

**West Midlands
Combined Authority**

Mapping Inequality of Transport: Understanding and Reducing Inequalities in Transportation in West Midlands (DSSGx UK 2019)

PROJECT PARTNERS

[Transport for West Midlands](#) (TfWM) is a part of the [West Midlands Combined Authority](#) (WMCA), a cluster of 17 local councils and three Local Enterprise Partnerships, working collaboratively to deliver a more prosperous West Midlands region. Within the WMCA, TfWM are responsible for freight, private and public transport strategy. As part of this remit, TfWM is supporting the WMCA in the review and publication of an updated Local Transport Plan (LTP) for the area incorporating the three cities (Birmingham, Coventry, Wolverhampton) and four metropolitan boroughs (Dudley, Sandwell, Solihull, Walsall) that constitute the Birmingham metropolitan area. The LTP is a document that sets out policies to promote safe, integrated, efficient and economic transport to, from and within the area, as well as plans to implement those policies. The LTP green paper was published for public consultation in 2021 and is expected to be finalised towards the end of this 2023.

THE PROBLEM

The Birmingham metropolitan area is the second largest metropolitan area in the UK with a population of 4.3 million people. As the region grows, both economically and in terms of population, it is important to ensure that the LTP delivers high quality and fair access to transportation. The 2019 DSSGxUK project was motivated by the question how to quantify equity of access to public transportation in practical ways that could inform policy development around the LTP.

TfWM has two key performance indicators (KPIs) that relate to equity of access to public transport provision:

- Proportion of households that can access the economic centre of the metropolitan area within 45 minutes via public transport.
- Proportion of households that are within 400 metres of a local bus stop.

The limitations of these metrics were recognised. Not everyone works in the city centre, for example, and many journeys, particularly journeys made for social and leisure purposes, are not likely to be to the centre. Likewise, physical proximity to a bus stop does not necessarily mean the buses serving that stop will take a user where they want to go in a reasonable time. TfWM knew that the existing policy had led to some areas being isolated from public transport networks, with poor access to private vehicles and a congested road network – this being particularly prevalent among areas with high minority and low-income populations. Transport planners had some instinct for which areas are experiencing isolation, but the volume, scope, and extent of the problem had not been analysed and quantified.

The challenge TfWM brought to the 2019 DSSGxUK summer programme was to combine available data on public transport networks with sociodemographic data to find and visualise alternative ways to measure equity of access to transportation services, and to understand how different demographic groups are affected. The remit was to help policy makers find people who are left out of the public transport system and to give them visibility through data. The ultimate goal was to offer insights on how to make access to transportation in the West Midlands fairer with a view to feeding these insights into the formulation of the LDP, which was in the early planning stages at this time.

THE DSSGX UK PROJECT

Formulation of informative accessibility metrics

The first step of the project addressed ways of quantifying access to public transport that can offer a more nuanced view than the existing KPIs. Transport access was reframed in terms of individual journeys rather than aggregate measures. A single journey involves travelling at a particular time from a particular area to a particular point of interest, such as a hospital, a post office, or a job centre. Capturing each of these dimensions is necessary to put the individual at the centre of transport accessibility planning. Furthermore, the cost of a journey also has multiple dimensions such as fare, travel time and total required walking distance. These different dimensions affect different demographic groups differently.

Computation of accessibility metrics from data

The team designed a tool to calculate these different dimensions of cost for journeys from each neighbourhood to each user-specified point of interest (e.g., hospital, job centre, post office) and time window (e.g., weekday morning peak.) Neighbourhoods were defined to correspond to the Middle Layer Super Output Areas (MSOAs) of the UK census. The centroid of the MSOA was used as an indicative starting point for journeys. Routes and costs were calculated using OpenTripPlanner a widely used open-source application for transport analysis. Running on a Java server, this tool constructs multimodal networks of roads and transport routes connected by junctions and stops based on standard data input. It uses the A* algorithm, which searches for the shortest paths in a graph, to find reasonable itineraries via the combination of transport and walking for the given journey. For each origin, destination, time-window triple, several journeys were sampled, and median costs were stored. In parallel, the population of different demographic groups across neighbourhoods was calculated. Computations were done in advance and stored in a database to enable rapid exploration of the data.

Identification of access inequalities and opportunities for improvement

By combining the transport costs and demographic layers together, "at-risk" neighbourhoods could be identified with a large population of certain disadvantaged groups but poor access to certain points of interest, thus pointing to opportunities for improvement in provision of transport services. An

interactive web-based dashboard was built that allows the user to explore and compare access across regions and populations.

The analysis made it clear that existing TfWM KPIs focus very heavily on work-related travel only. With the new visualisations, TfWM gained insight into other travel patterns and consequently noticed where investment went and was lacking.

The code for the DSSGx UK tool is available at <https://github.com/alan-turing-institute/DSSG19-WMCA-PUBLIC>

A presentation of the results of the project from the 2019 DataFest event in the Shard can be viewed at https://www.youtube.com/watch?v=V_Y9PYQpUp8

FOLLOW UP WORK

After the summer fellowship programme ended, additional development work was done on the tool by Professor Hakan Ferhatosmanoglu from the Warwick Department of Computer Science and his PhD student Chris Conlon, using funding provided by Warwick's Policy Support Fund, in collaboration with the TfWM Data Insights team. This extension sought to improve the 'accessibility' metric to include other areas of 'cost' identified by bringing together the disciplines of policy and transport planning to create a simple, easy-to-use tool to inform transport and policy assessments. The web-based tool was designed so the user could filter by demographic groups, accessibility costs, points of interest and time strata, to visualise the density of the chosen population against accessibility costs. The project also sought to define a single at-risk score or accessibility index, to identify areas of high population density but low accessibility.

The backend and frontend code for this extension is available in the following repositories:

- <https://github.com/cmconlan/TfWM-Accessibility-Tool>;
- <https://github.com/cmconlan/TfWM-Accessibility-Tool-Frontend>

An online interface (since deactivated) was deployed at:

- <https://transport-access-tool.dcs.warwick.ac.uk/>

In December 2020, the government announced the approval of a vaccine for the Covid-19 virus and the planned roll-out of this vaccine to vulnerable groups. These included those above the age of 60, those working in a primary care facility and those with underlying health conditions. For TfWM, it was paramount that these vulnerable groups were able to travel to a vaccination site or centre safely by the most suitable travel option available to them, be that car, taxi, or public transport. There was also a requirement to ensure distribution vehicles were able to effectively transport the vaccine to the vaccination sites and centres. The capabilities of the DSSG tool were ideally suited to support these tasks. This led to a further collaboration between the TfWM Data Insight team, in collaboration with Integrated Transport Services, Emergency Planning, Network Resilience, the Regional Transport Coordination centre, and the University of Warwick to understand the accessibility of vaccination sites for vulnerable groups and to coordinate planning efforts to areas that had poor access. A map showing accessibility of vaccination centres obtained from this work is shown in Figure 1. An 'at risk score' was also calculated to understand the level of fairness or disparity in access for identified groups which divided the generalised cost in that area by the population count in that area. Filtering this score by the number of people aged 60 or over who live in each MSOA allowed the WMCA to

rank areas in order of priority for vaccination accessibility support. An example of such a ranking is shown in Figure 2.

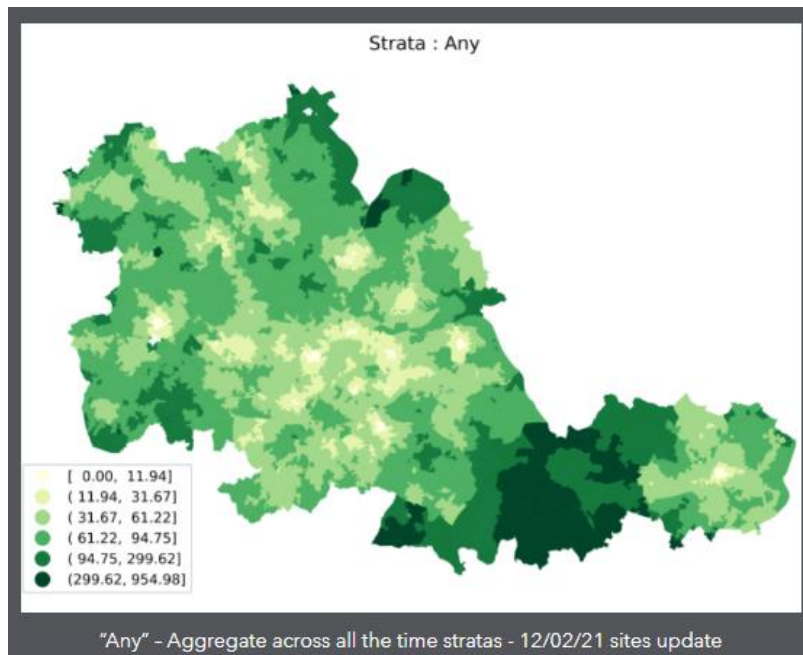


Figure 1: Access to vaccination sites and centres for each output area in the West Midlands. The higher the score and darker the green the poorer the access for those living in those areas.

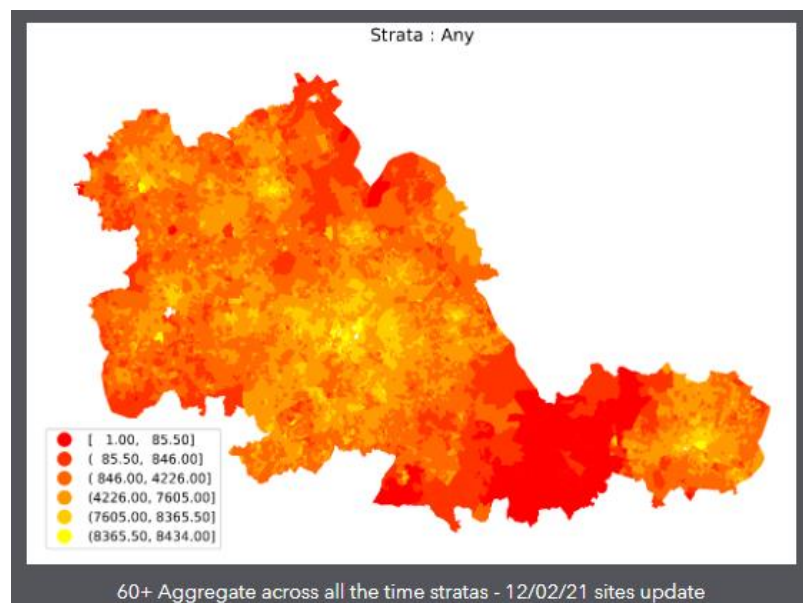


Figure 2: Ranking of areas for accessibility support based on accessibility to vaccination centres and proportion of vulnerable population. The lower the score and darker the red the poorer the access for those living in those areas and the higher the density of population for the indicated group, i.e. rank 1 indicates the areas of top priority for accessibility support.

LONGER TERM IMPACTS

According to Charmaine Grant, principal research analyst at TfWM, this project raised awareness across TfWM of the importance of considering accessibility when designing transport plans to improve social and economic mobility. It facilitated better cross departmental communication and understanding by bringing together different teams involved in transport policy, planning and research work. She noted that there was considerable benefit in proposing a fairly open question about which there was little internal expertise since this allowed the team to upskill internally and provided an opportunity to introduce new thinking into the organisation.

At the level of transport planning and policy design, the project was instrumental in illustrating the importance of building a spatial model tailored to the specific services needing to be accessed rather than using a general, aggregated measure of access. This triggered a review of accessibility and how it should be incorporated into the KPIs that will feature in the new LTP. This is a complete overhaul and will change how TfWM delivers schemes moving forward to consider all needs for access to services and will improve the way accessibility is evaluated in the region. The newly published green paper on the Local Transport Plan, the policy team have since included 'Improve Accessibility' as one of the three core drivers for change:

- [Reimagining transport in the West Midlands | Transport for West Midlands \(tfwm.org.uk\)](https://www.tfwm.org.uk/media/uuuhqpb4/big-moves-summary.pdf)
- <https://www.tfwm.org.uk/media/uuuhqpb4/big-moves-summary.pdf>

The final version of the LTP will likely include KPIs and other aspects that reflect some of the lessons learned from the DSSG project. This will become clearer later in the year and will need follow-up after the publication of the LTP.

There is scope to share the tool with other transportation authorities across the UK in the future, particularly if the TfWM approach to accessibility attracts broader interest. This would require careful consideration of how to sustainably resource this provision.

“Working with DSSG has been a really positive experience allowing us to work with cutting edge data scientists who care deeply about improving the experiences of people. Working with the fellows has allowed us to solve analytical problems we would never have undertaken without the support of DSSG and learn best practice in data science.”

Charmaine Grant, Transport for West Midlands