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CHAPTER 4 “IMPLICATIONS FOR PUBLIC POLICY”

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INTRODUCTION

The penetration of mobile Internet into the sphere of individual mobility is a source of immense and potentially profound transformations, whose scale we are only now beginning to glimpse. These transformations concern both the actors and modes of tomorrow’s transport, and the mobility practices of connected individuals who are able to obtain real-time access to new sources of travel information and to new transport services (ridesharing, bikesharing services, etc.). The smartphone is at the heart of these transformations, both as a tool for the collection of new data that can be used to create new mobility services, and also as a medium for mobile applications that facilitate the use of these services. Such services benefit from the scale effects brought by the Internet and the smartphone’s capacity to connect people and facilitate payments. In addition, the incorporation of these services into digital platforms is significantly increasing their visibility.

For governments, the challenges raised by these transformations are substantial (Canales *et al.*, 2017). They need to adapt to this “digital revolution” in transport, at a time when new entrants are already exploiting the opportunities offered by platform services based on decentralised coordination between users. But they also need to ensure that it leads in the direction of more sustainable mobility. Yet the effects of the new services on mobility practices, and in particular on the use of the private car, remain deeply uncertain, whereas traditional public transport is threatened by competition in certain categories of trips and certain territories. In addition the new shared mobility services seem rather to reinforce inequalities between city centres, where they are primarily developing, and rural and periurban areas.

This fourth chapter discusses the main challenges to public policy raised by the smartphone and the incursion of digital technology into the individual mobility sector. The changes currently underway bring new opportunities, especially in the form of data that can provide better information on individual travel practices and also contribute to the development of new public mobility services, better suited to collectively defined needs and objectives. However, they also bring new difficulties for public authorities, notably relating to the proliferation of private actors offering mobility-related services, and to the issue of integrating new transport modes, based on sharing and on-demand services, with the more traditional modes of transport, and in particular public transport.

The chapter is divided into three parts. The first considers how the increase in information on mobility and the new forms of interaction with citizens rendered possible by the smartphone can lead to changes in the management of mobility and in the planning of transport policies. The second focuses on the new challenges posed by the need to integrate the new mobility services, based on mobile applications, with existing transport systems and into public space. And finally, the third part explores the prospects associated with the integration of mobility services into digital platforms, and in particular the implications of the implementation of the recent concept of MaaS (for Mobility-as-a-Service).

1. NEW PERSPECTIVES FOR TRANSPORT NETWORK MANAGEMENT AND TRANSPORT PLANNING

The digitisation of lifestyles and the proliferation of sensors and connected objects has brought a proliferation of new data (the famous big data), but also new methods of interaction between citizens and

public authorities (Berntzen and Johanessen, 2016), which offer the latter the prospect of smarter management of cities (Al Nuaimi *et al.*, 2015; Batty, 2013; Crittenden, 2017; Hashem *et al.*, 2016; Kitchin, 2014). The promises of the smart city are immense (Glaeser *et al.*, 2018). On one side, they relate to the optimisation of urban functions (transport flows, waste management, energy efficiency, etc.) and on the other side greater citizen participation in public decisions (Clarke and Margetts, 2014; Cocchia, 2014; Kitchin, 2014; Paskaleva, 2009).

Governments face the challenges of incorporating these new data and new forms of citizen involvement into their practice (Anshari and Lim, 2017; Nica *et al.*, 2015). They need to acquire expertise on the benefits, but also the limitations, of big data, develop skills in handling these massive databases, and finally master both the organisational and the cultural transformations associated with the emergence of new methods of urban management, in which the timeframes of decision-making and action in particular can be significantly reduced (Gonzalez-Bailon, 2013; Mc Neely and Hahm, 2014).

The smartphone, which is spreading very rapidly through the world's population, is contributing both to the production of new urban data, especially in the field of mobility (see chapter 3) and also to the emergence of new forms of citizen participation, called M-participation or Mobile-participation (Bilge *et al.*, 2016; Ntalian *et al.*, 2017; Wimmer *et al.* 2013). Compared with other digital media, the main advantages of the smartphone are its mobility and its huge versatility: it enables people to obtain information, to communicate, to shop, to access transport services, to entertain themselves, etc. In addition, the data it produces are individual, geo-located, dated and available in real time. The smartphone also enables people to receive and exchange information with third parties: other individuals, private organisations and public authorities (Attard *et al.*, 2016). Mobile participation thus allows for new types of citizen engagement in political decision-making, at any time and regardless of physical location (Wimmer *et al.*, 2013).

In the sphere of urban transport, the smartphone offers public authorities new options for action in the management of transport networks and in planning mobility policies.

1.1 Transport network management

The smartphone raises two new prospects for the management of transport networks. The first concerns real-time network management, the second the monitoring of transport networks.

The smartphone can capture movement, recording the flows travelling on different transport systems. It can be used to measure the volume of those flows and also to assess their fluidity, especially in terms of speed and therefore congestion levels. The smartphone can also be used as a tool to detect defects in the transport networks, for example the location of potholes in a road (Forsl f and Jones, 2015). With social media and collaborative apps, users can also share qualitative information, even in real time, on the networks they use and especially on the service quality (Gal-Tzur *et al.*, 2014). Hence they can report the disturbances (accident, traffic jam, etc.) they encounter, the presence of speed traps on the roads and inspectors in public transport, or else the location of hazards such as potholes, defective road signs, etc. (Kanhere, 2011; Vasundhra and Sreehari, 2017). These new data are in general very reliable, comparable with and sometimes better than traditional data, such as those produced by road sensors (Gu *et al.*, 2016). They are also often cheaper than traditional data, although their analysis demands specific skills that can raise the cost.

These new data are of great interest to cities. The potential uses are very broad and only just beginning to be explored. These uses relate in particular to the management of traffic congestion, user safety and the maintenance of transport infrastructures.

Smartphone data can contribute to the identification of recurrent traffic congestion on a road, and to the adoption of measures to increase fluidity, for example by improving traffic light timing at a smart junction or adjusting dynamic road charging. The smartphone can also be used to identify the vehicles, and therefore the users, who contribute to congestion on the networks at peak times, so that specific measures can be introduced to target those users. Some cities, for example, have established incentives for commuters to

change their working hours or use public transport instead of the car. The smartphone can then be used to monitor whether practices have in fact changed.

With better monitoring of transport infrastructure performance, it also becomes possible to detect and therefore to tackle safety blackspots in the system, for example where high numbers of road traffic accidents occur. The management of traffic flows at big events (concerts, sports, etc.) can also be improved, since the new data allow close-grained spatial and temporal analyses of changes in traffic volumes on the networks and the source and destination of flows, even in the case of occasional, one-off events.

Reducing the time taken to obtain information on system disruptions also means that they can be resolved more quickly: arrival of the emergency services at the scene of an accident, faster ambulance access to hospitals, or user warnings and traffic diversions ahead of a congestion or accident zone.

Finally, with smartphone data and crowdsourcing, system maintenance also benefits from new possibilities to acquire faster and more comprehensive information on the condition of infrastructures. Several cities have already launched apps (like FixMyStreet) which help them reduce the cost of collecting data of this kind and to cut the response time of municipal services.

Some organisations are beginning to offer mobility management solutions to local authorities. One example is the collaborative application Waze with its Connected Citizens program, which enables member cities to obtain real-time access to the app data in exchange for urban data, for example on roadwork schedules. Finally, companies like Google are trying to develop global real-time urban flow management solutions that integrate real-time data from large numbers of data sources on the transport networks, transport services, parking and mobility practices. All these solutions may prove interesting, but they also raise questions over who controls the management of public transport networks.

1.2 Transport planning

Transport planning is about conducting surveys and using models. The objective is to understand the characteristics and determinants of mobility in a given territory, to scale new infrastructures and new services accordingly, and to assess the social and environmental impacts of transport policies, whether existing or planned. Public authorities found their decision on multiple databases, notably relating to population, land use, transport networks and the travel practices of residents.

Up to now, travel patterns have mainly been analysed from surveys conducted with a representative sample of households, using questionnaires administered on paper, by phone or online. Because they are infrequent, restricted to a short period of time (one day, sometimes one week) and to the inhabitants of a single area only, these surveys have well-known limitations. Moreover, developing countries do not generally have access to data of this kind, because of the high cost of generating them.

With the smartphone, the mass of data on individual trips has exploded. These data come mainly from the traces generated by smartphone connections to mobile networks (phone, Internet) and to Wi-Fi antennae. The GPS signals used by navigation apps and by some new mobility services, such as ridesourcing services, are also a useful source of information on urban travel.

Urban authorities now need to think about integrating the new data into their transport policy assessment and planning exercises, as well as linking them with traditional databases (Chandrasekar, 2015). The promises made by those who market these data or studies based on the data are very appealing, but the reality sometimes falls short of expectations. The public authorities need to develop expertise on the strengths and limitations of such data, notably in concert with the academic community, which has been examining these questions for some years. The limitations of these new data lie especially in the shortage of socio-economic information on the people travelling, or else in the difficulty of reconstructing the reasons for travel and, sometimes, the modes of transport. Traditional mobility surveys therefore remain essential, although they need to evolve (transition to smartphone, inclusion of GPS journey tracking, etc.).

Smartphone data also have multiple advantages. They provide a full picture of journeys across the territory, the variability of these journeys in space and time, and also the impact of trips made by people who are not resident in the territory but visiting, whether occasionally or regularly, for work, recreation, etc. They are also useful for analysing mobility in low-density areas, where the samples in classical mobility surveys are generally too small for robust statistical analysis. Finally, the analysis of the new car sharing and bikesharing services, which are absent or poorly represented in mobility surveys, benefits from the data taken from the mobile apps used to organise these services. With the Movement platform, for example, Uber shares anonymised data on its drivers' journeys with municipalities (the aim being also to smooth relations with local authorities, ruffled by the risks of rising traffic and conflicts with traditional taxis...)

Moreover crowdsourcing offers another prospect for urban planning (Jones *et al.*, 2015), particularly in the transport sphere where day-to-day problems can encourage citizen involvement. In fact, the possibilities offered by crowdsourcing in the mobility sphere are extremely rich: mapping of informal transport networks (Ndibatya *et al.*, 2017) as has been done in Nairobi (Kenya) with the Digital Matatus project (Williams *et al.*, 2015), rerouting of cycle routes to reflect the actual practices of cyclists (GPS tracking with volunteers) and their suggestions for improvements, etc. The challenge for the authorities is to create new data at limited cost, and also to develop greater citizen participation in the assessment and planning of transport policies, traditionally highly technocratic domains that are gradually (but often timidly) opening up to forms of co-construction with users (Bickerstaff *et al.*, 2002; Douay, 2010).

2. PUBLIC CHALLENGES ASSOCIATED WITH THE EMERGENCE OF NEW TRANSPORT MODES AND MOBILITY SERVICES

The smartphone is gradually penetrating every sphere of life, including our mobility practices, where its use is profoundly transforming the very experience of travel (Wang *et al.*, 2016). The smartphone provides new possibilities for on-the-move activities. It also offers real-time access to numerous mobility services, which may either provide travellers with information and guidance, or with access to shared and/or on-demand transport solutions (Aguilera and Rallet, 2016).

Applications that provide real-time information and advice on available modes, and on the best routes, etc., give individuals greater control over their mobility, and usually greater flexibility as well (Khoo and Asitha, 2016). By offering new solutions for geolocation, for coordination between individuals and for payment, the smartphone is also boosting transport services based on vehicle or ride sharing and on-demand transport systems like ride-hailing, a modernised form of taxi service (Le Vine and Polak, 2015; Meyer and Shaheen, 2017). Many of these services existed before the smartphone, having been created or developed with fixed Internet. However, the smartphone gives a powerful boost to their potential for expansion, not only simplifying their use but also offering innovations such as mobile payment and, above all, real-time access.

Generally, these new services are encouraged – and even in some cases financially supported – by the public authorities. They see them as a way to encourage the development of start-ups and to foster multimodality, intermodality and rational car use, without the need for massive investment in public transport (Jonuschat *et al.*, 2015). A reduction in household motorisation levels is another outcome anticipated from the new possibilities for vehicle and ride sharing (Cervero *et al.*, 2007). However, the new mobility services also carry risks, such as competition with public transport (Rayle *et al.*, 2014), increased automobile traffic, diversion of traffic flows to inappropriate areas, or else occupancy of public space, as has happened with freestanding self-service bicycle schemes.

For the moment, the impact of the new smartphone-based services remains highly uncertain (Grischkat *et al.*, 2014; Yin *et al.*, 2017). However, it is clear that the public authorities will play a critical role in making them a permanent presence in transport systems, urban spaces and individual mobility practices (Docherty *et al.*, 2017; Karim, 2017; Sprei, 2017). While the decarbonisation of transport needs to be a central goal of public policies, the social consequences should not be minimised (Snellen and de Hollander, 2017).

2.1 A new frame of reference for sustainable transport policies

The emergence of these new services profoundly changes the frame of reference within which transport policies are developed (Canzler and Knie, 2016; Spickermann *et al.*, 2014). The authorities need to adjust to a multitude of new actors, some of them in conflict with the traditional players, for example with transport operators over making their data available to multimodal navigation apps, with traditional taxis over competition with ride-hailing schemes, etc. Individuals themselves, in particular car owners, are becoming stakeholders in the development of certain shared transport services (like peer-to-peer rental and car sharing).

The use of an individual transport mode (car, bicycle, scooter) is no longer necessarily associated with ownership. Moreover, vehicle or ride sharing services break the usual dichotomy between individual transport and public transport. The role of the car in sustainable mobility policies is once again in the balance with the emergence of car-based shared mobility services (Hildermeier and Villareal, 2014): public authorities need simultaneously to encourage these shared uses and to continue efforts to reduce the presence of the car. Furthermore, the presence of these new services in public space raises new challenges for urban planning.

These changes also challenge the role and future of public transport (Franckx and Mayeres, 2015; Gössling, 2018; Iacobucci *et al.*, 2017). Public transport is in competition with certain shared transport modes, whereas the relationship with other modes, such as self-service bicycle schemes, which in some cases provide a solution to the problem of the “last mile” (Shaheen and Chan, 2016), seems more complementary. In addition, the smartphone could offer the potential for new forms of on-demand public transport to develop, in particular in low-density areas and during off-peak times.

With regard to road transport, car users today have more control over their journeys with real-time navigation apps, which have the potential to reduce congestion. However, these apps can also cause problems, for example when they divert traffic towards unsuitable areas, such as a street with a school. Moreover, users are switching away from public traffic information towards private navigation apps and in particular collaborative apps, which can cause problems for the real-time management of road traffic. Finally, multimodal apps and shared modes favour intermodality and alternatives to the private car, while at the same time road navigation apps reinforce the advantages, and therefore potentially the use, of private and shared cars.

In addition, the current concentration of new mobility modes and services in (large) urban centres (Dowling and Kent, 2015) and the difficulty of developing them in suburban areas, where dependency on the private car is particularly high, raise the question of the role of the authorities with respect to the socio-spatial inequalities generated or exacerbated by the current model of deployment of the new services (Jeekel, 2017; Rotaris and Danielis, 2017).

2.2 Public action in response to the new mobility services

Fostering the development and implementation of the new mobility solutions in urban areas, and regulating them, presents municipal authorities with several new challenges. These primarily affect the transport sphere: adapting public transport, redefining the role of the car, connecting shared and on-demand services with other forms of transport, taking into account new socio-spatial inequalities. There is also the question of opening up public and private transport data to encourage the emergence of innovations and competition between the actors (Ojo *et al.*, 2015). And finally, there are new challenges facing urban planning, which needs to adjust to the arrival of these new services and work to connect them with the other modes of transport in order to promote intermodality.

2.2.1 Open data in the transport field

Data have become a fundamental driver of urban innovations, and the question of access and interoperability in relation to urban data runs through most thinking on smart cities. Open data, in particular,

has become a strategic issue. The different actors interested in producing new urban services are calling for open public data. It is also a priority for public authorities as a way to promote transparency in public action and encourage the production of innovative urban services that are better matched to the needs of citizens. In particular, open data should encourage the creation of start-ups.

In reality, opening up public data is often complicated (particularly with the need to set standards) and costly, especially for small local authorities. It also creates situations of conflict between the traditional operators of urban services, who are obliged to open their data, and newcomers who do not always share their data.

In the transport sphere, debates around open data have been on the rise in recent years with the arrival of the new services, and in particular multimodal navigation platforms that need real-time public transport data (Abrantes and Linton, 2016; Hemetsberger, 2016). Finland, for example, has incorporated open public data on transport into its recent Transport Code.

The provision of real-time public transport data is the main point around which debate crystallises, although other data, notably relating to parking, traffic, etc., are also important to the production of innovative services. In London, the data provided by the transport organising authority (Transport for London) enabled CityMapper to design a new bus service, called SmartBus. It covers routes not served by traditional public transport, on which CityMapper, using data collected by its users on its multimodal platform, has identified sufficient demand.

This example illustrates why some of the historical operators see the opening up of public transport data as a threat. In the Paris region, the main public transport network operator for a while resisted making its data available to CityMapper, arguing unfair competition. However, other actors are developing different strategies to organise and manage their data, and using open data as an opportunity for sharing. In other words, sharing data becomes a way of obtaining access to other data. The operator Transdev, for example, is in the process of developing a platform for the collection and sharing of transport data, whereby actors have access to the data of other platform partners (currently free of charge) provided that they open access to their own. Cities themselves – such as Lyon in France – are beginning to organise the collection and sharing of public and private transport data, which enables them to play a central role in this new ecosystem of data producers and users.

For a field like transport, however, the issue is not restricted to sectoral data alone. Innovative mobility services will also arise through cross-referencing to public data in the fields of energy, health, environment, leisure, etc.

2.2.2 The car, public transport and shared transport services

In most of the world's cities, measures have been introduced in recent years to discourage use of the private car: urban tolls, higher parking fares, taxes or bans on polluting vehicles, public transport development, etc. But with the smartphone, the image of the car is changing: while it continues to draw censure for its impact on the environment, on health and on safety, it is also becoming a medium for shared practices – with ridesharing – and for household demotorisation (Le Vine and Polak, 2017; Nijland and van Meerkerk, 2014), with car sharing. As a result, the public discourse has shifted, with the shared car being perceived as one of the solutions for more sustainable mobility.

Nonetheless, the impact of the large-scale development of ridesharing and car sharing on automobile traffic and household car ownership remains uncertain. There is a risk of pernicious effects (Jin *et al.*, 2018). For example, ridesharing might capture market share from public transport, with the result that road traffic levels ultimately remain static or even increase. The effects of car sharing are also ambivalent: positive in terms of reducing household motorisation, but less clear in terms of cutting automobile traffic, because of the potential for induction effects. Finally, despite the smartphone, car sharing and ridesharing are difficult to develop in suburban areas, which are precisely the territories where motorisation rates and individual car use are most intense.

For public authorities, it is a tricky balance. The goal is to effect a gradual transition towards a model that fosters the sharing of vehicles and rides, without undermining public transport or increasing car traffic. The issues differ depending on local conditions, as well as the types of territories and flows, with the biggest priority being commuting journeys that cause congestion at peak times.

Public support for ridesharing should focus not on direct financial rewards for ridesharing practices, which would tend to stimulate substantial increases in automobile traffic, but rather on measures that bring benefits in terms of mobility conditions, such as dedicated road lanes and reserved parking spaces. However, such measures will only really work if, in parallel, individual use of the car continues to be discouraged.

Public efforts in favour of short distance ridesharing should probably concentrate on specific categories of journeys, identified on a case-by-case basis: peaktime commuting journeys on particular urban arteries, feeders to specific mass transit lines and major out-of-town employment hubs from suburban areas. For the first category, the creation of reserved lanes at peak times (not necessarily the same lanes already dedicated to public transport) seems to be an effective measure to combat high congestion on these arteries. For the second category, the goal could be to introduce “regular ridesharing routes” from communities with high car dependency. It is here that developments could be used to stimulate ridesharing and make it safe: pedestrian routes to stations located at appropriate spots, with favourable parking conditions near public transport stations and in out-of-town employment hubs. Public education campaigns to ridesharing will also be necessary (Dowling and Kent, 2015).

The development of car sharing, which generally works well in city centres, needs to be adapted to suburban areas. In particular, it needs to be combined with social policy in favour of access to mobility for modest households, and also with housing policies, which can facilitate the sharing of vehicles between the residents of a building or neighbourhood in order to encourage at least the partial demotorisation of households.

At the same time, changes to public transport are needed as a result of the development of shared modes and services, which must be better integrated with public transport in order to consolidate or increase the latter’s market share. In particular, bikesharing and car sharing services should be developed near public transport stations. Parking for ridesharers near these stations also needs to be better organised, in order to foster forms of complementarity between the new mobility solutions and public transport, in particular for journeys from suburban areas, where park-and-ride solutions should be deployed.

However, public transport also needs to adapt. Firstly, ridesharing and ride-hailing services raise questions about the costs of public transport. These new services could in fact replace certain low-viability lines, provided that less well-off travellers continue to have guaranteed access. Some territories, for example in the US, already fund feeder journeys to mass transit routes in private-hire vehicles, replacing the buses that previously provided this service. A similar approach could also be taken to certain night bus lines.

Secondly, new data and the smartphone stimulate the modernisation of public transport, with an emphasis on better quality of service. As illustrated by Citymapper’s SmartBus experiment in London, it is possible with the new data to identify areas and journey types where public transport could capture market share. They can therefore be used to develop new services, better aligned with user needs. Furthermore, with the smartphone, public transport can contribute to the development of on-demand transport services, although the only partial success of the Helsinki experiment in Finland shows that finding the right business model for this type of service can be difficult.

Finally, the public authorities need to think about how to incorporate the new mobility services into public space (Rowling and Kent, 2015). On the one hand, the use of these services can be stimulated through good planning. Here we are thinking particularly about dedicated road lanes and parking spaces, but also the choices regarding the location of these services (car sharing fleets, ridesharing zones, etc.). For the authorities, one of the goals is to limit the negative externalities of these new services, such as the spread of free-standing bicycles in public space. Systems for taxing or imposing control of these externalities will need to be implemented, so that the costs are not borne by the public purse but by those who provide or use the services.

3. THE NEW CHALLENGES OF INTEGRATED MOBILITY PLATFORMS AND MAAS (MOBILITY-AS-A SERVICE)

Over the last few years, the digitisation of the mobility market has led to the emergence of a multitude of digital platforms, of varying longevity, variously proposing mobility services relating to multimodal passenger information, guidance for car users, or shared and/or on-demand transport. Only a few of these services have achieved real success and become popular operating in several cities around the world (e.g. CityMapper, ZipCar, Uber, Mobike, etc.) and in some cases even available in multiple countries (e.g. Waze and GoogleMaps).

In cities, some of the highly publicized mobility players currently rub shoulders with a plethora of other services aimed at a smaller and more local clientele, especially in the field of day-to-day ridesharing. Users sometimes have difficulty finding their way around these services, and identifying the solution best suited to a particular journey. It is true that multimodal apps are beginning to include a growing number of transport modes, in particular ride-hailing services and car and bike sharing options. However, it is still rare for these applications to offer an integrated and simple method of paying for all the transport solutions involved in providing a door-to-door service.

Now, with the smartphone and today's large database processing capacity, such integration is becoming possible. Indeed, the smartphone is a single tool that can simultaneously 1) access real-time information on all available transport services and on the most efficient way of combining them for a given journey, and 2) host relatively simple solutions for locating and paying for these services. Big digital platforms including a plethora of public and private services should therefore emerge rapidly in the sphere of mobility, and in particular urban mobility, where the issues are particularly critical. Through a single interface, these platforms – which guarantee the genuineness of the services and the security of financial transactions – will integrate a variety of mobility services offered by professionals or individuals.

For the moment this dynamic of integration is still in its infancy, but its acceleration is likely to be rapid. However, it will bring about changes that are profound and currently unpredictable, in the mobility market, in the relations between its actors and also in travel practices. Governments and public authorities face the risk of disintermediation and therefore loss of control over urban mobility, which could fall into the hands of a few big private actors capable of managing the totality of transport services in an area, and of steering individual practices along commercial lines that are not necessarily compatible with collective interests. In particular, the role of public transport could be undermined.

Yet the integration of mobility services also opens up real opportunities for public authorities, provided that they manage its implementation in a way that effectively reconciles the collective and individual objectives of sustainable mobility (Canzler and Knie, 2016). This is precisely what is proposed by the recent, though still indeterminate, concept of MaaS – Mobility-as-a-Service (Jittrapirom *et al.*, 2017). The idea of MaaS is that the integration of the totality of mobility service within a territory – i.e. both the types of services integrated and the conditions of access to them – should be orchestrated by public authorities. The other key feature of MaaS is that it will offer mobility packages (by the month, by the year) that provide access to a set of services, similar to the system that exists, for example, in the telecommunications sector. The explicit aim of this servicialisation of the mobility market is to steer travel practices towards more sustainable forms based on combinations of public transport and shared transport modes, put together to meet individual needs.

3.1 The gradual digital integration of mobility services by private actors

More and more mobility solutions are now accessible by smartphone, but they are sometimes hard to understand. Integration reflects the need of the actors (and particularly start-ups) to make their services visible. It also reflects the need of individuals to find their way around the current plethora of services, each

of which must at present be downloaded as a mobile app, with its own specific interface that people must learn how to use.

We are already seeing the first steps in digital integration. These essentially entail adding new mobility solutions (ride-hailing services, car sharing, bikesharing, ridesharing) to real-time navigation systems, which initially only offered assistance with public transport, the private car and walking (generally separating the private car from the other modes). This phase is already well advanced, the only difficulty being access to real-time data.

In the next stage, users will not only be able to choose the mode or modes of transport they want, but also to access them physically and, in particular, to pay for them. Solutions are beginning to develop. In some of these, payment is integrated into the initial app, in others the user is redirected to the digital platform that operates the chosen mobility service. With Google Maps, for example, it is now possible to book and pay for an Uber ride without going via the Uber app. In the Paris region, Waze has in recent months added a dynamic peer-to-peer ridesharing app (called Ouhop): Waze users who have chosen this option receive a real-time notification telling them that a pedestrian is interested in the trip (or part of the trip) that they are making. They can then choose to pick up the pedestrian, in which case they are transferred to the Ouhop dynamic ridesharing platform, where they accumulate points that can be used to get rewards (fuel coupons, car maintenance coupons, etc.).

This dynamic of digital integration in the mobility service market is also driven by actors from outside the transport world. These generally take advantage of the fact that they already have large numbers of users and considerable financial resources to develop extremely complex algorithms linked into massive databases, putting them in a dominant position to form strategic partnerships with the most popular mobility services. The Chinese social network WeChat thus includes a growing number of mobility applications, in particular the Didi ride-hailing service and the dockless bikesharing service Mobike. In some Chinese cities, it is also possible to pay for public transport tickets from the WeChat app: people can use their smartphones both to pay and to obtain the QR code to show in the bus or subway. Google, via its subsidiary Alphabet, is in the process of developing a global digital mobility platform combining real-time information and access (booking, payment) on all modes of transport, as well as a real-time parking service. The target customers are cities, and the platform's ambition is to offer them a smart tool for managing all urban travel, regardless of transport mode.

This dynamic towards the integration of a wide variety of transport services into digital platforms can be expected to continue and intensify, because the economic potential is large (Heiskala *et al.*, 2016). Citydwellers want solutions that will enhance their day-to-day experience: reducing the time spent in traffic jams and looking for a parking space, finding a quick alternative solution in the event of public transport problems, etc. For their part, local authorities are looking for solutions based on the use of ICT to improve urban mobility for both individuals and the community. Finally, the prospects for economic benefit are also linked with the fact that many services outside the transport field, but which are interested in real-time GPS information and the mobility practices of consumers, could join such platforms, for example restaurant or cinema ticket booking services, shopping delivery services, special offers in certain shops, etc. In fact, Waze already offers local shops the possibility of buying personalised advertising space, based on GPS information about its users' real-time position and travel behaviour.

3.2 The challenges to public authorities of digitally integrated mobility service and the MaaS concept

Many cities already offer integrated access and payment on services run by different public transport operators (such as the Navigo Pass in the Paris region), or between public transport and other transit services (Karmagianni *et al.*, 2014; Li and Voegelé, 2017; Link *et al.*, 2017). For example, Shanghai's public transport card (MetroCard) can also be used to pay for a taxi ride. In Singapore, passengers can pay for the bus and subway with their smartphone. These initiatives facilitate and therefore encourage the use of public

transport. Most of the time, however, these forms of integration are still limited in the modes of transport they cover, and in particular maintain the traditional opposition between public transport and the car.

3.2.1 Challenges and opportunities

However, the dynamic of integration in the mobility market, which is in fact also present in most other urban services (Baraud-Serfaty *et al.*, 2017), challenges public authorities to link together the new forms of public and private transport, including those based on the car. The challenge lies in particular in the role of public transport within the global offering of transport services, against a background of upheavals linked with competition from new operators (like CityMapper in London with SmartBus) and car-based shared mobility services which operate on a preset route model, now being offered in certain cities by Uber and Lyft, or Blablacar in France.

However, the digital integration of mobility services also opens up new possibilities for transport policy. It increases the visibility of shared transport modes, and clarifies the connections between them and other modes, in particular public transport and walking. It also eliminates certain obstacles to the use of public transport, but also multimodality and intermodality, in particular the difficulties of accessing real-time information and the complexity inherent in the different pricing systems. In an ideal world, integrated mobility services make it possible for users both to plan and pay for door-to-door journeys in real time without having to worry about who is providing the services they are using, or about the methods of paying for those services, since the smartphone can function simultaneously as an instrument and proof of payment. Finally, the digital integration of mobility services opens the way to pricing innovations based on the notion of mobility as a service (the journey from A to B) rather than a series of service segments. More specifically, it raises the possibility of the emergence of urban mobility packages to which people subscribe, as they currently do with mobile phone packages, choosing a mix of options such as public transport, shared mobility solutions, or even parking spaces. By combining financial incentives with improvements in the quality of urban transport, this strategy could encourage significant and above all lasting changes in travel practices (Sochor *et al.*, 2015), in a context where environmental arguments are not sufficient and measures that are simply hostile to the individual car are limited in their impact and in reality penalise the poorest households and people living outside city centres.

3.2.2 The MaaS concept

In these new conditions, the concept of MaaS – Mobility-as-a-Service – is gradually emerging as a possible innovative response by public authorities to the new challenges and opportunities associated with integrated digital mobility solutions. In this conception, the public authority is the entity that organises and regulates the introduction of one or more digital platforms that aggregate and closely integrate mobility services, at least those that meet public goals, across the territory under its jurisdiction (Rooijakkers, 2016). In this model, the platforms are developed and run by private operators, but in close collaboration with the public authorities, which outsource the market for urban mobility to them (under supervision) and, in particular, allow them to include public transport in their global offering (i.e. not only real-time schedules but also ticket payment). Now the ability to sell public transport tickets is a very important issue for future urban mobility platforms (Lund *et al.*, 2017), in particular in cities where, as in Europe, public transport already plays a powerful role in structuring travel patterns, especially commuting patterns.

For the authorities responsible for transport, the advantage is that when transport becomes a service to which users subscribe, the needs of users for flexibility in timetables, journeys and modes are met more effectively. The other goal of servicialisation is as a disincentive to the ownership and individual use of the car. Ultimately, the aim is to improve urban mobility without massive investment. Public transport and green modes in general need to remain at the core of this new system, but solutions based on car sharing, other intermediate modes (notably the bicycle) and walking, must also have a place. The range and flexibility of mobility solutions should help to reduce road congestion but also to reinforce the role of public transport,

by providing solutions to the problem of managing the “last mile” and by compensating for the lack of public transport provision in certain areas and at certain times.

3.2.3 Implementation of MaaS

MaaS is a concept, a global framework for the reorganisation of transport policies. Its implementation depends on political goals and, above all, on local contexts: travel practices, condition of transport systems (in particular the public transport network), or else the characteristics of urban forms.

MaaS, in the sense of the integration to varying degrees of different transport services, has already been tested in several cities around the world (Kamargianni *et al.*, 2016), particularly in northern Europe, Finland being a pioneer in this field with the city of Helsinki (Jittrapirom *et al.*, 2017). However, some experiments, such as the Smile platform in Vienna (Austria), have been short-lived.

According to the cities where such experiments have taken place, the number of mobility services integrated into the system is variable, as are the tariff packages proposed to users. With certain platforms, like My Cicero in Italy (which also includes access to municipal services other than transport), each service is paid for individually. But this type of initiative does not fully follow through on the logic of servicialisation implicit in the MaaS concept, the aim of which is to make mobility a service to which the user subscribes. The subscription approach guarantees more regular use of services, therefore offering the prospect of a profound and also more lasting transformation in mobility practices. These kinds of subscription packages already exist, for example on the Whim platform in Helsinki (Finland) and the UbiGo platform in Göteborg (Sweden).

The monthly or annual subscription options allow users to choose the basket of services best matched to their needs and financial resources. A particular advantage of the digital platform and the subscription system is that the multiple public and private mobility operators who provide the services become “transparent” to the user, as do the prices associated with the use of the services. It greatly facilitates the use of the services, with single or combined modes, and hence also encourages multimodality and intermodality (Gebhardt *et al.*, 2016). The objective of this new system is also to discourage car ownership by facilitating access to a vehicle (car sharing, peer-to-peer rental) or to a ride in a vehicle (ride-hailing, ridesharing) at the user’s convenience, without the need to bear the costs of purchase, insurance, maintenance and parking associated with vehicle ownership.

For public authorities, the change of paradigm associated with the implementation of MaaS is significant, not to say radical. In fact, the aim of the MaaS concept is to place the user’s needs at the centre of transport policy, by fostering the development of public or private services that are better matched to those needs, which themselves are now better known thanks to the new mobility data captured from smartphones (see above). The implementation of the MaaS concept would also seem to go some way towards reconciling the collective goal of decarbonising urban transport and individual aspirations for travel that is less uncomfortable, safer, cheaper and more environmentally friendly (Karlsson *et al.*, 2016). The objective of public policy is still to reduce car dependency, but it seems that this goal can be fulfilled by moving beyond simple – and not very popular – “anti-car” measures towards mobility solutions that are genuinely alternative and offer a quality of service comparable with the private car in terms of comfort, reliable travel times and above all a full door-to-door transport solution.

The servicialisation of the mobility market obliges public authorities to reposition themselves as regulators of a mobility offering that is no longer restricted to traditional public transport, nor indeed necessarily to a strictly urban context. In particular, the goal of dissociating car ownership and car use, which is central in MaaS, raises the question of the inclusion of interurban mobility services in the platform. Indeed, vehicle ownership is often motivated by the lack (or costs) of alternative solutions for family holiday trips or long-distance commutes. The expansion of interurban commuting, which relies massively on the private car, is also an argument in favour of cities incorporating interurban services into their mobility platforms, and

could help to increase the number of platform users. In particular, it could attract people from the suburbs who work outside their urban area of residence, most of whom currently use their car to travel to work.

One of the main levers available to the transport authorities is the licence to sell public transport tickets. Without this possibility, digital mobility platforms would be less attractive. Urban authorities can decide to grant this licence to a single platform (as in Göteborg) or to several, as in Helsinki, which decided in favour of competition between platform operators (Rooijakkers, 2016). The authorities also have a role in coordinating the different mobility actors, old and new, and ensuring the operability of the different technical systems (Mukhtar-Landgren *et al.*, 2016).

More broadly, the implementation of MaaS implies a new public governance of urban mobility, based for example on a public mobility agency that would oversee the articulation and integration of both public and private mobility solutions that coincide with the collective objectives of sustainable development (Ambrosino *et al.*, 2016). The role of public transport, and more generally green modes, in the new mobility services market, is one of the critical elements (Hensher, 2017). It also resonates with the need for better quality of service in public transport (comfort, reliable journey times, on-board Wi-Fi, etc.) and better connections, including in public space, with the new shared modes and services (see above).

Finally, the implementation of MaaS needs to be attentive to socio-spatial inequalities that could be amplified by the unequal distribution of existing mobility services (public transport and new services), the difficulties that some people may experience in using digital tools, or else the gaps that may open up between those who are able to afford the packages that provide access to “top of the range” mobility services and those who are not.

CONCLUSION

With the smartphone, urban mobility is beginning to undergo changes that are profound but still highly uncertain (Lyons, 2015), affecting the travel patterns of individuals and the organisation of transport systems. They are part of a broader process of reorganisation in human activities (Aguilera *et al.*, 2012), in urban services and in public policies, driven by the spread of ICT and the digital revolution (Batty *et al.*, 2012).

Thanks to their smartphones, individuals now have access to a multitude of applications to help them at any moment in their choice of itineraries and transport modes. Shared and on-demand modes, situated between traditional public transport and the private car, are going through an unprecedented phase of development with mobile Internet and payment, which the authorities hope will help to reduce traffic congestion and pollution. The GPS data recorded by smartphones are also raising hopes for more comprehensive and real-time knowledge of urban mobility, opening the way to more effective management of traffic flows and transport systems. Finally, the smartphone is bringing new prospects for interactions with citizens and citizen participation in transport planning.

This chapter has identified the big challenges now facing public authorities in the development and implementation of transport policies as a result of the spread of the smartphone and the digitisation of urban mobility. The first challenge is to take advantage of new data and new opportunities for interaction with citizens to improve the targeting and effectiveness of transport policies. The second challenge is to integrate the new mobility services into transport systems and public space, connect them with public transport (Shaheen and Chan, 2016) and modernise existing public transport systems. And finally, the third challenge is that of transitioning to a conception of the urban mobility market as a service, based on the digital integration of transport services in pursuit of sustainable mobility objectives.

Tackling these three challenges will entail profound transformations in the nature of public action. These changes are first conceptual, linked with greater attention to users in a domain that is traditionally highly techno-centric (Papa and Lauwers, 2015). Second, the necessary changes are also of a technical nature because of the proliferation of big data which, for all its benefits, nevertheless retains many limitations with

regard to public action (Schintler and Kulkarni, 2014; Steenbruggen *et al.*, 2015). Third and finally, the transformations needed are political, because of the proliferation of actors now operating in the transport field, a development that demands the construction of new forms of coordination and governance (Roojakkers, 2016).

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