Making Smart Fair: Building inclusive, fair and sustainable transport for cities of the future

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Executive Summary

This paper examines debates over 'Smart cities' which have emerged in recent years as a technology-led response to problems facing the world's conurbations, which are growing in number, size and complexity. The main focus of this paper is on transport in a smart city. While definitions of a smart city vary, broadly they are understood to harness and harmonise technological innovations - especially Big Data and the Internet of Things (IoT) – to improve outcomes in terms of efficiency, sustainability and citizen engagement (Debnath et al., 2014; Gil-Garcia et al., 2015).

A variety of perspectives are apparent in the growing literature from academic, corporate, government and popular media sources on smart cities. On the one hand, smart city innovations are seen as value-neutral, self-evidently obvious solutions to problems in urban planning. In this view, smart city solutions go hand-in-hand with wider trends at both the up- and down-stream level (Elmaghraby, 2013; Vermesan et al., 2011). Upstream trends include the collection, harmonisation and analysis of big data between private and public stakeholders to predict and provide traffic flows more efficiently. Down-stream, they include the increasing use of smartphones, navigational and ride-hailing apps by citizens, and a predicted increase in the use of electric (EVs) or even autonomous vehicles (AVs).

Others express caution or even scepticism. Some worry that the smart city might just be a 'neoliberal' city, where private consultants, engineering corporations and tech start-ups erode democratically-elected and often cash-strapped public authorities with self-serving technological 'solutionism' (Grossi & Pianezzi, 2017). Echoing wider and largely unresolved concerns over the use of Big Data, others worry that ethical and privacy concerns may easily be over-ridden in the collection of personal data (Kitchin, 2016).

This paper will critically review these views, but also seeks to add to them with three novel contributions. Firstly, this paper argues that concerns over smart city ethics have been rather generic and much greater attention needs to be given to issues of inclusivity and fairness, especially regarding gender. Secondly, it is argued that smart city advocates need to take sustainability concerns far more seriously, and move from away from a digitally-enhanced 'predict and provide' model of urban transport planning, and towards a 'decide and provide' model which is far more radical: for instance, trying to foster a modal shift away from privately owned cars, not simply replacing them with EVs or AVs. Finally, following the COVID-19 pandemic, the very role and purpose of urban centres may change very radically. Smart city discourses will adapt to such changes to remain relevant, and many solutions to problems of inclusivity and sustainability in urban mobility might not be smart at all.

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Part 1: Defining and realising the Smart City

Do Smart Cities actually exist?

According to the global consulting firm HIS Markit, a smart city is one in which information and communications technology (ICT) is integrated into many or all of its functional areas. These functional areas include energy, sustainability, transport, physical infrastructure, governance, security and safety (Arrowsmith, 2014). To consider what it might be like to live in a truly smart city, picture the following scenario:

"Imagine life for the citizen of the smart city: you awake in your sustainably built home, and take your morning shower in recycled industrial wastewater, cost-efficiently heated overnight. Eating breakfast, you scan the flat screen, fed by maximum bandwidth internet, where the special, easy click local neighbourhood menu allows you to compare your daily energy use with other houses in the area, confirm your webcam appointment with your doctor, top up the balance of your all-purpose travel card, order your groceries and leave messages for your child's teacher. You can even watch television on it. Outside, your electric car is waiting. On the edge of the central congestion zone, you park in a charging area and, paying with your travel card, get into a three-wheeled utility vehicle which, via a network of special lanes and sensor-controlled pedestrianised areas, delivers you to another parking dock at your workplace." (Kirby, 2013 in Hollands, 2015, 63)

Perhaps what is most evident from this 'futuristic' smart city vision (written in 2013) is how many elements of it are already present in many of our lives in 2020. In developed cities, fast broadband, electric cars, webcam GP consultations, multi-use travel cards and online grocery shopping are increasingly unremarkable. Should we therefore conclude that the smart city is already here? Perhaps it is more useful to consider the 'smartness' of cities as being a journey rather than a destination. The smartness of a city depends on wider trends in technological innovation, a city's specific level of economic prosperity, the governance style of its leaders and their appetite for harnessing new technologies, and the availability of a pool of 'knowledge workers' in a given area (Meijer & Bolívar, 2016; Winters, 2011).

> *Box 1: Songdo – the story of a 'model' smart city*
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> One the oft-cited case studies of a smart city is Songdo International Business District (IBD) in South Korea. Built from scratch on reclaimed land close to the capital Seoul, the city was designed by American architects Kohn Pedersen Fox (KPF) in a £35billion development begun in 2004, then the largest private real estate development in history. Songdo integrates the latest in networked technologies, with ubiquitous broadband, traffic- and air-quality monitoring devices, wide roads and cycling infrastructure, and state-of-the-art domestic waste management in its purpose-built apartment blocks. The wide-spread use of surveillance cameras has invited some criticism over privacy, and despite huge investment of economic and political capital, it has been dogged by construction delays. Although two American universities and several high-profile companies have opened premises there, there has been a slow take-up of its commercial and cultural centres, suggesting a lack of appeal to the 'smart workers' it was hoped it might attract (Shapiro, 2006; Zettelmeyer, 2020), possibly as a result of the 'top-down' inorganic nature of its instigation and design (Yigitcanlar & Lee, 2014).

Case studies of smart cities often point to two 'exemplars': Masdar (UAE) and Songdo (South Korea). Both of these projects are still unfinished and despite highly ambitious plans for integrating technology and delivering sustainable outcomes, each has been beset by numerous practical and financial challenges (see Yigitcanlar et al., 2019 and *Box 1*).

Restricted to only these utopian 'bespoke' smart cities, the concept may seem like a distant dream. But other, much more well-established cities, are supposedly already well along their 'journey' towards smartness. A variety of global private-sector metrics – such as the indices of SmartCitiesWorld[2] or the IESE Cities in Motion Index[3] - are designed to measure and rank smart cities, with cities like Amsterdam, New York, London, Seoul, Singapore and San Francisco often dominating (Liu et al., 2018). London was named the IESE Number 1 smart city in 2019, scoring highly on measures of human capital, its public transport system, urban planning, and governance, among other indicators.

How Smart can we go?

In smart transport, usually referred to in the literature as Intelligent Transport Systems or ITS, and the main concern of this paper, many smart city applications are already at hand, even in cities which do not reach the heights of these league table rankings. On the user side, these include the use in ride-hailing apps like Uber and Lyft, and navigational tools like Googlemaps and Citymapper which provide real-time information on car traffic and public transport. On the side of planners and local authorities, these include the collection of movement data via traffic monitoring devices or e-ticket barriers on buses or metro stations which can enable travel demand management, inform public transport routing decisions, or improve emergency vehicle access.

In the future, ITS could take on a far more radical meaning if the promises of Mobility as a Service (MaaS) and/or Connected Autonomous Vehicles (CAVs) become reality. MaaS tries to make the mobility alternatives to car ownership so easy and convenient that citizens simply choose not to own a car. In Helsinki, Finland, citizens can use an app called 'Whim' which presents a variety of multi-modal options to get them to their desired destination. All aspects of the journey are bookable through the app, paid for by either a monthly subscription or pay-as-you-go option (Goodall et al., 2017). Taking the possibilities for MaaS a step further, the example illustrated in Box 2 shows the potentially game-changing potential of MaaS for our cities.

Box 2: Lisbon: Modelling a radically different urban mobility

The city of Lisbon, Portugal, was used as a model case study by the OECD's International Transport Forum. They modelled the effects of deploying a city-wide fleet of six-seat vehicles (shared taxis) offering on-demand, door-to-door shared rides in conjunction with a fleet of eight-person and 16-person mini-buses (taxi-buses) that serve pop-up stops. Users would book rides using a smart device and a central management system would allocate shared-taxis or taxi-buses and routing using an algorithm. If private car use were restricted to two or fewer days in a working week, the model predicted the effective elimination of peak-hour traffic, a reduction of traffic emissions by one third, and 95% less space required for public parking, freeing up miles of street space for alternative use (OECD/ITF, 2016). If the fleet used electric vehicles rather than ICE ones, carbon savings could be much higher.

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[2] https://www.smartcitiesworld.net/home

[3] https://www.iese.edu/faculty-research/cities-in-motion/

If Connected Autonomous Vehicles were also introduced and were used as a 'service' rather than a privately owned 'asset' (at least for urban travel), there could be scope for even greater traffic efficiency, further reduced emissions (especially if CAVs were also electrified from a clean grid), and reduced car accidents (Alkhanizi et al., 2019). So, what is stopping us from realising these numerous smart benefits?

Barriers to smart travel

MaaS is sometimes seen as applying a 'Netflix-style' business model to transport, so that the information that the user sees on their screen is accurate, timely and intuitive, and smart travel choices are made easier and cheaper. The hard work goes on behind the scenes. This is where complexity, the diverging priorities of transport stakeholders, and issues of ethics, diversity and inclusion can bring the utopian visions of smart travel back down to earth.

Collecting and transferring real-time data on the movements of buses, trains, and metro systems requires a vast degree of institutional capacity, which outside large cities like London, is often absent, especially in cities in the developing world, but even in smaller cities in the global North (Pojani & Stead, 2015). Transport for London (TFL) do share real-time data with private companies like Citymapper, but Citymapper do not offer a payment facility. Consolidating a myriad of multi-modal ticketing options (especially for train tickets, which have their own complexities and legacy issues) may require more than a well-designed app (Deloitte, 2017).

It may also be challenging to encourage data-sharing between stakeholders with diverging objectives. It is often envisioned that smart travel apps use an 'asset-light' model, similar to Alibaba or Airbnb, and create value by bringing together a range of offers to the user from different 'suppliers' (Goodall et al., 2017). But this requires all supplier-stakeholders to *want* to be involved. This may be difficult. Ride-sharing companies like Uber may wish users to use their own bespoke app where they can offer other services or advertising. Conversely, bus companies might be wary of sharing an app platform with the likes of Uber for fear that users might prefer a taxi over a bus, when the two options are presented side-by-side (Government Office for Science, 2019).

Privacy and security challenges also persist in the realm of smart travel. Although there are wider concerns over ethics in the use of data generally, these are even more acute when using data describing people's physical movements, either using travel-card data at bus and train stations, or, more controversially, using facial recognition or the IP address or MAC address produced by mobile devices. As Kitchin (2016) notes, lack of consent and truly reliable anonymisation of location data may, at best, create distrust among citizens and at worst could lead to profiling and 'anticipatory' policing.

Security is crucial for engendering trust. The Think Tank *New America*'s report titled "Smart is Not Enough: How to ensure the technologies of the future don't break our cities (and us with them)" warns that the term 'smart' may be a synonym for 'hackable', presenting huge risks if entire cities, linked by IoT devices, sensors and IT management systems, are jeopardised (Cohen & Nussbaum, 2019).

Finally, a broader point about justice is the danger that the advantages of smart cities are only realised in such locations which are already, in global terms, very wealthy. As most population growth is forecast to be greatest in cities in the global South, it is an open question whether the benefits of smartness can be extended to cities like Mumbai, Lagos or Sao Paulo. As the next section explores, even within developed world cities, there are existing issues of fairness in urban transport infrastructure – especially for minorities and women – which smart city advocates need to address.

Part 2: Gendered inequalities in urban transport

The Male City

Long before the term 'smart city' had ever been coined, the design and management of our cities was set along a path to the benefit of certain users and the detriment of others. Bluntly, urban transport infrastructure was made by men, for men. Largely, it still is.

As described by the Transport historian Barbara Schmucki, British cities as we know them were largely designed (or re-designed) in the post-war period, at a time when city planning was dominated by middle-class car-driving men who created infrastructures in their own image. We saw the embedding of the car as the primary transport mode at the expense of others. The result was that "neither other forms of transport, such as bicycles and pedestrians nor different experiences of men and women were [planners'] focal point" (Schmucki, 2012, 85). This had, and continues to have, gendered implications. In 1975, 69% of men had a driving licence but only 29% of women did, so men were far more likely to have profited from roadbuilding and the creation of car parks. Although women now account for around 45% of all licence holders in the UK (DVLA, 2015), women are far more likely to use public transport or walk than men (ref?). In the UK, a third more women than men travelled by bus in 2017 (Gill, 2018), a trend generally repeated in most cities in the global North (Ng & Acker, 2018). Yet expenditure on local 'public transport', including buses, generally accounts for around 8% of total UK government spending, whilst the lion's share is spent on rail and road, which are both used more by men (Gill, 2018).

There are complex and interacting socio-economic factors for these gendered differences in modal choice. These cannot be explored in depth here, but they include domestic divisions of labour in terms of breadwinning/child-rearing, a stronger male cultural affinity for driving, and wider gendered income inequality (International Transport Forum, 2019; Lo & Houston, 2018; Miralles-Guasch et al., 2016). Whatever the causes, the result is that the needs of drivers are attended to more closely than those of other urban transport modes, and this creates a series of disadvantages for women in the city.

These disadvantages can be summarised in terms of higher cost, lower connectivity, a lack of facilities, and safety and health concerns. Firstly, women are more likely to be in low-pay and/or part-time employment and to rely on buses to get to work, yet are penalised by bus fares which continually rise above inflation (DfT, 2020), sometimes this extra commuting cost borne by women is called the 'pink tax' (International Transport Forum, 2019). Secondly, many bus routes assume a 'hub and spoke model' for commuters to get in and out of city centres, yet these do not adequately cater to many working mothers, whose daily journeys are often more complex, involving dropping off children for school or childcare en route.

Such travel complications can lead working mothers to accept more local, less well-paid employment, further entrenching gender inequality (Longworth, 2016). Thirdly, although women generally need to use toilets more often than men to urinate, or due to menstruation or for baby-changing (Beebeejaun, 2017), city centres have fewer public toilets than ever before, with 32% of public toilets in England & Wales having closed between 2000 and 2018 (Knight, 2020). While 'semi-public' toilets may be available in department stores or shopping centres, these are more easily accessible to wealthier groups. Fourthly, although the UK appears to fare much better than many other countries in this regard, women are still far more exposed to sexual harassment and assault on public transport than men (Gekoski et al., 2017). A final issue, and one raised by campaign groups like 'Mums4Lungs' and 'Living Streets', is that as women are more likely to be on the street, they are therefore more likely to be exposed to dangerous levels of air pollution being emitted from the cars driving, or idling, next to them.

Gendered barriers to active transport

Given that women are less likely to drive than men, one might expect women to be more likely to take up active travel. Yet although women are more likely to walk than men, they are much less likely to cycle. In the UK around 11% of women cycle regularly, compared to 22% of men (Arup; SusTrans, 2019). Although around 30% of women report they would like to cycle more, safety is the main reason they do not (SusTrans, 2018). For these would-be female cyclists, our cities can be hostile places, dominated by cars and intimidating 'MAMILs' (Middle-Aged Men In Lycra). Safety concerns are also compounded by childcare-related duties which make travelling by bicycle more complex, a lack of financial resources to buy or store a bike, and perceived necessity to arrive at work feeling and looking presentable, even if shower and changing facilities are available (which they often are not). While some people, male or female, will never wish to use a bike, these factors may combine to mean that women who might like to cycle feel they cannot, and are forced into long walks or inconvenient and costly buses.

Research from the Netherlands, long seen as leaders in cycling, shows how things might be different. The use of 'cargo-bikes' – which can carry tools, shopping and even one or two small children – by mothers, is increasingly common in cities such as Amsterdam where cultural gender norms and perceptions of road safety are quite different to the UK and other countries. Boterman (2020) describes how cargo-bikes used by mothers are viewed as signifiers of a successful – if somewhat knowingly 'hip' – urban middle-class lifestyle.

But active travel also includes walking. For many women, cycling on a regular basis will never be feasible, but the entry-level 'costs' to walking are much lower. Making cities more walkable and more welcoming to women can mean wider pavements to accommodate mothers with prams, more public toilets, and creating spaces which feel safe and secure (i.e. with good street lighting and CCTV where necessary). Without such provision women can easily be inclined to use buses or cars for walkable journeys. Care needs to be taken that active travel is not used as a synonym for cycling, excluding the most basic and inclusive transport mode there is.

One also needs to accept that for some people, like pregnant women, the disabled or elderly, cars may remain the only viable urban travel mode. The inclusivity case needs to be made: that encouraging active travel and public transport use by those who can, will reduce congestion for those who cannot.

Smart and inclusive?

It is not clear if 'smart' cities are the answer to these problems of the 'male' city. The data which provides the foundation of smart mobility is often blind to gender, among many other demographic variables. As discussed earlier, data may be collected revealing people's location and movements, for instance when they tap travel cards on buses or at metro stations, but disaggregating such data to identify *gender* differences may not be possible. If it becomes possible, there may be concerns over disclosure, consent and ethics. Furthermore, for those people who walk or cycle, they may leave no 'digital footprint' to trace in the first place, unless we resort to facial recognition or the collection of MAC or IP addresses from personal devices which, as mentioned in Part 1, raises many ethical dilemmas.

There is the danger that the smart city just makes it easier for (predominantly male) commuters to drive to work, and does little to address the urban mobility needs of women. It is possible, likely even, that as long as the fields of engineering, data science and planning are dominated by men, the smart city of the future will fare no better than the 'dumb' city of the post-war years in addressing gender inequalities in urban mobility.

Nesti argues that both discourses of smart cities and of gender in urban studies often tend to talk past each other. She argues for 'gender mainstreaming' in smart city development so that a smart city is also an inclusive one. This can be done through short- and long-term strategies.

Short-term strategies might include developing smart devices aimed at improving women's safety, health, and wellbeing in cities; engaging with women and their associations at each stage of the smart governance model, to ensure that their needs and priorities are taken into consideration (Nesti, 2019), and then encouraging and nudging safe and sustainable consumption, mobility, and lifestyles among women. There are existing tech solutions already, such as 'Safetipin', an app for women to report urban safety issues - poor/no lighting, blocked footpath, open wiring etc - so that relevant authorities can deal with them promptly.[4]

This issue of citizen engagement features heavily as an essential element of smart city visions, but it is often easier said than done. Engagement with citizens who are often marginalised – women, and also ethnic minorities, the very old, young or disabled – is a perennial problem for urban planning. Webster & Leleux (2019) argue that young people may often know much more about their local urban areas than policy-makers. An opportunity afforded by technology may be to go with the grain of how (young) people naturally communicate and express themselves – e.g. taking photos, using social media – and finding ways to integrate such 'smart' feedback into policy-making.

Long-term strategies for gender mainstreaming include encouraging more girls into STEM subjects at school, and thereby into careers in engineering, data science and urban planning, possibly assisted by gender quotas in these male-dominated fields. As shown in Box 3, there are examples which illustrate the difference having women in key positions can make to urban travel. It is also possible that as new innovations in smart cities emerge, of which we are currently unaware, having women in key positions might mean these can be exploited to specifically address gender issues.

Box 3: Seleta Reynolds, Los Angeles Department of Transportation

When Seleta Reynolds became General Manager of the Los Angeles Department of Transportation (LADOT) in 2014, she identified many gender-specific problems. Firstly, research showed that women were more likely than men to travel in the middle of the day, and peak usage time is around 2pm. She ensured that services were not reduced at this time. Secondly, she saw that women's perceptions of safety meant that whenever they share trips with men, whether on a bus, train, or (someday) an autonomous car, they need more cameras and public reassurances to feel safe enough to access these options. Thirdly, when they rolled out 'BlueLA', Los Angeles's first electric vehicle (EV) car sharing service, they learned that women wanted the option to add their family's caregivers to their accounts, even though their last names do not match. LADOT enabled this option. These issues had not previously been addressed by Reynolds' peers, and show how having a woman in a key role can mean overlooked problems can be revealed and addressed. (Ng & Acker, 2018)

[4] https://safetipin.com/about-our-company/

Part 3: Sustainability in the Smart City

Can urban travel be smart, inclusive and sustainable?

Numerous horizon-scanning publications explicitly advocate research and development into smart *and sustainable* cities. The United Nations Economic Commission for Europe Committee (UNECE) has called smart sustainable cities one of its priority activities, employing the following definition: "A smart sustainable city is an innovative city that uses information and communication technologies (ICTs) and other means to improve quality of life, efficiency of urban operation and services, and competitiveness, while ensuring that it meets the needs of present and future generations with respect to economic, social, cultural and environmental aspects" (United Nations, 2015). In urban transport, we already see some smart technology deployments which might deliver more sustainable outcomes, as either their primary goal or a subsidiary outcome.

We can point to a few existing examples. Smart motorways use sensors and cameras to detect when to automatically change speed limits or use hard shoulders for additional capacity during busy periods. In the UK, smart motorways have attracted controversy following a number of fatalities and near misses, leading to a scaling back of AI and a reversion to human camera-operators (BBC News, 2020). In theory, however, smart motorways might not only reduce journey times but might reduce emissions and air pollution by reducing traffic jams and vehicle 'idling'. In city centres, Automatic Number Plate Recognition (ANPR) is also widely used to enforce congestion zones and reduce car use and associated emissions.

On the user-side, SatNav, Citymapper and Googlemaps and the like use real-time traffic data to encourage drivers away from congested areas, increasing efficiency and reducing fuel use and emissions. Other apps, which show users different modal choices and associated costs and journey times, have been shown in some instances to successfully nudge users away from car use and onto public transport (Politis et al., 2010), although the evidence here is somewhat mixed, and other studies suggest that apps often at best succeed only in making drivers change departure times, rather than changing modes (Poslad et al., 2015).

Other emerging apps, such as those which help drivers locate parking space to reduce 'cruising', or which help taxi drivers locate rides, may also reduce unnecessary driving and related emissions (Chen et al., 2017). Other smart transport developments may make 'greener' transport options more attractive and convenient, potentially pulling users away from cars, or at least Internal Combustion Engine (ICE) cars. Some studies have shown passengers are more likely to use and are willing to pay more for buses when they receive real-time bus information (Politis et al., 2010). Barbecho Bautista et al. (2019) have piloted a smart system to improve the efficiency of electric vehicle charging, which might overcome anxiety felt by would-be EV owners over charging. Using journey data and data on charging stations (and likely waiting times at each charging station), they have designed a system that calculates the best place for a vehicle to stop and charge for a given journey to minimise waiting and charging times.

Smart travel beyond the car?

What is abundantly clear from these examples is that they are overwhelmingly aimed at increasing efficiency and speed for car-users, with sustainability gains in the form of reduced fuel consumption and/or emissions as a happy co-benefit. In terms of sustainability, there is always the danger of the 'rebound' effect: any reduced fuel use due to quicker journeys can easily be cancelled out by people travelling more with the time saved. And in terms of gender equality issues described earlier, any smart benefits for car users will accrue disproportionately to men.

The primacy of the car, and the neglect of cycling or walking in smart city visions is apparent across academic, public and private-sector discourses. Reviewing European Commission policy documents on smart cities between 2014–2018, Behrendt (2019) found that of 39 relevant documents, only one mentioned cycling, and even that was framed as a 'threat' to the roll-out of connected autonomous vehicles. This disparity shows that if something like a humble bicycle isn't considered 'smart', it is in danger of not being considered at all, and hence not attracting research, funding and political capital.

The marginalisation of cycling is somewhat surprising given that both smart cities and cycling can deliver goals of healthier, more sustainable cities with reduced congestion. Perhaps making cycling smarter might not only make it more 'visible' to policymakers and planners, but might also make it a more appealing modal choice for would-be cyclists too. Behrendt (2016) has worked on the idea of 'smart velomobility', which might take two forms. One is where users hire publicly-owned bikes which are fitted with smart monitoring systems, providing data on their journey both to the user (via a smartphone app) and to local authorities keen to understand cyclists' journey trends, such a form already exists in Copenhagen. The other form is already available to – usually more committed – cyclists who download cycling apps to monitor their performance and progress. Benrendt's research suggests cyclists appreciate such feedback – e.g. miles travelled, calories burned, carbon emissions 'saved' – and it may motivate them to build cycling into their everyday practices.

But encouraging more cycling might ultimately mean addressing the distinctly non-smart barriers to active travel, which were discussed earlier and which have been long-standing: providing more bike storage in city centres and places of employment, embedding more supportive pro-bike social norms, and - chiefly - creating cycle routes which are accessible and feel safe. Addressing safety is perhaps the most obvious yet the most challenging barrier to overcome, as in urban areas this often means reducing car traffic and reallocating road space. Here the visions of the smart city, which often imply the continued primacy of the car – and at worst, its expansion – come into closest tension with visions of the sustainable city.

Beyond 'predict and provide'

For many years there has been criticism of a dominant government approach to transport policy which has sought to *predict* travel demand and *provide* adequate capacity for it, mainly by building more roads and motorways. In a never-ending cycle, capacity is filled, demand increases ,and further roads are required. Whilst this approach has benefitted car manufacturers, haulage firms, engineering consultants, oil companies, builders and motorist associations, it has been criticised for encouraging more road travel, increasing pollution, and neglecting public transport and active travel provision (Docherty, 2011). There is a risk that smart city initiatives may simply make it easier for public and private providers to predict travel demand accurately and provide for it in an efficient (and profitable way), and thus perpetuate this cycle.

There is even the possibility that smart city initiatives could make things worse. Some evidence suggests that app-based taxis might take people away from public transport, or even induce journeys that would not have happened otherwise. In both cases, this means more traffic. A survey of ride-hailing services like Uber and Lyft in San Francisco showed at least 8% of ride sourcing trips are induced, while 39% shifted from taxi, 33% from public transit, and only 6% shifted from private car trips (Rayle et al., 2016). Similarly, CAVs could also replace public transport, not private cars, making traffic worse, not better. As described earlier (see Box 2, Part 1), there is game-changing potential for reducing traffic, congestion and pollution by moving away from private car ownership to a Mobility as a Service (MaaS) model. The key to making sure that ride-hailing and/or CAVs do not make the situation worse may be to ensure that price signals encourage sharing as much as possible (at least, once social distancing measures related to COVID-19 are eased), and to offer alternative attractive modal options to reduce the number of cars (whether ICE, EV or CAV) required in the first place.

The most vehement critics of smart cities see smart city development as reinforcing a neoliberal growth agenda and consumerist culture, which focusses on wealthy people in wealthy cities who can afford private services like Uber and Airbnb. For Evans et al., (2019) "smartness reframes urban sustainability challenges as market opportunities for corporations to sell digital solutions" (558). This logic can extend beyond transport. Smart grids, using smart meters and top-down management systems might be preferred to local community energy projects. Managing urban waste can be seen as an issue of managing logistics using algorithms to optimise waste collection routes, not reducing consumption. Distributing more city Uber licences might be prefered to encouraging the likes of *BlaBla Car,* a citizen-based lift-sharing platform which, while popular in continental Europe, has never really caught on in the UK[5].

At its worst, smart city initiatives can lead to corporate capture of local authorities, the deepening of inequality and increased environmental degradation. The case study of Genoa, Italy, described in Box 4, may be a cautionary tale.

Box 4: Genoa: Smart city? or elite capture and environmental disaster?

Grossi & Pianezzi (2017) describe a case study of Genoa, Italy, as an example of how corporate interests started to interfere with the local municipal government, and the language of smartness, measurement, competition, and citizens as 'customers' started to permeate governance discourses. In particular, they claim a corporate capture of Genoa's public officials led to excessive building and urbanization on the outskirts of Genoa, which caused hydrogeological instability. In 2014, following heavy rains, flooded causing one fatality and hundreds of millions of euros of damage. In response, the local councillors cited that 'smart' technological solutions - including apps which alert residents to danger - could have saved lives, but did not question the corporate-led development which caused the floods in the first place. This, the author claims, is evidence of the very real dangers for citizen wellbeing, sustainability and democratic accountability which smart cities can create.

[5] www.blablacar.co.uk/

Part 4: Where is the Smart City in the post-COVID world?

In this final section we identify some important emerging social, spatial, and political developments, which may render the smart city yesterday's news. At very least, recent events may make urban planners pause to think not only about what smart tech can do for the city, but more fundamental questions about what the city is *for*.

Among other functions (like culture, hospitality, and transit), urban centres have traditionally been major sites for retail, and centres of employment. These have been two of the large 'pull' factors for overall mobility. In 2018 around 20% of all UK trips were for shopping, and 18% for commuting – with most of these done by car (DfT, 2019). Until very recently, many of these trips would have had city centres as their destination. Recent developments in online shopping, the decline of the high street (Grimsey et al., 2020), and the rise of home-working – all of which have been 'turbo-charged' by the COVID-19 pandemic – may ultimately mean fewer cars. While we recognise the pain and distress caused by the pandemic and economic downturn, these consequences create huge potential for making cities more 'liveable', and addressing the challenges of gender inclusivity and sustainability, which are key concerns of this paper.

In the UK, local and national authorities seem eager to avoid people resorting to their cars as the only 'social-distanced' modal choice in the short-term, and to capitalise on this crisis to embed 'active travel' for the longer-term. Many councils have built pop-up cycle lines and fast-tracking pre-planned cycling infrastructure with new DfT funds. Given a historical reluctance to risk upsetting the voting motorist, it is quite something to witness politicians calling for road-space to be reallocated from drivers to cyclists, permanently.

The UK Department for Transport's new publication "*Gear change: a bold vision for cycling and walking*" (DfT, 2020) certainly shows a level of ambition not previously seen, with a new regulatory body 'Active Travel England' intended to be similar to Ofsted in terms of "raising standards and challenging failure", the devolution of greater powers to local authorities, and significant funding. However, the £2 billion announced for Active Travel should be seen in contrast to a recently announced *£27* billion for road-building, suggesting that the car's primacy among policy-makers remains secure (Topham, 2020).

It is also positive that there is an explicit acknowledgement of gender inclusivity and sustainability in this document. The government say that the "ability to deliver a right to cycle requires infrastructure and routes which are accessible to all regardless of age, gender, ethnicity or disability and does not create hazards for vulnerable pedestrians" (DfT, 2020, 40). However, the report does appear to equate active travel with cycling, and says far less about walking. In terms of sustainability the report notes that more active travel will be vital if we are to meaningfully reduce emissions from road travel – which currently account for a fifth of the UK's carbon footprint.

In regard to reconciling smart city visions with active travel, this report differs from previous government rhetoric, which often tried to 'square the circle' between, on the one hand, supporting the Industrial Strategy (by promoting smart innovations and the tech sector) and making transport sustainable, on the other (Lyons, 2019). There appears to be much more support for low-tech 'off the shelf' transport solutions, in the place of utopian smart city visions. But the tension between smart cities and active travel is not reconciled, merely ignored for now. As Glenn Lyons notes, “there is no mention of how walking and cycling may be affected if and when some of the ‘radical new technologies’ come on stream. For example, where will all those ‘robot’ delivery vehicles fit into this vision of reallocated street space for active travel?” (Lyons, 2020).

As Lyons notes, the UK government seems to be calling for a ‘decide and provide’ rather than the ‘predict and provide’ model of the past. “This is supply-led demand instead of demand-led supply, recognising that behaviour changes in response to the environment it is presented with.” Although, as mentioned above, the continued support for large-scale road building may undermine this. Although the bulk of new roads planned are inter-city motorways (and not in cities), previous evidence suggests that creating more capacity leads to more car-ownership. And car owners, once they have ‘sunk costs’ into a car are likely to use their cars for short, suburban as well as inter-city trips. Having it both ways – more car provision *and* more active travel – seems likely to fail.

Where have the ideas behind the ‘Smart City’ and ‘Intelligent Transport Systems’ gone in this post-COVID reality? Time will tell if data scientists, technologists and urban planners can show if and how smart city solutions can work *with* active travel and more inclusive, fair and sustainable urban mobility, and not against it.

If the government is serious about encouraging walking and cycling, then ‘smart’ ways of doing so may well emerge. For instance, instead of smart car traffic management, we can envisage smart bike traffic management, using IoT devices (perhaps on an opt-in basis) to determine popular cycling routes and improve safety and journey times. Citizens could be urged to use smartphones to identify problems in walking and cycling infrastructure and feed them back to planners so they can be rectified quickly, and citizens can feel engaged in infrastructural improvements. And crucially, more women should be engaged, both as citizens and as decision-makers, to identify gender-specific transport and infrastructure problems which men might miss, and address them with smart or non-smart solutions as necessary on a case-by-case basis. As we have argued in this paper, if solutions are not inclusive, fair, and sustainable, then they are not really very ‘smart’ at all.

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