Dreaming of the Travelers' Experience in 2040

Exploring Governance Strategies and Their Consequences for Personal Mobility Systems

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Dreaming of the travelers' experience in 2040: Exploring governance strategies and their consequences for personal mobility systems

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Abstract

The boundaries between collective and individual transport are fading. Current solutions for payment and planning of trips are suboptimal for journeys that span across individual, collective and shared transport modalities. The discussion around these innovations often tends towards public authorities needing to strengthen their integrating role, or towards the private companies developing key innovations. We argue that focusing on only one of these perspectives, either integration or innovation, is likely to lead to what we call 'subtopias'. Furthermore, we discuss and resolve the conflict between the two roles based on four different scenarios, ranging from nightmare to utopian dream. Our claim is that a balance is needed between, rather than a prevalence for private and public, for integrated and innovative mobility services to manifest themselves. As we see it, authorities will need to direct, harmonize and coordinate specific elements of personal mobility systems in order to be able to facilitate a seamless multi-modal mobility experience for travelers.

Keywords: Personal mobility, government, user experience, service design

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1 Introduction

1.1 Shared mobility: rising pressure on individual and collective transport

For decades, in personal mobility there has been a distinction between private means of transport on the one hand, which can meet an individual's current transportation demand (e.g., car, motorcycle and bicycle), and public transport services on the other hand, in which individuals make use of publicly available seat capacity in vehicles operating in regularly offered services (i.e., bus, tram, metro and train) (see Table 1).

Table 1. Public, shared and private transport services for personal mobility *(*Continuous is always dependent on possible erratic supply)*

Transport service	Infra-structure	Vehicle	Driver	Locations and times*	Trips	Examples
Public	Dedicated	Service	Service	Scheduled lines	Combined	Train, metro, tram, some bus
	Shared	Service	Service	Scheduled lines	Combined	Bus, ferry, some tram
Shared	Shared	Driver owned	Driver traveler	Continuous	Combined	Ride sharing
	Shared	Driver owned	Service	Service hours	Dedicated	Ride hauling
	Shared	Service	Driver traveler	Continuous	Dedicated	Free roaming bike or scooter sharing
	Shared	Service	Driver traveler	Continuous	Dedicated	Car and bike rental and docked sharing
	Shared	Service	Service	Service hours	Combined	Jitney
	Shared	Service	Service	Continuous	Dedicated	Taxi
Private	Shared	Driver owned	Driver traveler	Continuous	Dedicated	Car, motorbike, bicycle, scooter

In this traditional dichotomy, a distinction is made between small-scale (individual) and large-scale (collective). However, for a long time, there has been a third category of shared transportation services, in which individuals make use of the same vehicle, but at different times, and of which the route and schedule is adapted to the traveler's needs (i.e., shuttle bus, taxi, rental vehicles). Up until recently, these shared transportation services did not receive a lot of attention, as they were usually relatively expensive, and therefore served only a small market segment [1].

Technological developments, such as positioning systems (e.g., GPS), mobile data communication (e.g., 3G/4G), route planning systems and online reservation

systems, have considerably changed the economic characteristics of the shared mobility services that were traditionally at the interface of private and public transport. The easiest way to illustrate this is with the example of what we would call shared scatter bikes: bike-sharing systems that do not use dedicated pick-up and drop-off locations, like MoBike and Lime. These bikes offer individual transportation at a schedule that fits travelers' needs, but the bikes can be used by other travelers as well, and with that, the capacity that the service offers, is available to everyone, provided that a bicycle is located nearby. It is likely that self-driving technology will also make sharing easier and cheaper for larger vehicles, due to their increased efficiency (operational time versus stationary time) and because a human driver is no longer required (which reduces labor costs). In addition, the advent of self-driving vehicles will remove the need for travelers to go to where a shared vehicle is located, but instead, the vehicle can come to them. Although technology is an enabler for new mobility services, a cultural shift from ownership to access based will be necessary for those services to become a success (according to Mulley [2]).

1.2 The governance of innovations in mobility

Innovations often come from specific niche players that disrupt the existing landscape of regime players [3][4]. In mobility, that regime was, for a long time, formed by the particular players in private and public transport, with niche players stepping in shared services, often backed by the power of platform technology. The obvious exception was formed by taxi's; a shared form that existed within the regime.

Innovations generally have the character of a clash between the niche players, in our case of shared systems, and the regime players, in our case of traditional public transport, private transport and taxi's. As the shared mobility providers moved in, the effect was further fragmentation, as regime and niche generally are not natural allies. This meant a broader set of players, not necessarily 'playing nice', forcing regulators to choose an approach in regulating access of new players (e.g., the municipality of Amsterdam in the case of bike-sharing service Obike and ridesharing service Uber), and possibly also the integration of the new and existing transport modalities in terms of scheduling and ticketing, in some cases through a public transport authority (such as in London and Sydney).

1.3 The consequences for personal mobility providers

The rise of shared mobility services as a 'third modality type' in personal mobility can be assumed to influence both public and private transport. Due to the competitive new (shared) mobility providers, private transport might become less interesting for some travelers, while in other regions, the new shared services offer a distinct advantage over public transport offerings. Individual (private) transport

has proven to be less strong especially in dense urban areas, where the required capacity is not available in a spatially efficient way. On the other hand, public transport has proven to be less strong especially in less populated areas, where the desired capacity cannot be offered in an economically viable way. Therefore, shared mobility providers with a small spatial footprint (bikes, mopeds, scooters, car sharing) can provide additional value in densely populated areas, whereas shared mobility providers that offer comfortable transport over longer distances – and that, thus, are likely to use larger vehicles (autonomous cars, taxi-buses) – can provide additional value in less populated areas. In short: in densely populated areas shared mobility providers are likely to compete with private transport modalities, while in sparsely populated areas, shared mobility providers may replace public transport services. Jittrapirom et al. [5] expect that a wide range of alternative modes and customized mobility services will increase accessibility of personal mobility services.

In comparison to private transport, public transport has the disadvantage that it does not offer door-to-door transportation. In addition, for public transport, vehicle and infrastructure capacity are not easily scalable, and operations can be susceptible to disruptions [6]. The disadvantages of private transport, on the other hand, are the limited operational time and high stationary time of the vehicles, the limited capacity of the transportation infrastructure (which can make private transport modalities unreliable in terms of travel time), and finally the fact that with private transport the vehicle needs to be stored at the end of the journey, which also makes it more complicated to take a different transportation service for the onward or return journey [7]. Shared mobility services address these weaknesses by providing shared capacity, door to door. The biggest advantages of shared mobility services are: better pre- and post-transport for public transport (first and last mile solutions), less searching for parking spaces, and increased flexibility for the traveler. With autonomous vehicle technologies it will be possible to solve some of the system level problems of car-sharing, since these vehicles will be able to redistribute themselves in the network at a system-wide level [8].

1.4 The travelers experience in 2040

It is to be expected that by 2040, due to the increasing sophistication of shared mobility services, the pressure on traditional mobility services will increase. The physical and digital infrastructure can support these new mobility services well, vehicles can operate on their own, platforms have been developed that offer reliable access to travelers, shaping the personal mobility experience for the traveler.

For travelers, this new context could mean the availability of a vehicle close by, providing a door-to-door experience, and the availability of infrastructure for that vehicle by more efficient and coordinated use of the shared space. Public transport is seen as the regular availability of a transport option at predetermined times (in

general, a moving seat), at a little distance, with a platform for planning the transfer (and possibly paying and reserving the seat). Disturbances play an important role here. Shared mobility providers offer the availability of a vehicle (possibly shared with others), with little worrying about transport infrastructure properties (such as congestion and routes), since the platform optimizes the planning for the traveler. However, reservations might be necessary, as shared mobility systems have a limited number of vehicles in their fleet, which is possibly not enough for the peak capacity.
A risk for travelers in this new context is that they will be confronted with a wider variety of mobility solutions, and - unless mitigated by a purposeful policy and design strategy - with a highly fragmented landscape of solutions for planning and payment.

1.5 'TRIP'-platforms

Digital service platforms will play an important role in the integration of future personal mobility services, to facilitate the interaction between travelers and transport suppliers [5]. Their role can be summarized as 'TRIP': Transaction, Reservation, Information, and Planning. First, they enable the transaction: the traveler can pay for the trip and is identified by that payment when he or she makes the trip. Secondly, the reliability of shared mobility providers, in particular of (self-driving) subsystems, but also of more traditional car sharing services, is enhanced by the possibility of reserving them. Thirdly, the platform communicates real-time with travelers before and during their trip, indicating available travel options and their properties, as well as information about the traveler's current journey. Finally, the platform offers the traveler the possibility to plan his or her trip in advance, but also optimizes the trip real-time, for example in the event of disruptions. All these TRIP-elements can be offered by individual mobility providers for their own specific personal mobility service, but the value of the platform will increase greatly if the mobility providers offer their services through one integrated digital (TRIP) platform.
In their research of the Dutch OV-chipkaart, Joppien, Niks, Niermeijer & Van Kuijk [9] suggested that it is beneficial for the adoption of TRIP-platforms if the system offers a seamless experience across individual mobility providers. In addition, these authors applied the Technology Acceptance Model [10] to the adoption of TRIP-systems, thus arguing that for successful adoption, these systems should offer a clear benefit (perceived usefulness), as well as easy access to and use of the system (perceived ease of use).
One TRIP-platform does not necessarily have to combine all elements, but may, for example, also specialize only in planning the journey (like the public transport planning feature of Google Maps, 9292 in The Netherlands, or CityMapper in for example London, RuterReise for Oslo), or rather only in handling the transactions (like Oyster in London, Octopus in Hong Kong, OV-chipkaart for the Netherlands and RuterBillett in Oslo) [11].

1.6 Innovation versus integration

Along those lines we want to look at the shift from existing segmented mobility providers (private, public and shared) to a new landscape in which different types of personal mobility services can be linked and integrated by TRIP-platforms. The promise of new personal mobility services is that they will be highly innovative and that they are well integrated, with each other and with existing systems. However, the concern is that forthcoming innovations, both in terms of new mobility providers as well as with regards to TRIP-platforms, due to their disruptive nature might either lead to monopolies or to fragmented landscapes.

According to Smith et al. [12], the public and private sectors can adopt two new roles in the value chain: as mobility service integrators or as operators. They discuss that market-driven development could either increase efficacy of and access to public transport or create an unjust transport system. On the other hand, the risk of a public-controlled development is that a system is created which is not attractive for end-users. A public-private scenario seems to be a preferable option. Li & Voege [13] also acknowledge the concerns on the possibility that the (pan-)European or global mobility service market may be dominated by a few big players, and that an appropriate policy framework is necessary to prevent unfair competition. Jittrapirom et al. [14] also highlight concern over the possibility of mobility intermediaries that can influence price by controlling supply and demand of the mobility market.

Kamargianni et al. [15] use six main stages of cooperation to describe mobility services: 1) cooperation only in terms of providing discounts for combined subscriptions; 2) ticketing integration; 3) payment integration; 4) ICT integration; 5) institutional integration; 6) integration with tailored mobility packages. Similarly, Lyons et al. [16] distinguish several Levels of MaaS Integration (LMI), like the Level 0-5 SAE taxonomy for automation of road vehicles[1], where Level 0 is No integration (the transport system is experienced as a series of discrete modes), and Level 5 is Full operational, informational and transactional integration across modes for all journeys. Moving from lower to higher levels of MaaS integration means, the cognitive effort for the traveler to plan, book, pay for and execute the journey successfully will reduce.

[1] https://www.sae.org/standards/content/j3016_201609/

2 Method: Exploring governance strategies through scenarios

To which extent the overall mobility system of a region is innovative and well-integrated depends to a considerable extent on the governance of the system. For example, Joppien et al. [9] noted that even though the Dutch OV-chipkaart uses similar technological solutions as its counterparts in Hong Kong (Octopus) and London (Oyster), when it was introduced the Dutch system initially was met with quite some public dissatisfaction and resistance, which the authors attribute to the complexity of the system. This complexity, the authors suggest, might be at least partly due to the fact that the Dutch system has no central travel authority or governing body, but is overseen by a committee, consisting of governments, transport providers and consumer organizations. With regards to governance of mobility systems, Snellen & De Hollander [17] observe that due to the speed of current technological developments, policymakers will need to switch from a reactive mode to a more proactive one. To investigate the potential impact of governance strategies of personal mobility systems on the travelers' experience, we use explorative scenarios [18], in which the main variations are the degree to which the system facilitates innovation by mobility providers and TRIP-system providers, and to which extent the elements of the personal mobility system are integrated.
We argue that focusing on only one of these perspectives, either integration or innovation, will lead to what we call 'subtopias'. The conflict between the two roles form the basis of four different scenarios, ranging from a future mobility nightmare to a utopian ideal (see Fig. 1). Based on the scenario outcomes, we identify the qualities that are crucial for the success of innovative solutions in personal mobility systems.

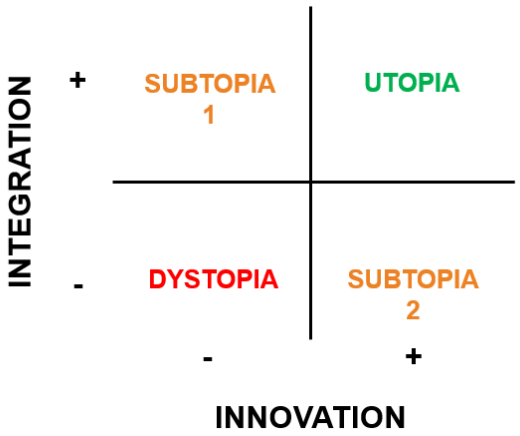

Fig. 1. Innovation vs. integration: four scenarios for the future traveler experience

3 Future mobility scenarios: from nightmare to utopia

The challenge niche players provided to the existing regime players is not played out yet. Here we have a look at how niche and regime, existing players and newcomers, could collide and provide a typology for possible confrontations. Our aim is to see how these confrontations can be seen in the light of the possible user experience.

Below we present four explorative future scenarios that outline the primary concerns regarding the quality of personal mobility, depending on whether a system is developed that features:

- No innovation and no integration (Dystopian nightmare)
- Innovation but no integration (Subtopia 1)
- Integration but no innovation (Subtopia 2)
- Integration and innovation (Utopian ideal)

3.1 Dystopian nightmare: No innovation, no integration

In this scenario, monopolization of certain travel service modalities has occurred, either because the operators are state owned and do not face competition, or because travel service modalities have been captured completely by powerful commercial parties (e.g., just one taxi company, just one bike sharing company). In addition, governments have not invested in the physical and digital infrastructure required for the integration of personal mobility services. Some of this can currently be seen in Venice (see Veeneman et al. [19], pp. 103) where travel information is not well developed (and global players are trying to win the market). This has overall resulted in a fragmented landscape in which there are no TRIP-platforms integrating access to travel services, and there is very little competition between travel service providers.

Disadvantages

- As operators that offer travel services face little to no competition, innovation of travel services is stifled, which leads to higher costs and lower quality for travelers;
- Not being regulated causes both mobility service operators and owners of TRIP-platforms to focus mostly on geographical areas with the highest market potential, leading to increasing costs and declining service for less populated areas;
- As a result of limited regulation there are no open connections (Application Programming Interfaces, or API's) between mobility

providers and TRIP platforms, preventing integration. A second effect is that travel data are not shared and not utilized, thus monitoring whether mobility services are used efficiently is not possible, which makes these services unnecessarily expensive;
- There is no shared physical and digital TRIP-infrastructure: each transport operator has its own app and card, and in addition there are several commercial TRIP-platforms, each providing access to a part of the mobility providers available. This leads to increasing complexity of use, no discount/products for multi-modal travels, and very limited overall insight in (costs of) journeys;
- No connection: the different travel services are poorly connected physically, because no transfer hubs have been developed and no one coordinates the alignment of schedules of different operators.

In this scenario, collective and shared mobility have become inferior to individual transport because it is too complex, unattractive, uninviting and expensive. Hence, travelers increasingly opt for individual transport, which society cannot accommodate. The physical infrastructure does not have enough capacity to accommodate the increase in individual transport, which causes serious congestions, there are negative consequences in terms of sustainability and economic impact, and personal mobility is not affordable for everyone.

3.2 Subtopian scenario 1: Innovation, but no integration

In this scenario, there is fierce competition between commercial parties in terms of mobility providers and TRIP-platforms. Governments do not coordinate or regulate the integration of the different mobility service providers, do not have a governance system in place for the TRIP-platforms, and/or do not regulate access to TRIP-data (preventing commercial companies from developing integrating TRIP-platforms). Some of this is currently visible in United States, with little governmental interest in bringing the various modes together and many private parties providing services. Remarkably, this is also the case to a limited extent in the Netherlands, where all public transport operators can be accessed through the OV-chipkaart system, thus integrating part of the private/collective/shared mobility systems mix. However, the current system does not have an open architecture, limiting third party TRIP-platforms and new mobility services to access it.

Advantages
+ Due to the competition between mobility service providers (both commercial and semi-government), price levels of mobility services and TRIP-platforms are attractive to users;
+ Also because of the competition, there is a lot of innovation in terms of mobility providers and TRIP-platforms. New mobility providers continuously try to enter the market, and existing providers are constantly

trying to introduce new services in order to cut cost or obtain a competitive advantage;

+ Because the approach is so decentralized, and because there is fierce competition, mobility providers ensure they offer tailored solutions for local/regional situations, in order to win concessions.

Disadvantages

– Door-to-door planning and payment are not possible, because there are multiple, complementary TRIP-platforms, but not a single player that covers all mobility services. As a consequence, travelers need to use a large number of different subscriptions, apps and identification methods in order to 'compile' their journey;
– In the overall mobility system, there are large differences in 'playing rules' and user experience between different mobility providers. Therefore, using collective and shared mobility providers has become too complex for certain user groups (e.g. infrequent travelers, elderly, tech-averse, low literates);
– Because the government does not regulate the TRIP-platforms, and for these parties the highest margins are in densely populated areas (due to the large number of transactions/journeys in densely populated areas), the TRIP-platforms give less priority to providing access to mobility services in less-populated areas;
– As authorities have limited influence on the TRIP-platforms, the platform simply focuses on how to offer the best journey to individual travelers and how the highest profit/turnover can be obtained, and does not optimize for collective, societal goals such as sustainability, limiting nuisance of new mobility modalities (think bike sharing or taxi services), fair working conditions, and reducing congestion;
– Privacy guarantees for travelers are strongly dependent on the business model of the mobility service provider and/or TRIP-platform operator.

In a model with multiple TRIP-platforms, each covering a part of the mobility services, and, in addition, many personal mobility operators active, the mobility system runs the risk of faltering, because of the lack of integration. Personal mobility needs door-to-door solutions to be attractive to travelers; however, the lack of integration in this scenario limits that. Competition keeps individual parts of the system innovative and attractively priced, but the system as a whole attracts fewer customers than it could potentially, thus leaving small margins for all the TRIP-platforms and mobility providers that are in fierce competition with each other. Also, the playing field being so overcrowded with many actors can lead to undesirable side-effects, such as congestion, overcapacity (e.g., Beijing's bike sharing services), increased pollution and undesirable working conditions.

3.3 Subtopian scenario 2: Integration, but no innovation

In this scenario, the TRIP-platform and mobility providers are regulated by the government in order to ensure integration. However, its regulation is focused so much on integration, that there is very little competition in terms of the offering of mobility provider (in certain areas monopolization has occurred), and the TRIP-platform is owned by a monopolist, with no serious competition. Some of this is currently visible in London, with a strong authority in TfL, but little room for external innovators [19].

Advantages

+ One single TRIP-platform makes door-to-door planning and payment possible, multimodal discount products and/or subscriptions are possible;
+ If the TRIP-platform is state-owned or regulated, the tariff-system can be simplified and include incentives for use, such as price capping (limit on the price charged for a travel);
+ Strong regulation and integration have resulted in consistent 'playing rules' and user experiences across mobility providers, and a relatively simple and accessible system for all target groups;
+ Best price possible (travelers never pay too much), but dependent on the incentives that the TRIP-platform provider is subject to.

Disadvantages

– Because the TRIP-platform has a monopoly, the incentive to innovate the platform and to limit the margins for offering 'tickets' through the platform are limited. This leads to less advanced functionality, an outdated user experience and higher prices.
– In case the TRIP-platform is monopolized by a large, international, commercial party, service provision is less likely to be tailored to the local context.
– Privacy guarantee for travelers is strongly dependent on who (which party) is responsible for integration.

In this scenario, government, in its desire for integration, has created monopolies and stifled the innovative power of private companies. Companies are not stimulated to enter the market or to improve their services. Customers are drawn by the overall user experience of the personal mobility system, but prices keep rising, forcing the government to offer subsidies to travelers or mobility providers to keep price levels at an acceptable level. Secondly, new services are hardly introduced; in time increasing the gap in quality between collective and shared mobility on the one hand and private mobility on the other, increasingly making collective and shared mobility the choice mostly for those who cannot offer private mobility solutions.

3.4 Utopian ideal: Innovation AND Integration

In this ideal scenario an optimal combination has been found between encouraging competition and thus innovation and efficiency on the one hand, and giving access to too many mobility providers and multiple TRIP-platforms on the other hand. Closest to this are probably examples from Lyon and Vienna [19], with strong authorities nurturing integration and allowing private parties to develop innovative services on their infrastructures.

Advantages

+ The government has ensured the development of a shared digital and physical TRIP-infrastructure (backend) with open API's, which allows for multiple TRIP-platforms to offer planning, travel information, reservation and ticketing services. The competition in TRIP-platforms stimulates the platforms to develop innovative new service offerings and ensure a high level of usability;
+ As the government is responsible for the TRIP-infrastructure, it has full-access to the travel data of all mobility providers to support the development of suitable mobility policies;
+ The government has regulated both TRIP-platforms and mobility providers to ensure integration in terms of a consistent user experience and 'playing rules', cross-provider subscriptions, door-to-door planning and ticketing, and best price policies;
+ Government can use its regulation of TRIP-platforms and mobility providers to stimulate reaching collective, societal goals, such as avoiding congestion, increased sustainability, fair working conditions, and avoiding undesirable side-effects of (new) mobility providers;
+ The fact that the physical and digital infrastructure is shared makes it easier for companies that offer TRIP-platforms or mobility providers to enter the market, as they do not have to possess expertise in this area or invest in it; hence, increasing competition;
+ Through management of concessions it is ensured that travelers have the choice of an optimal amount of mobility providers (collective, shared and individual) to choose from for their journeys, ensuring competition. This stimulates existing mobility providers to innovate their offerings and to offer attractive price-levels for consumers;
+ Because there is a clear and transparent central application process for mobility providers who want to start offering their services, and because these services can then be accessed by all travelers through the TRIP-platforms, innovative new mobility providers are stimulated to enter the market.

This scenario suggests that for innovative and affordable door-to-door solutions with a high level of user experience, the governance of personal mobility systems requires both an integration *and* an innovation component.

4 Seven qualities of successful personal mobility systems

When looking at the scenarios, we can see certain recurring elements that are positive or negative for travelers and/or society as a whole. We have identified seven qualities as crucial for the success of innovative solutions in personal mobility systems: integration, best price, easy entry, simplicity, comfort & reliability, high quality at a good (acceptable) price, and privacy (see Table 2).

Table 2. Seven key elements of integrated and innovative personal mobility services

What	*How*	*Why*
Seamless	• Door-to-door planning and payment for all modalities • Right physical and digital infrastructure	• Fits needs: people are travelling from A to B • Stimulates combining different transport modes • The car does this as well
Best price	• Very simple tariff system • Price capping • Price comparison • Personalized ticketing advice	• Transparency • Trust in the system • Competition (between mobility providers)
Easy entry	• Little mental and financial barriers to start using system • Easy onboarding • Simple system (little knowledge needed)	• Increase adoption for large target group • Increase inclusiveness • Decrease polarization between individual and collective transport
Simplicity	• Consistent and limited number of 'playing rules' • Consistent user experience	• Increase adoption • Keep public transport public: for everyone (including elderly, low literates, etc.)
Comfortable & reliable	• Open data on travel(er) information • Traveler incentives (nudges) • Demand responsive	• Travel times are predictable (on time) • Guaranteed capacity (being able to sit/enter vehicle)

High quality & fair price	• Competition on services, vehicles, TRIP-platforms • Strong directive role on infrastructure (physical and digital)	• Stimulate competition: innovation, optimization • Keeping personal mobility affordable • Monopolized infrastructure leads to 'winner takes all' situation
Privacy is ensured	• Traveler has high level of control over own data concerning travel information, location sharing, transaction data	• Legislation • Higher awareness among customers (trend)

5 Discussion

When looking at the future of mobility in the changing world, it is still unclear what the outcome will be. The new mobility service providers are currently developing their services and bringing them to markets across the globe. Consequently, users can provide little insight in their preferences, as they have very little feel for what these services will really mean to them. Moreover, policy makers have little understanding of the behaviors the users will show once services appear, and little idea about the consequences and possible needs for intervention. At the same time, the world of mobility services is changing rapidly.

In that uncertain context, research meets its boundaries. Empirical research lacks mature cases. Modeling is hampered by current assumptions. Quantitative research lacks the future data sets. All are rooted in the old world. Still, all these approaches contribute to building a first understanding of how one can make these new mobility services work, albeit with limitation. They do this by narrowing down the set of possible futures and providing a tricky triage of what futures are more and less likely.

This article has taken a different approach, and this is its main limitation and contribution. We have structured the possible field of options by looking at the possible role of key stakeholders in providing innovation and integration in future mobility. This provides a broader perspective on possible futures and possible issues, and should support researchers down the line in structuring their view on the future personal mobility field. In addition, we provided a framework on what qualities should be expected from these new mobility services for the traveler.

There seems to be an increasing importance of customer-centric innovation, and attention to the user perspective in the development of mobility services (e.g., [16],[1],[20]).

According to Kamargianni & Matyas [6], policy frameworks and recommendations for the sustainable development of the market, fair competition, financing, passenger rights, privacy and security, service quality standards, social inclusion, and safety, should ideally be proposed by the government on a national (or even international) level in order ensure open and interoperable standards across different regions. Thereby making a comparison with the telecommunication market, with global standards for GSM networks and global roaming.

Smith et al. [12] explored three development scenarios (and their implications for public transport): market-driven, public-controlled and public-private development. All three scenarios will probably have a large impact on future traditional public transport, but the consequences may differ. For example, they agree that the level of regulation is a key factor, with too much regulation impeding innovation (leading to unattractive mobility services), and too little regulation leading to mobility services that do not serve the public interest [12].

The authorities have an important role in setting open data policies: in order to enable mobility services to work between user, public and private providers, agreed data protocols and data sharing are needed [21],[13], but also to safeguard privacy: one of the principal sources of concern about the smart card payment methods (or similar) is privacy of data [22],[23].

6 Conclusion

The boundaries between collective and individual transport are fading. Current solutions for payment and planning of trips are suboptimal for journeys that span across individual, collective and shared transport modalities. Travelers will soon be confronted with a wider variety of mobility solutions, and - unless mitigated by a purposeful policy and design strategy - with a highly fragmented landscape of solutions for planning and payment. The success of innovative solutions in personal mobility systems, including more sustainable alternatives, depends on the choices travelers will make in that landscape.

The discussion around these innovations often tends towards either public authorities needing to strengthen their integrating role, or towards the private companies developing key innovations. We argue that focusing on only one of these perspectives, either integration or innovation, is likely to lead to what we call ‘subtopias’. Furthermore, we discuss and resolve the conflict between the two roles based on four different scenarios, ranging from nightmare to utopian dream.

All mobility services need an infrastructure, including a digital TRIP-platform. Private monopolistic control over the infrastructure can be a real risk, as it could eventually hamper innovation by stifling competition on that infrastructure. This is where public actors can play a valuable role in providing open infrastructures, for

transport and data. On that infrastructure, private parties can develop innovative services for travelers. The new fragmented world of mobility services creates new possibilities for private parties to monopolize the data infrastructure, the digital platform. Our claim is that a balance is needed between, rather than a prevalence for private and public, for integrated and innovative mobility services to manifest themselves.

As we see it, authorities will need to direct, harmonize and coordinate specific elements of personal mobility systems in order to be able to facilitate a seamless multi-modal mobility experience for travelers. On the other hand, the authorities will also need to organize openness and flexibility in order to make the system attractive for innovators to enter the market. Lastly, the authorities will certainly continue to play an (even increasingly more important) role in issues regarding privacy and data protection.

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