A Scoping Indicator Identifying Potential Impacts of All-Inclusive MaaS Taxis on Other Modes in Manchester

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Transport Findings

We present a spatial scoping indicator of the potential impacts of an all-inclusive taxi service as part of a plausible but hypothetical Mobility as a Service (MaaS) package in Manchester UK. Our indicator identifies the number of people in each area who have some potential for mode shift from walking, cycling, public transport or car commuting to an all-inclusive taxi service within a MaaS package. We find the method quick and straightforward. In our case study, potential to shift from walk to an all-inclusive taxi service within a MaaS package is almost double the potential shift away from car, which represents a risk of increased car use.

1. RESEARCH QUESTIONS AND HYPOTHESES

Definitions of Mobility as a Service (MaaS) are varied but include the notion that it provides subscribers with the ability to use a number of modes, including taxi services, within the MaaS package (Mulley 2017). Docherty, Marsden, & Anable (2018); Lyons (2018); Pangbourne et al. (2019); and Polis (2017) hypothesize potential for both positive and negative effects of smart mobility services such as MaaS, and uneven spatial distribution of effects of its component parts, such as an all-inclusive taxi service within a MaaS package. If the mode shift from car driving to an all-inclusive taxi service within a MaaS package occurs, this might be environmentally beneficial, but only if the vehicle fleet becomes smaller and reduces emissions (e.g. Becker, et al., 2019). If mode shift to taxi from walking, cycling, or public transport occurs, this may have negative consequences (e.g., increased energy use, air quality impacts, and reduced physical exercise).

The purpose of scoping indicators is to identify where issues may occur—in this case, relating to a specific MaaS component—and identify where further investigation may be appropriate in order to contribute to the detailed specification of a scheme appraisal. Scoping indicators alone are not used for final decision-making. Practitioners require scoping indicators which are not overly complex and can be implemented in a timely and cost-effective manner. This framework of a scoping indicator, designed as a precursor to more in-depth analysis, is used in appraisal frameworks such as the UK WebTAG social and distributional impact assessments (DfT 2014). Social and distributional impact assessment is concerned with specific groups of people in specific places rather than measures of whole scheme performance (Geurs, Boon, and Van Wee 2009; Lucas et al. 2016; DfT 2014). For this reason, this scoping indicator does not consider people and trips originating outside the area where an all-

inclusive taxi service within a MaaS package operates. Were we to include trips originating outside the city using a taxi as a last-mile mode, the potential impacts in a specific locality may be drowned out by the aggregate level metrics. This is in line with the approach adopted in social and distributional impacts assessment frameworks.

Questions based on hypotheses. For residents within the area where an all-inclusive taxi service within a MaaS package operates:

- What is the maximum number of people who could consider replacing their current trips with all-inclusive taxi journeys if that became a possibility as a result of a hypothetical MaaS package in a Greater Manchester context?

- What is the spatial distribution of this potential for mode change within the area where an all-inclusive taxi service within a MaaS package operates?

2. METHODS AND DATA

Data Sources: ACORN geodemographic classification data via UK Data Service: https://www.ukdataservice.ac.uk/

Small-area counts of annual vehicle miles traveled: Cairns et al. (2014).

Postcode population data: https://www.nomisweb.co.uk/census/2011/postcode_headcounts_and_household_estimates

Census travel to work by mode: https://www.nomisweb.co.uk/census/2011/qs702ew

UK National Travel Survey: proportion of trips under 5 km in UK by mode: https://www.nomisweb.co.uk/census/2011/qs701ew

The method is described in the following steps. Analysis was carried out in R (principally using tidyverse & tmap packages). An R script is available at https://github.com/DrIanPhilips/ImpactsMaaSWalkCar.

Step 1: Select postcodes within 5 km of the city center

Whim self-identifies as a MaaS provider and is described as such in academic literature (Hensher 2017; Mulley 2017). Its West Midlands service advertises an unlimited MaaS package for £349 per month. This includes a package of several services (bus, train, car-hire, taxi) and unlimited taxi journeys with its partner Gett if the journey begins within 5 km of the city center and is under 5 km in length (Whim 2018). We assume a similar rule would apply in Greater Manchester. To represent this in GIS, postcode centroids within 5 km (3 miles) of Manchester Town Hall were selected. This involved the simple GIS vector geoprocessing tasks of creating a buffer and extracting postcode points. This

scoping indicator considers people making journeys under 5 km as residents in the area which would be covered by an all-inclusive taxi service within a MaaS package.

Step 2: Define affordability

Affordability was estimated using ACORN, a commercial geodemographic classification of postcodes. Released in 2017, this dataset operates at a finer spatial scale than the 2011 census data and includes more recent information. The purpose of this step is to identify areas where residents are most likely to be able to afford an all-inclusive MaaS package (not to predict uptake of the service by specific individuals). Those residing in ACORN category 4 ("Financially Stretched") and 5 ("Urban Adversity") postcodes are less likely to be able to afford MaaS, and were thus excluded. Other research has used ACORN categories as an indicator of affluence and deprivation (e.g. Birkin, 2019). ACORN categories 4 and 5 are associated with lower household incomes and lower travel expenditure than other groups (CACI 2017).

Step 3: Estimate potential for mode shift to MaaS

In areas where MaaS is likely to be affordable, we estimated the current number of commuters by mode based on the 2011 census data. We selected short commutes under 5 km (because of the distance limitation of the Gett service) using the proportions given in the previously mentioned NTS data. This gives an indicator of the potential for mode change to an all-inclusive taxi service within a MaaS package. To take some account of potential for adoption based on current motoring behaviors, we also carried out the calculation only considering postcodes where the mean annual car vehicle-kilometers traveled is below the mean for the city region. Robinson, (2018) and Segment Project, (n.d.), argue that lower than average car use is an indicator of the potential to make use of a MaaS package.

Step 4: Examine spatial distribution of potential for mode shift

This is done by presenting the subsequent findings as maps and as a summary table.

3. FINDINGS

In the study area (see Figure 1), most residents are deemed unlikely to be able to afford the MaaS unlimited package (67% of population). Further, people using nonmotorized modes who have difficulties using a mode/service or scheme due to affordability are at particular risk of negative outcomes including air quality (e.g. Barnes, Chatterton, & Longhurst, 2019), traffic collisions (e.g. Graham, McCoy, & Stephens, 2013), and transport-related social exclusion (DfT 2014; Lucas 2012). The number of people potentially affected is 16,000 (4% of population). This is an example of a scoping indicator identifying a potential issue; it is not an exhaustive list of impacts. This finding can then contribute to determining the detailed specification of a scheme appraisal.
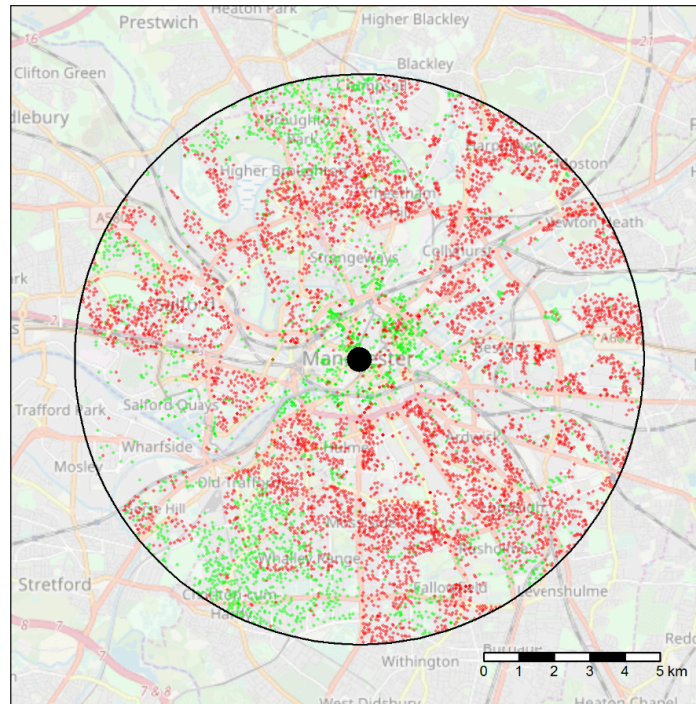
Figure 1: Postcodes where People are More Likely to be Able to Afford a MaaS Package are Shown in Green; Those Less Likely are Shown in Red. The 5 km Buffer and Center are Marked

Table 1 shows that potential to shift from walking to an all-inclusive taxi service within a MaaS package is almost double the potential to shift from car travel. Walk trips with potential to switch to an all-inclusive taxi service within a MaaS package are an order of magnitude higher than for bike, metro, and train trips, and more than 7 times higher than for bus trips.

Figure 2 shows the spatial distribution of the number of commute trips which could be substituted for an all-inclusive taxi service within a MaaS package.

Figure 3 focuses on the modes with the largest potential for change—walk and car. The highest counts of potential to change from walking are concentrated near the city center, whereas higher counts for cars occur toward the edge of the 5 km buffer.

The findings of our scoping indicator are that there is potential for mode shift which justifies further investigation. Potential for mode shift is not evenly distributed spatially or socioeconomically. In the study area, more walkers have potential for mode shift than car users, which represents a risk of increased car use in this area. In the present case study, the scoping indicator results offer a justification for where to carry out more in-depth analysis of potential impacts. This is useful in situations where practitioners need to provide a business case to justify committing resources. To be clear, this indicator does not predict future commuter behavior.

Table 1: Counts of People with Potential to Change from Different Modes to an All-Inclusive Taxi Service within a MaaS Package (mean car km traveled per person for Greater Manchester is 4,254 km per person per year)

Mode	Number of people with below average car use and potential to shift mode to an all-inclusive taxi service within a MaaS package	Number of people with any level of car use and potential to shift mode to an all-inclusive taxi service within a MaaS package
Walking commuters traveling under 5 km	10,007	10,515
Car commuters traveling under 5 km	5,900	7,200
Bicycle commuters traveling under 5 km	317	372
Bus commuters traveling under 5 km	1,347	1,490
Metro (tram) commuters traveling under 5 km	294	343
Train commuters traveling under 5 km	84	89

This scoping indicator offers an approach to identify potential issues which may result from specific MaaS components in specific places. We believe this approach will be useful in generating a set of indicators to identify issues with different modes and components of the MaaS system, which would aid the development of detailed appraisal tools, models, and policies.
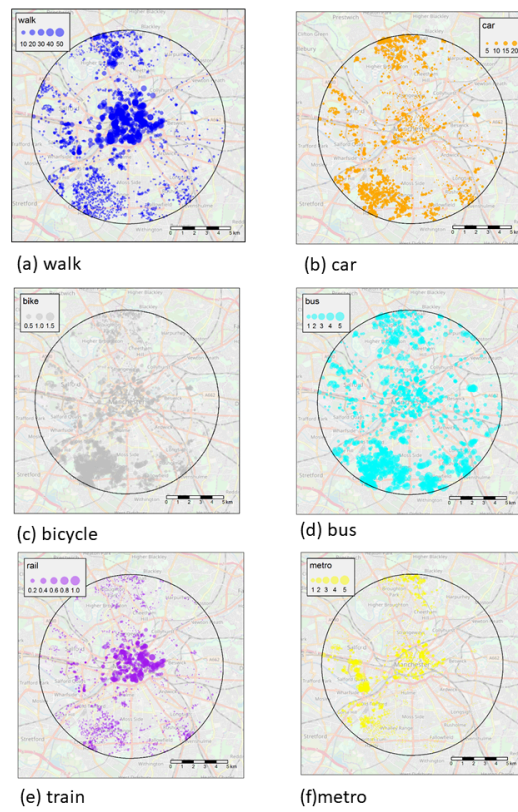
ACKNOWLEDGMENTS

Figure 2: Number of Commutes (under 5 km) per Postcode which have Some Potential to be Replaced by an All-Inclusive Taxi Service within a MaaS Package. The Mode is Labeled beneath the Map. Note the Different Legends for each Mode
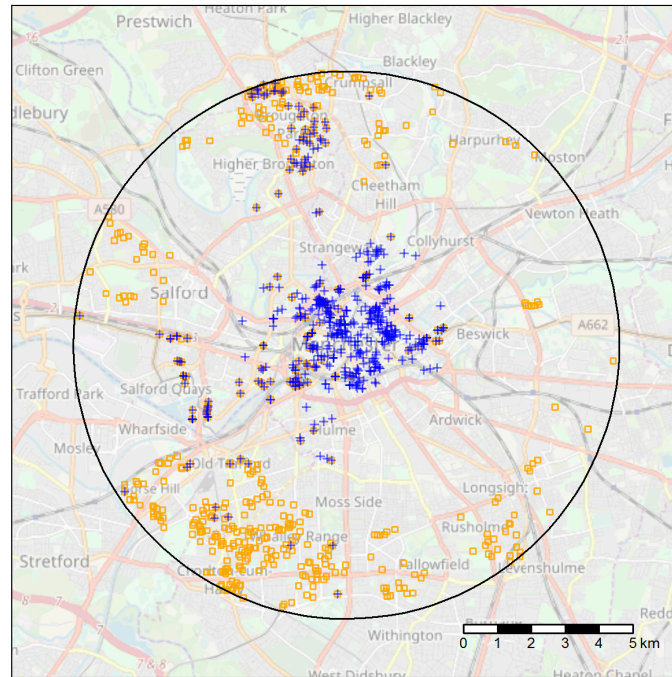
Figure 3: Highest Quartile of Potential Shift to an All-Inclusive Taxi Service within a MaaS Package: Cars (>4 People per Postcode) are Shown in Orange and Walkers (>6 People per Postcode) are Shown in Blue

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