

IMPACT: Improving flood disrupted road networks with a dynamic people-Centric digital Twins

Dr Qiuchen Lu, Associate Professor at the Bartlett School of Sustainable Management, UCL



Introduction

The effects of climate change have resulted in record rainfall, which significantly disrupts road networks and transportation, causing damage to infrastructure, road closures, increased travel times, and potential economic and social impacts.

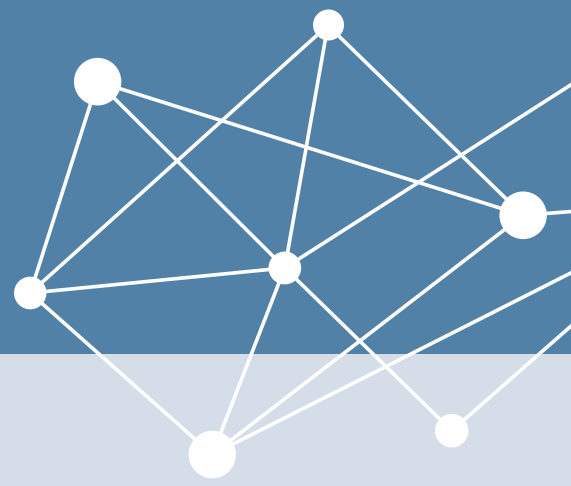
This project looked into Improving flood disrupted road networks with a dynamic people-Centric digital Twins (IMPACT), developing an innovative people-centric digital twin (DT) to evaluate the dynamic congestion risks across multiple transportation modes during flooding events.

The digital twin was comprised of three distinct layers:

- The Data and Context layer integrates and contextualises primary multimodal data, encompassing road networks, commuter behaviour patterns, and diverse traffic flows.
- The Mapping and Integration layer establishes connections between topological analyses of road networks and the functional performance of multimodal transport systems.
- The Evaluation layer introduces novel indicators for assessing vulnerabilities.



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Who's involved?

Dr Qiuchen Lu, Associate Professor at the Bartlett School of Sustainable Management, UCL and Royal Academy of Engineering/Leverhulme Trust Research Fellow at the Royal Academy of Engineering, and **Professor Tao Cheng**, Professor in Geoinformatics, SpaceTimeLab, UCL & Group Lead at the Alan Turing Institute.

When did the project start and finish?

The project began in April 2024 and completed at the end of January 2025.

Key challenges this project sought to solve

There were three main challenges:

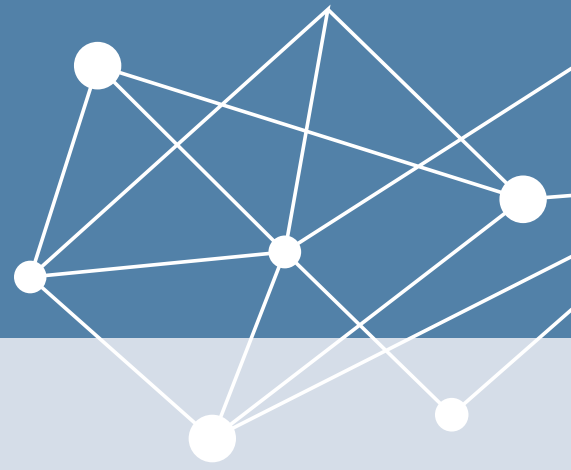
- Wanting to analyse the risk in a dynamic way, a need highlighted after interviewing many different stakeholders, such as London Resilience Groups and Transport for London (TfL).
- Cross-domain integration — as analysing transportation and urban flooding is difficult, as there are so many areas in London to include and therefore cover from the chosen designated area of King's Cross to Farringdon. The team needed to integrate all their findings together to showcase user characteristics and different economies.
- Currently there is no study that focuses on the multimodal nature of urban flooding, so the team wanted to resolve this as well as provide a risk analysis.

What was the key aim of the project?

The team wished to examine how digital technologies can improve the resilience of the transportation network during flooding by focusing on transportation in one of the busiest parts of London – King's Cross to Farringdon. Three different modes of transportation were used – car, bicycle, bus – to model how these meet the risk of resilience.



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What did DAFNI allow you to do that you couldn't otherwise have achieved?

It was important for the team to build connections with the DAFNI team and use a platform that is excellent in supporting data sharing strategies. It can be very difficult for researchers to obtain the data they need and the IMPACT team are willing to share their data as a benefit for all researchers in infrastructure resilience worldwide, not just in the UK.



"We learnt how the platform is run, how we can contribute to the platform and in turn how the platform can contribute to our research", said Dr Liu, Associate Professor at the Bartlett School of Sustainable Management, UCL. ***The DAFNI platform can help not just academic researchers but also people working in industry and government as it is excellent for collaboration, and a channel for all of us to build and maintain these collaborations. DAFNI embraces the differences in data and modelling which have benefitted this project so much and we hope to continue a longer-term collaboration with DAFNI."***



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What outputs from the project will you share?

The findings were presented as a poster at the DAFNI-DINI showcase in March 2025 and two journal papers have been written – one has been accepted and the other is under review.

All the multimodal data from King's Cross to Farringdon is uploaded on DAFNI and will be shared once the paper has been published.

How do you anticipate other researchers, policymakers and stakeholders using this work?

Digital Roads of the Future in Cambridge is the stakeholder in partnership with Dr Liu and Professor Cheng, which covers many different partnerships and groups in both government and industry. The team are keen to showcase their work through Future Road's channels and engage in further discussions in preparation for potential collaboration with Transport for London.

What would you identify as the main impact of this work?

The results will be confirmed once the team's submitted paper is published, however the project has already been attracting a lot of interest, particularly from the hub, Transportation Resilience, as well as other transport organisations and researchers.

How could this work benefit society as a whole?

This work will help to improve the resilience of transportation networks.

Next steps

The team have already applied to continue their project with DAFNI and hope to continue developments and follow on from the results.

