Methods to assess the active travel potential of new residential developments

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1 Introduction

Twin crises of transport and housing

Need for greater integration between planning and transport

Need for early intervention and input to planning process

Potential usership for actionable tools to assess whether new developments will support active travel (academic, planning, advocacy, policy)

Reference Megan Streb's work if possible? (or mention the underlying themes)

In the UK, transport and planning policy areas have typically been dealt with in isolation, despite the clear linkages between them. New housing development sites that are within walking and cycling distance of work, public transport links and other key trip attractors can help meet a range of policy objectives, not least the government's target of doubling cycling by 2025 and commitment to becoming zero carbon by 2050.

We are at the interface between two major challenges: the pressing need for sustainable transport (which can tackle a range of issues from physical inactivity and obesity to air pollution)[1] and affordable housing (ref). These needs are widely recognised, yet there are a lack of consistent methods to enable the integration of transport and planning.

1.1 The importance of time

For any analysis of active travel potential to have genuine impact on both site location and design, it must occur at the earliest possible stage of the planning process, and feed into the selection of sites to be taken forward in the Local Plan. It is thus important that tools and methods for assessing active travel can be applied to any location, including sites that have not yet been built and locations where a planning application has not yet been made.

The creation of new infrastructure or services to support active travel must also happen at an early stage in site construction.
On an individual level, travel behaviours are most likely to change at the onset of major life events such as moving house or starting a new job (ref). It is thus important that the capacity for sustainable travel is built into new residential developments from as soon as the first homes are occupied, rather than being added on several years later. If new developments do not support walking, cycling and public transport from the outset, this risks baking in car dependency. It could also contribute towards inequality of access for the vulnerably housed/employed (ref)...

However, it is also beneficial for methods to be applicable to existing sites. This can reveal how close active travel levels at a site are to their theoretical potential, and where there may be barriers or opportunities to improve walking and cycling access. It could also enable the longitudinal use of these methods to assess changing conditions pre- and post-construction.

1.2 Expected users

We anticipate that scalable methods to systematically assess the walking and cycling potential of new residential developments will be of interest to a wide range of stakeholders working at local, regional and national levels. This could include researchers, transport and planning officers, developers, advocates, and policy advisors.

1.3 Objectives

The methods described here tackle four overarching objectives. Firstly, to improve our ability to analyse planning data relating to new residential developments at a national level. Secondly, to assess the location of development sites in terms of existing and potential suitability for active travel. Thirdly, to identify potential barriers for walking and cycling in the area surrounding a site, and ways in which those barriers could be overcome. Fourthly, where possible, to assess the suitability for active travel of the internal layout of a site and its direct connectivity to surrounding neighbourhoods.

2 Methods

The methods described below are used in a prototype web tool which is currently available for 35 case study sites across England. With further development, these methods could be applied nationwide.

[1] https://www.gov.uk/government/publications/cycling-and-walking-investment-strategy-cwis-report-to-parliament

2.1 Selection of case study sites

As case studies, we chose 35 large residential development sites. We focus on large sites, mainly with >1000 new homes. They were selected to represent a diverse range of types of development including urban extensions, urban regeneration schemes and new settlements such as proposed Garden Villages. The majority of the sites have been profiled as part of two Transport for New Homes reports; the Project Summary and Recommendations July 2018 and Garden Villages and Garden Towns: Visions and Reality, providing a wide range of background information. In most of these sites construction remains in progress as of early 2021, while a small number were completed prior to 2021, and others had not yet reached the construction phase.

2.2 Planning data

UK Planit is a national database of planning applications based on scraping and aggregating data from the websites of more than 400 planning authorities. The ability to make use of this full national dataset allows analysis of planning data in ways that were not previously possible.

Planning applications relate to a wide range of activity. There was no standardised indication of the type or size of a development which is being planned.
Consequently an 'app_size' classification was added to the the PlanIt database with the aim of flagging large scale strategic residential developments as 'Large' and other residential developments with >10 dwellings as 'Medium'.

The classification rules for 'app_size' used three sources of indirect proxy indicators for larger scale developments:

1. The number of documents associated with the application (more than 100 indicating a larger development),
2. The number of days before a decision is taken (more than 8 weeks indicating wide community interest),
3. And the type of an application (environmental impact assessments often being associated with large developments).

Using these three indicators a crude classification was made, although it was known that many applications of interest were being missed.

We used our 35 case study sites to further improve the derivation of the 'app_size' field within PlanIt. All planning applications within the 35 areas were reviewed and compared against existing classifications and known missing cases. From this it was noted that many such applications included key words (such as 'garden village') and often a number of prospective residences in the 'description' field (eg '2,300 new mixed-tenure dwellings'). Subsequently a new set of rules was developed within PlanIt to extract the key words and a new 'n_dwellings' field. These were then used as additional proxy indicators of development scale within the process for deriving the 'app_size' classification (specifically 'n_dwellings' more than 40 indicating 'Large' and more than 10 indicating 'Medium').

2.3 JTS and accessibility?

2.4 Demographic and travel data

In the UK, the best available travel information at high levels of geographic resolution is the 2011 Census travel to work origin-destination (OD) data, which formed a foundation of the analysis. Travel to work accounted for around 20% of total UK travel by distance before the coronavirus pandemic led working from home levels to increase from around 5% to 40% of the workforce. We used MSOA data to demonstrate the methods although higher resolution data could be used.

Converting the OD data to desire lines, we used their Euclidean distances and number of journeys to demarcate a study area around each site. The study area incorporated all desire lines with length <= 20 km where the number of journeys by foot, bicycle and car/van drivers met a threshold value. The threshold value was set as $t = d/250$, where t is the threshold value and d is the number of dwellings the site will contain at completion.

2.5 Disaggregation of OD data

Zone centroids are often used as journey start and end points for the mapping of OD data (PCT ref). However, in reality each journey has a unique origin and destination. The use of zone centroids distorts the mapping of travel patterns, artificially causing journeys to aggregate to a limited number of routes. This is particularly problematic when mean journey lengths are relatively short in relation to the size of the zones being used, such as for journeys by foot.

We developed new methods to disaggregate origin-destination data, enabling multiple origins and destinations within a single MSOA zone, as illustrated in Figure **??** below. To do this, we located the buildings within each zone, and assigned journey start and end points to a random selection of these buildings. For cases where buildings were absent from OSM but residential roads were present, we automatically generated buildings along the residential roads. This disaggregation method was used for all case study sites having < 20 desire lines within their study area.

2.6 Journey routing and road characteristics

Having obtained data on commute modes of travel and assigned appropriate destinations, we then identified routes for these journeys. For all desire lines lying within the study area around each site, we generated cycling and walking routes for the journeys to work. We also combined the individual routes into a series of route networks.

For cycle journeys to work, we used a set of algorithms created by CycleStreets.net. Three routing options are available, representing fast, balanced and quiet routes. For the fast routes, journey times are minimised. For the quiet routes, a parameter representing cycleability is maximised. This typically generates routes that avoid following busy roads. The balanced routes represent an intermediate between the fast and quiet approaches.
Factors contributing to the cycleability parameter include road type, cycle path width and surface quality, barriers and obstructions, signage and route legibility, and the gradient of route segments (https://www.cyclestreets.net/api/v1/journey/).

It is useful to have these three different versions of the cycle routes, because this can reveal places where for example a direct road may link to a destination, but its cycleability may be too poor for most people to consider using it. If the 'quiet route' to a given destination is considerably longer than the 'fast route', it suggests that the introduction of dedicated cycle infrastructure along the line of the fast route would likely help to improve cycle accessibility.

For journeys to work on foot, we used the Open Source Routing Machine (OSRM) routing engine.

In addition to the commuter journeys, we also generated routes for journeys from each site to the nearest town centre. This included both walking and cycling routes, as long as the town centre was within 6 km of the site. There is no data available on the number of journeys residents make to their nearest town centre, however we know from the National Travel Survey that across England in 2018/19, 15% of journeys were for commuting, 19% were for shopping, 8% were for sport/entertainment, 9% were for personal business, and 5% were for visiting friends (but not at a private home). Many of these journeys are likely to involve going to the town centre, either as a destination or as a means of accessing further travel. We therefore made a simple assumption that the number of journeys to the nearest town centre are equal to the total number of commuter journeys from a site.

The generation of the cycle routes allows estimation of route length, weighted mean cycleability of route segments, minimum route segment cycleability, weighted mean gradient of route segments, and maximum route segment gradient. The generation of the walking routes allow estimation of route length and duration.

2.7 Mode shift scenarios

For each site, we generated two scenarios, Baseline and Go Active, as illustrated in Figure 1. The 2011 Census journey to work data represents baseline conditions. For the Baseline scenario, we simply adjusted this data to represent the population, at completion, of the chosen residential development site, rather than the population of the MSOA(s) that the site lies within. For any given OD pair and mode:

$$T_b = T_m / P_m * d * hs$$

where T_b is the number of trips in the baseline scenario; T_m is the number of trips from the MSOA(s) the site lies within, according to the 2011 Census; P_m is the total population in 2011 of the MSOA(s) the site lies within; d is the number of dwellings the site will contain at completion; and hs is the mean UK household size.

The Go Active scenario represents the potential for increased uptake of walking and cycling, in the presence of high quality infrastructure and sustained investment. We calculated this increased uptake purely in terms of a switch from car/van driving to walking or cycling. Other modes of travel such as bus and rail were kept constant, and no change was made to journeys that already took place by foot or bicycle in the Baseline scenario. We also assumed that the journey destinations and the total volume of travel remains the same as in the Baseline scenario.

To generate the increased cycle uptake in Go Active, we used the 'Go Dutch' cycling uptake function from the Propensity to Cycle Tool (Lovelace et al 2017). This represents the proportion of journeys that would be undertaken by bicycle if cycle mode share corresponded with average cycling levels in the Netherlands. This function controls for route length and hilliness.

To generate the increased walking uptake in Go Active, we used a set of simple estimations. For journeys <= 2.0 km in length we assumed a walking mode share 30% above baseline levels; for journeys of 2.0 - 2.5 km length, walking mode share was increased by 20%; for 2.5 - 3.0 km by 10%; and for 3.0 - 6.0 km by 5%. The application of this uptake model nationwide is illustrated in Figure 1.

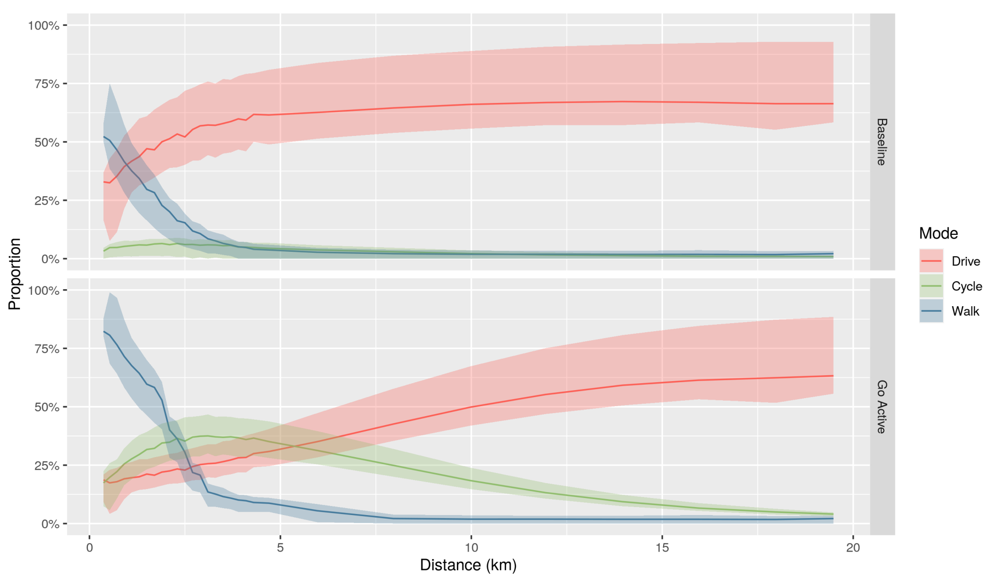

Figure 1: Overview of the uptake model underlying the Go Active scenario compared with the Baseline scenario which is based on data from the 2011 Census. The bands represent the range within which the majority of origin-destination pairs fall, from the 20th to the 80th percentile.

2.8 Analysis of routes and route networks

To calculate the total flows per mode along each route segment, we combined the routes into a route network, producing separate route networks for walking routes, fast cycle routes, balanced cycle routes, and quiet cycle routes. It is then possible to analyse these flows alongside other segment level data. Using a clockface-style zoning system, we divided the surroundings of each site into a number of zones. Within each zone, we calculated the mean cycleability of route segments from the fast, balanced and quiet cycle route networks, weighted by distance travelled. We also assessed the circuity of the walking and cycling routes, calculating mean circuity of routes passing through each zone, weighted by distance travelled within the zone. The zonal values generated can be overlaid on a map, together with the routes or route networks.

2.9 Within-site metrics

The measures discussed so far relate to journeys to work or to other destinations. The majority of the length of these journeys will take place outside the boundaries of any given new residential development. However we also wanted to investigate the internal layout of the sites themselves. In particular, the circuity of routes within a site can reveal features relating to the design of the site. Low circuity suggests direct routes and legible street patterns that are easy to navigate. The comparative circuity of routes by foot, by bicycle and by car can also be used as an index of filtered permeability (ref).

To assess in-site circuity, we created 20 pairs of random origin and destination points within each site. We generated driving routes for journeys between each pair of points, then reset the point locations based on the results of this routing. This constrained the points to be directly on the road network, preventing walking and cycle route origins and destinations from spawning on nearby footpaths. We then generated walking and cycle routes for journeys between each pair of points. For comparability, these journeys were all routed using OSRM. The mean circuity of the walking, cycle and driving routes in each site could then be calculated and compared to one another.

To assess the links across site boundaries, we also calculated the number of unique locations where walking and cycling routes crossed the boundary of each site.

3 Results

3.1 Analysis of planning data

PlanIt Large applications nationwide

The PlanIt API enables nationwide analysis of planning application data. Across the UK, the PlanIt web scraper identifies 15.7 million applications from over 400 Local Planning Authorities. Using the new 'app_size' definition, we have classified 1.3% of these as Large. Within the geographical bounds of the 35 case study sites we found 6400 planning applications, of which 11% are classified as Large.

The changes we made to the 'app_size' classification raised the proportion of 'Large' applications within our case study sites from 3% to 11% and reduced 'Medium' applications from 10% to 8%.

The distribution of 'n_dwellings' values found in the sample of 6400 applications is illustrated below.

The results of changes to the method of assigning 'app_size' are shown below, for planning applications within our 35 case study sites.

3.2 Travel in the wider area around a site

Baseline travel patterns

Some of our case study sites were already partially complete by that date, meaning the MSOA data reflects, in part, the actual journeys of site residents themselves. However, in most cases the census data is best seen as an indication of travel patterns in the local area surrounding a site, rather than a reflection of the site itself.

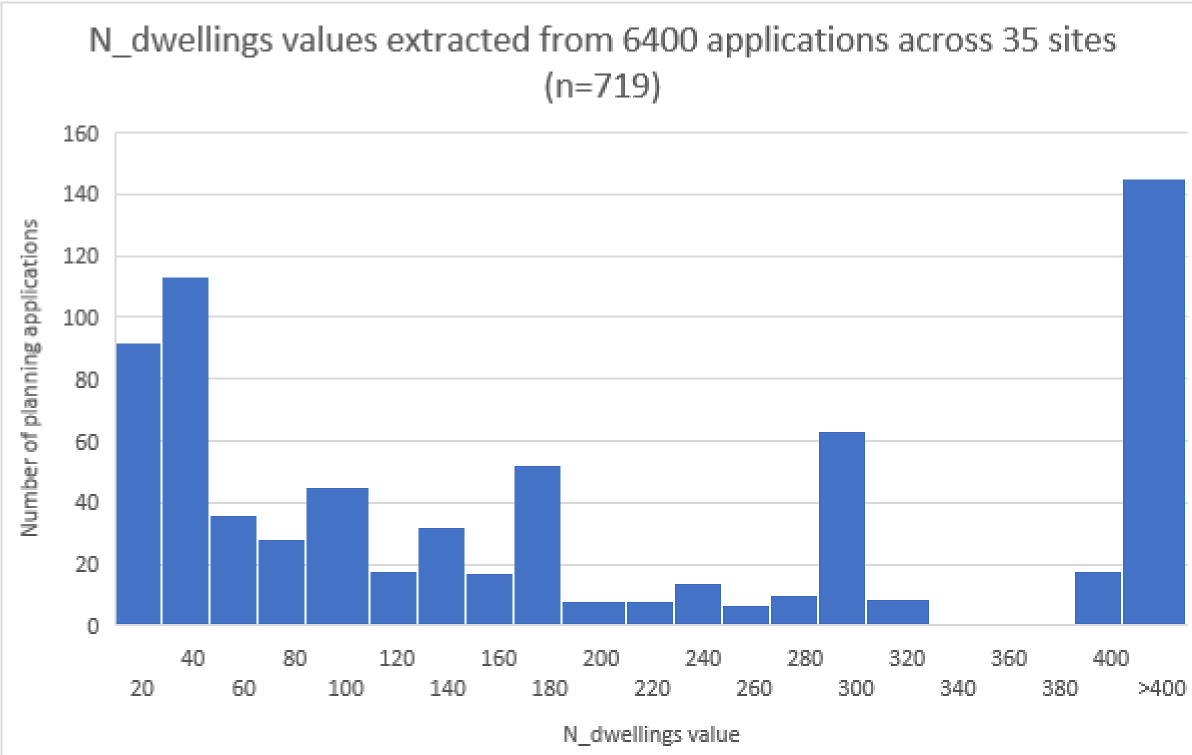

Figure 2: Number of dwellings identified in planning applications within the 35 case study sites

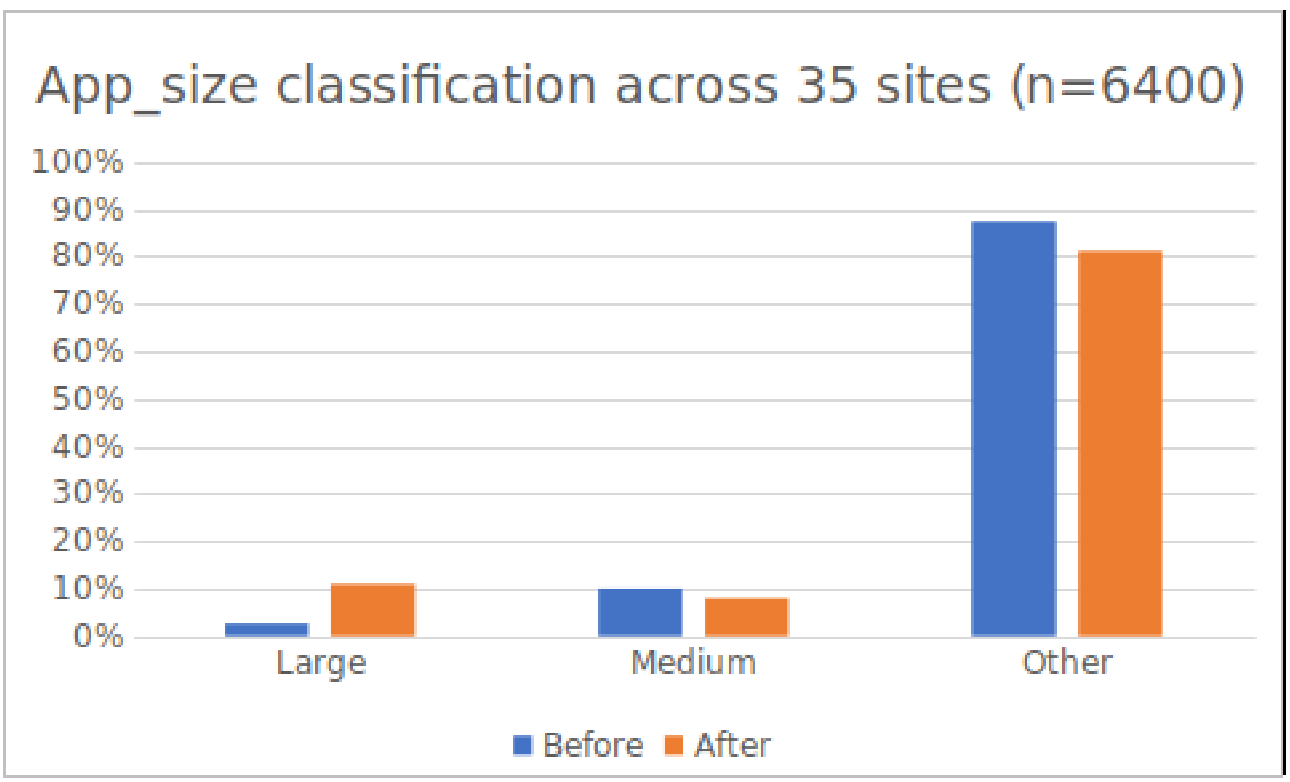

Figure 3: Classification of the size of planning applications within the 35 case study sites

Potential for change

Zoned (and overall) route-based measures of circuity and cycleability.

LTN mapping?

3.3 Travel in the site itself

In-site circuity

Links across site boundary

4 Discussion

Importance of location

Importance of site design

Importance of time

Additional analysis possible - POIs - circuity using random points either side of site boundary

5 Conclusion

importance of open source