New mobility concepts: myth or emerging reality?

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Abstract

Urban mobility seems to be at the edge of a transition towards a new mobility concept. Transport users will not buy and own a car anymore. Rather they will have a contract with a mobility service provider that will fulfil the whole variety of urban mobility needs, including offering the users shared cars. This concept is nowhere fully implemented, yet. However, the building blocks of such a concept seem to form in Europe, in Asia and even in some US cities. The paper describes such a new urban mobility concept based on sharing-instead-of-owning. It eplains the status of the emerging building blocks that form such an urban mobility concept. New mobility options, ICT technologies both on front-end applications (smart-phones, key card systems for vehicles) and on back-end (reservation and payment systems) seem currently to become available. However, the market is still forming, but with some public transport operators, most car-manufacturers and large system operators setting-up mobility service schemes the competition is driving the development of a new mobility concept. It seems to us that transport research has largely neglected the emergence of such new mobility concepts. We are lacking behavioural studies e.g. on how a user would perform modal choice in such new concept, as well as modelling studies providing us with impacts on transport demand.

Keywords: seamless multimodal travel, fifth mode, car-/ bike-sharing, public transport, innovation system.

Résumé

La mobilité urbaine est à la veille d'une transition vers un nouveau concept de mobilité. La consommation de transport ne sera plus conditionnée par l'achat ou la propriété d'une voiture. Au lieu de cela, elle sera basée sur un contrat avec un fournisseur de services répondant à l'ensemble des besoins de mobilité urbaine, y compris ceux basés sur l'utilisation partagée de l'automobile (car-sharing). A ce jour, ce concept n'est pleinement mis en œuvre nulle part, mais il émerge par morceaux en Europe, en Asie et même dans certaines villes américaines. Le document décrit ce nouveau concept de mobilité urbaine concept basé sur le partage de préférence à la possession, et il décrit l'état actuel des différents constituants de ce concept qui deviennent actuellement disponibles: nouvelles options de mobilité, nouvelles technologies de l'information et de la communication tant dans leurs applications frontales (smart-phones, systèmes de carte clé – key card - pour les véhicules) qu'en arrière-plan (systèmes de réservation et systèmes de paiement). Certes, le marché est toujours en phase de formation, mais l'émergence du nouveau concept est poussée par la concurrence entre d'une part certains exploitants de services de transport public, d'autre part la plupart des constructeurs automobiles et enfin quelques opérateurs de grands systèmes. Les auteurs estiment que la recherche sur les transports a largement négligé ce phénomène: il manque à la fois des études comportementales - portant par exemple sur le choix modal face à ce nouveau concept de mobilité-, et des études de modélisation évaluant l'impact du concept sur la demande de transport.

Mots-clé: transport multimodal, cinquième mode, auto-partage, vélo-partage, les transports publics, système d'innovation.

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1. Introduction

Passenger transport nearly always is intermodal. Passenger trips start by foot, than may change to bike, car, public transport or long distance transport means. Such trip chains have been researched for long and their implementation was promoted by European, national and urban policy-makers, in particular with regard to foster sustainable mobility by modal-shift away from cars towards alternative modes. Some cities were successful and increased substantially their modal-share of public transport or bikes. However, still private car transport dominates in many cities and much more in surrounding areas. Obviously though tackled, the barriers for further improvement of intermodal transport like insufficient interchanges, lack of multimodal information, fragmented ticketing systems, lack of flexibility and comfort present an obstacle for such multimodal transport becoming the dominating passenger transport paradigm.

However, will this remain in the future? Or can we identify signals for a true multimodal transport paradigm emerging? In this paper we will argue that urban mobility seems to be at the edge of a transition towards a new mobility concept, which could constitute such a paradigm shift. Transport users within a wider agglomeration area would not need to buy and own a car anymore. Rather they would have a contract with a mobility provider that will fulfil the whole variety of urban mobility needs, including offering them shared cars. This multimodal one-stop-shop services concept is nowhere fully implemented, yet. However, the building blocks of such a concept seem to form in Europe, in Asia and even in some US cities, despite that for these regions different passenger transport demand developments can be expected due to the differences in drivers of transport demand. Many European countries are facing an ageing society and a declining population, both leading to stagnating or even declining passenger transport demand in the next decades. Inward migration, a younger population and higher birth rates than in Europe are expected to further increase population in the US also continuing the growth trend of passenger transport demand. Asia is also expected to experience strong transport demand growth, though improvement of economic situation, and related growth in car-ownership in several Asian countries, will be the more important driver than population growth.

This paper describes the emerging multimodal one-stop-shop urban mobility concept that will be based on sharing-instead-of-owning. It explains the building blocks of such an urban mobility concept and uses the heuristic of technical innovation systems (TIS) to demonstrate that such a multimodal concept is emerging today, at least in Germany.

In the paper we use the term “multimodal” also to indicate that the users change their behaviour from being focussed on the use of a single mode, which was in most cases the private automobile, to developing a true multimodal behaviour that exhibits a flexible choice of transport mode let it be public transport, bike-sharing, car-sharing, ride-sharing, rental cars potentially also in combination with private vehicles i.e. cars or bikes.

2. Building blocks – new and existing ones

There are several acknowledged strategy approaches to develop sustainable urban mobility. Important strategic planning objectives emphasize to plan for a city enabling short distance trips (“Stadt der kurzen Wege”) in which public transport is able to form the backbone of urban passenger transport and to ensure that city (growth) is developing along the public transport axes. Corresponding strategic sustainable transport objectives can be summarized as avoid – shift – improve, i.e. avoid travel e.g. by shorter distances, shift it to the environmental friendly modes and improve the efficiency of the remaining transport (see also Schade et al. 2011).

New Mobility Concepts constitute an additional strategic approach to foster sustainable mobility. External drivers and technological progress push the emergence of building blocks that only together will form the new mobility concepts. Essential external drivers seem to be the increase of mobility cost driven by growing fossil fuel prices as well as demographic change leading to both a growing share of elderly people with specific transport needs but also a growing number of young people grown up with the internet and smartphones (“Digital Natives”). Important new building blocks are: (1) new usage concepts summarized as sharing-instead-of-owning, (2) small (electric) vehicles, (3) new business models and new players as mobility service providers as well as finally (4) new information and communication technology (ICT), which are briefly discussed in the following sections.

2.1. New usage concepts – sharing-instead-of-owning

The keynote theme of the global computer fare CeBIT this year (2013) was “Shareconomy”. This highlights the growing importance of the new usage concept of sharing-instead-of-owning as a first building block of new mobility concepts. In the mobility domain the concept becomes visible by three well known mobility services:

- **Bike-sharing** offers public bikes usually at fixed stations (a few flexible schemes exist) and requires purchase of annual or short-term usage passes to take a bike and return it at any of the stations, usually then being for free the first 30 minutes of bike-usage. Maintenance of bikes is organized by the operator. In Europe such systems became popular with the opening and success of the Paris “Velib” bike sharing in 2007, though similar schemes date back until 1998 in Rennes. In the US 2013 could be the year when bike-sharing took off with doubling of number of shared bikes over the year by opening up of schemes e.g. in New York, Chicago, Los Angeles and San Francisco. However, the biggest bike-share schemes with more than 50.000 bikes in one city are operated in China today.
- **Car-sharing** enables for registered members of the scheme to take cars that are either based at fixed stations where they have to be returned to as well (station-based systems) or that are based within a designated area in which they can be picked-up and parked at any location within the area (flexible systems). The operator (or the owner in case of private car-sharing) is responsible for maintenance of the vehicle. Some schemes enable only short rental durations (hours or a few days), while others also enable to take a car for holiday trips (i.e. for several weeks). Schemes may offer only a few vehicle types (e.g. only urban vehicles like Smarts) or the whole range from small urban vehicles to nine-seater buses. The latter provides a high flexibility for users with differing transport needs.
- **Ride-sharing** (or car-pooling) allows to share a unique ride (e.g. a longer trip between two cities) or regular trips (e.g. to work, which is then rather car-pooling). Today the driver offers the trip at an online platform and registered users are able to approach the driver and make a reservation for the trip.

Car-sharing and bike-sharing both profit from the capabilities of new ICT to allow for ad-hoc bookings of vehicles. Even ad-hoc ride-sharing becomes possible i.e. a driver entering his car, making his offer of a trip from A to B and immediately finding passengers who would join and pay him for part of that trip from C to D or B. Also relevant for the success of ride-sharing schemes will be the habit of Digital natives to participate in social networks and to generate trust by rating systems, which can also be applied to drivers/users of ride-sharing.

Of course, cost is most often an argument for participating in such sharing systems. However, also flexibility and comfort gain importance as arguments. Flexibility for instance as always the best suiting car could be used, like a convertible car for a trip in the sun or a nine-seater for the weekend family and relatives trip. Comfort as all maintenance (oil, tyres, etc.) is organised by car-sharing operators (Adler 2011).

2.2. Small (electric) vehicles

In the past there were rather clear borders between different vehicle types, in particular the bike and the car. The bike was a non-motorised vehicle to carry one person as far as he/she was feeling comfortable with, usually a few kilometres in rather flat area. The car was motorised and enabled higher speeds and longer distances, but required significant road space and weighed 1-3 tons. Today different kinds of small electric vehicles may satisfy usage profiles located between the car and the bike, let it be pedelecs (i.e. bikes with support of an electric motor and limited speed), electric scooters, segways, two- or three seater electric urban vehicles (see Fig. 1). Such vehicles form another building block as they could alter mobility patterns both when they become used in private ownership or when they become part of vehicle-sharing systems.

Fig. 1. Small electric vehicles: twike, twizzy, segway, kick-trike, e-tuc-tuc (photos: WS)

2.3. New business models and new players

Widespread adoption of sharing concepts and of new electric vehicles requires viable business models as the third building block to develop innovative mobility concepts. Before innovative solutions become successful on markets one can observe various business models to emerge, some of them surviving and expanding, others collapsing and disappearing again. The situation seems to differ for bike-sharing and car-sharing. For bike-sharing the large majority of operators set-up station-based systems at which the bikes have to be taken either by using a smart card or by entering a code at the stations. A few operators were implementing a flexible system with booking and opening of bikes via mobile phones, like the DB with the call-a-bike system starting in 2001. But, also the DB is testing the system with fixed stations in several of their cities. Thus it seems that stations-based systems like in Paris, Barcelona, Milan or Brussels emerge today as successful business model from the niche of bike-sharing systems.

For car-sharing the situation differs. Car-sharing systems of the early 1990ies were often set-up as co-operations of private persons in some cases involving also the administration of their home city. Since then, some of them developed successfully into private businesses keeping their approach of a station-based system and forming networks of cooperating local car-sharing companies covering some dozen cities in Germany (e.g. Stadtmobil, Cambio or Greenwheels) or in the US and the UK (e.g. ZipCar). Cars in such a classical system can be used by registered users who paid an annual fee and for each rental time-related cost and distance-related cost are charged. The fleet offered in such systems may cover the whole varietey of passenger cars from the two-seater Smart, to compact cars like Opel Corsa, station wagons like Opel Astra Kombi, limousines like Audi A4 or nine seaters like Mercedes Sprinter. These “classical” car-sharing systems have seen the start-up of competing alternative systems. In particular the “flexible” car-sharing in which usually a standard fleet is operated (e.g. all cars being Smarts) within a defined area in which the cars can be picked-up and returned at any location in the area. Such systems were started for the public in Ulm in Germany in early 2009 followed by the second one in Austin, Texas. This first system was Car2Go from Daimler. Due to the success of these first two trials the Car2Go system was expanded to other cities in Germany, Europe and the US and a cooperation with Europcar was initiated. At the beginning of 2013 Car2Go reported 275.000 registered users globally. Similar systems have for instance been started by BMW (DriveNow) and Citroen (MultiCity), while Volkswagen (QuiCar) or Peugeot (Mu) have started station-based systems. Today, nearly every car manufacturer has taken first steps to participate at the growing car-sharing market, increasing the competition with established classical systems. In parallel, also private car sharing (peer-to-peer) receives more support, but develops less dynamic than both the business driven approaches. Also “focused” systems offering car-sharing at specific locations, in particular at railway stations, develop further. However, as Flinkster, run by the Deutsche Bahn (DB), reveals these systems seems also to expand towards a station-based system with further stations, at least in bigger and more attractive cities. An overview on the diversity of car-sharing business models is presented in Table 1.

Table 1. Typology of car sharing business models (own compilation)

Type of car-sharing	Car locations	Fleet composition	Pre-booking time	Rental duration	Maintenance	Examples
Classical	At stations, fixed	Full range of vehicle types	Ad hoc	Hours, weeks, unlimited	Operator	Stadtmobil, Gambio, QuiCar (VW)
Flexible	In area, flexible	Standard type of vehicles	Ad hoc	Hours	Operator	Car2Go (Daimler), DriveNow (BMW), MultiCity (Citroen)
Private	At homes, disperse	Full range but random mix	Required (days)	Days, limited	Private	TaMyCa Autonetzer
Focussed	(Mostly) at train stations	Limited mix of vehicle types	Limited	Days, weeks	Operator	Flinkster (DB), Mobility
Short-term rental	At car rental offices	Limited mix of vehicle types	Hours	Days, weeks	Operator	Europcar, Sixt

Ride-sharing like organised by the German platform Mitfahrgelegenheit or the French Covoiturage also gained importance. Covoiturage today has some 4 million registered users. New tools enable ad hoc sharing of rides, like OpenRide. First offers that combine car-sharing with ride-sharing emerge as well, like DriveNow with flinc.

In general, all these approaches could complement public transport (PT) in a sense that they combine the time table based PT with flexible mobility options for those trips too inconvenient or impossible with PT.

2.4. New ICT technologies

The fourth building block improving or even enabling at all the new sharing-based business models are ICT technologies. Such technologies include hardware and software improvements. In particular smartphones and specific mobility apps enable to obtain travel and vehicle information in real time, book tickets, reserve shared vehicles or participate in ad hoc ride-sharing.

Together with new business models of a mobility service provider the new ICT technologies will support to overcome the information barrier and the fragmentation barrier of past multimodal systems. The information barrier concerns in particular that for a multimodal trip from A to B in the past the information systems of all involved modes must have been consulted separately to elaborate a full plan of the trip. A new multimodal service would provide timetable information and cost of all modes including also car- and bike-sharing (e.g. http://www.qixxit.de/). Again, also car manufacturers started to develop such systems like Citroen (http://www.multicity.citroen.de/). More difficult currently seem to be the fragmentation of ticketing and payment systems, such that for a multimodal trip still for each mode a separate payment will have to be made. Moderate steps forward have been made by railway operators like the DB who together with their long distance ticket also offer a ticket for public transport in the German destination city.

3. Fifth mode – seamless integrated passenger transport

The first time that the Fifth mode appeared to us as a term in the EU policy scene was at the High Level Conference on the Future of Transport in 2009. We would summarize it as seamless multimodal integrated passenger transport enabled by a one-stop-shop mobility service provider (MSP), as shown in Fig. 2, who puts together the different building blocks explained in the previous section. The MSP integrates the offer of the different modes and either is one of the operators (for instance the PT operator) who has contracts with the other operators or could be a newcomer in the mobility business like an IT company (e.g. IBM, SAP, Google) or technology company (e.g. Siemens). The transport user would have one contract with an MSP and via the ICT-based interface offered by the MSP could get all multimodal information for a trip from A to B, book tickets or make reservations for all modes of the trip. After each month (or shorter period) the MSP would charge the user for all its trips, independent with which mode they have been made.

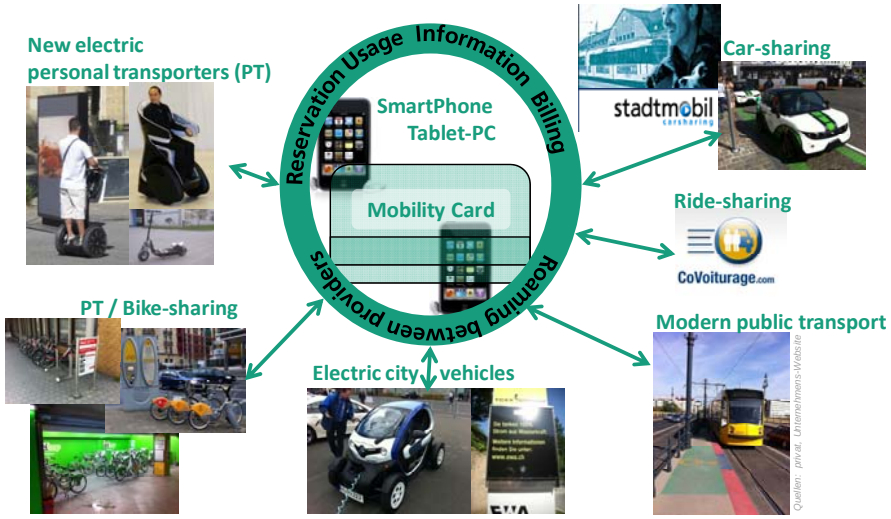

Fig. 2. Building blocks of Fifth Mode enabled by the mobility service provider (own compilation)

Most convenient for the transport user seems to be if a nationwide offer is provided by the MSP such that not only in his/her home town the full mobility services are available, but also nationwide. However, looking at ongoing developments in Germany it seems that regional and competing MSPs will develop. In Stuttgart and Berlin the Daimler company is testing the multimodal service Moovel. It brings together the transport services of the regional public transport company, Car2Go i.e. the car-sharing from Daimler, nextbike a bike-sharing operator, mitfahrgelegenheit the ride-sharing operator and mytaxi the app to electronically order taxis. In Berlin there is even a second MSP offering similar integrated services. Via the project BeMobility the BahnCard 25 mobil plus is intiated offering in one package Berlin public transport, long distance rail transport and both car-sharing (Flinkster) and bike-sharing (call-a-bike) all operated by the DB. Berlin anyhow seems to be a laboratory to test new mobility solutions. For instance, 10 car-sharing operators compete for customers in the city. Also in other cities co-operations between some of the operators emerge. Most often seem to be the cooperation between public transport and car-sharing operators like in Hamburg, Hannover, Frankfurt or Karlsruhe.

Assuming that the outcome of the market development of the Fifth Mode would be several regional MSPs within Germany, but also within Europe it seems that national and European policy-makers will have to take care that the full user-benefits of such a market can be captured. This would be the case when a user has a contract with his/her regional MSP that enables him/her to conveniently and flexibly use all modes in his/her region, but via roaming between MSPs also in other national or European regions.

4. Innovation System of Fifth Mode mobility concepts

To analyse if such a system transition as the previously described Fifth Mode could happen it is worth to look at the innovation system that must support such a transition to develop a Fifth Mode. Fig. 3 presents an overview of the innovation system. We have discussed the driving framework conditions like increasing fossil fuel prices and mobility cost fostering car-sharing as well as the change of values of the young generation who have grown up with the internet, smartphones and apps (digital natives) and also demand for having more options and higher flexibility while owning a car becomes less important than owning the technology to be part of the social networks.

Besides these driving forces it seems in particular to be the industrial system that is pushing the fifth mode, at least in Europe and in particular in Germany. The research system reveals a few authors that address such changes for a while already (e.g. Canzler/Knie 2009 and earlier works) and recently several authors dealing with the future of mobility and mobility innovations (Huber et al. 2011, Schade et al. 2011, Schade et al. 2012, Rammler/Sauter-Servaes 2013).

The political system could have such transition on the agenda, at least some paragraphs in the White Paper on transport from 2011 can be read as to foster such multi-modal solutions that involve new mobility concepts and require novel ICT solutions as part of Smart City Initiatives (European Commission 2011). Another policy driver for Fifth Mode solutions, in particular visible in German national policy, comes from research and R&D funding of electricmobility. Significant shares of these funds go into field trials of multimodal urban solutions involving small electric vehicles (e.g. bike-sharing with pedelecs) or multimodal mobility cards (e.g. the already mentioned BeMobility project). However, it seems that the political system is not aware, yet, that a successful Fifth Mode will also require regulation on roaming between different MSPs to extend the scope of the Fifth Mode.

Nevertheless it seems to us that the industrial system is leading the transition towards the new mobility concept of the Fifth Mode. Nearly all car manufacturers have set-up their own car-sharing system, are collaborating with existing ones or have purchased established car-sharing operators (like Volkswagen bought GreenWheels). Also some new entrants appear in the market using the promotion of electricmobility as entrance. A prominent example is the Paris electric car-sharing operated by Bolloré. In Germany also the big public transport companies begin to take seriously the opportunities of collaboration of public transport and car-sharing. Actually the literature reports about car-sharing being more successful in cities with good public transport, thus the two being complimentary. In Berlin, Frankfurt, Hamburg, Hannover, Karlsruhe etc. the public transport operators have established collaborations with car-sharing operator(s) (Loose/Glotz-Richter 2012).

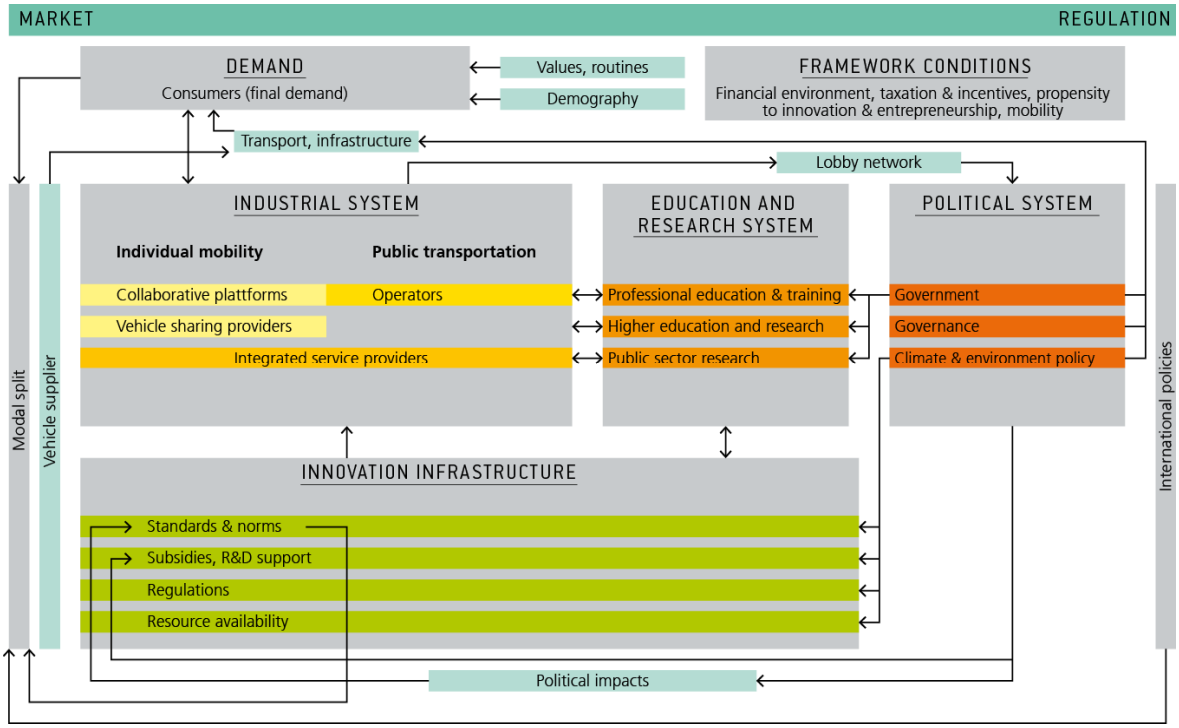

Fig. 3. Innovation system of Fifth-Mode new mobility concepts (own representation)

The theory of technical innovation system (TIS) also supports the analysis of the performance of such a system as well as a qualitative/quantitative judgement of the status of an innovation system. Though the Fifth Mode new mobility concept does not constitute a pure technical innovation system, we think that it can be tested against the criteria of a TIS as described by Bergek et al. (2008). As this would be an extended paper on its own, we highlight in the following a few quantifiable indicators that measure the performance of a TIS. The first indicator is related to *market formation* in Germany, which shows that the number of car-sharing operators in Germany doubled between 2005 and 2011 and the number of users roughly doubled between 2008 and 2012 (left hand side Fig. 4). The second indicator relates to *guidance of search* provided by expert opinion about the point of time when mobility services would replace 25% of private car sales. On average about 50% of experts expect that this will never happen. However, in Germany the majority of experts expect it to happen; one quarter of all German experts think that this would happen between 2020 and 2024. Both constitute interesting signals in favour of such multimodal mobility concepts emerging in the future.

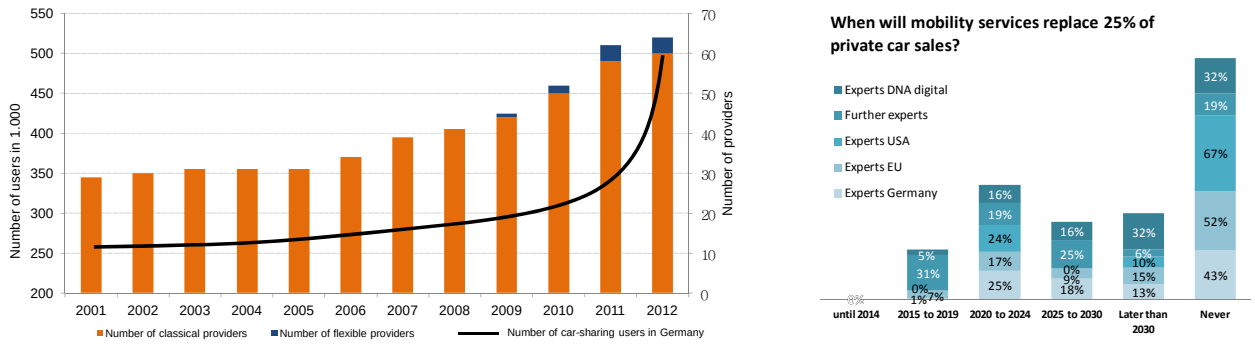

Fig. 4. Development of service providers and users of car-sharing in Germany, left hand side (Fraunhofer ISI 2012, BCS 2013), expert expectation for point in time at which mobility services would replace 25% of private car sales in percent. Each regions total experts account for 100%, right hand side (Maas 2012).

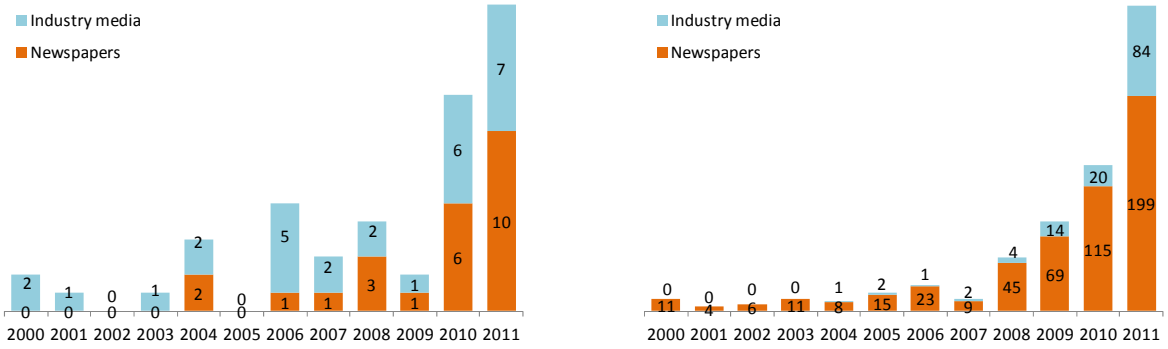

Fig. 5. Number of published articles in newspapers and industry media with topics "multimodal" and "Mobilität", left hand side; the same with "Carsharing" and "Mobilität", right hand side (Maas 2012, using LexisNexis Germany, data from 2012)

Fig. 5 presents another relevant indicator for TIS that refers to *legitimation* of an innovation. As example for *legitimation* we provide the development of the number of articles in newspapers and industry media on topics related to the Fifth Mode. On the left hand side we show the numbers for the combined terms "multimodal" and "Mobilität" revealing a strong growth 2010/2011 though still remaining at moderate levels. On the right hand side the combination of "Carsharing" and "Mobilität" is presented, which exploded from 2008 until 2011. These and further indicators of the TIS analysis exist that reveal the take-off of the innovation system of seamless multimodal integrated transport. Thus, we conclude such a system is taking-off, at least in Germany.

An important debate concerns the question who would be the integrator of the Fifth Mode? Are there any signals that innovation system analysis could detect? Actually there is no clear signal, but candidates who operate at least part of such integrative ICT platforms. Amongst these would be the Deutsche Bahn with their route planer and links to their mobility services, Siemens as operator of several traffic management systems in Germany that could also form part of a backbone of such integrated systems, the Moovel platform of Daimler or the Google Transit service. This list is surely not exhaustive as developments on that market occurs highly dynamic today.

5. Conclusions

This paper raises the question if the Fifth Mode style new mobility concept is a myth or emerging reality. Applying the heuristic of technical innovation systems (TIS) assessing innovation and market indicators we conclude that these provide very strong signals that the Fifth Mode is actually an emerging reality. In an analysis of economic aspects of sustainable mobility Schade/Rothengatter (2011) concluded that it would also rank among the top five priorities to achieve sustainable mobility, a view that was supported by an expert survey amongst transport experts also carried out by that study.

The Fifth Mode would develop in steps. In the end a successful transition to such a new urban mobility concept requires integration of the different mobility services, public transport, variants of car-sharing, bike-sharing and ride-sharing such that a customer only signs a contract with one mobility provider to fulfil his/her complete mobility needs. Technologies both on front-end applications (e.g. smart-phones, key card systems for vehicles) and on back-end (e.g. reservation and payment systems) seem to be available. Innovation system analysis reveals that the market is already forming, and with most car-manufacturers, several public transport operators and a few large system operators setting-up local systems the emergence of an integrated system seems getting closer.

It seems to us that transport research has largely neglected the emergence of such integrated new mobility concept, though there exist some studies on car-sharing and a few on bike-sharing, but virtually none on such a fully integrated Fifth Mode MSP. Transport science is thus lacking behavioural studies e.g. on how a user would perform modal choice in such a new mobility concept, as well as modelling studies providing us with their potential impacts on transport demand, energy consumption and climate impacts. In fact, the industry domain seems to be more aware of the development than the scientific community, and is actually pushing it.

Policy-makers should also play a role in developing the system as they are requested to provide basic foundations of such mobility concepts: roaming, data protection and standardisation in a sense that integrators of the Fifth Mode get access to required information like time tables. As in the case of mobile phone communication roaming between different mobility providers in different cities/regions should be feasible. This will still require developing a suitable policy framework.

We argue that according to current signals of innovation system analysis market formation in Germany seems to be in a leading position. However, developments in France, the US or China indicate that such systems could emerge there as well. Schade et al. (2012) highlight that this would have significant global impacts on the current business model of the automotive industry. Globally the success of a Fifth Mode MSP could imply that more than 20 million cars that were expected to be sold in 2030 would not be sold that year.

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