Institution: University of Aberdeen

Unit of Assessment: 12 (Engineering)

Title of case study: [IC6] The Future of Mobility as a Service

Period when the underpinning research was undertaken: 2012-2019

Details of staff conducting the underpinning research from the submitting unit:

Name(s):	**Role(s) (e.g. job title):**	**Period(s) employed by submitting HEI:**
John Nelson	Professor in Engineering (Transport Studies)	07/2007-2020
Caitlin Cottrill	Senior Lecturer, Engineering	01/2013-present
Pete Edwards	Professor in Computing Sciences	10/1988-present
John Farrington	Professor in Geography	10/1969-04/2014
Lorna Philip	Senior Lecturer in Geosciences	08/2007-present

Period when the claimed impact occurred: 2013-2020

Is this case study continued from a case study submitted in 2014? N

1. Summary of the impact (indicative maximum 100 words)

Intelligent Mobility (IM) is the optimised movement of people and goods. In the transport sector, where industry is increasingly reliant on technology and data to facilitate movement of people and services, the challenge is how to address complete end-to-end journeys, particularly in rural hard-to-access areas. At the University of Aberdeen, the Centre for Transport Research, in collaboration with the School of Natural & Computing Sciences, has undertaken innovative research which has underpinned the development of shared mobility models to enhance transport services for populations in hard to serve areas and informed UK government implementation of internet access in rural areas. The research has also contributed to the growing national interest in Mobility as a Service (MaaS), leading to GBP2,000,000 investment from government and the development of proof of concept with industry.

2. Underpinning research (indicative maximum 500 words)

Intelligent Mobility (IM) – using novel ideas and new innovative technologies to transport people and goods in an easier, more efficient and more environmentally-friendly way – is a growing global market. In fact, research has shown that, by 2030, this global industry could be worth as much as GBP1,400,000,000,000, bringing benefits to governments, corporations, and the travelling public around the world. Whilst urban residents will be able to take advantage of new mobility services – which depend on reliable and equitable digital access – rural communities, including those in the UK, will be far less able to benefit fully from these advances, as a result of poor digital and physical connectivity.

Expanding capability and embracing technology-centred services can bring certain challenges such as developing effective communication networks with passengers on social media and providing an enhanced customer experience whilst protecting the privacy of their personal data. Multi-disciplinary research at Aberdeen's Centre for Transport Research (CTR) has brought together experts from Transport, Engineering (Nelson, Cottrill) and Computing Science (Edwards) in order to facilitate better understanding amongst policymakers and industry representatives of how people– in different settings (urban/ rural) – will benefit from and adapt to IM.

Research led by CTR has been carried out in four main areas:

1. Understanding the basis of digital exclusion **[P1, P6]:**

Research led by CTR (Nelson, Edwards, Cottrill, Farrington) under the Rural Digital Economy Hub (funded from the Research Councils UK's Digital Economy Programme, led by the EPSRC) [P1] examined instances of digital exclusion in rural areas of the UK [3] and its impact on the availability of IM services to these traditionally under-served populations [1]. Importantly, the research showed that digital limitations could act as a considerable barrier to implementing more efficient mobility practices across the UK, and that providing accessibility and connectivity to rural communities presented significant challenges because of combined problems of transport poverty and digital exclusion [3]. These problems were found to include a strong technological/ technical component common to both the transport and digital spheres in terms of the quality and availability of infrastructure and services [1]. In 2017, Cottrill was commissioned by Foresight, UK Government Office for Science, to outline the potential long-term implications of these connectivity limitations for transport and mobility opportunities in the UK [P6, S6]. Cottrill outlined opportunities for enabling more inclusive access such as the development of adequate digital skills across end users to ensure widespread uptake of digital transport services, development of a workforce with more targeted digital skills to ensure the continuing design and implementation of digital transport systems and data management/handling as a key component of transport network design, development and implementation [P6].

2a. Understanding efficient information provision **[P2]:**

As part of an ESRC funded project, through a linked series of interdisciplinary studies using semi-structured interviews and qualitative analysis [P2], CTR (Nelson, Edwards, Cottrill) addressed issues of transport information provision through analysis of social media data [4], and ethnographic evaluation of passenger experience [2], leading to the development of 'TravelBot' a Twitter-based tool for sending, receiving and sharing travel disruption information in collaboration with FirstGroup, the world's largest public transport operator [7]. Via the Twitter application programming interface (API), the team developed a Twitter Monitoring Infrastructure to collect the Tweets sent from and mentioning the accounts of subsidiary companies. By applying content analysis to the data, they demonstrated as proof of principle, that information sharing between passengers and transport providers using mobile phones and digital social media can significantly improve passenger satisfaction using minimal digital resources. The research found that this was particularly important in rural areas as it helped to overcome transport information limitations and improved access to the available transport supply [7].

2b. Proof of concept studies **[P4]:**

The EU Horizon 2020 'Easily diStributed Personal RapId Transit' (ESPRIT) project [P4] led by the French Alternative Energies and Atomic Energy Commission (CEA) was an innovative 16-partner pan-EU collaboration to develop purpose-built, lightweight, stackable electric vehicles. As part of this project, CTR (Nelson) led work on work package 8: the dissemination, demonstration and exploitation activities of the project in preparation for commercialising the ESPRIT concept as part of its 'realisation' phase. As a proof of concept, Nelson worked with research partners FirstGroup to develop lightweight, stackable electric vehicles designed for efficient one-way car-sharing journeys in areas difficult to serve by public transport [5]. Prototypes of the vehicles were successfully demonstrated in France (Lyon), Spain (Barcelona) and Glasgow in 2018 with commercial exploitation expected by 2022.

2c. Travel Demand **[P5]:**

SocialCar, a Horizon2020 project [P5] coordinated by FIT Consulting SRL (Italy) aimed to develop a new communication network for IM that would share carpooling information integrated with existing transport and mobility systems in order to provide end-users with a simplified travel experience and allow comparison and choice between multiple travel options. CTR research (Nelson, Cottrill) underpinned the development of a new journey planning App (*RideMyRoute*), available on the App store. Whilst this was a concept phase project it has outlined the potential long-term implications of connectivity limitations for transport and mobility opportunities in the UK and identified opportunities for enabling more inclusive access in rural area [6]. By introducing a new intermodal trip planning algorithm and supporting data structure, CTR staff contributed to

outlining features that could increase the attractiveness of MaaS options in suburban markets. The app, trialled in four European test sites, demonstrated capacity to suggest trip planning solutions and that 85% of these solutions involved connection from carpool to public transport. The project brought together ITS developers, social scientists, economists, transport engineers, car-poolers and public authorities from the UK and 12 other European countries.

3. References to the research (indicative maximum of six references)

References:

[1] Velaga, N.R., Beecroft, M., **Nelson, J.D**., Corsar, D. and **Edwards, P**., 2012. Transport poverty meets the digital divide: accessibility and connectivity in rural communities. *Journal of Transport Geography*, *21*, pp.102-112. DOI: https://doi.org/10.1016/j.jtrangeo.2011.12.005

[2] Gault, P., Corsar, D., **Edwards, P**., **Nelson, J.D**. and **Cottrill, C**., 2014, October. You'll never ride alone: the role of social media in supporting the bus passenger experience. In *Ethnographic Praxis in Industry Conference Proceedings* (Vol. 2014, No. 1, pp. 199-212). DOI: 10.1111/1559-8918.01027

[3] **Farrington, J., Philip, L**., **Cottrill, C**., Abbott, P., Blank, G. and Dutton, W.H., 2015. Two-speed Britain: Rural internet use. *Available at SSRN 2645771*. DOI: https://dx.doi.org/10.2139/ssrn.2645771

[4] **Cottrill, C**., Gault, P., Yeboah, G., **Nelson, J.D**., Anable, J. and Budd, T., 2017. Tweeting Transit: An examination of social media strategies for transport information management during a large event. *Transportation Research Part C: Emerging Technologies*, *77*, pp.421-432. DOI: https://doi.org/10.1016/j.trc.2017.02.008

[5] Mounce, R. and **Nelson, J.D**., 2019. On the potential for one-way electric vehicle car-sharing in future mobility systems. *Transportation Research Part A: Policy and Practice*, *120*, pp.17-30. DOI: 10.1016/j.tra.2018.12.003

[6] Wright, S., **Nelson, J.D**. and **Cottrill, C.D**, 2020. MaaS for the suburban market: Incorporating carpooling in the mix. *Transportation Research Part A: Policy and Practice*, *131*, pp.206-218. DOI: https://doi.org/10.1016/j.tra.2019.09.034

[7] Gault, P., **Cottrill, C.D**., Corsar, D., **Edwards, P**., **Nelson, J.D**., Markovic, M., Mehdi, M. and Sripada, S., 2019. TravelBot: Utilising social media dialogue to provide journey disruption alerts. *Transportation Research Interdisciplinary Perspectives*, *3*, p.100062. DOI: https://doi.org/10.1016/j.trip.2019.100062

4. Details of the impact (indicative maximum 750 words)

Intelligent mobility has the potential to transform the ways we move people and goods. Research at the University of Aberdeen has shed new light on the development and provision of new transport services, particularly in relation to rural communities and passenger experience. This research has informed digital infrastructure requirements in the UK, raised awareness of innovation in transport services, secured investment from the Scottish government to pilot new services, and enabled operators and industries to rationalise the transition to IM.

Creating an evidence base for national digital policy decisions
Through research on Internet access and use in rural and urban areas in the UK [3], CTR has raised awareness of the impact of low-speed broadband connection on people's use of the internet, highlighting the implications for availability of IM to both policymakers and industry in collaboration with the University of Oxford Internet Institute (OxIS), which releases a biannual survey of internet use. The portion of the OxIS 2011 sample that falls within areas defined by UK, Scottish and Welsh administrations as being in some degree 'rural' or 'remote rural' is about 200 individuals - insufficient to provide a sound basis for large-scale generalisations about rural Internet use and the effect on the potential for Digital Economy in rural Britain.

CTR collaborated with OxIS to release the 2013 Oxford Internet Survey, which directly engaged with users by conducting interviews with a representative sample of 800 rural residents across Britain, ensuring robust analysis of the data generated in order to gain better understanding of barriers to Internet use related to, for example, age, income, education, and location-specific technology limitations [3]. The survey was launched following a workshop in October 2013, where findings were discussed with speakers from Ofcom and the Scottish Government. In 2019, Oxford Internet Survey released a follow-up survey supported by the Department of Digital, Culture, Media and Sport, Google Inc. and BT, stating that '*the oversample (from the 2013 survey) was critical since there are a relatively small proportion of deep rural households in Britain*' [S1].

In 2013, CTR was invited to submit written evidence to a small-scale enquiry led by the Department for Environment, Food and Rural Affairs (Defra) titled 'Rural Broadband and digital-only services', the outcome of which was to ensure the 'hardest to reach' would be given priority access to broadband [S2]. The inquiry was updated and broadened (2017-2019), concluding that current Government policy had failed to reduce the digital divide between urban and rural areas. The report drew on Aberdeen research to highlight digital public services such as farm governance activities as being one of the areas being affected by lack of digital infrastructure [S3; 60, p15] to underpin recommendation 7 [S3; '*future digital services policies should reflect "needs not numbers" to ensure that the rural minority had the same digital opportunities as the urban majority*'. [S3; 73, p16] In March 2020, the UK Government issued an official response to the committee's findings agreeing that 'Government must actively monitor, encourage, and where appropriate, intervene to ensure that rural areas are not left behind and that any 'digital' divide between rural and urban areas can be closed', confirming that in response to recommendation 7, that the development team 'is already undertaking user research with farmers with no internet connection and poor mobile phone connectivity' [S4].

CTR (Cottrill) was a key contributor to the underpinning evidence-based study that underpins the Transport Systems Catapult 2016 report, 'Intelligent Mobility Skills Strategy' (https://ts.catapult.org.uk/imskills/), which was cited in Parliament in 2017, with Dr Yolande Herbath, the Catapult's strategic lead, informing debate and the government round table on future skills. The University of Aberdeen's Centre for Transport Research (CTR) was involved with the Transport Systems Catapult (TSC) under the University Partner Programme (UPP) from 2014 to 2017 [P3]. During this time, CTR undertook a significant range of activities with the Catapult and external partners, including organising and leading knowledge exchange activities and facilitating connections with partners in Scotland. These activities drew upon findings from research conducted by CTR with core relevance to intelligent mobility and contributed to activities undertaken by TSC.

As a direct impact of the IM Skills Strategy, the Department for Transport commissioned the Connected Places Catapult (the TSC's successor organisation) to undertake a study on foresighting the Future of Transport Skills, the outcomes of which will be published in Spring, 2021

(https://bit.ly/3eozqyr). The Automotive Council's Skills Working Group revisited its governance arrangements (2020) reflecting shifting their focus from short-term solutions to plug gaps and address immediate stressors to the longer term horizon [S5].

In 2018, Cottrill was commissioned by the UK government's Foresight Future of Mobility Project to prepare a report titled, 'Data and Digital Systems for UK Transport: Change and its Implications' [S6], which is cited as commissioned work, underpinning the report titled, 'A time of unprecedented change in the transport system: The Future of Mobility' (2019) prepared by the office of Sir Patrick Vallance (Government Chief Scientific Advisor since 2018) [S7] to 'inform the UK's response to a range of challenges and opportunities'.

Securing government investment to pilot Mobility as a Service (MaaS)

Aberdeen CTR has adopted an interdisciplinary approach in line with MaaS Scotland (Mobility as a Service (MaaS) Alliance Scotland), which is a network of 75 public and private organisations operating across the MaaS supply chain in Scotland. MaaS Scotland is a partnership between Technology Scotland and ScotlandIS and brings together businesses in the transport sector to share knowledge and develop joint projects to demonstrate the commercial, environmental and social advantages of MaaS. MaaS Scotland therefore plays a major role in the evolving development of IM, based on research findings that incorporate improved information systems and better integration of transport supply and demand.

In 2018, MaaS Scotland submitted a paper to the Scottish Government calling for investment to support MaaS pilot projects throughout Scotland. As a result of the research, the Scottish Government made an investment of GBP2,000,000 in 2019, administered through Transport Scotland, to support the development of these pilot projects. Alongside the fund, a Scottish Government working group was established to develop and scope how the investment should be spent, which included identifying thematic areas, refining evaluation criteria, and ensuring maximum engagement from industry partners. CTR, through one of its PhD students, provided an important voice to this group, helping to create a programme that looks set to significantly advance MaaS development and deployment in Scotland. According to the Chief Executive Officer for Technology Scotland:

'*CTR has been central to the creation of a separate working group on rural MaaS. This is a hugely important subject, particularly in Scotland where the rural economy plays such an important role.*' [S8]

Enabling operators and industry to rationalise the transition to IM

Central to the IM concept is journey planning, which includes the need to integrate existing data sources and formats. Nelson, Cottrill and colleagues worked with FirstGroup plc, the leading provider of transport services in the UK and North America, to develop a social media strategy to provide journey disruption alerts. FirstGroup have confirmed that CTR's research has influenced both their engagement with research and helped to provide a roadmap for market readiness, stating that CTR '*have assisted First in its understanding of the scope for, and application, of innovative public transport solutions in real world scenarios. These form part of our wider objective, to achieve growth in use of and modal shift to public transport*' [S9].

5. Sources to corroborate the impact (indicative maximum of 10 references)

[S1] Oxford Internet Survey, 2019 – see page 30
[S2] 'Rural Broadband and digital-only services', Defra report (2014)
[S3] 'Rural Broadband and digital-only services', Defra report (2019)
[S4] UK government response to Defra report (2020)
[S5] Testimonial letter from Connected Places Catapult
[S6] Foresight Commissioned report (2018)
[S7] 'The Future of Mobility' report, Government Chief Scientific Advisor (2019)
[S8] Testimonial, Chief Executive Officer for Technology Scotland and press release: https://maas-scotland.com/scottish-government-commits-to-2m-maas-investment-fund/ (2018)
[S9] Testimonial, UK Director of Strategy, Head of Policy and Managing Director of the UK (FirstGroup)