Walking as a service – Does it have legs?

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Abstract

Amidst the hype and prospects offered by technological innovation for shaping the future of mobility, it can be easy to overlook the humble and enduring place and potential of walking as a means of movement in our mobility system. Yet walking may already be part of the change taking place, as technological innovation and behaviour come together. This paper considers the potential significance of pedestrian navigation that has been placed in the hands of smartphone users, referring to it as ‘Walking as a Service’ (WaSa).

For individuals physically able to, walking can provide a number of positive attributes including independence, reliability, flexibility, exercise and affordability. Such attributes may compare favourably with other means of transport for shorter journeys. Yet in spite of this it is often not the mode of choice. One of its limitations can be the cognitive challenge – when faced with the unfamiliar - of judging how long a journey could take on foot and determining how to navigate to the destination. Google Maps Navigation now addresses this with what appears to be ever improving attention to usability. Audio-visual assistance ‘holds your hand’ on your journey and keeps track of how far you have left to go and the estimated time needed. With a focus on the UK, the paper explores the prospects for, and place of, WaSa in the future of mobility, also highlighting an apparent sharp increase in average walking trip rate from 2015 to 2018. It draws out a distinction between the business model of Mobility as a Service (MaSa) - which sells access to mobility - and that of WaSa (which sells access to geography and consumers) and puts forward the WaSa Circle of Virtue wherein WaSa is able to support sustainability and profitability.

1. Introduction

This article was written prior to the onset of the global pandemic and state of lockdown introduced in the UK on 23 March 2020 which had significant implications for travel behaviour, including walking.

Type ‘pedestrian’ into Google and it informs you that as a noun it means “a person walking rather than travelling in a vehicle” while as an adjective it means “lacking inspiration or excitement; dull”. Conversely, travelling in/on a vehicle has seemingly been the central focus of inspiration and excitement as industry and government attention and investment in a number of countries has pursued innovation concerning a connected, electric, autonomous and shared future of mobility (with adjectives such as ‘smart’ and ‘intelligent”).

This paper focuses upon the pedestrian and seeks to highlight that far from being dull, walking in our cities (and perhaps elsewhere) is at the nexus of technological innovation and sustainable urban mobility – and it is big business. It is thriving, or has the potential to thrive, thanks, in part, to Silicon Valley harnessing the power of geography.

In March 2019, the UK Government published its approach to innovation in urban transport: ‘Future of Mobility: Urban Strategy’.

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This sets out nine principles that should be followed where possible in facilitating urban mobility. Principle number three is that “[w]alking, cycling and active travel must remain the best options for short urban journeys” (DFT, 2019a: 39). The threat to walking and cycling for short journeys from other competing options was recognised, yet with 45% of journeys of urban residents in England being under two miles, the opportunities for walking and cycling to play a major part in urban mobility remain clear. 79% of all trips in England under one mile were walked in 2018, but this drops to 31% for trips between one and two miles (60% are by car). However, two fifths of people agree that many of the car journeys they make under two miles could just as easily be walked (DFT, 2018a). Walking has great potential.

There are growing imperatives for this potential to be realised in terms of public health and climate change. Poor air quality and physical inactivity contribute to millions of deaths worldwide each year. The World Health Organisation points towards the co-benefits of promotion of active travel (WHO, 2011); contributing to reducing carbon emissions while improving air quality, people’s physical fitness and mental wellbeing. With mounting concern over climate change, on 27 June 2019 the UK endorsed in law a commitment to it achieving net zero carbon emissions by 2050. Transport sector is a major contributor to carbon emissions and one which has so far failed to achieve emissions reduction (CCC, 2019). To address this legally binding commitment, technological innovation in the transport sector will not be sufficient – there is a need for significant behaviour change (supported by technological developments including big data and artificial intelligence). Travel demand management (TDM) therefore has a major part to play in the future of mobility: harnessing what the digital age has to offer as part of encouraging and supporting changes in how we travel.

This paper is motivated by a wish to consider the changing prospects of walking as part of a look to the future of mobility and the role of TDM. While it has the potential to make a substantial contribution (perhaps particularly in urban areas) it might appear a mode that prompts relatively little attention and excitement from governments and industry, where addressing both mobility and economic prosperity are imperatives (DFT, 2019a). However, the paper’s assertion is that in fact walking could be the mode that epitomises the disruptive effect of technology on mobility. This is based upon consideration of the pedestrian navigation functionality now incorporated in Google Maps (see Fig. 1) and which is continuing to advance in terms of its usability credentials (see later).

In January 2019 I suggested the term ‘Walking as a Service’ (WaaS) for this on social mediaa (see Fig. 1) which generated a lot of interest. Comments included: “reliable and carbon neutral” (James Falkner); “And utilising country’s largest, most sophisticated and most used transport network. ‘Hidden’ quite literally under our feet” (Rod Fletcher); “……and its free!” (Vineet Abbishek); and “Walking - it’s the mode of the future!” (Susan Claris). Another comment pointed to the real potential of WaaS to change behaviour: “cognitive skills in mentally mapping an area, and cognition of time…[i]f one or other is lacking then this limits ability to think through whether a walk works or not for a certain journey” (John Parkin). It seemed clear that this form of private sector-led TDM merits closer examination.

The paper is structured to provide its examination of WaaS as follows. The next section considers walking as a mode, including benefits and impediments to its use, and the role of navigation. It highlights also empirical evidence to suggest the possibility of a renaissance in walking. The following section addresses Google Maps and its pedestrian navigation feature including ongoing developments to its usability and the apparent win-win-win for pedestrians (ease of wayfinding), businesses (attracting and profiting from visitors) and Google (monetising geography). Section 4 examines WaaS in the context of Mobility-as-a-Service (Maas). It distinguishes between the fragile business model of Maas founded upon selling access to mobility and the seemingly more established and compelling business model of WaaS founded upon selling access to geography and consumers. The concluding section considers the place of WaaS in the future of mobility, putting forward the prospect of a WaaS Circle of Virtue wherein WaaS is able to support sustainability and profitability in a cycle that invests in walkability and wayfinding, realises increased levels of walking, and in turn yields profit and growth in the (local) economy. The paper draws particularly but not exclusively upon empirical insights, experience and policy considerations from the UK and London.

2. Walking as a mode

2.1. A neglected mode with great potential

"Walking is the easiest way for most people to get more active and benefit their physical and mental health" (Living Streets, n.d.: 4). Tight et al. (2011) summarise characteristics of walking – it uses the human body as its powertrain, is exposed to the weather, vulnerable to collisions with motor vehicles, requires little training, is environmentally friendly, and healthy. Walking in terms of overall mode share in Great Britain dropped from 35% in 1975/76 to 22% in 2008 (Tight et al., 2011) with the suggestion that this paralleled the rise of car dependence (Tolley et al., 2001) and sedentary lifestyles and a sense of utilitarian walking becoming an inferior mode (Lumsden and Mitchell, 1999). Lumsden and Mitchell described walking as “a year-round, readily repeatable, self-reinforcing, habit-forming activity, and the main option for increasing physical activity in sedentary populations” (Lumsden and Mitchell, 1999: 272) while noting a lack of interest in walking among planners and in turn coverage in transport policies.

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3 Google Maps is not the only online service for pedestrian wayfinding (see for example www.walkit.com) but its prominence in mapping capability across multiple locations globally and the ongoing innovation involved make it an appropriate focus for this article.
(2017) points to problems affecting walking including noise, delays, narrow pavements and pavement parking, reflective of a power imbalance between walking and motorised modes. He also remarks on the main technological development associated with walking being that of app-based navigation.

A recent study of Londoners’ travel (TFL, 2017) suggested that there were 3.6 million daily journeys by motorised modes that could be walked – either entirely (around 2.4 million) or partly (as a trip stage – around 1.2 million). Shopping and personal business and leisure account for more than half of the former and nearly a million daily journeys (mostly by car) would take less than 10 min to walk. Nearly half of the latter 1.2 million trip stages are for work reasons and are currently made by bus and/or Underground. The study notes the focus on Londoners rather than visitors to London and hence the potential to considerably underestimate the potential for growth in walking in central London given its high volume of daily visitors.

2.2. A walking renaissance?

Assuming consistency in the measurement of walking over time, the average number of trip stages walked per person annually in England has shown gradual decline in urban and rural areas over some years (Fig. 2) but this decline has reversed since 2014. Between 2014 and 2017 the three-year average rate of trip stages per person per year has gone up by 14% for England overall (12% in urban areas, 18% in London and 29% in rural areas). The increase is higher for males (15%) than for females (12%) and higher for leisure trips (16%) than for utility trips (11%). It has gone up across all age bands with the greatest increase being 27% for those aged 40–49.

Fig. 3 shows that while overall trip rate had been following a trend of decline in recent years, it too has seen an upturn - since 2015. Commensurate with this is an upturn in walking for trips (as distinct from trip stages) of less than one mile (DfT, 2019a). Short trips (under one mile) have substantially contributed to overall trip rate change over time (most trips are local). Indeed Kit Mitchell in his analysis of NTS data over a longer period observes that “almost all the change in the total number of trips since 1985 has occurred because of changes in the number of trips shorter than 1 mile” (DfT, 2018b: 8). The comparison, for trips under one mile, of walking
trip rate change to overall trip rate change (dotted and dashed lines respectively in Fig. 3) shows little change over this period. Walking is not (yet) becoming very much more dominant as a mode for shorter journeys (in spite of its potential noted above). However, shorter journeys (< 1 mile) themselves show a recent upward trend (23% increase from 2015 to 2018) to which walking contributes substantially (a 30% increase from 2015 to 2018 in walking trips < 1 mile accounting in 2018 for 79% of all trips < 1 mile).

What is not clear is whether this upturn in walking, as part of an upturn in shorter trips, will continue and what explains it. What part could changing (urban) form and its design, changing behaviours (e.g. top-up grocery shopping), crowding on public transport, congested roads, changing attitudes, changing circumstances (economic and social) and improvements in wayfinding be playing?

2.3. Walkability and wayfinding

Walkability concerns ‘how friendly an area is to walking’\(^8\). Ewing and Handy (2009) conceive of how walkability is not only

\(^8\) https://en.wikipedia.org/wiki/Walkability
directly affected by physical features (including the built environment, flows of vehicles and people and weather), but is also indirectly affected by urban design qualities (e.g. legibility, human scale and linkage), and human reaction (in terms of sense of safety and comfort as well as level of interest) (see also Clark and Scott, 2016; and Götschi et al., 2017). Making areas more walkable is a non-trivial undertaking, particularly where retrospective improvement is being pursued. Improved walkability (see Speck, 2013) happens generally by design rather than by accident. Alfonzo (2005) refers to a ‘hierarchy of walking needs’: feasibility (whether the person is able to in terms of their mobility, time and responsibilities); accessibility (walking infrastructure and availability of destination attractions); safety (presence of people and signs of incivility); comfort (urban design characteristics and relationship with motorised traffic); and pleasurability (scale, diversity and aesthetic appeal). Middleton (2011, 2016) highlights the importance of looking beyond only seeing walking as a means of getting from A to B to seeing and understanding what happens between A and B as well as understanding the place of walking in people’s everyday lives. Walking can provide a form of ‘psychological respite’ or can provide a setting for social encounter (Durkin et al., 2007).

Vandenberge et al. (2016) in examining literature on walking and walkability note the emphasis on place-based factors (“including land use mix, population density, proximity to transit, sidewalk connectivity, safety, and accessibility”) and by contrast surprisingly limited attention given to wayfinding which, given the cognitively demanding nature of wayfinding and its potential to influence “people’s willingness to walk”, seems something needing attention. They go on to review available wayfinding literature9 and observe little available insight into the links between wayfinding and walking behaviour including the choice of walking over other modes.

Meanwhile they point to one study in London suggesting that 55% of trips made on the underground would have been quicker to walk. According to Fendley (2016), at least prior to the development of Legible London (see below), 44% of pedestrians were using the Tube Map for planning journeys (see also Arquati, 2008), in spite of it lacking accurate scale or geographic representation, thereby encouraging very short public transport journeys to be made (Clark et al., 2017). Since 2015, Transport for London has provided a map of the Underground showing walking times between tube stations10, “following popularity of other unofficial versions”11. It has been described more recently as something that “will inform tourists and new London residents of the journeys you simply needn’t bother swiping your Oyster card for”12.

AIG (2006: 3) suggest that “[m]any people avoid walking if it requires them to navigate through an unfamiliar territory. The sense of the unknown - how long will it take, where a street leads to - creates ‘risk’, especially of getting lost or increased journey times”. Mackett (2019) highlights the high prevalence of forms of mental illness across the general public (around a quarter of adults in England) – notably anxiety and depression. From a survey of respondents with mental health conditions, he identifies the following factors associated with wayfinding as causes of anxiety when travelling: feeling disoriented, getting lost, remembering where one is going and having to take decisions about where to go (Mackett, 2019: 14).

What follows is the importance of supporting wayfinding with good signage and indeed a citywide system of signage – something now addressed in London by ‘Legible London’ with its network of over 1700 signs (TfL, 2007) integrated with bus stops, tube stops and taxi ranks which have maps oriented to their location and position (‘heads up’) and which provide 5 min and 15 min walking circles superimposed (based upon a walking pace of 2.8 mph) – see Fig. 4.

At its heart, this initiative addresses four key questions: (i) where am I?; (ii) where is it (the destination I am seeking or may choose); (iii) how do I get there?; and (iv) what else is around here? – thereby giving people the confidence to walk and explore (Clark et al., 2017). This reflects John Parkin’s point earlier concerning spatial and temporal orientation when wayfinding. Legible London underlines the importance of wayfinding as a determinant of propensity to walk, with evaluation evidence suggesting a resulting increase in interest in walking (Vandenberge et al., 2016). Fendley (2016: 166) indicates that “[i]t is used over 1 billion times a year, and its return on investment is forecast to be in the heady 5:1’s”.

Landmarks are key reference points in wayfinding (Vandenberge et al., 2016). Inclusion of landmarks in Legible London is based on a specific set of criteria and incorporates commercial buildings (e.g. retail). However, organisations are not able to pay to be represented – something which Clark et al. (2017) contrast with Google Maps – though “it is safe to assume that branded businesses have long served as landmarks in both locating places and wayfinding practice” (Dalton and Thatcher, 2019: 37).

May et al. (2003) in their urban navigation requirements study found “that landmarks were by far the most predominant navigation cue [often referred to by name rather than function], that distance information and street names were infrequently used, and that information is used to enable navigation decisions, but also to enhance the pedestrian’s confidence and trust” (May et al., 2003: 331). In this extensively cited paper it is noted, bearing in mind the date, that “the business case for navigation and related services remains to be proven” and that “more widespread and detailed digital mapping coverage and enhanced mobile data transfer rates have resulted in the technological feasibility of mobile navigation aids for pedestrians” (May et al., 2003: 331). The passage of 17 years has resulted in both these issues being responded to in the form of Google Maps Navigation (addressed in Section 3, including implications for spatial knowledge acquisition).

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9 Campbell and Lyons (2008) point to the substantial amount of research into wayfinding that has been conducted, notably in the field of psychology – also noted by Vandenberge et al. (2016) who suggest that this often involves experiments that do not reflect the greater complexity of real-world conditions.


2.4. Summary

The following points can be made about walking as a mode:

- Walking in the UK remains a significant mode but has seen decline over several years in the face of a car dependent society, compounded by a relative lack of interest from (transport) planners and policymakers.
- A recent and seemingly significant upturn in walking has been observed (in line with an increase in trip rate overall and trip rate for short trips under one mile). This may or may not be a sign of things to come and is not yet explained.
- A considerable proportion of journeys in urban environments are within reach of walking and indeed many individuals consider that such trips are walkable. There is unrealised potential.
- Research and advocacy exists concerning the importance of improving walkability of environments as an enabler of, and stimulus for, more walking.
- The digital age has unlocked considerable opportunity to address matters of spatial and temporal cognition in the form of journey planning and navigation support – available on mobile devices.
- In spite of an apparent disconnection in terms of their coverage in the literature, improved walkability and wayfinding together could help realise walking’s full potential to contribute to public health and tackling climate change.

The disconnection in the literature between walkability and wayfinding may be explained (in part) by the majority of travel being not only local but also familiar – it involves trips to familiar destinations (in the context of people’s everyday lives) with perhaps the inference that the traveller would already know how to get to such destinations on foot and not therefore need support with navigation. This may be true for many trips. However, it is suggested that there are reasons why a service such as Google Maps Navigation could be helpful in further supporting the prospect of walking:

(i) An individual may have a mental map of their existing means of travel to a familiar destination/interchange but no mental map of how the trip/trip stage would/could be made on foot (‘I routinely use the metro to go three stops and never realised it was walkable but I’d get lost if I tried’).

(ii) Beyond navigation concerns, individuals may have no appreciation of how far a journey is on foot and how long it would take (‘its just outside the city centre so I assume it makes sense to take a cab’).

(iii) There are particular destinations that are new even if the individual is broadly familiar with the (urban) environment concerned (‘we’re meeting at that new restaurant, I’ve no idea where it is, can you pick me up if you’re driving there anyway?’).

(iv) Some individuals may not consciously consider walking because it is viewed as an inferior (lower speed and lower tech) mode (‘not sure I could cope with trudging there on foot and arriving hot and bothered, and I just don’t have the time’).

(v) The individual is entirely unfamiliar with an area and the means of reaching particular destinations (‘its my first time here so I grabbed an Uber from the train station to meet up with friends’).
(vi) Because of some or all of the factors above, an individual does not consciously consider walking for a trip or stage in their choice set when deciding on how to travel (‘it’s never occurred to me to consider walking, I just always jump on the bus’).

Such issues could be especially relevant in urban areas with their rich fabric of streets, where multiple destinations and modes exist, and where there is a strong presence of taxis (and perhaps ride-hailing) which provide an (increasingly) convenient means of side-stepping navigation by letting a driver take you (almost) to the door.

With this in mind attention now turns to Google Maps Navigation – an innovation that is lowering (or which holds the prospect of lowering) the barriers to walking in terms of the support it provides.

3. Google Maps navigation

Google Maps Navigation is a stark illustration of how the passage of time can move us from academic studies (exploring user needs and contemplating future developments that might meet such needs) to a reality in which what was once contemplated has not only been delivered but in a form that exceeds what might have been imagined a decade or two before (May et al., 2003). It is not the only source of digital wayfinding support13 for pedestrians but it has a dominance in the market (e.g. Mackett, 2019) and extensive geographic coverage.

3.1. Introduction

Google Maps first appeared in 200514, with Google Street View (and its 360 degree panoramic street-level view of certain locations) introduced in 2007. By 2015 Google Maps reportedly had over one billion users15. Apps such as Google Maps have become the de facto interface between the physical and the digital world, meaning people need never be lost again - even if they don’t have a sense of direction16. The beta release of Google Maps Navigation was in 2009 and it launched outside the USA the following year17.

Google Maps Navigation is easier to experience than to explain. However, the ever-improving functionality and usability is – when casting one’s mind back to the start of the millennium – breathtaking. This is ‘here and now’ mobility, devoid of hype and what-ifs. It knows where you are now geographically (if you let it). Type in a postcode or a business/service name for where you want to go and it comes up with suggestions to help you locate and confirm your destination. Within seconds you know an estimate of how far away it is and how long it would take on foot. If you choose to set off, the estimated time of arrival is continually updated (giving a sense of whether you are walking more or less quickly than the service’s assumed walking speed). Two- and in some cases three-dimensional representation of buildings give a sense of place with your route ahead clearly marked (even to the level of detail of which side of the street to walk). You can see the names of individual buildings and businesses clearly marked, thus providing reference point landmarks as well as the street names. Audio wayfinding instructions are to hand as well if needed. This said, as with all products, it can take some investment of effort to become familiar with, and tune in to, using it. One of the challenges can be initial orientation in terms of where you are and where you need to physically head in relation to the map and direction on your smartphone. There is also a dependence on GPS to ensure things are really in tune.

3.2. Ongoing innovation

However, Google Maps Navigation, in spite of its impressive achievements over the last 10 years, remains a work in progress. At the annual Google I/O Developer Conference in 2018, Google Vice President Aparna Chennapragada explained the latest developments that concern augmented reality18:

“Our teams have been working really hard to combine the power of the camera (the computer vision) with Streetview and Maps to reimagine walking navigation. So here’s how it could look like in Google Maps; let’s take a look. You open the camera. You instantly know where you are. No fussing with the phone. All the information on the map – the street names, the directions – right there in front of you. Notice that you also see the map so that you stay oriented” (see Fig. 5).

This augmented reality is now being rolled out for users of Google’s Pixel smartphones. There is also, under development, improved locational accuracy beyond GPS-dependency – called Visual Positioning System which it is claimed can “estimate precise positioning and orientation”.

Whether or not the experience is variable between geographic locations is a moot point. However, the experience in London

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13 An alternative service to Google Maps is Baidu Maps (available in Chinese Language only and originally offered in China). This is not only being used for wayfinding but has been demonstrated as a rich data resource for system analysis. For example Dong et al. (2017) and Zhou et al. (2018) have used location search data from Baidu Maps to measure economic dynamics in real time and estimate numbers of people (ahead of time) in a particular geographic area.


18 https://www.youtube.com/watch?v=w-wRmuWZ4Y.
Fig. 5. Google adds augmented reality to pedestrian navigation.

suggests that a concern over navigation for an unfamiliar journey by foot is rapidly becoming a thing of the past. It is also more than navigation — it is about instilling greater confidence in the individual to make sense of the time and distance involved in walking to destinations. It can provide a source of assurance, a sense of ability to travel independently, to be in control. This may, of course, not overcome other walkability issues that conspire against considering walking as a travel choice.

3.3. A win–win–win situation?

There appear to be at least three winners from the Google Maps Navigation innovation:

(i) **The pedestrian** is afforded free access to a versatile (and, perhaps increasingly, intuitive) service to support them on their walk trips and indeed in terms of searching for and locating amenities and services.

(ii) **The proprietors/occupiers** of premises and facilities are more easily discoverable by people (and their custom) that they seek to attract to their locations. By having their names included on buildings in the mapping display to pedestrians, they are enhancing landmark detail that in turn benefits the pedestrian (regardless of whether the premises concerned is the pedestrian’s destination). Through ‘Google My Business’, businesses can, for free at present, set up a profile that will appear in Google Search and Maps results and on Google Maps.

(iii) Google is benefiting from both of the above (and other sources besides — see below) through the data it gathers (from users who make it available knowingly or not), the targeting of information it can provide and the fees it can charge for advertising. As the saying goes, ‘if a product is free then you are the product’. While the business listing is currently free, businesses can pay for enhanced appearance on Maps (e.g. showing their logo) and can pay to appear in search results (e.g. “Thai restaurants in central London”). As part of its endeavours to see how it can further monetise Google Maps, Google has, it appears, been exploring whether or not it could charge businesses for their listings. The power of geography is a lucrative business and one for which Google now has a mature, complex and continually developing ecosystem.

Google Maps is made available for other businesses to use in their own products and services through an API (Application Programming Interface) which allows such products and services to make requests to Google Maps and then embed the received information in their own offers to users. This is, of course, at a price. The Uber App relies upon the Google Maps API. In 2016 Uber reportedly invested $500 M in seeking to provide an alternative (to also support its driverless vehicles development) through Google

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19 Notwithstanding the access/data charges associated with the smartphone users’ mobile network provider and the data passed to Google in return for service usage.

20 Through surveying restaurant businesses and customers in Brisbane, Yen et al. (2020) offer a very recent demonstration that “customers arriving on foot, by bike or by public transport all contribute significantly more to the restaurant trade than business owners and managers think” (Yen et al., 2020: 12).

21 [https://www.intertwineinteractive.com/blog/seo/will-google-charge-for-google-my-business-listings/](https://www.intertwineinteractive.com/blog/seo/will-google-charge-for-google-my-business-listings/)

22 [https://www.ft.com/content/e0d1a45e-5522-11e6-be6d-26e0c26b3e60](https://www.ft.com/content/e0d1a45e-5522-11e6-be6d-26e0c26b3e60)
increasing the fees for use of its Maps. Indeed, Uber has said that “[w]e rely upon certain third parties to provide software for our products and offerings, including Google Maps for the mapping function that is critical to the functionality of our platform”\textsuperscript{23} Over three years, Uber has paid Google some $58 M for mapping. At the end of 2016 it was estimated that Google Maps could grow into a $5bn business by 2020\textsuperscript{24} and more recent coverage\textsuperscript{25} expects profits to grow through API pricing increases and location-based advertising.

Whether or not this win–win–win is felt for pedestrians, businesses and Google, and will continue to be felt by all parties affected remains to be seen. There may be unanticipated consequences (positive and negative) as well as limitations - under Google's control - to the benefits different parties can enjoy. In relation to the latter, for example, it is not currently possible to manually stipulate a walking speed in Maps Navigation and neither does it appear clear how the estimated walk time for a journey is calculated (though personal experience is that it's estimate is conservative). Another example may concern the routes offered by the service for reaching a destination. Are there more scenic routes (that are perhaps longer or passing fewer (sponsored) landmarks) that are also more walkable and attractive? Are there safer or more accessible routes? Is it within Google’s present or future gift to address this and would it do so?

3.4. Consequences for spatial knowledge

As the smartphone has become increasingly ubiquitous, and as use of services such as Google Maps Navigation has grown, research has sought to understand potential implications for the acquisition of spatial knowledge and “how we see and understand the world around us” (Dalton and Thatcher, 2019: 37). Focusing and relying upon a navigation system can compromise spatial knowledge acquisition as less attention is paid to the surrounding environment (Brügger et al., 2019). Over a period of time studies have found that more fragmented spatial knowledge arises from mobile map use compared to use of paper maps (Willis et al., 2009; Brügger et al., 2019). Mobile map use encourages passive navigation practices that can result in simplified spatial knowledge characterised by landmarks “rather than a mixture of landmarks and other more complex features and connections” (Dalton and Thatcher, 2019: 27). In a comparison with Google Maps and Legible London, Wang and Worboys (2016) also found that Google Maps' users had poorer orientation during their wayfinding task than those using Legible London maps because of difficulty relating current location to the destination on a limited screen size as well as less attention being paid to route and surroundings - succinctly expressed as “...with Google Maps you cannot see the whole space – you are like a blinkered horse”. Vaez et al. (2019) report similar empirical findings when comparing Google Maps with use of local signage for unfamiliar tourist travel. They also highlight the limited social interaction with surroundings associated with Google Maps use.

There is more to be understood regarding the consequences of mobile map use for how we interpret the world around us (Vaez et al., 2019). It could tend towards spatial knowledge that is increasingly characterised by landmarks of (big-brand) businesses at the expense of a richer picture incorporating local businesses and the fabric of the built environment (Dalton and Thatcher, 2019). This may be compounded by a tendency for mobile map use such as Google Maps Navigation to favour “walking along navigation friendly edges, such as major highways, or on less attractive street segments” (Vaez et al., 2019: 13). However, if it plays a part in improving the appeal of walking this could nevertheless encourage chance encounter and (some) new spatial knowledge to be acquired.

Having considered the prospects for walking and the supporting technological innovation, attention now turns to how WaaS relates to the current interest in the phenomenon of MaaS.

4. WaaS in the context of MaaS

4.1. The birth of a new term

MaaS as a term is in its infancy (Heikkilä, 2014). It introduces a new intermediary role into the mobility ecosystem which aims to provide end users of the transport system with convenient (and potentially more flexible and price-competitive) access to multiple modes through a single platform, as opposed to having to engage directly with multiple mobility, information and transactional services across different modes. In concept, the appeal is the prospect of more usable, affordable and seamless travel. Uber is an example of MaaS in terms of a smartphone App for ride hailing that provides convenient access to, and payment for, available vehicles. Uber - in a form that covers more travel options than only ride hailing on its platform (something the company is currently pursuing) - would epitomise MaaS. Another example from the Finland-based company ‘MaaS Global’ is Whim\textsuperscript{27} (see Lyons et al, 2019).

There has been considerable recent interest in MaaS. There has also been much hype (Giescke et al., 2016). Lyons et al. (2019) provide a user perspective on MaaS. They suggest that far from being new, MaaS is another evolutionary step in the development of integrated, seamless, multimodal travel. They offer an interpretation of MaaS as the mobility system beyond the private car as shown in Fig. 6 and refer to this as a hierarchy of need. The mobility intermediary is depicted as the higher ‘nice to have' layer in the hierarchy

\textsuperscript{23} 11 April 2019 - https://www.cnbc.com/2019/04/11/uber-paid-google-$8-million-over-three-years-for-map-services.html.
\textsuperscript{24} https://www.businessinsider.com/google-maps-could-be-a-5-billion-business-by-20207r=US&IR=T.
\textsuperscript{26} https://keyurjain.com/maps-in-mind.
\textsuperscript{27} https://whimapp.com.
while the basis for a viable alternative to the private car is having a suitable availability and quality of mobility services (themselves underpinned by the existence of vehicles and infrastructure with which to run such services). With such services in place, information services then have a role in facilitating and supporting individuals planning and undertaking their journeys – TDM starts to come into its own. The mobility intermediary layer can in turn (across modes) further reduce the cognitive effort associated with mobility. Lyons et al. (2019) also offer a ‘Levels of MaaS Integration’ taxonomy, underlining the evolutionary rather than new status of MaaS. This suggests that existing services such as Google Maps Navigation (which spans driving, transit, walking and cycling) can be classed as MaaS.

4.2. Interpreting WaaS through the lens of MaaS

The suggestion has been made that walking may be played down as a modal option within MaaS (Transport Committee, 2018). Walking for many journeys remains the glue that connects one or more wheel-based modes to the locations people are travelling from and to. In this sense, it features in journey planning services and mobility intermediary services as part of the offer – it is an enabler. For instance, Uber offers what it refers to as UberPool where rides can be shared between people and two years ago it introduced a cheaper Express Pool version within which users are required to walk at the beginning/end of their journeys to/from shared pick-up/drop-off points. It is unclear whether this is motivated by some or all of: customer service; sustainability; and demand/income growth. Unclear too are the future prospects for, and effects of, such a service.

However, walking does not necessarily feature in MaaS as a travel option in its own right as an alternative to other means of reaching a destination (for journeys within walkable distance). It may be that one reason for this is that it detracts from selling mobility to consumers and thereby supporting a revenue stream to justify the investment made by an intermediary and its supporting mobility service providers. Google Maps Navigation represents an intriguing exception here since it offers the user a range of modes for which directions and journey time estimates can be provided.

Fig. 6 considers how WaaS relates to the depiction of MaaS as the mobility system beyond the private car, with the layers in the hierarchy interpreted as follows:

- **Infrastructure and vehicles** - MaaS may, for many people in a number of locations, struggle to offer a compelling alternative to the private car due principally to the state of the bottom two layers in Fig. 6 (e.g. the availability of a bus fleet, the coverage and completeness of a cycle network, the existence of a train station or tram stops). Meanwhile, extensive infrastructure exists for WaaS.

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286 Indeed in travel behaviour itself, whether or not people are conscious of it, walking provides an enabling function to using other modes – e.g. for the ‘door-to-door’ car journey.

289 https://www.uber.com/newsroom/expresspool/.
(as Rod Fletcher put it (see Introduction), the “largest, most sophisticated and most used transport network”) and being physically able to walk constitutes having the means (‘vehicle’) to use the infrastructure. The quality of the infrastructure may of course be highly variable from location to location.

**Mobility services** – With respect to Waas, what equips the walking experience can be conceived of as the mobility service. Just as mobility services in MaaS can be variable in their offer and hence attractiveness to the user, the same is true of walking as part of Waas. Attractiveness will depend upon the individual’s level of physical fitness, the suitability of their footwear and attire, the form and function of artefacts they are carrying and the (perceived) ambience and functionality (e.g. number of (signalised) crossings) of the walking environment. Walking’s viability (in absolute terms or when set against other options) will also depend on distance and time (and its ability or not to meet other social-psychological requirements such as sociability or solitude).

**Information services** – With the preceding layers in place, Google Maps Navigation (or alternative equivalents) provides the means to plan and execute the journey. Stradling (2006) refers to the three ‘efforts’ of travel – the physical, cognitive and affective (emotional) efforts. Google Maps Navigation can significantly reduce the cognitive and in turn negative affective effort of undertaking a walking journey (thereby affording the individual the ability to devote more attention to matters besides the task of getting from A to B). If an individual knows how to get to their destination, how far it is and has a sense of how long it will take, they feel in control of their journey and can potentially derive greater positive utility from the experience of their time spent making the journey (for example listening to music).

**Transaction** – Waas, unlike MaaS, is free to the end-user. There is therefore no need for a transactional layer in the system (from the user perspective) – potentially further adding to convenience and control. The user is not, however, getting something for nothing. In exchange for using Google’s service, they are provided data to Google that it will monetise.

**Mobility intermediary** – For MaaS, the mobility intermediary layer is what, for some commentators, is the embodiment of MaaS itself. It is the value-added layer for the user, designed to integrate the layers below and across mobility services and provide enhanced simplicity and usability of the mobility system beyond the private car. It is a layer whose existence depends upon effective brokerage between mobility service providers and consumers). Meanwhile in terms of Waas, in one sense this layer is either redundant (since the preceding layers already provide the user with the enablers of walking) or is synonymous with the information services layer. Another sense, there is clearly an intermediary role that underpins Waas – but it is rather different to MaaS. It concerns brokerage between organisations whose premises represent wayfinding landmarks, representation of geography and the consumption of geography (and marketing) by the end user. Were Waas to be treated as a part of MaaS by a mobility intermediary then the mobility intermediary role would have further significance in promoting walking to the user as one of the travel options within a MaaS offer.

**User** – The user’s placement at the top of the hierarchy is not to suggest that this is the least fundamental consideration but rather that when considering Waas or MaaS, a user-perspective should be central.

5. Concluding discussion – Waas and the future of mobility

TfL (2018) identifies eight barriers to walking (for London): not having enough time; too much traffic, and traffic travelling too fast; personal security concerns; having other ways of travelling that work better; streets are not pedestrian friendly; not being fit enough; road danger concerns; and having a disability. This might suggest the information services layer of Waas is not a barrier compared to lower layers (Fig. 6). Yet TfL (2018) also indicates that 70% of walkable trips are made by car with nearly one-third of walkable trips taking less than 10 min. The potential for walking remains clear.

The barriers above are in part attitudinal and a product of societal norms. We are currently in what appears to be a transitional phase for our mobility system (Lyons, 2015) with behaviour change, social and attitudinal change, and technological innovation spelling uncertainty over the future of mobility. At the same time, the future is ours to shape. This paper has sought to give greater prominence to the important part walking plays and can, in the future, play to a greater extent with the support of technological innovation and the power of geography.

5.1. Business models

Waas has a very different business model underlying it to that of MaaS:

- MaaS is founded upon selling access to mobility
- Waas is founded upon selling access to geography and access to consumers

In relation to MaaS, the intermediary role has been the subject of recent and significant venture capital investment as well as hype. Uber became a public company on 10 May 2019 with an initial valuation of $80bn before trading of shares began. Yet in its IPO filing, the company stated that it may never make a profit (in spite of growth in revenue)30. The business model for (private sector) MaaS mobility intermediaries remains questionable with challenges engaging both mobility service providers and users at price points that are attractive to both and which offers remaining margins for the intermediaries’ profitability (Lyons et al., 2019). Meanwhile it would appear that Waas and its intermediary layer are founded upon a very different business model wherein

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advertising is the fundamental source of revenue for the intermediary as part of a wider ecosystem of big data concerning details and behaviours of business and consumers. Google Maps, while already generating revenue, is (reportedly) substantially under-monetised. It is not yet clear whether or not both business models are sustainable and will co-exist or whether new forms of business model will emerge as part of the overall mobility marketplace.

5.2. The Waas Circle of Virtue

From a transport policy perspective - where responsibilities include carbon reduction - it is important to understand, and potentially influence, how MaaS and Waas evolve. As set out in the strategy for the future of urban mobility (DfT, 2019a) referred to at the start of the paper, walking should be the mode of preference for short trips; short trips should not be monetised unnecessarily by MaaS through selling access to motorised mobility. Encouraging journeys under two miles and especially those under one mile to be walked should be a top priority, supported by Waas and walkability measures.

Both MaaS and Waas (unless publicly funded or subsidised) have financial sustainability to consider which could be at odds with fulfilling the sustainable transport objectives of public authorities. Waas has the prospect of providing a ‘sweet spot’ where Walking aimed at Sustainability as well as Walking aimed at Shareholders can be successfully pursued. We must guard against innovations in mobility that could – for profit or in the supposed interests of consumer convenience – see walkable trips being unduly undertaken by other means.

The prospect of a symbiosis between sustainability and shareholders exists in relation to Waas which it can be suggested could point towards the creation of a MaaS Circle of Virtue (CoV) as shown in Fig. 7:

- Public (and private sector) investment in walkability that focuses upon improving the attractiveness of the public realm, in terms of the infrastructure for walking but also the ambiance of the environment for walking, helps address the barriers to walking.
- Improvement in navigability that addresses the key questions of ‘how (easily) can I find my way?’, ‘how far is it?’ and ‘how long will it take?’ provides a further enabling function for walking’s viability and attractiveness.
- These hold the prospect of leading to an increase in walking.
- The Waas business model benefits from an increase in walking, with the prospect of then connecting more consumers to businesses – with the opportunity for an increase in profit (for the intermediary (Google) and for the businesses (featuring as landmarks) in the Google ecosystem).
- This leads to growth in the local economy that enables further investment in walkability.

This conceptual depiction is ideological and simplified. It merits further examination to better understand the interplay between the different elements in practice31 and establish whether indeed a symbiosis exists or could be enabled.

5.3. Closing remarks

While this paper has sought to highlight the significance of walking as part of TDM approaches in the digital age and to emphasise

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31 Vaez et al. (2019) note the need for cities to consider how they might influence how (unfamiliar) visitors navigate the built environment in the interests of local commerce.
its importance and potential for the future of mobility, it also points to the need for further work, including the following. Empirical research is needed to better understand the nature and extent of use of WaaS and in particular Google Maps Navigation for walking trips – and the consequences for both travel choices as well as people’s interactions with the environments through which they pass and the businesses therein. There is a need also – from a public sector perspective – to better understand how Google is evolving its service offerings and in what ways scope exists to shape the service to pedestrians in a way that it beneficial such that the CoV can be at play.

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