CASE STUDY

DeMAND

Transport modelling to highlight new routes for urban mobility

WHO WE ARE

The Connected Places Catapult (CPC) is an independent, trusted, expert broker operating at the intersection between the public and private sectors and between local, regional and national decision making. We promote UK innovation and broker relationships between government, academia and industry providing support and solutions for innovators to commercialise their projects and research. With our deep expertise in technology, we bridge the gap between buyers, suppliers, innovators and industry. Our agile approach enables us to convene our partners to act rapidly to create new market collaborations responding to public funders and industry needs. We boost demand for innovation to unlock wider economic and environmental benefits.

> **CPC has spearhead the transport modelling community in the development of agent-based models. The use of mobile phone data and the methodology developed in this project will catapult the industry into the new realm of alternative transport modelling.**
>
> **Nila Sari** – Principal Transport Modeller, Department for Transport

> **Our work with Connected Places Catapult has showcased how unique aspects of mobile network data, in this instance activity-chains, can be used to build synthetic populations to better understand how populations move and behave. We're delighted to collaborate with CPC to combine their agent-based modelling expertise with our mobile network data expertise to develop new and innovative mobility solutions.**
>
> **Chris Wroe** – Head of Data and Analytics, O2 Motion, Telefonica UK

Challenge

Local and transport authorities in the UK currently are unable to assess the impact that New Mobility Services, Demand Responsive Transport and Mobility as a Service might have on travel behaviours. Autonomy and flexibility are changing the way we travel. However, the transport models used by Local Authorities to assess the demand for travel are unable to consider the full complexity of travellers' needs and the contribution shared mobility makes in a well-established public transport system. The shared mobility market is entirely technology-driven and is growing exponentially. None of the new mobility services have demonstrated to be commercially viable in the long-term.

A key change from traditional transport models is the need to represent the door-to-door users' journeys and the multimodality where on demand shared mobility services are integrated with fixed scheduled public transport systems. Department for Transport (DfT) is looking at new methods to predict the demand for new mobility services and provide Local Authorities with tools to set up multimodal and seamless integrated solutions helping users to travel smarter.

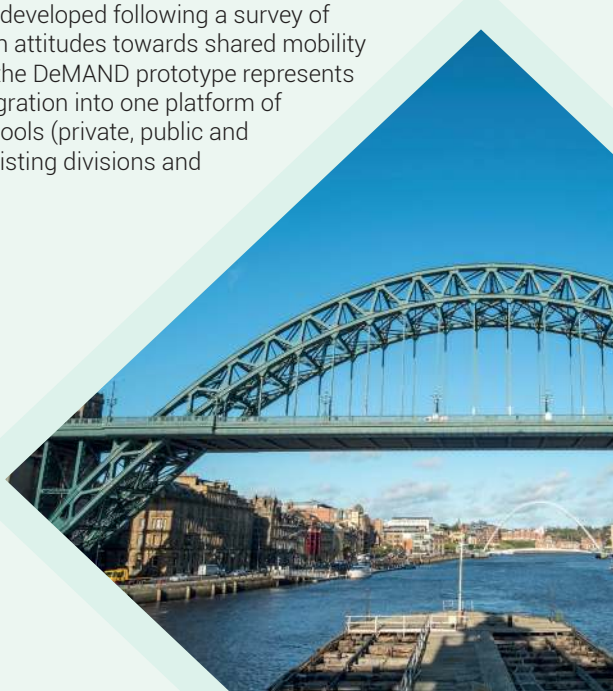
Solution

The 2019 DeMAND project developed a large-scale agent-based model, which represents a digital twin for the Tyne and Wear and is best placed to appraise the changes in travel behaviours when new technologies or trends emerge. This can either be the introduction of a new mode of transport, such as shared mobility, e-scooters and bike sharing schemes or digitally powered Demand Responsive Transport.

Tyne and Wear was selected as the study area for the urban prototype to maximise the transferability of the modelling tool. The region has the lowest car ownership in the UK and a preference for using public transport. The multimodal public transport has the highest bus use per head of population in the North of England and extends to the Tyne and Wear Metro, 844 bus services and 230 rail services, the Shields Ferry and Newcastle International Airport.

The DEMAND model represents a synthetic population of nearly 650,000 agents (individual people) replicating the transport choices and preferences within Tyne and Wear. Each agent bears the socio-demographics characteristics, spatial information and daily activity schedules thanks to the use of anonymised and aggregated mobile network data, sourced from O2Motion (Telefonica).

Mobile Network Data provides up-to-the minute insights on travel demand and the complex variability of people's travel behaviour plus the additional demand coming from logistics activities at local and national level as lorry and van drivers are also captured. The methodology used applies machine learning to speed up the data analytics. It includes preference for shared mobility services gathered from two behavioural models developed following a survey of residents providing insights on attitudes towards shared mobility in Tyne and Wear. Ultimately, the DeMAND prototype represents the first step towards the integration into one platform of different transport modelling tools (private, public and freight transport) removing existing divisions and siloed approaches.



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Department of Science

Outcomes

An open source-based platform MATSim (Multi-Agent Transport Simulation) has been used to create the agent-based model enabling transport demand and population behaviour to be simulated. A key innovation is large-scale modelling applied together with an activity-based approach to replicate daily movements of people, involving different modes and more than one origin and destination per agent. The model allows for the testing of different policy interventions and the demand for new mobility services in isolation or when integrated with existing fixed scheduled PT services (Rail and Bus.) This maximises the benefit for users and operators.

The prototype generated valuable insights for Nexus, the Tyne and Wear Passenger Transport Executive, which supported the project. Nexus will use these insights to unlock innovation in the region and to support the North East Combined Authority Future of Mobility strategy.

Key characteristics of the model are:

- Synthetic Population of 647,768 agents (58% of total population) thanks to the large sample provided by mobile network data with a complex travel pattern (from internal trips to 21 trips in one day);
- Agent-based model built for an average weekday at higher spatial and temporal granularity to study behavioural changes after the introduction of mobility service across the 24 hours;
- Demand for travel segmented by purpose (home, work, education, leisure, logistics defined as local and long distribution) and modes of transport (car, active travel, bus, underground and rail);
- Agents' characteristics derived by socio-demographics information (age, gender, income). Their transport choice and decision process are integrated in the agent-based model thanks to behavioural models developed from data gathered from a survey of residents.

The analysis of the survey results revealed residents' attitudes towards shared mobility:

- Early adopters of the shared service are car drivers ('Older less mobile car owners' and 'Town and rural heavy car use' as defined using the DfT population segments). Those with an higher value of time (travelling for work) are less likely to choose shared transport;
- Although initial uptake of shared mobility in case of introduction of a new service will be 8%, shared mobility rapidly generates trust in customers;
- To reduce the anxiety linked to the travel time uncertainties, results from the behavioural models suggests the adoption of a short walk to reach pick-up points rather than provision of a door-to-door service to users.

CPC creates value

- CPC has been recognised as a leader in innovation and thought leadership in the Intelligent Transport Systems and the uses of big data winning the Industry Award for 2019 for Europe, Middle East and Africa during the ITS World Congress Hall of Fame.
- The CPC Modelling Team have built up unique experience in the use of Mobile Network Data achieving quick generation of synthetic population for agent-based modelling. Also, the relationship developed with the O2 Motion team (Telefonica) allowed to open the market for the activity-chains dataset.

Benefits

- Enables DfT to shape the evolution of future demand models.
- Provides DfT with a new methodology to assess and appraise new technologies and trends, and the demand for emerging on-demand mobility services and MaaS schemes.
- Introduces a culture of sharing and collaboration with other organisations and demonstrates the transferability of the modelling tools.
- Advances the use of machine learning to quickly generate a synthetic population using MND.

The Connected Places Catapult recognises that agent-based models, like the one developed in DeMAND, are the next steps for modelling demand for travel. Further investment is required to develop the tools needed to a standard which will inspire confidence in a wider adoption. We see a need for two types of demonstrators:

Urban: Defined by a data-rich environment where legacy dataset will need to be integrated with new generation big datasets, Mobile Phone Network Data, sensors and Internet of Things (DeMAND Project)

Rural: Where all legacy datasets are present but often outdated and not reflecting the current travel patterns from users. Location-based data can help to rapidly generate more recent travel patterns. (AsSeTS for Rural Mobility Project)

CPC continues to work with Nexus to help them derive value from this model and will work with local authorities and universities to exploit the DeMAND agent-based model methodology and outputs and support the uptake of agent-based modelling in transport.

To find out more about the Connected Places Catapult and how we can help you develop the future skills that address the needs of your organisation please contact ***info@cp.catapult.org.uk***

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