REF2021

Institution: University of Leeds

Unit of Assessment: UOA 14

Title of case study: Cycle network policy, planning and investment transformed by the Propensity to Cycle Tool

Period when the underpinning research was undertaken: Jan 2015 to June 2020

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:
Dr Robin Lovelace	Asst. Prof. Transport Data Science	2013 - present
Dr Malcolm Morgan	Research Fellow	2015 - present
Dr Joseph Talbot	Research Fellow	2019 - present
Professor Mark Birkin	Prof. of Spatial Analysis & Policy	1981 - present
Professor Martin Clarke	Prof. of Geographic Modelling	1976 - 2018

Period when the claimed impact occurred: March 2016 to December 2020

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

1. Summary of the impact (indicative maximum 100 words)
The Propensity to Cycle Tool (PCT) has revolutionised strategic cycle planning in England and Wales. This evidence-based tool quantifies cycling potential at national, city and street scales, leading to the creation of joined-up networks available to millions of people. The PCT has been used by >35,000 transport planners, consultants, advocates and members of the public, directly influencing the design and construction of cost-effective cycle networks worth >GBP500,000,000. The tool informed the majority of UK local authority applications to the GBP250,000,000 government COVID-19 Emergency Active Travel Fund. Planners across Europe, USA, Australia and New Zealand have adopted the approach internationally.

2. Underpinning research (indicative maximum 500 words)
The UK government is committed to doubling cycling by 2025, in response to growing health, air pollution and climate crises. Transport planners, policy-makers and other stakeholders require robust evidence on cycling potential to inform the investments in cycling infrastructure needed to deliver this policy aim **[1]**. Many cities in the UK and worldwide lack integrated evidence on transport pathways, topography and potential user demographics to optimise the planning of 'whole bicycling network' approaches. Our research, in collaboration with Prof. Rachel Aldred (Westminster) and colleagues, identified the major barriers preventing such an approach in England **[2]** and led to the development of the Propensity to Cycle Tool (PCT).

The PCT project tackled structural problems on a national scale, building new concepts, methods and open-source software for evidence-based transport planning. The multi-disciplinary and multi-institution (Universities of Leeds, Cambridge, Westminster and LSHTM) project ran in four phases from January 2015 until present, with a total investment from the UK's Department for Transport (DfT) of GBP497,000, and additional ESRC Consumer Data Research Centre (CDRC) funding. Dr Robin Lovelace initiated the project and led the development of the PCT, leading to the deployment of a web application that has had >35,000 users since 2017.

Based on origin-destination data, the PCT models cyclists' use of infrastructure for current levels of cycling and scenario-based 'cycling futures' **[1, 2]**. Four scenarios are presented to users of

the tool. These include 'Go Dutch' and 'Ebikes', which explore futures in which cycling becomes as popular in the UK as it is in The Netherlands, and the impacts of electric cycles on cycling uptake. The cost effectiveness of investment depends not only on the number of additional trips cycled, but on wider impacts such as health and carbon benefits. The PCT reports these at area, desire line, route level and route networks for each scenario, building the strategic case for change. The underlying origin-destination and route network modelling methods developed at Leeds received funding (GBP118,000) from the DfT **[1]**.

A unique and highly innovative aspect of the PCT is its provision of travel data at high resolution, down to the street level, based on underpinning research modelling origin-destination data across large geographic regions using novel 'Big Data' sources **[3]**. Building on this work, Dr Lovelace and colleagues at Leeds created the computational architecture and software that enabled the tool to be scaled-up **[4]**. This led to a follow-on DfT contract (GBP240,000) to deploy the methods nationally. The new computational methods for transport planning underlying the PCT's codebase were peer-reviewed and published in the open source *stplanr* software package, enabling access and use by researchers and decision-makers worldwide **[4]**. *stplanr* is now in the top 15% of 16,000 R Project for Statistical Computing packages by global downloads (88,000 to date). Additional methods for processing geographic data representing transport routes were developed. A new algorithm called *overline* was developed in Leeds to efficiently convert transport routes into a route network layer, underpinning the PCT's policy-relevance **[5]**. The algorithm enabled provision of map layers visualising current and potential future cycling levels on roads in a way that scales nationally.

Key elements of the PCT's design are its flexibility, such as enabling modifications to calculate safe routes to school for the whole of England. Additionally, being an open-access transport model means it has been used by multiple stakeholders. In response to the coronavirus pandemic, the approach was adapted in collaboration with Lucas-Smith (CycleStreets) to prioritise new pop-up cycleways on roads with the highest propensities for cycling, by reallocating space on wide roads or pavements to create new cycle ways and underpinning the national Rapid Cycleway Prioritisation Tool **[6]**.

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

[1] Lovelace, R., Goodman, A., Aldred, R., Berkoff, N., Abbas, A. & Woodcock, J. 2017. The Propensity to Cycle Tool: An open source online system for sustainable transport planning. *Journal of Transport and Land Use* 10 (1): 505–528 [*Describes the approach underpinning the PCT, publicly available at www.pct.bike, and the vision for open-access transport planning tools*]

[2] Aldred, R., Watson, T., **Lovelace, R.** & Woodcock, J. 2017. Barriers to investing in cycling: Stakeholder views from England. *Transportation Research Part A: Policy and Practice* 128: 149-159 [*Examines barriers to effective investment in cycling underpinning the PCT*]

[3] Lovelace, R., Birkin, M., Cross, P. & **Clarke, M.** 2016. From Big Noise to Big Data: Toward the Verification of Large Data sets for Understanding Regional Retail Flows. *Geographical Analysis* 48: 59–81. [*Development of methods and concepts for using large datasets in movement research*]

[4] Lovelace, R. & Ellison, R. 2018. stplanr: A Package for Transport Planning. *The R Journal* 10: 7–23. [*Paper describing software underlying the PCT*]

[5] Morgan, M., **Lovelace, R.** 2020. Travel flow aggregation: nationally scalable methods for interactive and online visualisation of transport behaviour at the road network level. *Environment & Planning B: Planning & Design:* DOI: 10.1177/2399808320942779 [*Methods for visualising data that underpin the route network layer in the PCT*]

[6] Lovelace, R., Talbot, J., Morgan, M., Lucas-Smith, M. 2020. Methods to Prioritise Pop-up Active Transport Infrastructure. *Transport Findings* 13421: DOI: 10.32866/001c.13421 [*Methods for prioritising investment in pop-up cycleways in response to COVID-19*]

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

The PCT has become the **main government-endorsed tool for strategic cycle network planning** across England. The PCT has led to the construction of joined-up regional cycle networks in towns and cities **[A]** and has been used by campaign groups and national, regional and local government involved in cycling planning, investment and advocacy **[B]**.

Informed by our research, the former Minister of State at the Department for Transport explained how the DfT now "*encourages all Local Authorities to follow the LCWIP* [Local Cycling and Walking Infrastructure Plans] *guidance by taking a whole network approach to planning and prioritising schemes. All Local Transport Authorities are able to access a range of planning tools, such as the Propensity to Cycle Tool*" **[A]**. The tool's value was acknowledged by the then Secretary of State for Transport in the Cycling and Walking Infrastructure Strategy (2017), part of the Infrastructure Act (2015), explaining how local authorities should use the tool: "*The Propensity to Cycle Tool can assist with the preparation of Local Cycling and Walking Infrastructure Plans...in defining potential demand for cycling, identifying the most promising routes and areas for investment, and estimating future capacity needs for route and area-based measures*" **[C]**.

The Policy Director at Cycling UK explained how the "*DfT's decision to back the PCT marked the start of a major change of approach in UK cycle planning. Before the PCT, UK cycle planning had mostly been done on a piecemeal basis*" **[B]**. From 2017 onwards, CyclingUK promoted PCT "*as a tool for local cycling advocates to engage in a positive dialogue with their local authorities, to help shape their local cycle network plans, prioritise schemes and help their local authorities in securing investment...as part of the LCWIP process. The Department* [DfT] *has since provided funding for a consortium of organisations (including Cycling UK, as well as Sustrans, Living Streets and two private sector consultancies) to support councils to develop their LCWIPs. This includes supporting them in the use of the PCT.*" **[B]**

The PCT has been **used by the majority (at least 57 of 79) local transport authorities in England and Wales [D], and private sector transport planning consultancies for their work on cycling investment plans [A, D]**. The PCT ensures that investment is spent cost-effectively to create joined-up networks where cycling potential is high. Examples include:

- Transport for Greater Manchester (TfGM), which used the PCT's "Go Dutch" scenario (19% of commute trips and 41% of school travel trips made by cycling) to inform its near-term GBP160,000,000 cycling strategy. The first route chosen for construction based on the tool (Chorlton-Manchester cycle way) aimed to "*improve the lives of 30,000 residents*" and this has been followed up with a further construction project (Oxford Road in Manchester). "*Without support from the tool and the resulting robust case, the project would likely not have been funded*" (TfGM infrastructure lead **[E]**).
- Liverpool City Region, where the PCT was central to the business case that secured a major (GBP16,000,000) European project, by providing strong evidence to locate the 55 km of cycleways that will be built as a result of the investment. The Development Manager, Merseytravel **[F]** confirmed that "*projects that the PCT has informed currently have a value of over £100m, covering a network of 31 cycle corridors, as part of the LCWIP. The PCT has been used to help develop a vision of and ambition for a future in which cycling grows dramatically in the six Local Authorities*" of Liverpool City Region.
- The national charity CyclingUK used the PCT as the basis for its national campaign to encourage cycling advocacy groups to develop maps similar to those used for the London Underground to create visions of cycling futures. This enabled informed discourse between council officers, consultants, and lobby groups with clear outcomes. "*We encouraged them to use the PCT to draw up 'tube-style' cycle network maps… A map produced by campaigners in Bristol helped convince their council to commit £35m for investment in cycling over 5 years*" **[B]**.
- Walk Ride Bath used the PCT to underpin their campaigning, as corroborated by their chair: "*I cannot stress enough the significance of the contribution PCT has made to our day to day campaigning work in Bath. Before the PCT we had to rely on guesswork and*

unreliable/inaccessible/expensive datasets from sources such as Strava or DfT's very sporadic traffic counters, greatly reducing our ability to produce evidence-based recommendations. With the PCT, we are empowered with the best available data on cycling potential. Knowing that council officers are using the PCT as part of planning and developing strategic cycle networks for the region greatly enhances its impact and its ability to act as a bridge between cycle advocates and local government. It has already had a transformational impact on our work and has helped several other campaign groups around the country in a similar way. The PCT is a focal point for campaigners and key active travel network decision makers in local authorities across the country" **[G]**.

- The Local Cycling and Walking Infrastructure Plan (LCWIP) Officer (2018-2019) and Cycling and Walking Officer for Dorset County Council (2019-present) wrote in his letter **[H]**: "*The Propensity to Cycle Tool (PCT) has been a vital means for local authorities to develop plans for improving cycling…In the past …planning was based on local knowledge and bolted on to other schemes in an adhoc manner. Other uses to which the PCT has been put include helping to develop maintenance hierarchies for cycle routes, by helping to identify the routes with the highest levels of likely use. The PCT team…have developed software… which potentially has saved tens of millions of pounds in consultancy fees for public bodies and will help evidence hundreds of millions of pounds of investment in schemes to enable active travel*".

The PCT informed local and national government responses to COVID-19. After the start of the global pandemic, Dr Lovelace was commissioned by the DfT and Sustrans to help transport systems cope with reduced public transport use and to inform a sustainable 'restart' to the economy. The Economic Advisor in the DfT's Walking and Cycling Team explained that "*75% of non-London local authorities used the PCT or Rapid cycleway prioritisation tool to inform and prioritise their proposed schemes. This will significantly improve the likelihood that the £175m, allocated in tranche 2, delivers value for money*" **[I]**.

The PCT team has actively supported representatives of numerous transport planning institutions in their **application of the tool for cycle planning outside of the UK**. *"The PCT has revolutionised the practice of strategic cycle planning nationally, with international actors, including the European Cyclists' Federation, also promoting it"* as noted by the Policy Director at CyclingUK **[B]**. International actors known to have adapted PCT for their use include Transport Infrastructure Ireland, Brisbane City Council (Australia), NORCE (Norway), Lisbon Metropolitan Region (Portugal) and ViaStrada (New Zealand). The Chief Executive of Cycling Industries Europe (CIE) corroborated the European reach: "*The tool had a substantial impact on our thinking and investment decisions...As a result of the work of CIE, our partners and stakeholders, over €1billion was committed by governments and cities on new cycling investments during 2020 and we are currently leading cycling's contribution to a possible €20Billion to be committed to cycling in the EU's Recovery and Resilience Facility. We need tools like the PCT to make sure this money is committed to infrastructure that will truly deliver behaviour change, and at present the PCT is unique in that role. Based on the principles of the PCT we were able to propose to the EU a commitment of €5.2 billion needed for the support for the development of the e-bike sector across 27 countries. As a result of Dr Lovelace's path-breaking research we have invited him to become a contributor to the European Market Impact and Intelligence Expert Group*" **[J]**.

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

[A] *UK Parliament Written Questions, Answers and Statements, Cycling and Walking,* Hansard, UIN 176625, 8 October 2018.

[B] Letter of corroboration from the Policy Director of Cycling UK, describing the national impacts of the PCT.

[C] The official document setting out the government's Cycling and Walking Infrastructure Strategy, delivering on the *Infrastructure Act 2015: Cycling and Walking Investment Strategy.* Department for Transport 2017.

[D] Database of uses of the PCT collected at workshops and based on stakeholder interviews, informing a document showing how the PCT has been used in at least 57 Local Authorities in England and Wales.

[E] Letter of corroboration from the Transport for Greater Manchester Infrastructure Lead for the Bee Network, describing how the PCT informed the strategic cycle network plan, and the Chorlton Cycleway in particular.

[F] Letter of corroboration from the LTP Development Manager, on behalf of the Programme Development Officer, Merseytravel, describing how the PCT has impacted cycle planning in the Liverpool City Region.

[G] Letter of corroboration from the Chair of Walk Ride Bath.

[H] Letter of corroboration from the Cycling and Walking Officer, Highways, Dorset Council, noting how local authorities develop plans for improving cycling and walking infrastructure using the PCT.

[I] Letter of corroboration from the Economic Advisor, Walking and Cycling Team, Department for Transport, explaining how the PCT was used to develop COVID active travel fund applications.

[J] Letter of corroboration from Chief Executive of Cycling Industries Europe, describing how their use of the PCT has influenced approaches to transport planning and led to funding of projects to map cycling potential.