to advise on how the DfT can re-estimate their demand models using new data and incorporating new methods.

**Professor Andrew Smith** was appointed as academic advisor on econometric benchmarking to energy regulator Ofgem, to provide advice on developing econometric cost models for the next price review. Andrew carried out a similar role for water regulator Ofwat; feeding into the final determination of water bills to be announced in 2019. In his role on the Advisory Board of the Italian Transport Regulation Authority, Professor Smith contributed to a report on the application of benchmarking tools in rail and regulated sectors. The report was presented at a seminar in Turin: “The art of ART: measuring efficiency for growth, development, and better quality in transport”.

**Professor Andrew Smith** and **Dr Phill Wheat** have been appointed to a Scientific Advisory Committee for SNCF Reseau to advise and evaluate SNCF's econometric analysis to establish track access charges for the French railway network.

**Bryan Matthews** was appointed to the Disabled Persons Transport Advisory Committee. The committee has a statutory role to advise the Minister of Transport and the DfT on transport issues for disabled people.

With the recent acceleration of emerging technologies such as Internet of Things, Cloud Computing and Big Data, transport systems (roads, vehicles, people and services) have become more connected than ever. The aim of **Dr Haibo Chen's** EU H2020 funded projects is to enhance understanding of the impact of connected, cooperative and automated transport on mobility for both people and goods. AUTOPILOT, ELVITEN, OptiTruck and other projects under the Connected Mobility theme are described on page 19.

Led by **Professor Rich Romano**, installation of a new pedestrian laboratory (Highly Immersive Kinematic Experimental Research - HIKER) is



NICE says roads should be “safe, attractive and designed” to help people use their cars less.

nearing completion (page 15).

Led by **Professor Oliver Carsten** the ITS work on [Intelligent Speed Assistance \(ISA\)](#) is coming to fruition. As part of its Third Mobility Package, the European Commission is proposing the compulsory fitment of a range of crash-prevention systems on all new vehicles; this is predicted to save 25,000 lives across the EU member states in the period 2022-2037.

### New roads should prioritise cyclists and pedestrians

As reported in the BMJ, the National Institute for Health and Care Excellence (NICE) has recommended that local authorities should prioritise cyclists, pedestrians, and public transport when building or upgrading new roads in order to encourage greater levels of physical activity. Research at ITS underpinning this aim includes the **XCYCLE** project led by Professor Oliver Carsten (page 14) and the **Propensity to Cycle Tool (PCT)** led by Dr Robin Lovelace (page 17). The city of Bologna has introduced an incentive scheme for active travel ([watch the video](#) – this was part of the **EMPOWER** project (described fully on page 28).

### Awards, Fellowships and Prizes

**Dr Chiara Calastri** won the Eric Pas award at the International Association for Travel Behaviour Research (IATBR) for

the best PhD dissertation in the field of travel behaviour research. Chiara won this highly competitive award for her thesis “Capturing and modelling complex decision-making in the context of travel, time-use and social interactions” supervised by Professor Stephane Hess and Dr Charisma Choudhury.

IATBR also gave an honourable mention to another former ITS student, **Dr Fiona Crawford**, for her thesis “Methods for analysing emerging data sources to understand variability in traveller behaviour on the road network” supervised by Professor David Watling and Dr Richard Connors.

**Dr Charisma Choudhury** and Professor Susan Grant-Muller were awarded prestigious [Alan Turing Fellowships](#), which are designed to support researchers with proven excellence in data science and artificial intelligence, to collaborate with other Turing Fellows.

**Dr Eva Heinen** received a Certificate of Appreciation from the Transportation Research Board (TRB) “in recognition for excellent work organizing and conducting the paper review process for the TRB Bicycle Transportation Committee”.

**Dr Kate Pangbourne** was awarded a place on the [Aurora Leadership Programme](#) run by AdvanceHE whose aim is to develop the leadership potential



Last mile food delivery by robot – part of Dr Morganti's UAF research.

of professional and academic women in the higher education sector.

PhD student, **Kate Palmer** (supervised by Dr James Tate, Dr John Nellthorp and Dr Zia Wadud) was awarded a 2018 Piers Sellers Prize at the University of Leeds for exceptional PhD research. Her publication in *Applied Energy* shows that battery electric vehicles are now cheaper to own than combustion engine cars.

**Dr Eleonora Morganti** was awarded a University Academic Fellowship (UAF) and will work with the University of Leeds School of Food Science and Nutrition. Her research into food distribution and related topics has gained momentum internationally.

**Dr Ian Philips** has an Economic and Social Research Council (ESRC) fellowship. His research, "Accelerating innovation in new mobility services: matching sustainable new business models to local potential" was awarded under the National Productivity Innovation Fund - a research funding stream connected to the UK Industrial Strategy. Work done previously by Dr Philips for his PhD has led to funding for Sustrans from the Scottish Government to construct a capability to walk and cycle microsimulation model.

**Dr Tyron Louw** won an International Research Mobility Scheme award to visit the National Advanced Institute for Science and Technology (AIST) in

Tsukuba, Japan where he gave presentations on the research on Human Factors and Automation, conducted at the University of Leeds Driving Simulator, and explored potential future collaborations.

**Dr Gustav Markkula** was awarded a prestigious Engineering and Physical Sciences Research Council (EPSRC) fellowship to research safe coexistence of humans and self-driving vehicles. Attending his first ever TRB meeting in January, Gustav received the best paper award for his work on modelling of road user behaviour, granted by the TRB simulation and measurement of operator performance committee. Gustav's work on modelling various aspects of driver and road user behaviour continued successfully in 2018, and his results show, for example, why people maintain the lane better when thinking about something other than driving.

## International Research Visitors

Our visitors included: **Professor Tatsuru Daimon** from Keio University, Japan hosted by Dr Gustav Markkula and Professor Natasha Merat; **Dr Ricardo Daziano** from Cornell University, USA hosted by Dr Thijs Dekker; **Dr Annesha Enam** from Bangladesh University of Engineering and Technology hosted by Dr Charisma Choudhury and Professor Stephane Hess; **Professor Zhongyin Guo**

from Tongji University, China and **Professor Marjan Hagenzieker** from TU Delft, Netherlands hosted by Professor Natasha Merat; **Professor Shinya Hanaoka** from Tokyo Institute of Technology, Japan hosted by Professor Simon Shepherd; **Dr Erlend Dancke Sandorf** from the Swedish University of Agricultural Sciences, Umeå, Sweden hosted by Dr Romain Crastes dit Sourd; **Jiping Xing** from Southeast University, China hosted by Professor Ronghui Liu and Dr Charisma Choudhury; **Dr Song Yeonjung** from Osaka University, Japan hosted by Professor Andrew Smith.

Visiting postgraduate researchers included: **Paolo Bragolusi** from the University of Padua, Italy hosted by Professor Stephane Hess; **Giulia Pulvirenti** from the Università degli Studi di Catania, Sicily hosted by Professor Richard Romano and Professor Natasha Merat; **Ignacio Tiznado Aitken** from the Universidad Catholica in Chile hosted by Professor Karen Lucas; **Silvia Varotto** and **Pablo Nuñez Velasco** from TU Delft, Netherlands and **Shuwei Zhang** from Tongji University, China hosted by Professor Natasha Merat.

ITS hosted visits from three high-level **delegations from China**: (i) SWJT led by its Party Chief and the Dean of the Joint SWJT-UoL School; (ii) Government officials from Zhejiang Province; and (iii) BJTU Key-State Laboratory in Railway Control. These meetings drew attention to the research and teaching ITS has to offer, particularly in railway research.

## Alumni

An exciting initiative resulted in the successful launch of the ITS industry mentoring scheme for Masters students. The programme links students with a mentor who has volunteered their time to assist in developing career ideas, confidence and employer awareness. Mentors are often ITS alumni who are working in the transport profession. During the pilot scheme in 2018 alumni provided support and guidance for more than 30 students.

We were delighted to welcome back alumna **Emma Roberts** as guest speaker at our induction week networking event in October. Through our seminar series

we hosted nine alumni speakers who presented their various industry experiences through a range of sector topics.

## Alumni prize winners

**Agachai Sumalee**, Social Impact Winner at the British Council Alumni Awards.

The award acknowledges those who have made an exceptional contribution to creating positive social change.

**Yazan Madi** was awarded Best Project Manager by Dubai's Roads and Transport Authority (RTA), UAE.

**Samira Marx Pinheiro** was awarded the Voorhees-Large Prize for her Masters dissertation in Transport Economics.

**Steven O'Hare** won the Runner Up prize for New Master of Modelling.

## Employer visits

Our alumni are true ambassadors for [ITS employer visits](#) which we host twice a year for those interested in recruiting ITS graduates. Employers from the transport sector 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 meet ITS graduates. International students from over 30 countries, make up two-thirds of our full-time cohort. Employers offering international job opportunities would be greatly welcomed. We also invite employers to upload job advertisements directly onto our [LinkedIn](#) page.

## Staff Changes

In 2018 we celebrated the promotion of **Dr Charisma Choudhury** to Associate Professor, and **Professor Ronghui Liu** (pictured) to Chair of Networks and Transport Operations.

## New staff and leavers

We welcomed **Dr Morgan Campbell**, **Dr Kaushali Dave**, **Jorge Garcia de Pedro**, **Dr Foroogh Hajiseyedjavadi**, **Dr Yue Huang**, **Dr Like Jiang**, **Dr Chris Leahy**, **Dr Yee Mun Lee**, **Tamara Muroiwa**, **Dr Evangelos Paschalidis**, **Dr Guillhermina Antas-Torrao**, **Dr Jim Uttley** and **Dr Chongfeng Wei**.

We said farewell to **Dr Magda Cepeda-Zorrilla**, **Dr Daryl Hibberd**, **Dr Dongyao Jia**, **Dr Ruth Madigan**, **Dr Giulio Mattioli**, **Dr Hongbo Ye**, **Dr Fangni Zhang**, **Hrvoje Jukic** and **Rosie Samuel**.



Professor Ronghui Liu, flanked by colleagues Fan Liu and Dr Jun Xun at the Beijing Metro field trial of their project 'Energy-efficient Automatic Train Operation' (page 25).

## Postgraduate Research Students

During 2018 we had 74 PhDs studying at ITS. We welcome the active participation in our research culture of: Khaled Abdullah, Samuel Adjei-Appiah, Ilyas Alhassan, Mahmoud Al-Khazaleh, Zihao An, Peter Atkinson, Jeroen Bastiaanssen, Jawaher Binsuwadan, Martyna Bogacz, Jake Bruce, Davide Bruscoli, Julian Burkinshaw, Andrew Bwambale, Fanta Camara, Mauro Capurso, Juan Castellanos-Vanegas, David Chikwendu, Rafael Cirino-Goncalves, Christopher Cook, Anna Correa-Pereira, Edmond Daramy-Williams, Louise de-Tremerie, Patrick Dichabeng, Stephen Dixon, Joel Dodsworth, Rafael Dos-Reis, Lawrence Duncan, Umoh Edemeka, Anthony Ezenwa, Cristhian Figueroa-Martinez, Thiago Guimaraes-Rodrigues, Thomas Hancock, Md Bashirul Haque, Probo Hardini, Thalia Hernandez-Amezcuca, Rashed Ishmael, Rizal Kamaruddin, Naphat Ketphat, Alexandros Kontotasios, Edward Lambert, Gengze Li, Qiyang Liu, Henry Lo, Davide Maggi, Tahera Mayat, Ioanna Moscholidou, Tamas Nadudvari, Haruko Nakao, Taufiq Nugroho, Lamprini Papafoti, Evangelos Paschalidis, Mickael Perrier, David Pierce, Vishnu Radhakrishnan, Teekanya Rujinarong, Ehsan Sadraei, David Simpson, Fangqing Song, Daosadeth Soysouvanh, Panagiotis Spyridakos, Sidi Sun, Tianli Tang, Yvonne Taylor, Jack Thompson, Lap

Kwan Tjiong, Panagiotis Tsozeridis, Nur Ubaidillah, Chinebuli Uzundu, Ying Wang, David Wyatt, Zhuoqian Yang, Weiyei Yao, Jingyan Yu and Weiming Zhao.

In addition, ITS staff co-supervised eight students based in other University of Leeds schools: Sakarias Bank (Psychology), Gyeonghwa Lee (Design), Kate Palmer (DTC Low Carbon Technologies), Nura Kabuga, Charlotte Stead and Daisy Thomas (Engineering), Eusebio Odiari and Eugeni Vidal-Tortosa (Geography).

## PhD Awards

Thirteen of our students were awarded postgraduate research degrees in 2018. Congratulations to **Izza Anwer** 'The effective use of ITS and other advanced communication technologies in reducing the transport impacts of disaster'; **Julian Burkinshaw** 'Commuting and the role of flexible working practices'; **Andrew Bwambale** 'Developing travel behaviour models using mobile phone data'; **Magda Cepeda-Zorrilla** 'Road users' perceptions and attitudes as a barrier against cycling in cities: a comparative analysis'; **Joel Dodsworth** 'The application of vehicle classification, vehicle-to-infrastructure communication and a car-following model to single intersection traffic signal control'; **Anderson Etika** 'Developing an effective speed limit compliance-intervention for



Dr Yao Yao and Dr Tatjana Zimasa celebrate the award of their PhD flanked by Prof Oliver Carsten and Prof Samantha Jamson.

Nigerian drivers: A study of drivers who work in a fleet company with strong safety culture'; **Andrew Gillies-Smith** 'Optimising Britain's railways – economic perspectives'; **Alvaro Guzman-Jamarillo** 'Understanding the role of power during the planning of BRT systems'; **Sheriff Idriss-Yahya** 'Incorporating social justice into transport futures: Development of a new futures method for strategic transport planning in Sub Saharan Africa'; **Aswin Siregar** 'How can speed enforcement be made more effective?'; **Daosadeth Soysouvanh** 'Freight transport in least developed landlocked countries: A case study of Laos PDR'; **Yao Yao** 'Appropriate speed: impact on road safety and emission' and **Tatjana Zimasa** 'The influence of mood and cognitive load on driver performance: Using multiple measured to assess safety'.

## RESEARCH PROJECTS

We deliver internationally excellent research, which impacts upon transport policy and practice, and contributes to the wider economy and society. We work collaboratively with colleagues across the globe using skills ranging across engineering; mathematical, spatial and dynamic modelling; economics; political science; social science and psychology.

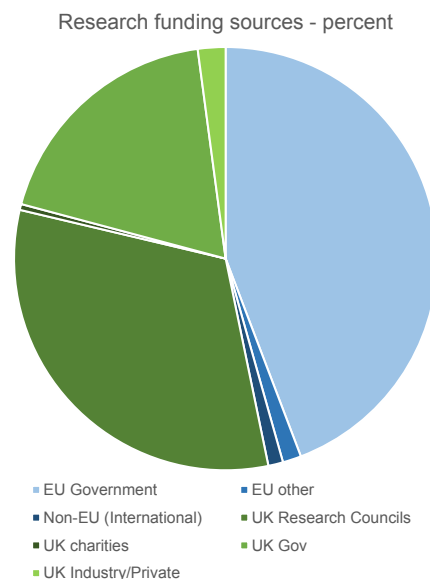
The quality of our research delivery is accredited by ISO9001:2015. The professionalism and ethics of our services lead to a high degree of customer satisfaction.



## THEMES

Research projects have overlapping areas of interest but are grouped in the following pages under the broad transport-related themes of:

- Air Quality & Health
- Appraisal & Economics
- Automation
- Big Data
- Choice Modelling
- Connected Mobility
- Energy
- Global South
- Rail Research
- Social & Political Science



Our research funding is won in almost equal measure from UK and EU.

## AIR QUALITY & HEALTH

### ADAPT

Grant holder: **Dr Kate Pangbourne**  
 Investigators: **Samuel Bennett, Dr Alexander Baker**  
 Funded by: **EPSRC**  
 Dates: **June 2016 to May 2021**  
 Collaborative partners: **See website**  
 Website: [adapt.leeds.ac.uk](http://adapt.leeds.ac.uk)

**Abstract:** ADAPT is funded by the 'Living with Environmental Change Challenge' Fellowship programme. The over-arching vision is to develop more effective methods of influencing people to choose sustainable travel modes. A dataset of travel behaviour-change communications has been created and now has nearly 300 examples, mostly from UK sources. These have been tagged with useful metadata and have argument diagrams completed in AML format. Work is ongoing to add new diagrams in a json compatible format. We used this dataset to derive messages for our first stated preference experiments styled as online surveys. The surveys focus on arguments and framings for persuasive messages for walking or cycling. The statistical analysis is complete. The preliminary results were presented at five conferences (UTSG 2018, Cycling and

Society 2018, ISSA, RGS Annual Conference 2018, Walk21 Bogotá). A Laidlaw Scholarship student summer intern (Susan Preston) undertook ethnographic work on trains and buses to help us understand more about the uses of travel time. We explored persuasive arguments that highlight time-use during journeys. In 2019 we will supplement the initial research with focus groups on the same topic and trial the behavioural impacts of targeted messaging. Follow us on Twitter: [@ADAPT\\_travel](#)

**Publications:** Wells S and Baker A. 2018. Lying in Real World Argumentative Dialogue Systems. *International Society for the Study of Argumentation, Amsterdam*

Bennett S, Pangbourne K and Baker A. 2018. Persuasive messages to encourage walking: how effective are environmental arguments? *Poster presented at Walk21 Conference, Bogotá, Colombia.*

Pangbourne K. 2018. Mobility and ageing: a review of interactions between transport and technology from the perspective of older people. In: Curl A and Musselwhite C (eds), *Geographies of Transport and Ageing*. Palgrave-Macmillan, Basingstoke UK.

Pangbourne K, Stead D, Mladenović M and Milakis D. 2018. The case of Mobility as a Service: a critical reflection on challenges for urban transport and mobility. In: Marsden G and Reardon R (eds.) *Governance of the Smart Mobility Transition*. Emerald Publishing, Bingley, UK.

**Impact:** Dr Pangbourne has been appointed to Transport Scotland's National Transport Strategy Framework Working Group, the Advisory Board of the H2020 MoTiV project and is Chair of the SMARTeX Transport Card Forum Working Group on Young People. Kate spoke on implementing low emission zones policies to the Rural Economy and Connectivity Committee event at the Scottish Parliament ([video link to stakeholder event for Transport Bill](#)). Kate also spoke on policies to support air quality and health co-benefits from low emission zones and active travel policies at an information event hosted



Typical Junction in a South-East Asian City. Dr Chandra Balijepalli is investigating the impact of electric motorcycles in Indonesia. Video courtesy of Frank Montgomery <https://youtu.be/1514a7YDwxE>

by David Stewart MSP, attended by MSPs, their researchers and representatives from NGOs and companies.

## 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)**  
 Collaborative 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 aim of the Crossmodal project was 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).

**Papers:** Wardman M, Toner J, Fearnley N, Flügel S, Killi M. 2018. Review and meta-analysis of inter-modal cross-elasticity evidence. *Transportation Research Part A: Policy and Practice*. 118, pp. 662-681

Fearnley N, Currie G, Flügel S, Gregersen FA, Killi M, Toner J, Wardman M. 2018. Competition and substitution between public transport modes. *Research in Transportation Economics*. 69, pp. 51-58

Flügel S, Fearnley N, Toner J. 2018. What factors affect cross-modal substitution? – evidences from the Oslo area. *International Journal of Transport Development and Integration*. 2(1), pp. 11-29

**Impact:** We developed new, policy-relevant understanding of passengers' mode-switching behaviour through improved theoretical and methodological approaches and new empirical evidence.

## Uptake of E-Motorcycles in Indonesia

Grant holder: **Dr Chandra Balijepalli**  
 Investigator: **Professor Simon Shepherd**  
 Funded by: **Royal Academy of Engineering**  
 Dates: **March 2018 to January 2020**  
 Coordinating partner: **Institute of Technology Bandung, Indonesia**  
 Collaborative partners: **Center of Excellence, Automotive Control & System, Institute of Teknologi, Sepuluh Nopember Surabaya and Department of Transport Bandung City.**

**Abstract:** Motorcycle is a dominant mode of transport in Indonesia. Nearly three-quarters of vehicles are motorcycles in cities such as Jakarta, Bandung, and Surabaya. The road networks are highly congested with average speeds dropping below 10kph during peak hours and emissions from two-stroke engines are a real problem in terms of air quality.



SUITCEYES. Haptic conversation through Tactile Sign Language. Courtesy of LightHouse for the Blind and Visually Impaired, [lighthouse-sf.org](http://lighthouse-sf.org)

Despite major policy initiatives for alternative modes of transport such as Bus Rapid Transit and Mass Rapid Transit in Jakarta, motorcycles continue to grow in numbers due to the ease of purchase and lack of license checks. If motorcycles were electric powered the pollution problem could be reduced. The objective of this research is to develop a system dynamic model of the uptake of e-motorcycles in Bandung. The project will investigate the impact of subsidies, battery range and availability of charging points on the reduction of CO<sub>2</sub> and other emissions. We will adapt the system dynamic model developed for UK passenger cars, and a simpler model of Taiwan which looked at e-motorcycles, to the Indonesian context by calibrating the diffusion model to the uptake of e-motorcycles. The adaptation will consider similar experiences as revealed in Kunming, China where a panel of surveys was conducted over six years through a series of interviews. In order to build the local context, we will conduct sample-based interviews in Bandung to understand local preferences. A novelty of this work will be to link the outcomes of system dynamic model with a SATURN traffic simulation model of Bandung to reveal the impact on both emissions and congestion. This combined modelling approach will facilitate testing of policy sensitivity to various scenarios involving subsidies, availability of charging points and battery range.

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## GamECAR

Grant holder: **Professor Samantha Jamson**

Funded by: **EU H2020**

Collaborating partners: **University of Patras, Brainstorm Multimedia, CTAG, Spark Works, IFSTTAR, Kite**

Co-ordinating partner: **University of Patras**

Dates: **Jan 2017 to Dec 2018**

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

**Abstract:** Road transport is one of the major causes of environmental pollution. In addition, road traffic injuries are a serious public health problem in the European Region, with huge social and financially adverse effects. A leading cause for both issues is aggressive driving. Driver's style makes a difference in terms of fuel consumption - up to 35% between calm and aggressive driving. Individuals can contribute in the reduction of CO<sub>2</sub> emission associated to personal transportation by operating their vehicles more efficiently. To make this change more effective, GamECAR has put in place an innovative strategy built on Gamification. The GamECAR system unobtrusively senses physiological, behavioural, environment and vehicle data that compose a novel eco-driving index and provides the driver with personalized and proactive hints on how to adjust their current driving style. The setting of a multiplayer gaming

environment will give the driver the opportunity to set missions and invite other drivers to participate collaboratively or competitively. Evaluation of the developed technologies has been performed via small scale test campaigns at pilot sites in UK, Spain and France.

**Paper:** Dimitris B, Tselios C, Nousias S, Orfila O, Jamson S, Mejuto P, Amaxilatis D, Akrivopoulos O, Chatzigiannakis I, Lalos AS and K Moustakas. 2018. Managing non-uniformities and uncertainties in vehicle-oriented sensor data over next generation networks. *Presented at IEEE International Conference on Pervasive Computing and Communications.*

**Impact:** The use of innovative visualization techniques, such as Augmented Reality, will allow monitoring of the ecodriving score evolution and the production, for drivers, of a personalized plan for improvement of their driving efficiency.

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## SUITCEYES (Smart, User-friendly, Interactive, Tactual, Cognition-Enhancer, Yielding Extended Sensosphere)

Grant holder: **University of Borås, Sweden**

Co-Investigator: **Bryan Matthews**

Funded by: **EU H2020**

Dates: **January 2018 to December 2020**

Website: [suitceyes.eu](http://suitceyes.eu)

**Abstract:** There are an estimated 2.5M deafblind persons in the EU. Limited communication and mobility are major problems for this group. SUITCEYES proposes a new, intelligent, flexible and expandable mode of haptic communication via soft interfaces. Based on user needs and informed by disability studies, the project combines smart textiles, sensors, semantic technologies, image processing, face and object recognition, machine learning, and gamification. Perception of the environment is one of the challenges this project will address. This, among other wider benefits, will help to enhance a deafblind person's ability to travel safely in their



community. SUITCEYES continues Bryan Matthew's research in haptic devices for the visually impaired from his WHISPER project (described on page 5 ITS Annual Research Report 2015).

## Mapping Accessible Transport for Persons with Reduced Mobility

Grant holder: **Bryan Matthews**

Investigators: **Dr Like Jiang**

Funded by: **EU DG-MOVE**

Dates: **August 2018 to June 2019**

Coordinating partner: **Panteia (NL)**

Collaborative partners: **TIS (PT) and AARMIS (PT)**

**Abstract:** Specifically for persons of reduced mobility, this project aims to develop technical solutions and recommendations to provide travel information through digital means. There is a growing awareness (and accompanying political and commercial will) to provide information services that cater for disabled and older people, but there is much confusion as to how and what to include. This study will, therefore, increase the understanding of what is required by persons of reduced mobility, to learn from existing practices, and to propose and test a potential solution. In pursuing these objectives, the consortium will take into account the transport and information access requirements of a wide range of characteristics, including but not limited to mobility difficulties, visual or hearing impairment, and cognitive or learning disabilities. The research continues work that looked at travel information services for disabled people carried out at ITS under the auspices of the COMPASS project in 2013.



Mapping Accessibility, research by Bryan Matthews towards understanding what is required for persons with reduced mobility.

## APPRAISAL & ECONOMICS

### Programme Appraisal

Grant holder: **Professor Richard Batley**

Investigator: **Dr Richard Connors**

Funded by: **DfT**

Dates: **November 2017 to March 2018**

Coordinating partner: **ARUP**

Collaborative partners: **Peter Mackie, James Laird**

**Abstract:** This project proposed a methodology to properly account for synergies in transport investment appraisal. The underlying problem is that the value for money of implementing schemes A & B together may be greater (if complementary) or less (if competitive) than the value for money of A plus B when each scheme is considered in isolation. Whether schemes complement or compete with each other can depend on network conditions, leading to potentially huge numbers of transport model runs needed for scheme appraisal. To alleviate this computational burden, incremental, decremental and pair-wise analyses are shown to be effective. The result is an efficient systematic 6-step procedure for investment appraisal.

**Paper:** Submitted to 15th annual Scottish Transport Applications and Research (STAR) Conference

**Impact:** The project delivered its findings to DfT who are considering the proposed methodology for adoption into their guidance for appraisal.

### Land Value and Transport – Modelling and Appraisal

Grant holder: **Dr John Nellthorp**

Investigators: **Dr Manuel Ojeda-Cabral, Dan Johnson, Dr Chris Leahy, Dr Like Jiang**

Funded by: **West Yorkshire Combined Authority (WYCA), TfL and an EPSRC Impact Acceleration Account**

Dates: **January 2018 to August 2019**

**Abstract:** This project is contributing new spatial econometric models focusing on the relationship between rail accessibility and property values and exploring the potential for land value change (or uplift). These models take advantage of increasingly available data, and address various limitations of previous models in this field. The aim was to provide authorities at national & regional level with quantitative evidence which will help inform Business Cases for rail improvement, and the Business Case for Northern Powerhouse Rail (NPR) is one specific application. The model results for NPR were delivered to Transport for the North in November.



Installation in progress - the pedestrian simulator at the University of Leeds.

The concept for the research was developed through an earlier scoping study which identified significant gaps in the understanding of property value changes due to transport infrastructure investment. The models therefore include:

- A new theoretical framework;
- A more complete and detailed representation of accessibility to economic opportunities, as a driver of property values – by multiple modes including rail, walk and car;
- Recognition of a wide range of environmental factors.

**Outputs:** The models as a set include both cross-sectional, sectional and time series models, and address the residential and commercial property markets (the latter using smaller sample sizes; the residential dataset is in excess of 160,000 observations). The outputs include quantification and mapping of various scenarios, and economic appraisal/business case analysis using the results. Formal reports to the Advisory Panel and to sponsors have been delivered at milestones during the project. The Advisory Panel includes DfT, the National Infrastructure Commission, leading academics and others.

**Impact:** The North of England served as the location for the study area – a much wider area than is typically included in hedonic property price studies of transport

investment. The modelling results reveal the sensitivity of property values to changes in the region's rail network.

### CQC Efficiency Network

Grant holder: **Dr Phill Wheat**

Investigators: **Dr Alex Stead**

Funded by: **Local Authorities**

Dates: **April 2015 to March 2019**

Coordinating partner: **measure2improve**

Website: [www.nhtnetwork.org](http://www.nhtnetwork.org)

**Abstract:** The CQC Efficiency Network measures efficiency, evaluates the likely impact of changes to practice and process, and provides a stimulus to realizing efficiency savings. The University of Leeds provides state of the art benchmarking analysis for the Network.

**Papers:** Wheat P, Stead AD, Greene WH. in press. Robust Stochastic Frontier Analysis: A Student's t-Half Normal Model with Application to Highway Maintenance Costs in England. *Journal of Productivity Analysis*.

Stead AD, Wheat P, Greene WH. 2018. Estimating efficiency in the presence of extreme outliers: A logistic-half normal stochastic frontier model with application to highway maintenance costs in England. In: Greene WH, Khalaf L, Makdissi P, Sickles RC, Veall MR and Voia M-C (eds.) *Productivity and Inequality*. Springer Proceedings in Business and Economics.

### Impacts:

- This project was awarded an EPSRC Impact Acceleration Account which supports knowledge exchange and the delivery of impact from the outputs of on-going or completed EPSRC funded research. It is designed to support engagement with external non-academic partners which could include national and international businesses, public and third sector organisations, or community bodies.
- [Evidence to Transport Select Committee](#)
- CQC is referenced in the DfT's Incentive Fund Self-Assessment Process and contributes to the case for local authorities receiving enhanced incentive funding
- Collaboration is continuing for a further three years.

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### Ofwat

Grant holders: **Professor Andrew Smith and Dr Thijs Dekker**

Funded by: **The Water Services Regulation Authority (Ofwat)**

Dates: **January 2017 and ongoing**

**Abstract:** In preparation for its next price review (PR-19 as an update to PR-14), and in order to improve the efficiency of the regulated water industry, Ofwat is analyzing the driving factors of various cost components, including retail costs. We advised on the estimation and interpretation of the cost-efficiency models that form the basis for Ofwat's price review.

**Impact:** through influencing Ofwat's modelling, our work will directly impact on water bills in England and Wales for the next 5 years (to be announced in 2019).

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### DfT Robust Values of Travel Time Savings

Grant holder: **Dr Thijs Dekker**

Investigators: **Professor Richard Batley, Professor Gerard de Jong**

Funded by: **Highways England and DfT**

Dates: **Sept 2017 to Feb 2018**

Coordinating partner: **ARUP**

Collaborative partners: **Mark Wardman (SYSTRA), James Laird, Andrew Daly and Peter Mackie.**

**Abstract:** The objective of scoping study was for the DfT to develop a strategy to ensure robust updates to the National Values of Travel Time Savings (VTTS). (These were updated by the ARUP-ITS consortium in 2014/15). The phase 1 report outlined options available to the DfT for ensuring that VTTS, an important component of the DfT's appraisal and modelling framework, remain robust into the future. The phase 2 report presented specific recommendations around which options may be desirable according to varying criteria such as cost, feasibility and robustness of the resulting values.

**Outputs:** [values-of-travel-time-savings-scoping-study](#)

## Smart Measures

Grant holder: **Dr Thijs Dekker**  
 Investigators: **Dr Caroline Mullen, Dr Giulio Mattioli, Bryan Matthews, Dr Eleonora Morganti, Dr John Nellthorpe**  
 Funded by: **DfT**  
 Dates: **May 2017 to April 2018**  
 Coordinating partner: **TSC**

**Abstract:** The objective was to explore and identify how mid-sized cities use data and technology to monitor, evaluate and improve effectiveness of transport measures in relation to health, mode shift or reliability.  
 Impact: We have used city case studies and examples of smart cities' transport-related measures (e.g. cleaner buses, Clean Air Zones) to evaluate how these contribute to improving health and provide economic benefits.

## Participatory Budgets

Grant holder: **Dr Thijs Dekker**  
 Funded by: **Transport Authority Amsterdam and the Dutch Ministry of Infrastructure and Water Management**  
 Dates: **July to October 2018**  
 Coordinating partner: **Dr Niek Mouter, Delft University of Technology (TU Delft)**  
 Collaborative partners: **Dr Paul Koster (VU University Amsterdam) Dr Niek Mouter (TU Delft)**  
 Website: [www.participatie-begroting.nl](http://www.participatie-begroting.nl)

**Abstract:** Participatory Budgets introduced an alternative policy appraisal framework to the traditional



Automation research at ITS is preparing the way for a 'driverless' future.

Cost-Benefit analysis. Instead of eliciting willingness-to-pay and willingness-to-accept estimates from decisions over private budgets, this project directly elicited preferences over the optimal public budget spending in terms of public projects and tax reductions. A series of promising experiments were conducted in the context of transport projects (Transport Authority) and flood risk protection (Dutch Ministry of I&W).  
 Impact: The delivered reports are currently being evaluated to decide on their inputs in the actual policy making decision.

## ITF Capital Bias

Grant holder: **Professor Andrew Smith**  
 Investigators: **Dr Phill Wheat, Dr Jean-Christophe Thiebaud, Alex Stead**  
 Funded by: **International Transport Forum (ITF) and SNCF Réseau**  
 Dates: **Sept 2017 to March 2018**

**Abstract:** The background to the project derives from discussions held as part of the ITF working group on private investment in transport infrastructure. A key issue in economic regulation (at least in theory) is the problem of capital bias. Totex benchmarking is seen as a potential solution at least to the latter problem. The overall objective of the research was to answer the following question: can benchmarking work in transport? If benchmarking can work then the regulated model can be seen

as a good alternative to Public-Private Partnerships (which in many respects are seen to have been unsuccessful in transport in general).

**Papers:** The output of the research was a position paper setting out the issues and challenges in benchmarking, focusing on rail, roads and the utilities.

## AUTOMATION

### L3PILOT

Grant holder: **Professor Natasha Merat**  
 Investigators: **Dr Tyron Louw, Dr Daryl Hibberd, Dr Mina Torrao, Dr Jim Uttley**  
 Funded by: **EU H2020**  
 Dates: **Sept 2017 to August 2021**  
 Coordinating partner: **VW**  
 Collaborative partners: **See website**  
 Website: [l3pilot.eu/index.php?id=26](http://l3pilot.eu/index.php?id=26)

**Abstract:** Automated driving technology has matured to a level motivating a final phase of road tests which can answer key questions before market introduction of the systems. L3Pilot tests the viability of automated driving as a safe and efficient means of transportation on public roads. It will focus on large-scale piloting of SAE Level 3 functions, with additional assessment of some Level 4 functions.



Driverless car detecting people and vehicles at road intersection.

The functionality of the systems will be exposed to variable conditions with 1,000 drivers and 100 cars across ten European countries, including cross-border routes. The technologies being tested cover a wide range of driving situations, including parking, overtaking on highways and driving through urban intersections. The tests will provide data for evaluating technical aspects, user acceptance, driving and travel behaviour, as well as impact on traffic and safety.

**Impact:** With the comprehensive piloting of automated driving functions in test vehicles, L3Pilot will pave the way for large-scale field tests of series cars on public roads.

## InterACT

Grant holder: **Professor Natasha Merat**  
 Investigators: **Professor Rich Romano, Dr Gustav Markkula, Dr Oscar Giles, Dr Yee Mun Lee, Dr Ruth Madigan, Dr Jim Uttley, Michael Daly**  
 Funded by: **EU H2020**  
 Dates: **May 2017 to April 2020**  
 Coordinating partner: **DLR German Aerospace**  
 Website: [www.interact-roadautomation.eu](http://www.interact-roadautomation.eu)

**Abstract:** interACT will enable the safe integration of Automated Vehicles (AVs) into mixed traffic environments by designing, implementing, and evaluating solutions for safe, cooperative, and expectation-

conforming interactions between the AV and both its on-board driver and other traffic participants.

In more detail the project will:

- Study human interactions and develop psychological models of interaction between different road users that help with the design and selection of appropriate and safe interaction strategies for AVs.
- Improve methods for assessing the intentions, and predicting the behaviour of other traffic participants.
- Develop a novel Cooperation and Communication Planning Unit to enable the integrated planning and control of AV's behaviour, and the provision of time-synchronised Human Machine Interfaces for both the user on-board and surrounding road users.
- Develop a safety layer and provide fail-safe trajectory planning using formal verification methods to ensure safety in mixed traffic environments and reduce certification costs.
- Develop novel human-vehicle interaction designs and Human Machine Interface (HMI) elements to assist the interaction of the on-board user, the AV, and other road users, thus ensuring expectation-conforming behaviour by the AV.
- Establish new evaluation methods for studying the interactions of road users with AVs, and user acceptance of these vehicles.

- Project has also prompted a new collaboration between ITS and a group from Keio University in Japan.

**Papers:** Camara F, Giles O, Madigan R, Rothmüller M, Rasmussen PH, Vendelbo-Larsen SA, Markkula G, Lee YM, Garach-Morcillo L, Merat N and Fox C. 2018. Filtration analysis of pedestrian-vehicle interactions for autonomous vehicle control. *Proceedings of the 15th International Conference on Autonomous Systems*.

Fox CW, Camara F, Markkula G, Romano RA, Madigan R and Merat N. 2018. *When Should the Chicken Cross the Road? - Game Theory for Autonomous Vehicle - Human Interactions*. *Proceedings of the 4th International Conference on Vehicle Technology and Intelligent Transport Systems SciTePress 1*, pp. 431-439.

Markkula GM, Romano R, Madigan R, Fox CW, Giles OT and Merat N. 2018. *Models of Human Decision Making as Tools for Estimating and Optimizing Impacts of Vehicle Automation TRB Annual Meeting – best paper award*

## TRANSITION

Grant holder: **Professor Richard Wilkie, (University of Leeds, School of Psychology)**  
 Investigators: **Professor Natasha Merat, Professor Rich Romano, Dr Gustav Markkula, Dr Oscar Giles**  
 Funded by: **EPSRC**  
 Dates: **September 2017 to August 2020**  
 Coordinating partner: **University of Leeds**  
 Collaborative partners: **Volvo Cars**

**Abstract:** Driver error is a major contributor to many road accidents: there were 194,477 reported road casualties in the UK in 2014 (with an estimated valuation of £16.3 billion; DfT Reported Road Casualties Great Britain: 2014, Annual Report), and the most commonly recorded factor was the “driver/rider failed to look properly”, with four of the five most frequently reported contributory factors involving “driver error or reaction”. In this context the increased use of Automated Vehicles (AVs) that can control the vehicle and monitor and respond to road conditions without regular driver input has the potential to dramatically

reduce road death. A major concern, however, is that many AVs require human supervision, and despite our lack of understanding how human drivers interact with AVs there are already AV systems that are available for purchase and are being used on the roads (e.g. Tesla). In order to safely implement AV systems we need to understand the capabilities and limitations of drivers re-engaging steering control from AV systems under a variety of conditions.

Project TRANSITION will use sophisticated laboratory-based measures (including advanced vehicle simulators) to examine drivers re-engaging with the vehicle after a period of AV control. We will determine the capability of drivers regaining steering control under conditions that simulate various types of visual and cognitive load (e.g. driving at night, and/or when looking away at a satellite navigation system). These findings will be used to identify situations where drivers are particularly vulnerable to making steering errors and to develop the TRANSITION model of AV-Human transitions that will inform improvements to the design and implementation of AV systems.

This project is critical to improve AV systems to ensure they safely manage AV-human transitions, and to develop more effective human-machine interfaces between drivers and their vehicles. Whilst there has been widespread coverage of the development of fully automated vehicles, it is unlikely that full-automation will quickly become the norm. Indeed 'driverless' vehicles are already technologically possible, but there are significant barriers to adoption, and the prevalent view is that the human driver will remain the primary controller of the vehicle for some time. There are a number of reasons for this, including driving in regions where automation is not possible (e.g. poor GPS coverage, inaccurate mapping or poor road demarcation), needing human control of the vehicle when automatic systems fail, and not least because some drivers will continue to purchase vehicles that allow them to be in control for some periods. In this context, understanding



With the aid of Leeds City Council, by 2035, the research by [self-repairing cities](#) aims to make Leeds the first city in the world that is fully maintained autonomously.

the best way to ensure safe interactions between humans and automation remains a high priority.

### Driver monitoring during automation

Grant holder: **Professor Natasha Merat**  
 Investigators: **Dr Tyron Louw, Professor Rich Romano, Michael Daly, Anthony Horrobin**

Funded by: **Seeing Machines**  
 Dates: **September 2017 to May 2018**  
 Collaborative partners: **Seeing Machines**

**Abstract:** The aim of this collaboration is to investigate driver state during different levels of automated driving, using the University of Leeds Driving Simulator and the Seeing Machines Driver Monitoring System.

### Human Drive

Grant holder: **Professor Natasha Merat**  
 Investigators: **Professor Rich Romano, Dr Gustav Markkula, Dr Albert Solernou-Crusat, Dr Yee Mun Lee, Dr Chongfeng Wei, Dr Tyron Louw, Dr Foroogh Hajiseyedjavadi, Dr Evangelos Paschalidis, Dr Hamish Jamson, Michael Daly, Anthony Horrobin**

Funded by: **Innovate UK**  
 Dates: **July 2017 to February 2020**  
 Collaborative partners: **Nissan, TSC, Hitachi, Horiba Mira, Highways England, Aimsun, Cranfield University, Atkins**  
 Website: [humandrive.co.uk](http://humandrive.co.uk)

**Abstract:** The HumanDrive project is developing a prototype autonomous vehicle with the aim of demonstrating an automated journey on motorways, A-roads and country roads in live traffic and under different environmental conditions. The Grand Drive is planned from Nissan Cranfield to Sunderland. The system will be subjected to a robust testing process including simulation, hardware in the loop, private test track and small sections of public roads. The role of the Leeds team is to develop and test a series of vehicle control models in our state of the art motion-based driving simulator. The project is considering how more human-like behaviour from an automated vehicle affects user behaviour and acceptance. The experiences of drivers using the vehicle control models will be monitored to ensure the vehicle controls being developed are acceptable to a wide range of users.

### City Infrastructure Engineering

Grant Holder: **Professor Philip Purnell, School of Civil Engineering**  
 Co-Investigator: **Professor Natasha Merat**  
 Funded by: **EPSRC**  
 Dates: **January 2016 to July 2021**  
 Coordinating partner: **University of Leeds**  
 Collaborative partners: **UCL, University of Birmingham, University of Southampton**  
 Website: [selfrepairingcities.com/](http://selfrepairingcities.com/)



University of Leeds truck simulator is used for the design and testing of a system that informs drivers of potential collisions with cyclists in the XCYCLE project.

**Abstract:** This project aims to tackle the Grand Challenge of Zero Disruption from Infrastructure Engineering in UK cities by 2050. The project is developing technologies that will identify, diagnose and repair street-works through minimally invasive techniques including: Drones that can repair street lights and potholes; Hybrid robots to operate indefinitely within live utility pipes performing inspection, repair, metering and reporting tasks.

**Impact:** It is anticipated that this project will lead to a wide range of benefits for citizens' health, wellbeing, happiness and economic prosperity by reducing the impact of infrastructure engineering.

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## MANTRA (Making full use of Automation for National Transport and Road Authorities) (Self repairing Cities)

Grant holder: **Professor Oliver Carsten**  
Investigator: **Dr Zia Wadud**  
Funded by: **Conference of European Directors of Roads (CEDR)**  
Dates: **Sept 2018 to Sept 2020**  
Coordinating partner: **Trafficon Ltd**  
Collaborative partners: **Arndt IDC, HITEC, VTT Technical Research Centre of Finland, TU Delft.**

**Abstract:** At a time of quick development of connected and

automated driving, automation will affect the core business of National Road Authorities (NRAs). The MANTRA project seeks to answer the following questions:

- What are the influences of automation on the core business of NRAs in relation to road safety, traffic efficiency, the environment, customer service, maintenance and construction processes?
- How will the current core business, on operations & services, planning & building and ICT, change in the future?

MANTRA will apply a European transnational approach to facilitate the utilization of the results for all CEDR members.

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## XCYCLE

Grant holder: **Professor Oliver Carsten**  
Investigators: **Dr Daryl Hibberd, Professor Richard Romano, Michael Daly, Jeremy Shires, Dan Johnson, Dr John Nellthorp**  
Funded by: **EU H2020**  
Dates: **June 2015 - November 2018**  
Coordinating partner: **University of Bologna**  
Collaborative partners: **9 European industry and academic partners (see website for details)**  
Website: [www.xcycle-h2020.eu](http://www.xcycle-h2020.eu)

**Abstract:** Equalising the treatment of

cyclists in traffic will encourage cycling and make cycling safer. This project contributed to innovative and efficient advanced safety measures in trucks and at road junctions to reduce the number of accidents involving cyclists in interaction with motorised vehicles. The project developed technologies to improve 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. We developed an in-vehicle Human-Machine Interface (HMI) to warn truck drivers of imminent collision risk. Research was carried out on the new truck simulator, developed with University funding and with a cab donated by Volvo Trucks.

**Impact:** The recommended HMI design will be incorporated in a Volvo test vehicle. There will be large impacts on cycling safety by addressing some of the most severe collision scenarios.

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## Next Generation Driving Behaviour Models (NGDBM)

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

**Abstract:** The project developed novel mathematical models of driving decisions that explicitly account for the effects of stress levels and other characteristics of the driver alongside the effects of path-plan, network topography and traffic conditions. The project also focused on methodologies to combine experimental data collected from the University of Leeds Driving Simulator with actual traffic data collected using video recordings to increase the behavioural realism of the models.

**Papers:** Paschalidis E, Choudhury CF and Hess S. 2018. From driving simulators experiments to real world application: improving the transferability of car-following models. *97th Annual Meeting of the Transportation Research Board, Washington DC.*

Paschalidis E, Choudhury CF and Hess S. 2018. Modelling the effects of stress on gap-acceptance decisions combining data from driving simulator and physiological sensors.

*Transportation Research Part F: Traffic Psychology and Behaviour 59(Part A)*, pp. 418-435.

**Impact:** The research findings can have a significant impact on safety analyses and designing effective intervention strategies to manage driving stress.

## Pedestrian-in-the-Loop Simulator (HIKER)

Grant holder: **Professor Richard Romano**

Investigator: **Professor Natasha Merat**

Funded by: **EPSRC**

Dates: **January 2018 to December 2021**

Website: [uolds.leeds.ac.uk/facility/hikerlab](https://uolds.leeds.ac.uk/facility/hikerlab)

**Abstract:** Pedestrians represented roughly 24% of road fatalities and 22% of the seriously injured in the UK in 2015 (DfT, Reported Road Casualties Great Britain: 2015, Annual Report). In this context, the increased use of Autonomous Vehicles (AVs) and new systems such as automatic emergency braking have the potential to dramatically reduce road deaths. A major concern, however, is that the AVs and safety systems must be designed to take into account the capabilities and limitations of pedestrians.

This project has developed a new laboratory for Highly Immersive Kinematic Experimental Research (HIKER) to support safe experimental research in a repeatable fashion in which variables with respect to AV design, safety systems, and intersection configuration can be studied. The experiments can also look at the impacts of human factors including age, vision and mobility. What makes the simulator unique in the world is its very high resolution displays combined with its large walkable environment (9 metres by 4 metres) and its integration with driving simulators to test interactions between pedestrians and drivers.



HIKER, the cave-like pedestrian simulator was successfully installed and a launch event is planned for 2019. **Dr Andrew Tomlinson** is managing this state of the art facility.

**Impact:** HIKER will be used to support one EPSRC, two Innovate UK, and one H2020 project starting in 2019. Multiple additional projects have been proposed that will use this world leading facility.

## Programme for Simulation Innovation (PSI)

Grant holder: **Dr Gustav Markkula**

Investigators: **Dr Hamish Jamson, Michael Daly, Hrvoje Jukic, Oscar Giles, Professor Rich Romano**

Funded by: **EPSRC**

Dates: **December 2012 to March 2018**

Coordinating partner: **Jaguar Land Rover (JLR)**

Collaborative partners: **Dr Erwin Boer (independent researcher); Universities of Loughborough, Warwick, Cambridge, Sheffield and Manchester.**

Website: [gtr.ukri.org/projects?ref=EP/K014145/1](https://gtr.ukri.org/projects?ref=EP/K014145/1)

**Abstract:** In this collaboration with Jaguar Land Rover, ITS researchers investigated how virtual methods and driving simulators can be used for more efficient development of vehicles. Key results include: (1) Novel mathematical models, analysis methods, and technical integrations, permitting better observation, understanding, and evaluation of human behaviour in simulators. (2) Evidence that motion-capable simulators are reliable tools for testing anti-skid technology, reducing

the need to send vehicles to remote locations, saving time and money for manufacturers. (3) Evidence that when testing user interfaces of in-car technology, already low-cost, simple simulators can be highly useful, again permitting cost-savings. (4) Evidence that vehicle test drivers should remain unaware of changes made between tests, to vehicle specifications affecting handling and driving feel, as this can otherwise bias their perception of the way the car handles.

**Papers:** Markkula G, Romano R, Jamson AH, Pariota L, Bean A, & Boer ER. 2018. Using driver control models to understand and evaluate behavioural validity of driving simulators. *IEEE Transactions on Human-Machine Systems* 48(6), 592-603.

Markkula G, Boer E, Romano R, & Merat N. 2018. Sustained sensorimotor control as intermittent decisions about prediction errors: computational framework and application to ground vehicle steering. *Biological Cybernetics* 112(3), 181-207.

Markkula G, Romano R, Waldram R, Giles O, Mole C, Wilkie R. 2018. Modelling visual-vestibular integration and behavioural adaptation in the driving simulator. *Paper presented at the Driving Simulator Conference, Antibes, France.*



Simulated Jaguar in the 'Virtual Sweden' environment implemented at the University of Leeds Driving Simulator.

Romano R, Markkula G, Boer E, Jamson AH, Bean A, Tomlinson A, Horrobin A, Sadraei E. 2018. An Objective Assessment of the Utility of a Driving Simulator for Low Mu Testing. *Paper presented at the Driving Simulator Conference, Antibes, France.*

Sadraei E, Romano R, Jamson S, Markkula G, Jamson AH. 2018. Driving simulator motion base right sizing. *Paper presented at the Driving Simulator Conference, Antibes, France.*

Using driving simulators to develop new vehicles. Online. *Institute for Transport Studies, University of Leeds.*

**Impact:** The developed methods have been handed over to JLR, together with requisite training of key staff, and the project's results are now influencing JLR's use of and further investment in simulator technology. Ian Knight, JLR Programme Manager, about the ITS team: "They have carried out much-needed, rigorous studies of a nature that there is rarely time for in an industrial setting, providing sound scientific support for important cost-saving decisions for us going forward. Furthermore they have been extremely flexible in terms of tailoring their activities to maximise their relevance to Jaguar Land Rover's requirements whilst at the same time maintaining high academic standards." The developed methods for behaviour analysis also provided

part of the foundation for a £300K role for ITS in the InnovateUK VeriCAV project.

## BIG DATA

### HABITS

Grant holder: **Professor Susan Grant-Muller**

Investigators: **Frances Hodgson, Dr Gillian Harrison, Tom Redfern**

Funded by: **ESRC**

Dates: **February 2017 to February 2018**

**Abstract:** The project has considered the implications of 'track and trace' (T&T) data generated from mobile phones in relation to health impacts. Two areas of health impact have been considered: the health burdens of exposure to air pollution and health related to levels of travel activity. In response to the project objectives, the following outcomes have been achieved: Micro-level mobility data (a new and emerging data form) has been successfully interfaced for the first time with a model of transport – energy health impacts. This allows investigation of health outcomes from individuals travel choices (or from policy changes), together with outcomes related to other societal burdens.

- An indicator for equity in the distribution of impacts (health, energy) arising from the introduction of software app-based incentive schemes to encourage modal shift has been developed and demonstrated for the Newcastle city region. The indicator is derived from use of new micro location data together with small-area Index of Multiple Deprivation data.
- We have combined 'big data' arising from 1) the road network and 2) data from a NO2 monitoring sensor network (Newcastle Urban Observatory) into a newly developed method for estimating the spatio-temporal patterns of NO2 concentrations. This has been validated against the Official DEFRA roadside model. Our model shows a good correspondence with the DEFRA model but has advantages: for example, NO2 estimates aren't restricted to main roads and the model provides an estimate of the diurnal variations of NO2.
- A new prototype interactive software tool (the 'HABITS tool') has been developed to allow policy makers to explore micro-level mobility pattern data alongside patterns of NO2 for the Newcastle region. The tool also produces summary indices, including equity and health outcomes.

**Impact:** The findings are being taken forward in the project KARMA (described below). The new method for estimating the spatio-temporal patterns of NO2 concentrations is suitable for uptake by local/regional authorities to understand pollutant patterns and target resources appropriately. The HABITS tool is in prototype form but can be adapted to other forms of app-derived micro location data.

### KARMA

Grant holder: **Professor Susan Grant-Muller**

Investigators: **Frances Hodgson, Dr Gillian Harrison**

Funded by: **Turing Institute**

Dates: **Oct 2018 to December 2019**

**Abstract:** New micro-location data analytics for improved cross-sectoral policies mitigating transport, environmental and inactivity related

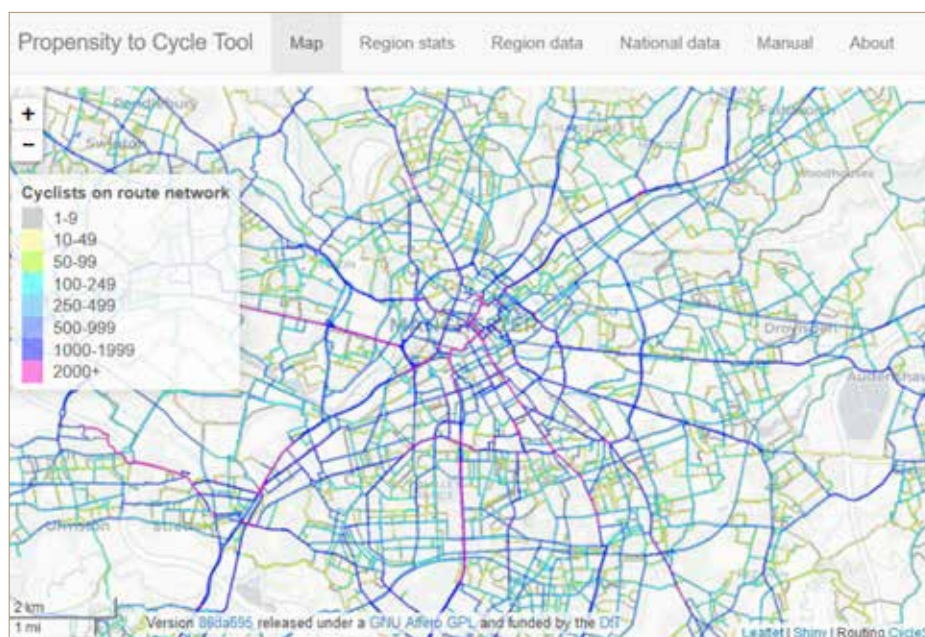


societal burdens. The KARMA goals are to: create a step change in understanding the cross-sectoral impacts of transport schemes by advanced analytics of next generation transport and other urban data (phone location signals, textual data, tap-in-tap-out, consumer transaction data, sensor data and others). KARMA objectives are to: 1) Create new database and model interfaces, secure access models and interoperability between next generation data and existing sectoral models, 2) Enhance existing models of transport-energy, transport-health and transport-security and safety impacts, building new models to fill research gaps 3) Explore the cross-sectoral implications of existing and newly designed initiatives (such as the use of persuasive technologies in travel choice), and 4) Improve the asset base (ecosystems and platforms) that support increased analysis and use of new digital mobility data, so that improved policies and initiatives can be developed and implemented (e.g. ethical frameworks, digital innovation, impact visualisation, business models).

## Propensity to Cycle Tool (PCT)

Grant holder: **Dr Robin Lovelace**  
 Investigator: **Dr Malcolm Morgan**  
 Funded by: **DfT and Local Authorities**  
 Dates: **January 2015 (Phase 1), September 2016 to December 2019 (Phase 2), 2019-2020 (Phase 3)**  
 Coordinating partner: **University of Cambridge**  
 Collaborative partners: **LSHTM, University of Westminster, CycleStreets.net**  
 Website: [www.pct.bike](http://www.pct.bike)

**Abstract:** New tools and methods for transport planning have been developed in a series of projects led by Dr Robin Lovelace. These included two projects funded by the Department for Transport: the Propensity to Cycle Tool (PCT) and the Cycling Infrastructure Prioritisation Toolkit (described below). New techniques for processing and visualising large travel datasets were developed and distributed in popular (over one thousand downloads per month) open-source software (Lovelace and Ellison 2018). The PCT is the first national, open access cycle planning tool. Furthermore, the underlying methods have led to new software for accessing open road crash



The Go Dutch scenario, used to inform investment in the 'beelines' network of cycleways in Manchester.

data, with the R package stats19 (Lovelace et al. 2019). It is informing discussion of how evidence is used in health policy (Monsivais et al. 2018) and has led to international follow-on projects, including with the World Health Organisation (Lovelace et al. 2018).

**Papers:** Lovelace R, Morgan M, Hama L and Padgham M. 2019. [stats19: A package for working with open road crash data](#). *The Journal of Open Source Software*, 4(33), 1181.

Lovelace R and Ellison R. 2018. Stplanr: A Package for Transport Planning. *The R Journal* 2018 (2): 49–61.

Monsivais P, Francis O, Lovelace R, Chang M, Strachan E and Burgoine T. 2018. Data Visualisation to Support Obesity Policy: Case Studies of Data Tools for Planning and Transport Policy in the UK. *International Journal of Obesity*, 42, 1977-1986.

Woodcock J, Abbas A, Ullrich A, Tainio M, Lovelace R, Sá TH, Westgate K and Goodman A. 2018. Development of the Impacts of Cycling Tool (ICT): A Modelling Study and Web Tool for Evaluating Health and Environmental Impacts of Cycling Uptake. *PLOS Medicine* 15(7): e1002622.

[Steering future cycleway investment](#). Online. *Institute for Transport Studies, University of Leeds*.

**Impact:** The PCT is having a “transformative impact on cycle planning in England” (Roger Geffen MBE) and is being used to inform the layout of cycle networks in cities across England and Wales. The PCT is the official tool in the Cycling and Walking Infrastructure Strategy and has been used by dozens of local authorities and transport planning consultancies including Transport for Greater Manchester (TfGM), who are using the PCT to inform their £100+ million ‘beelines’ network, with partners Systra, Jacobs, Arup, Bath, and Phil Jones Associates.

## Cycling Infrastructure Prioritisation Toolkit (CylIPT)

Grant holder: **Dr Robin Lovelace**  
 Investigator: **Dr Malcolm Morgan**  
 Funded by: **DfT**  
 Coordinating partner: **University of Leeds**  
 Collaborative partners: **CycleStreets Ltd, Phil Jones Associates, University of West of England**  
 Dates: **April 2017 to March 2018**  
 Website: [www.cyipt.bike/](http://www.cyipt.bike/)

**Abstract:** This project tackled the challenge that cycling uptake is often limited by infrastructural barriers which could be remediated cost-effectively. To meet the Government’s target to double cycling by 2025, it makes sense to prioritise interventions that will deliver the greatest benefit for a given budget



GamECAR: (page 8)

on the route network. The project was highly innovative in its use of big data to provide estimates of cost (based on recent evidence) and effectiveness (measured in expected levels of cycling uptake).

**Impact:** The project resulted in a working prototype that provides data on cycling infrastructure nationally, down to the level of individual streets. See website for more information and to try the tool.

## Greener Connectivity in Eastern Partnership Countries

Grant holder: **Dr Robin Lovelace**  
Investigator: **Colin Caine**  
Funded by: **World Bank**  
Dates: **Dec 2017 to Nov 2018**  
Coordinating partner: **ITP World**  
Website: [github.com/IntegratedTransportPlanning/gcvt](https://github.com/IntegratedTransportPlanning/gcvt)

**Abstract:** The aim of this project was to create a visualisation tool for the Eastern Partnership 'Greener Connectivity' project.

**Impact:** The completed web application is open source, and has the following features for informing the public debate on sustainable transport investment: uploading model outputs from the Cube transport modelling software; viewing statistics about current and proposed

regional international transport corridors (including rail and freight); and visualising origin-destination data and matrix skim data, against a prepopulated list of zones.

## Analysis of Roadworks Data

Grant holder: **Dr Robin Lovelace**  
Investigators: **Dr Malcolm Morgan**  
Funded by: **RAC Foundation**  
Dates: **July 2017 to November 2018**  
Coordinating partner: **University of Leeds**  
Collaborative partners: **Elgin Ltd**  
Website: [github.com/ITSLeeds/roadworksUK](https://github.com/ITSLeeds/roadworksUK)

**Impact:** This project demonstrated how the 'barrier to entry' to the complex world of roadworks data can be reduced with modern open source software. Like the one-minute-traffic-data project funded by the RAC Foundation, it resulted in software in the form of an R package. As a result of this package, getting 'EtON' roadworks data into a statistical analysis environment will make the data more accessible to stakeholders, with the potential to inform policies and operations around roadworks.

## CHOICE MODELLING

### DECISIONS

Grant holder: **Professor Stephane Hess**  
Investigators: **Dr Romain Crastes dit Sourd, Dr Charisma Choudhury, Dr David Palma, Dr Chiara Calastri, Thomas Hancock, Martyna Bogacz**  
Funded by: **ERC**  
Dates: **July 2014 – June 2020**  
Website: [cmc.leeds.ac.uk](http://cmc.leeds.ac.uk)

**Abstract:** Mathematical models of choice are used to understand and forecast behaviour, or value intangibles such as time. These outputs are key in many decision-making contexts. While current modelling techniques are faithful to economic theory, their behavioural and psychological soundness have been questioned. The Decisions project is developing choice models that more accurately represent the human decision-making process and the context of real-life choices.

This requires introducing behavioural and psychological elements in mathematical choice models and implies moving away from the 'homo economicus' framework to a more complex representation, where 'soft' factors such as social influence affect decisions.

We also consider context and temporality (long term vs short term) when modelling human choices which are generally not made in isolation. For example, the decision to commute by car is affected by the decision to live in a given area, which in turn is influenced by longer term decisions such as having a large family or not. Moreover, many choices are not restricted to a simple selection, but to a choice of quantity and quality, for example what to buy at the supermarket, and how much of each product. Our models seek to better represent these complex choices.

**Papers:** Webb EJD, Meads D, Lynch Y, Randall N, Judge S, Goldbart J, Meredith S, Moulam L, Hess S & Murray J. in press. What's Important in AAC

Decision Making for Children? Evidence from a Best-worst Scaling Survey. *Augmentative and Alternative Communication*.

Daly AJ & Hess S. In press. VTT or VTTS: a note on terminology for value of travel time work. *Transportation*.

Dada M, Zuidgeest M & Hess S. In press. Modelling pedestrian crossing choice behaviour on Cape Town freeways: caught between a stone rock and a hard place? *Transportation Research Part F*.

Tjong J, Hess S, Dekker T & Cabral M. In press. Impact of travel time constraints on taste heterogeneity and nonlinearity in simple time-cost trade-offs. *Transportation Research Record*.

Calastri C, Crastes dit Sourd R. In press. We want it all: experiences from a survey seeking to capture social network structures, lifetime events and short-term travel and activity planning. *Transportation*.

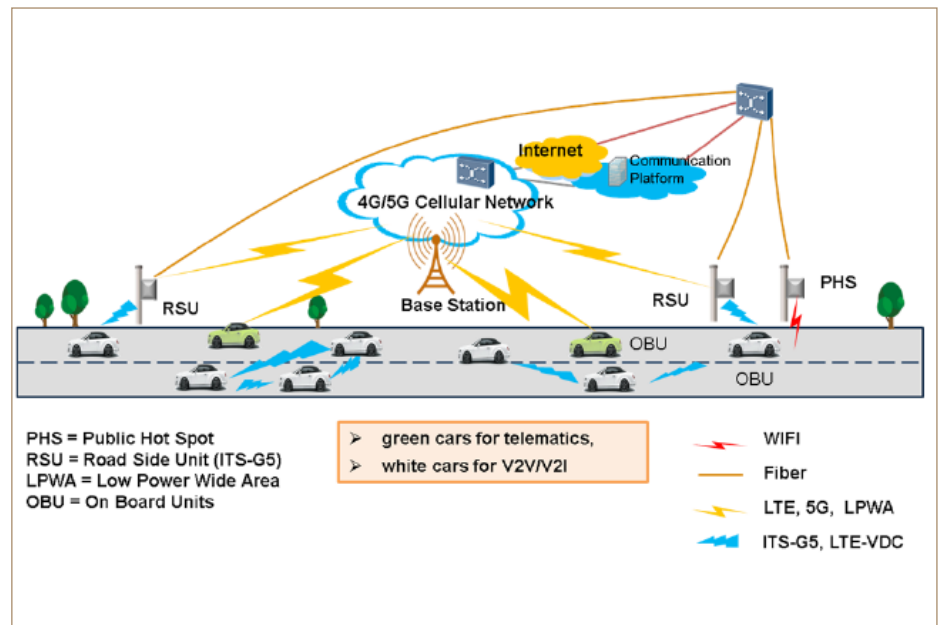
Calastri C, Hess S, Choudhury CF, Daly AJ & Gabrielli L. In press. Mode choice with latent availability and consideration: theory and a case study. *Transportation Research Part B*.

Calastri C, Hess S, Daly A, Carrasco J and Choudhury CF. 2018. Modelling the loss and retention of contacts in social networks: the role of dyad-level heterogeneity and tie strength. *Journal of Choice Modelling*, 29, pp 63-77.

Paschalidis E, Choudhury C & Hess S. 2018. Modelling the effects of stress on gap-acceptance decisions combining data from the driving simulator and physiological sensors. *Transportation Research Part F*, 59(A), pp 418-435.

Song F, Hess S & Dekker T. 2018. Accounting for the impact of variety-seeking: theory and application to HSR-air intermodality in China. *Journal of Air Transport Management*, 69, pp 99-111.

Hess S, Spitz G, Bradley M & Coogan M. (2018) Analysis of mode choice for intercity travel: application of a hybrid choice model to two distinct US corridors. *Transportation Research Part A*, 116, pp 547-567.



AUTOPILOT: Automated driving progressed by the Internet of Things.

Hess S, Daly AJ & Batley R. 2018. Revisiting consistency with random utility maximisation: theory and implications for practical work. *Theory and Decision*, 84(2), pp 181-204.

Ibraimovic T & Hess S. 2018. A Latent Class Model of Residential Choice Behaviour and Ethnic Segregation Preferences. *Housing Studies*, 33, pp 544-564.

## CONNECTED MOBILITY

### AUTOPILOT

Grant holder: **Dr Haibo Chen**  
 Investigators: **Dr Yvonne Barnard, Dr Gillian Harrison, Professor Oliver Carsten, Dr Kaushali Dave, Professor Simon Shepherd**  
 Funded by: **EU H2020**  
 Dates: **January 2017 to December 2019**  
 Coordinating partner: **ERTICO**  
 Collaborative partners: **46 partners in industry and academia (see website for details)**  
 Website: [autopilot-project.eu](http://autopilot-project.eu)

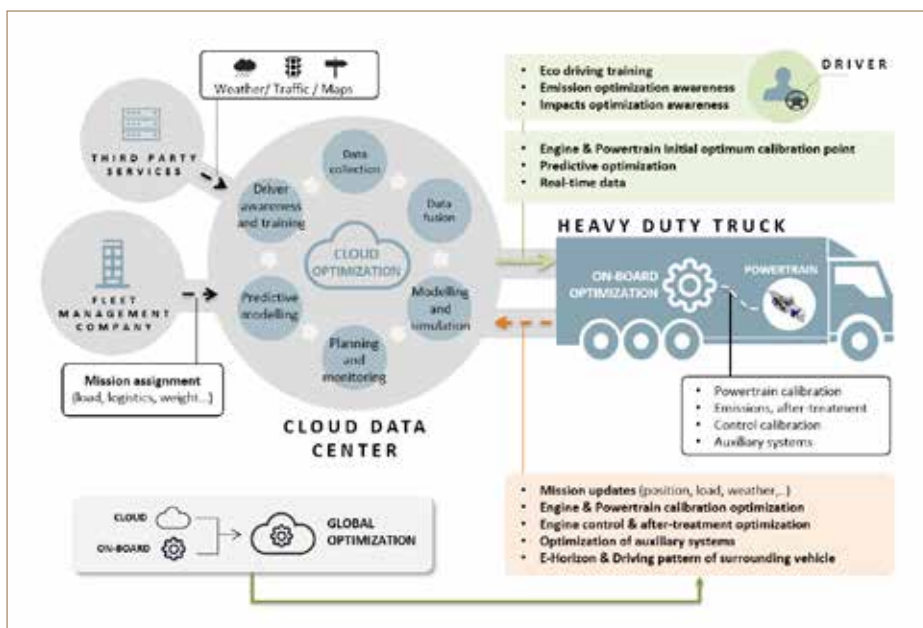
**Abstract:** 'Automated driving Progressed by Internet Of Things' (AUTOPILOT) brings the Internet of Things (IoT) into the automotive world. IoT enables connections between

objects or 'Things'. The IoT connects anything, anytime, anyplace, using any service over any network. The project aims to transform connected vehicles (i.e. moving 'Things' within the IoT ecosystem) into highly and fully automated vehicles. While using the IoT potential for automated driving, AUTOPILOT also returns data from autonomous cars to the IoT.

AUTOPILOT will involve vehicles, road infrastructure and surrounding objects in the IoT ecosystem, with particular attention to the safety-critical aspects of automated driving. The IoT-enabled AUTOPILOT cars are being tested in real conditions at six permanent large-scale pilot sites in Finland, France, Italy, the Netherlands, South Korea and Spain. The project aims to bring automated driving towards a new dimension.

**Paper:** Liu B, Jia D, Lu K, Chen H, Yang R, Wang J, Barnard Y and Wu L. 2017. Infrastructure-Assisted Message Dissemination for Supporting Heterogeneous Driving Patterns. *IEEE Transactions on Intelligent Transportation Systems* 18 (10), pp 2865-2876.

**Impact:** The newly-funded project, PAsCAL is testament to the success of AUTOPILOT.



Optitruck research aims to reduce the energy consumption of heavy duty vehicles by 20% globally.

## Optitruck

Grant holder: **Dr Haibo Chen**  
 Investigators: **Dr Dongyao Jia, Dr Richard Connors, Professor David Watling, Dr David Milne, Dr Yue Huang, Dr Kaushali Dave, Dr Malcolm Morgan**  
 Funded by: **EU H2020**  
 Dates: **Sept 2016 to August 2019**  
 Coordinating partner: **ERTICO**  
 Collaborative partners: **Ten partners in industry and academia (see website)**  
 Website: [optitruck.eu](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 CO<sub>2</sub> 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.

**Papers:** Liu J, Wan J, Jia DY, Zeng B, Li D, Hsu CH & Chen H. 2017. High-efficiency Urban-traffic Management in Context-aware Computing and 5G Communication. *IEEE Communications Magazine*, 55(1), pp 34-40.

Jia D, Liu B, Chen H, Fan J, Qiao C,

Wang J & Wu L. 2017. Message dissemination scheduling for multiple cooperative drivings. *IEEE Conference on Computer Communications Workshops* pp 277-282.

**Impact:** The newly-funded project, MODALES is testament to the success of optitruck.

## ELVITEN

Grant holder: **Dr Haibo Chen**  
 Funded by: **EU H2020**  
 Dates: **Nov 2017 to Oct 2020**  
 Collaborative partners: **21 partners in industry and academia (see website)**  
 Website: [www.elviten-project.eu](http://www.elviten-project.eu)

**Abstract:** 'Electrified L-category Vehicles Integrated into Transport and Electricity Networks' (ELVITEN) aims to boost the usage of all categories of electrified bicycles, scooters, tricycles and quadricycles (EL-Vs) in the urban environment and ultimately to achieve a mind-shift among users by providing them with a better EL-V experience. This will be achieved by designing and offering replicable usage schemes, consisting of support services, ICT tools and policies. EL-Vs of all categories are being tested in Genoa, Rome, Bari, Malaga, Berlin and Trikala. The project has three principal objectives: First, it seeks to make users more familiar and facilitate them to use EL-Vs instead of conventional vehicles for their private transport and for light urban deliveries. Second, it attempts to collect

rich information sets made of real usage data, traces from dedicated ICT tools, and users' opinions after real trips. Third it will generate detailed guidelines and business models for service providers, Planning Authorities and manufacturers in order to make EL-Vs more attractive and more integrated in the transport and electricity networks.

## CARTRE

Grant holder: **Dr Yvonne Barnard**  
 Investigator: **Dr Haibo Chen, Professor Natasha Merat**  
 Funded by: **EU H2020**  
 Dates: **Oct 2016 to Sept 2018**  
 Coordinating partner: **ERTICO**  
 Collaborative partners: **36 European partners (see website for details)**  
 Website: [connectedautomateddriving.eu/about-us/cartre](http://connectedautomateddriving.eu/about-us/cartre)

**Abstract:** CARTRE was a Coordination and Support Action to accelerate development and deployment of automated road transport by increasing market and policy certainties. To achieve this, CARTRE supported 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 included: the creation of a solid knowledgebase of all European activities, to support current activities and structure research outcomes by enablers and thematic areas; to set up 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.

**Paper:** Barnard Y, Zlocki A, Innamaa S, Gellerman H, Brizzolara D, Koskinen S, Chen H and Jia D. 2018. Assessing the impact of automated driving: needs, challenges and future directions. *Proceedings of 7th Transport Research Arena*.

**Impact:** The follow-on project, ARCADE is testament to the success of CARTRE.

## ARCADE

Grant holder: **Dr Yvonne Barnard**  
 Investigator: **Dr Haibo Chen, Professor Natasha Merat**  
 Funded by: **EU H2020**  
 Dates: **Oct 2018 to Sept 2021**  
 Coordinating partner: **ERTICO**  
 Collaborative partners: **24 European partners (see website for details)**  
 Website: [connectedautomateddriving.eu/arcade-project](http://connectedautomateddriving.eu/arcade-project)

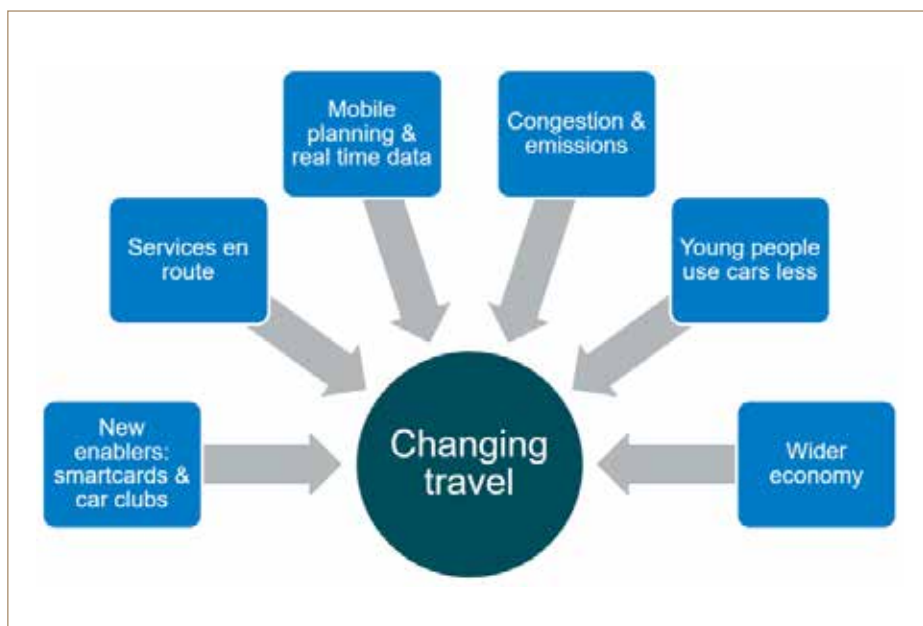
**Abstract:** ARCADE (Aligning Research & Innovation for Connected and Automated Driving in Europe) is a Coordination and Support Action for consensus-building among stakeholders for sound and harmonised deployment of Connected, Cooperative and Automated Driving (CAD).

ARCADE supports the commitment of the European Commission, the European Member States and the industry to develop a common approach to development, testing, validation and deployment of CAD in Europe and beyond.

**Impact:** ARCADE will establish a joint stakeholders forum 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). Towards this objective, ARCADE will organise the Second European CAD conference in 2019.

## The Smarter Travel Solution (STS)

Grant holder: **Jeremy Shires**  
 Investigators: **Dr Haibo Chen, Professor Simon Shepherd, Dr Chandra Balijepalli, Dr Gillian Harrison, Julian Burkinshaw**  
 Funded by: **Innovate UK**  
 Dates: **March 2016 – February 2018**  
 Coordinating partner: **Telefónica UK**  
 Collaborative partners: **C3UK, Firstgroup, WYCA, Leeds City Council, Ove Arup & Partners, City Car Club, Forum for the Future and South Yorkshire Passenger Transport Executive.**



The Smarter Travel Solution travel app will bring the management and completion of a journey under one umbrella.

**Abstract:** The aim of the project was 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 also provides the option to book and pay for tickets, hire cars, use car club and provide feedback on the journey. STS brings the entire management and completion of a journey under one umbrella, supporting and engaging users from first thought through to arrival in a 'one screen journey'.

**Impact:** The ITS input to this collaborative project looked at the impact of the STS travel app in terms of carbon mitigation and what changes it will have on travel decisions in particular for vulnerable user groups.

## ENERGY

### DEMAND

Grant holder: **Professor Greg Marsden**  
 Investigator: **Dr Ian Jones, Dr Zia Wadud**  
 Funded by: **RCUK**  
 Dates: **May 2013 to April 2019**  
 Coordinating partner: **Lancaster University**  
 Website: [www.demand.ac.uk](http://www.demand.ac.uk)

**Abstract:** DEMAND is a research centre funded through RCUK's End Use Energy Demand reduction portfolio. ITS has been leading research on the future of on-line shopping, the changing nature of business travel and the relationship between car ownership, travel costs and economic stress. In 2018, a key achievement was the launch of the Commission on Travel Demand's report on the future of travel. This report took evidence from 58 individuals and organisations to look at why recent reductions in per capita travel have been happening and what this means for policy and practice. The findings have been used by the Committee on Climate Change in their 2018 Progress Report to Parliament and their recent letter to the Secretary of State for Transport.

**Papers:** Jones I, Faulconbridge J, Marsden G, Anable J. 2018. Demanding business travel: the evolution of the timespaces of business practice. In: Hui A; Day R; Walker G (eds.) *Demanding Energy: space, time and change*. Palgrave Macmillan.

Mattioli G, Wadud Z & Lucas K. 2018. Vulnerability to fuel price increases in the UK: A household level analysis. *Transportation Research Part A: Policy and Practice*, 113, 227-242

Wadud Z, Royston S & Selby J. 2019. Modelling energy demand from higher education institutions: A case study of the UK, *Applied Energy*, 233-232: 816-826.

**Why are young people driving less?**

It is a combination of factors.

- More precarious employment
- Rising car insurance costs
- Starting families later
- Staying in education longer
- Living at home longer due to housing costs
- Shift to more urban living
- Preferences have changed

This is not just 'car later' but 'car less'. As young people start families they do use cars but not to the same degree as previous generations.

In the 1990s,  
80% of people  
drove by age 30

↓

Today, 80% of  
people drive by  
age 45

DEMAND: Society in changing. This is having a big impact on who travels and how much.

Rinkinen J, Shove E & Marsden G. 2018. *DEMAND Dictionary of Phrase and Fable* (1.7th edition). The DEMAND Dictionary presents revised terms and concepts through which energy can be known and understood.

**Impact:** The commission-on-travel-demand shows all of the resources and evidence from the Commission's first report. Presentations have been given to organisations including Committee on Climate Change, DfT, TfGM, Independent Transport Commission and the Passenger Demand Forecasting Conference.

## Electricity SATNAV

Grant holder: **Professor Jillian Anable**  
 Investigators: **Maria-Jose Ambrosio-Albala**  
 Funded by: **EPSRC**  
 Dates: **Sept 2017 to August 2019**  
 Coordinating partner: **Aston University**  
 Collaborative partners: **University of Southampton**

**Abstract:** The overall aim of this project is to design a real-time system to enable flexible electric vehicle charging/discharging from/to individual household or commercial renewable electricity resources. This is a multidisciplinary project using engineering and business model development as well as our role in consumer and behavioural research. Qualitative research has been conducted to investigate the

acceptability of peer-to-peer sharing of resources related to electricity supply and charging and the associated business models.

## UK Energy Research Centre Phase 3 (UK-ERC 3)

Grant holder: **Professor Jillian Anable**  
 Funded by: **UK Energy Research Centre**  
 Dates: **January 2016 to April 2019**  
 Coordinating partner: **Imperial College London**  
 Collaborative partner: **University of Oxford**  
 Website: [www.ukerc.ac.uk](http://www.ukerc.ac.uk)

**Abstract:** UK-ERC is a cross-research council funded 'virtual' research centre comprising a focal point for UK research on sustainable energy. It takes an independent, whole systems approach, drawing on engineering, economics and the physical, environmental and social sciences. The primary objective is to explore the UK energy transition in an uncertain world, and the synergies and trade-offs between the key drivers for this transition. Professor Anable works primarily within Theme 5 'Key challenges in energy system decision-making' with the work centering on the analysis of policy scenarios for carbon mitigation of the UK transport sector using the UK Transport Carbon Model (UKTCM).

**Papers:** Brand C, Anable J and Morton C. 2018. Lifestyle, efficiency and limits: modelling transport energy and emissions using a socio-technical approach. *Energy Efficiency*

Morton C, Wilson C & Anable J. 2018. The Diffusion of Domestic Energy Efficiency Policies: A spatial perspective. *Energy Policy*, 114: 77-88.

**Impact:** Project 5.6 (Energy/transport systemic change) has redesigned and developed the transport demand module of UKTCM (UK Transport Carbon Model) into a Scottish version of the Transport Energy and Air Pollution Model (STEAM). Both UKCTM and STEAM have been used to assess scenarios relating to the accelerated uptake of electric vehicles to meet Paris Agreement carbon budgets for the UK. Professor Anable has been invited as the only academic member of the UK Government's Electric Vehicle and Energy Taskforce.

## adVANce: Light Goods Vehicles Carbon Reduction

Grant holder: **Dr Anthony Whiteing**  
 Investigators: **Dr Eleonora Morganti, Professor Jillian Anable**  
 Funded by: **UK ERC**  
 Collaborative partner: **Oxford University**  
 Dates: **October 2016 to March 2019**

**Abstract:** Light goods vehicle (van) traffic has been the fastest-growing segment of road traffic in recent years, yet we know little about the reasons for this. The adVANce project is investigating trends in van use, the energy implications of such use and the opportunities for carbon and pollution reduction from the van sector particularly in urban areas, through case study work and analysis of vehicle MoT data. Insights into future use of vans in industries such as retail and food will be used as inputs into carbon modelling, to test the potential effects of various policies to reduce emissions in this key transport sector.

## UK Centre for Research on Energy Demand Solutions (UK-CREDS)

Grant holder: **Professor Jillian Anable**  
 Investigators: **Professor Greg Marsden, Dr Giulio Mattioli, Dr Zia Wadud, Dr Anthony Whiteing**  
 Funded by: **EPSRC**  
 Dates: **April 2018 to March 2023**  
 Coordinating partner: **University of Oxford**  
 Collaborative partners: **University of Leeds (School of Earth and Environment), University of Reading, University of Sussex, University College London, University of Lancaster**  
 Website: [www.creds.ac.uk](http://www.creds.ac.uk)

**Abstract:** CREDS is a new research centre established in 2018 with a vision to make the UK a leader in understanding the changes in energy demand needed for the transition to a secure and affordable low-carbon energy system. Transport and Mobility is one dedicated research strand (alongside 5 others) within the Centre and the transport theme will undertake seven interrelated subprojects. These explore (i) where transport energy demands are highest (in households with the highest combined domestic energy and mobility energy consumption and on long distance travel demands) (ii) the constraints and opportunities for transport flexibility, including on-demand mobility services and new charging and use regimes for electric vehicles (iii) how to accelerate the take-up of carbon and energy reduction policies, including understanding the distribution and diffusion of new mobility services. This theme is also continuing with a Commission on Travel Demand knowledge exchange activity, with the first inquiry topic of 'sharing'.

**Impact:** Evidence was submitted to the Science and Technology Committee inquiry on 'Technologies for meeting Clean Growth emissions reduction targets' and to the Committee on Climate Change consultation on 'Building a Zero Carbon Economy'.



INTALiNC. Tackling social exclusion in global south transport systems. Loadbearing by Ghanaian women – evidence of inequality? Photo courtesy of Emma Tsoneva.

## UK-CREDS Theme 4

Grant holder: **Professor Greg Marsden**  
 Funded by: **EPSRC**  
 Dates: **May 2018 to April 2023**  
 Coordinating partner: **University of Reading**  
 Collaborative partners: **Lancaster University, University of Leeds**  
 Website: [www.creds.ac.uk/flexibility](http://www.creds.ac.uk/flexibility)

**Abstract:** Flexibility is the capacity to use energy in different locations at different times of day or year (via storage or by changing the timing of activity); to switch fuels; to smooth or create peaks in demand or, in the case of mobility, to re-arrange destinations and journeys in ways that reduce energy demand and/or congestion. Flexibility is not only about adapting supply to demand or switching fuel to match existing patterns, it is also about recognising that patterns are not fixed: they vary and can partly be shaped by technologies. For example, institutions already intervene to shape patterns of energy demand, but the strategies used tend to work in the background with the aim of minimising disruption to services. The challenge is to find opportunities to adapt social rhythms to better match peaks and troughs of renewable supply.

To address this, we are understanding how energy demand is bound up with the rhythm of society and what people do by understanding the contemporary

timing of energy demand – domestic, non-domestic and in relation to the mobility of things and people. We will also assess interventions aimed at reducing peaks and increasing flexibility in the timing of energy demand. These will include technologies, pricing mechanisms and shifts in institutional timings to better understand how, where, and when people demand energy and whether they are likely to enable a more flexible management of demand.

## GLOBAL SOUTH

### International Network for Transport and Accessibility in Low Income Communities (INTALiNC)

Grant holder: **Professor Karen Lucas**  
 Funded by: **ESRC Global Challenges Research Fund**  
 Dates: **January 2017 to June 2018**  
 Coordinating partner: **Institute for Transport Studies, University of Leeds**  
 Collaborative partners: **University of Cape Coast (Ghana); University of Asia Pacific (Bangladesh); Lagos State University (Nigeria); University of Makerere (Uganda); University of Durham; University of Manchester; University of Oxford; University College London**  
 Website: [www.intalinc.leeds.ac.uk](http://www.intalinc.leeds.ac.uk)



Under Reform: how to generate more sustainable transport systems in Indian cities.

**Abstract:** This first International Network for Transport and Accessibility in Low Income Communities (INTALInC1) brings together partners from eleven academic and stakeholder institution in the UK, Africa and East Asia with a focus on finding innovative ways to address the mobility needs of low income populations in Low and Middle Income Countries. Our mission is to promote research that can provide the evidence-base for the delivery on socially sustainable and inclusive urban mobilities in the developing world context.

**Papers:** see website for workshop reports and other published resources

**Impact:** In the two years up to December 2018 INTALInC has convened eight multi-disciplinary 'research into practice' workshop events. These events in the UK, Africa and East Asia brought researchers into direct contact with policy makers, operators and communities to design more inclusive transport systems.

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## Transport and Social Exclusion in African Cities (INTALInC 2)

Grant holder: **Professor Karen Lucas**  
Funded by: **Volvo Research Foundation**  
Dates: **Jan 2017 to Dec 2018**  
Coordinating partner: **Institute for Transport Studies, University of Leeds**  
Collaborative partners: **Lagos State**

**University; University of Nairobi; University of Cape Coast; University of Cape Town; University of Pretoria**  
Website: [www.intalinc.leeds.ac.uk](http://www.intalinc.leeds.ac.uk)

**Abstract:** This project brought together partners from Africa, East Asia and the UK to produce a series of initial scoping studies and workshops on transport and social exclusion in African cities. These reports will promote further research with potential research funders and policy communities.

Partners have produced in-depth, qualitative scoping studies providing a knowledge base in five Sub-Saharan countries on the transport and mobility needs of low-income groups. This provides a valuable baseline for formulating future research. The Network has also convened two multi-disciplinary 'research into practice' workshops in African cities bringing together researchers, policy makers, transport operators and local community organisations.

**Papers:** see website for workshop reports and other published resources

**Impact:** The reports and workshops have served to significantly enhance the impact of INTALInC, as well as the capacity of partners in Africa to compete for further funding in this crucial area of transport and mobility for the most vulnerable populations living in developing cities.

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## Under Reform

Grant holder: **Professor Greg Marsden**  
Investigator: **Morgan Campbell**  
Funded by: **ESRC**  
Dates: **May 2018 to May 2020**  
Coordinating partner: **University of Leeds**  
Collaborative partners: **University of Birmingham, School of Planning and Architecture Delhi, Indian Institute of Science Bangalore**  
Website: [underreform.org](http://underreform.org)

**Abstract:** Under Reform is a two-year project looking at transport reform in India. It aims to develop cutting edge insights into how reforming transport governance works, and how best to generate more sustainable transport systems in Indian cities. In 2015 the Indian national government launched the Smart Cities Mission, aiming to reform transport governance more effectively than had been managed at individual city level. The project research will analyse previous and planned reforms in four of India's designated smart cities, considering their impact on the prosperity and quality of life of citizens. The aim is to move beyond simply identifying problems, rather developing an understanding of how to overcome them.

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## TrACE Phase 1 Transport Analytics Centre of Excellence in Cyprus

Grant holder: **Dr Paul Timms**  
Investigators: **Professor David Watling, Professor Simon Shepherd, Dr Gillian Harrison**  
Funded by: **EU H2020**  
Co-ordinating partner: **Cyprus Ministry of Transport of Communications and Works**  
Collaborating partners: **Institute of Transportation Systems (DLR) (Berlin-Germany), University of Cyprus, Cyprus International Institute of Management.**  
Dates: **Sept 2017 to August 2018**  
Website: [www.kios.ucy.ac.cy/trace](http://www.kios.ucy.ac.cy/trace)

**Abstract:** The project aims to establish a Centre of Excellence for Transport Research in Cyprus. Phase 1 of the project developed a business plan to be implemented in Phase 2, covering the next 15 years. Funding for the Centre in Phase 2 is expected to be provided by



the EU and the Government of Cyprus. TrACE aims to promote research, innovation and entrepreneurship in areas such as transport planning and related policies, sustainable mobility, intelligent transport systems, green and sustainable transport, maritime transport and the blue economy. The main geographical areas covered by TrACE will be Cyprus and the MENA Region (Middle East and North Africa), making use of the position of Cyprus as the 'crossroads of the Eastern Mediterranean'.

## Global Mobility Options for Sustainable Transitions (GMOST)

Grant holder: **Dr Robin Lovelace**

Funded by: **WHO**

Dates: **Dec 2017 to Nov 2018**

Coordinating partner: **University of Leeds**

Collaborating Partner: **University of Salzburg**

Website: [github.com/ATFutures/who](https://github.com/ATFutures/who)

**Abstract:** The benefits of active travel for individual and urban health, the environment, and society are becoming increasingly apparent. Many cities are preparing ambitious walking and cycling plans. However, transport authorities lack strong and actionable evidence to support this investment for a number of reasons, including: transport models have tended to focus on motor vehicles; data on active travel tends to be sparse and inaccessible; and data and models are often not accessible for many potential stakeholders.

**Paper:** Lovelace R, Groot N, Adepeju M and Padgham M. 2018. Estimating Cycling Potential on Route Networks in Accra and Kathmandu. *World Health Organization*.

**Impact:** The project tackled these problems by assessing the feasibility of tools to provide actionable, publicly accessible, and geographically detailed evidence to prioritise investment in walking and cycling for the case study cities of Accra, Ghana and Kathmandu, Nepal.

For further details about the tool please see Propensity to Cycle Tool on page XX



The ATO team successfully carried out a field trial on Line 7 of the Beijing Metro for energy-efficient automatic train speed control.

## RAIL RESEARCH

### Energy-Efficient Automatic Train Operation (ATO)

Grant holder: **Professor Ronghui Liu**

Investigator: **Dr Hongbo Ye**

Funded by: **Royal Academy of Engineering, Newton Fund**

Dates: **April 2017 to April 2019**

Coordinating partner: **Beijing Jiaotong University**

Collaborative partners: **TCT Ltd Beijing, Network Rail, First Group**

**Abstract:** The widespread development of urban railway systems in China and the rapid rise in train mileage has led to an explosion in energy consumption and carbon emissions. Beijing Metro is the city's biggest consumer of electricity. Most of the energy usage is taken by the train traction forces. The project tackles this problem by developing and testing energy-efficient Automatic Train Operation (ATO) systems based on sound optimal control theory, software verification and real-life test results. Combining the complimentary skills of two leading research groups from China and the UK on train optimal speed controls with industry enablers, we are developing energy-efficient train control methods and software that can be embedded in the train-borne ATO

systems to automatically generate individual train speed profiles in real time, according to the practical train operating situation and track conditions.

**Impact:** Reducing train traction energy will bring significant economic and environmental benefits. It is expected that the ATO system running with our optimal train control algorithm would yield 5% reduction in tractive energy consumption, an equivalent reduction of 30,000 tons of CO<sub>2</sub> emission per year for Beijing Metro.

### OPTIYARD – Optimised Real-time Yard and Network Management

Grant holder: **Professor Ronghui Liu**

Investigators: **Dr Hongbo Ye, Professor Andrew Smith, Dr Anthony Whiteing**

Funded by: **EU H2020**

Dates: **October 2017 to September 2019**

Coordinating partner: **UIC**

Website: [optiyard.eu](https://optiyard.eu)

**Abstract:** The European Commission's 2011 White Paper stated that, by 2050, rail should substantially expand its modal share over medium and long distances. This is consistent with the policy goals of expanding rail capacity, cited in both the Horizon 2020 and Shift2Rail calls. Considering the ambitious Horizon 2020 Key Performance Indicator calling for a



TrACE: Transport Analytics and Centre for Excellence in Cyprus: working towards a sustainable future in transport. (page 24)

surge in the utilisation of rail capacity within a range of 70-90%, rail yards, hubs and terminals play a key role in facilitating this step-change by contributing to a competitive, reliable and safe freight transport, thus making rail the preferred modal choice. As rail yards are the first and last points of customer experience for the physical journey, they must be easily accessible and fully adapted to efficient operations. OptiYard will provide decision support tools to infrastructure managers that will ensure a smooth transfer and optimised marshalling essential to the general efficiency of the transport chain.

OptiYard will design optimised processes for managing marshalling yards and terminals, considering their interaction with the network. The processes considered are those that have to be performed in real-time. With real-time interaction between yard and relevant network IT systems, OptiYard's software based planning and optimisation of processes will address critical operational points of the transport chain (both rail marshalling yards or as transfer points to other modes) to improve capacity and reliability. Most importantly, these improvements will enhance competitiveness whilst increasing service reliability and customer satisfaction by providing accurate and updated information.

### **RAPPORT - Real-time Accurate Positioning and Protection of Rail Transport**

Grant holder: **Dr Ronghui Liu**  
Investigators: **Dr Hongbo Ye, Dr Fangni Zhang, Professor Andrew Smith, Erik Thomasson**  
Funded by: **Innovate UK**  
Dates: **August 2017 to February 2018**  
Coordinating partner: **Incremental Solutions Ltd**  
Collaborative partners: **Network Rail, Arriva Rail North, Icomera UK**

**Abstract:** RAPPORT was an industrial research project developing technology solutions to reduce disruption and delays in UK rail. The project developed and helped bring to market a suite of innovative and revolutionary technology tools that will transform operational awareness of train locations and movements. Through the exploitation of enhanced location information and interactive mapping, RAPPORT delivered useable tools with practical operational benefits. These include accelerating accident and emergency response times to rail incidents; providing supplementary information to signallers at User-Worked Crossings to enable more accurate train location awareness and better decision making; improving service recovery procedures by presenting deeper insights into real-time delays caused by incidents.

By introducing innovative technology to existing systems provided by the collaborating partners, the project delivered a live trial of high value, low cost, state-of-the-art products with immediate use and benefit to the rail network, its users and moreover to the UK economy as a whole.

### **Smart Maintenance and the Rail Traveller Experience (SMaRTE)**

Grant holder: **Dan Johnson**  
Investigators: **Dr Fangni Zhang, Dr Kate Pangbourne, Professor Andrew Smith, Jeremy Shires**  
Funded by: **EU H2020/ S2R**  
Coordinating partner: **ITS**  
Collaborative partners: **University of Huddersfield, FIT Consulting, IST Lisbon, Fertagus, UNIFE, Luleå University of Technology, Ergoproject, UITP, London Underground Limited, Luleå Flygteknik**  
Dates: **Sept 2017 to August 2019**  
Website: [www.smart-rail.eu](http://www.smart-rail.eu)

**Abstract:** The project, Smart Maintenance and the Rail Traveller Experience, brings together two related but distinct areas of research. Smart maintenance and human factors are concerned with digitisation and the use of information to enhance decision making, either by industry players in respect of maintenance decisions, or by rail users in employing smart applications to navigate the rail system and its interaction with other modes.

The challenge of the smart maintenance stream of this work is to improve current rail maintenance systems, through the integration of predictive data analysis algorithms and online optimization tools within an improved Condition Based Maintenance strategy.

The challenge of the human factors stream of this work is to understand the current and future needs of passengers from the railway and other transport systems. These needs are characterised by rapid advances in technology and demographic change. We will consider human centred design in identifying aspects of the customer experience which could be improved and simplified through information and mobility support.

## NeTIRail

Grant holder: **Professor Andrew Smith**  
 Investigators: **Dr Manuel Ojeda-Cabral, Dr Phill Wheat, Dan Johnson, Dr Fangni Zhang, Bryan Matthews, Professor Chris Nash, Dr Thijs Dekker**

Funded by: **EU H2020**

Dates: **June 2015 – May 2018**

Co-ordinating partner: **University of Sheffield**

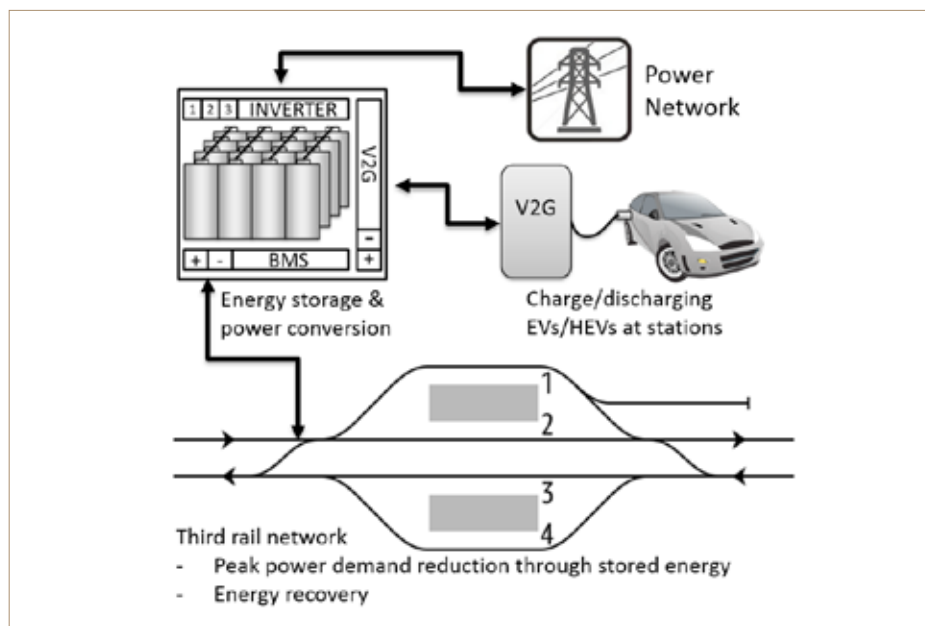
Collaborative partners: **VTI, UIC, ADS Electronic, AFER, TU Delft, IFSTTAR, TCCD, ALU-FR, Intader, SZ, RCCF**

Website: [netirail.eu](http://netirail.eu)

**Abstract:** The main purpose was 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 delivered innovative concepts of new technologies for railway operation and analysed current best practice to identify optimal solutions to be applied to different line categories across Europe. Moreover, it assessed 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 involved establishing the business case and associated cost, demand modelling and undertaking research on incentives and regulatory aspects.

**Papers:** Nash C, Matthews B, Smith A. 2018. The impact of rail industry restructuring on incentives to adopt innovation: A case study of Britain. *Proceedings of the Institution of Mechanical Engineers, Part F: Journal of Rail and Rapid Transit*.

Odolinski K and Wheat P. 2018. Dynamics in rail infrastructure provision: maintenance and renewal costs in Sweden. *Economics of Transportation*. 14, pp. 21-30.



Reducing Energy Demand - harnessing the braking energy from tracks to store in electric vehicles.

## Reducing Energy Demand (TransEnergy)

Grant holder: **Professor Andrew Smith**  
 Investigators: **Dr Jean-Christophe Thiebaud, Dr Romain Crastes dit Sourd, Alex Stead, Jeremy Shires**

Funded by: **EPSRC**

Dates: **July 2017 to July 2019**

Collaborative partner: **Mark Wardman (SYSTRA)**

Website: [www.sheffield.ac.uk/creesa/projects/transenergy](http://www.sheffield.ac.uk/creesa/projects/transenergy)

**Abstract:** The TransEnergy Road to Rail Energy Exchange project is an innovative technical and socio-economic research collaboration to provide energy buffering services to rail transport systems and electric vehicles. It will enable a step-change reduction in road and rail energy demand with attractive options to support adoption. Our contribution to this project is a major socio-economic study providing financial models and frameworks to support adoption and implementation.

## SNCF Strategic Partnership

Grant holder: **Professor Andrew Smith**  
 Investigators: **Dr Phill Wheat, Dr Jean-Christophe Thiebaud**

Funded by: **French National Railway Company (SNCF)**

Dates: **August 2017 to July 2020**

Collaborative partner: **SNCF Reseau**

**Abstract:** ITS experts are working with SNCF to develop and apply economics tools and capability to address key policy challenges. The areas identified to date include:

1. Cost benchmarking of SNCF RESEAU regional data;
2. comparison between economic and engineering model estimates of marginal cost for setting track access charges;
3. advances in marginal cost modelling techniques;
4. demand modelling – drawing on existing evidence from Great Britain;
5. drawing on best practice in respect of Social Cost Benefit Analysis towards developing a French handbook; and
6. drawing on ITS experience and expertise in assessing the economic / business case for technical innovations.

## SOCIAL & POLITICAL SCIENCE

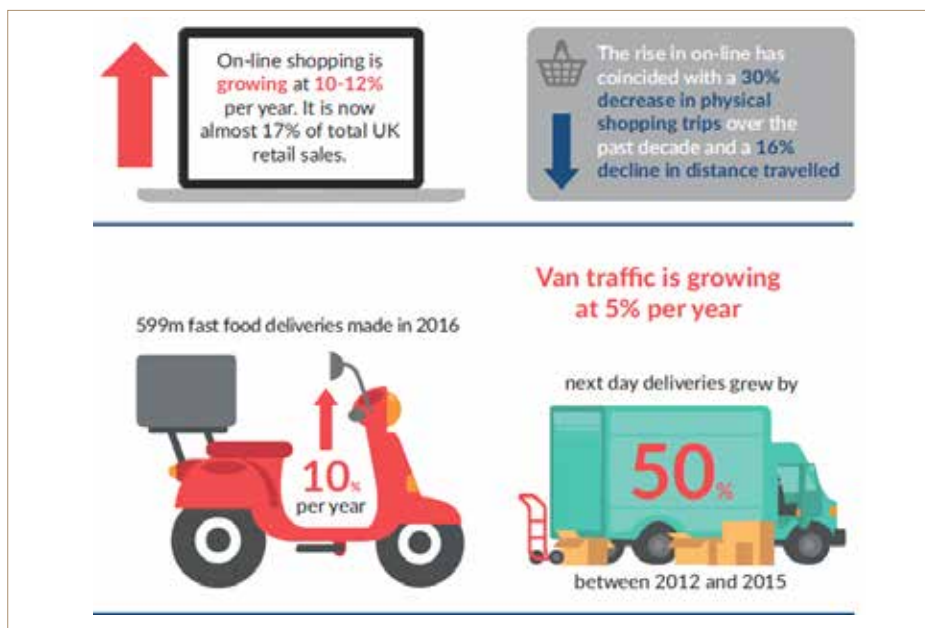
### Foresight Governance

Grant holder: **Professor Greg Marsden**  
 Funded by: **Government Office for Science**

Dates: **Sept 2017 to Feb 2018**

Collaborative partners: **University of Glasgow, Loughborough University, Alf Baird, Peter White**

Website: [www.gov.uk/government/collections/future-of-mobility](http://www.gov.uk/government/collections/future-of-mobility)



Future Streets.

**Abstract:** This study provided a rapid evidence synthesis of the governance of all forms of transport within the UK, differentiating arrangements between UK, England, Scotland, Wales and Northern Ireland and key regional or sub-regional governance arrangements. The second stage took a prospective view of future governance challenges given the changing nature of the surface transport system, including new mobility services.

**Impact:** Through expert reviews and workshops, the project has provided a key input to the Foresight Future of Mobility study, a key part of the Government's Industrial Strategy.

## Future Streets

Grant holder: **Professor Greg Marsden**  
 Investigator: **Professor Ronghui Liu**  
 Funded by: **DfT**  
 Dates: **Sept 2018 to Feb 2019**  
 Coordinating partner: **ITS**  
 Collaborative partners: **University of Glasgow, First Bus, Urban Movement**

**Abstract:** The Future Streets project is examining how the use of our streets is changing with the advent of ride-hailing, increased servicing and delivery, and new technology. The project will bring together a review of new technologies and of how the kerb side is regulated to consider the scope of potential change. These reviews will inform a simulation study of kerb side

performance under different future usage scenarios run using the ITS DRACULA model to understand under what conditions changing kerb side use impacts on general traffic flow. A design guide will be produced which integrates all of these inputs and interprets their significance for a range of different types of urban contexts. The work involves significant expert user group input to scope and validate the design guide.

## EMPOWER

Grant holder: **Professor Susan Grant-Muller**  
 Investigators: **Frances Hodgson, Dr Magda Cepeda-Zorrilla, Dr Gillian Harrison, Tom Redfern**  
 Funded by: **EU H2020**  
 Dates: **May 2015 to April 2018**  
 Coordinating partner: **Institute for Transport Studies**  
 Collaborative partners: **11 European partners (see website for details)**  
 Website: [empowerproject.eu](http://empowerproject.eu)

**Abstract:** The project investigated how to substantially reduce the use of conventionally fueled vehicles (CFVs) in cities by influencing the mobility behaviour of CFV drivers towards fundamental change. The EMPOWER approach is to reduce the use of CFVs by shifting trips to other modes/other vehicle types and promoting sharing and self-organisation to reduce demand overall. Undesirable impacts from CFV

use will be reduced via change to non-peak times and diversions to avoid particular areas or routes. To achieve this objective EMPOWER has created a set of tools for industry, policy makers and employers. These are empowering stakeholders by increasing the understanding of how to choose and successfully implement 'positive' evidence-based and cost-effective policy interventions. The EMPOWER tools are based on innovative mobility services in the context of existing infrastructure, policy and measures.

**Papers:** The website and Toolkit contain a range of summaries, published outputs and impacts.

**Impact:** The achievements of the project against its 5 objectives can be summarized as follows:

1. For the objective 'New mobility services to provide innovative positive policy measures (positive incentives)', the project developed new mobility services and technical implementations of 6 months+ duration in four living labs (LL) and seven Take-Up cities (TUCs). The research stimulated the development of mobility tracking functionality in the **Betta Points** app and desktop analytics functionality in the **Love to Ride** app and the development and implementation of the **Zwitch** app. Advisory services were provided for ICT provision in seven TUC's. Guidance notes were published for ICT tool users in delivering positive incentives schemes.
2. For the objective 'To develop an EMPOWER Toolkit to support a range of stakeholders', the architecture and interface for the Toolkit was developed with end-users in the design cycle. The Toolkit was populated guidance notes, an e-book on ethics, templates, deliverables, workshop slides and information on business models and scheme evaluation. A rich evidence data base was developed including external resources and evidence concerning positive incentives and a data 'sandpit'. This includes (anonymised) example App data, example analytics, synthetic dataset and links to an EMPOWER service (Commute Greener) API. Analysis has demonstrated the international reach of the Toolkit.

3. For the objective 'To gather evidence of the impact of positive incentives on behaviours related to CFV use', a body of evidence has been published on positive incentive impacts and to inform incentives design. The research has generated understanding and quantification of the effect of different incentives on travel behaviour, including cycling, walking and public transport use. TUCs and LLs have completed experimental work and real life implementation of positive incentive schemes. A guidance note and papers were published.
4. For the objective 'Concerning new and improved organisational models for successful implementation of positive policy measures', the development of new business models and generic templates for implementation of incentives has been completed in collaboration with TUCs/LL. Resources, training and bespoke advice were provided for individual cities. A guidance note, templates and other materials are published on the Toolkit.
5. For the objective 'To innovate in the evaluation method for new mobility services', a key piece of work involved the development of the agent-based FOUNTAIN model to allow a broader assessment of incentive scheme impacts. Assessment demonstrations for two cities were produced and model parameters for use with further cities produced and published. Guidance on the definition and measurement of vulnerability was produced, including a new index of vulnerability. Two workshops on evaluation were delivered resulting in the publication of 'Establishing a baseline' and 'Evaluation methodology'. Advisory services were provided to the seven TUC's for a practical approach to evaluation.

Exploitation of outputs included the following: Stakeholders from seven cities/regions were strongly embedded in the project following the EMPOWER TUC competition. A series of seven capacity building workshops, 2 webinars and numerous bespoke advice (written and in-person) openly offered to city stakeholders, over 70 follower organisations, the CIVITAS



RACER: Rapid Acceleration of Car Emissions Reductions.

network and other EU projects to support uptake of the outputs into policy. The EMPOWER Toolkit <https://empowertoolkit.eu/> was developed with a wide range of resource, example data and other supporting material. Ten accessible guidance notes were produced to encourage policy uptake, including an e-book containing ethical guidance and a 'brownfield' approach to ICT services, offering amends to existing Apps and adoption of locally established branding. This supports continued use and development of the EMPOWER concept/services beyond the project lifetime. EMPOWER ICT tools remain available for further uptake at subsidised cost.

Dissemination outputs exceeded those initially planned, briefly: 67 workshops & networking activities; 13 journal articles; 32 conference papers; 12 public presentations; 10 videos; 22 professional magazines / guidance notes.

### RACER (Rapid Acceleration of Car Emissions Reductions)

Grant holder: **Professor Jillian Anable**  
 Investigators: **Dr Caroline Mullen, Dr Giulio Mattioli**  
 Funded by: **EPSRC (via UK-ERC)**  
 Dates: **Oct 2016 to Sept 2018**  
 Coordinating partner: **Tyndall Centre, University of Manchester**

**Abstract:** With specific emphasis on the UK car fleet, this project tackles head-on the unprecedented mitigation challenge outlined in the Paris Agreement. With particular focus on deep and near-term mitigation, it examines the potential for the rapid penetration of highly efficient petrol and diesel models to deliver quantitative fleet-wide reductions in CO<sub>2</sub> emissions of around 50% within a single decade. Such levels of mitigation are beyond those yet countenanced, but are necessary if the UK is to play its fair role in delivering on the Paris commitments. It will proceed to develop a set of scenarios including narratives, policy mechanisms and regulatory regimes designed to equip decision makers with the wherewithal to consider seriously accelerating mitigation. Finally, it will offer a taxonomy and concise evaluation of more interventionist prospects to extend mitigation beyond existing technical and social norms.

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Baker-Graham, Alexander	ADAPT	Matthews, Bryan	Mapping Accessibility, NeTIRail, Smart Measures, SUITCEYES
Balijepalli, Chandra	STS, Uptake of E-Motorcycles	Mattioli, Giulio	UK-CREDS, RACER, Smart Measures
Barnard, Yvonne	ARCADE, AUTOPILOT, CARTRE	Merat, Natasha	ARCADE, CARTRE, City Infrastructure Engineering, Driver monitoring, Human Drive, InterACT, L3PILOT, Pedestrian Simulator, TRANSITION
Batley, Richard	DfT Robust VTTS, Programme Appraisal	Milne, David	OptiTruck
Bennet, Samuel	ADAPT	Morgan, Malcolm	Analysis of Roadworks Data, CylPT, OptiTruck, PCT
Calastri, Chiara	DECISIONS	Morganti, Eleonora	AdVANce, Smart Measures
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Daly, Michael	Driver monitoring, Human Drive, InterACT, PSI, XCYCLE	Romano, Richard	Driver monitoring, Human Drive, InterACT, Pedestrian Simulator, PSI, TRANSITION, XCYCLE
Dave, Kaushali	AUTOPILOT, OptiTruck	Shepherd, Simon	AUTOPILOT, STS, TrACE, Uptake of E-Motorcycles
De Jong, Gerard	DfT Robust VTTS	Shires, Jeremy	Reducing Energy Demand, SMaRTE, STS, XCYCLE
Dekker, Thijs	DfT Robust VTTS, NeTIRail, Ofwat, Participatory Budgets, Smart Measures	Smith, Andrew	ITF Capital Bias, NeTIRail, Ofwat, OPTIYARD, RAPPORT, Reducing Energy Demand, SMaRTE, SNCF Partnership
Giles, Oscar	InterACT, PSI, TRANSITION	Solernou Crusat, Albert	Human Drive
Grant-Muller, Susan	EMPOWER, HABITS, KARMA	Stead, Alexander	CQC Efficiency Network, ITF Capital Bias, Reducing Energy Demand
Hajiseyedjavadi, Foroogh	Human Drive	Tate, James	Air Quality projects (see ITS Annual Research Report 2017)
Harrison, Gillian	AUTOPILOT, EMPOWER, HABITS, KARMA, STS, TrACE	Thiebaud, Jean-Christophe	ITF Capital Bias, Reducing Energy Demand, SNCF Partnership
Hess, Stephane	DECISIONS	Thomasson, Erik	RAPPORT
Hibberd, Daryl	L3PILOT, NGDBM, XCYCLE	Timms, Paul	TrACE
Hodgson, Frances	EMPOWER, HABITS, KARMA	Toner, Jeremy	Crossmodal
Horrobin, Anthony	Driver monitoring, Human Drive	Torrao, Guilhermina	L3PILOT
Huang, Yue	OptiTruck	Uttley, Jim	InterACT, L3PILOT
Jamson, Hamish	Human Drive, PSI	Wadud, Zia	MANTRA, UK-CREDS
Jamson, Samantha	GameCAR	Watling, David	OptiTruck, TrACE
Jia, Dongyao	CARTRE, OptiTruck	Wei, Chongfeng	Human Drive
Jiang, Like	Land Value and Transport, Mapping Accessibility	Wheat, Phill	CQC Efficiency Network, ITF Capital Bias, NeTIRail, SNCF Partnership
Johnson, Daniel	Land Value and Transport, NeTIRail, SMaRTE, XCYCLE	Whiteing, Anthony	AdVANce, OPTIYARD, UK-CREDS
Jones, Ian	DEMAND	Ye, Hongbo	Energy Efficient ATO, OPTIYARD, RAPPORT
Jukic, Hrvoje	PSI	Zhang, Fangni	NeTIRail, RAPPORT, SMaRTE
Leahy, Chris	Land Value and Transport		
Lee, Yee Mun	Human Drive, InterACT		
Liu, Ronghui	Energy Efficient ATO, Future Streets, OPTIYARD, RAPPORT		
Louw, Tyron	Driver monitoring, Human Drive, L3PILOT		
Lovelace, Robin	Analysis of Roadworks Data, CylPT, GMOST, Greener Connectivity, PCT		
Lucas, Karen	INTALInC, Transport and Social Exclusion in African Cities		
Madigan, Ruth	InterACT		
Markkula, Gustav	Human Drive, InterACT, PSI, TRANSITION		

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