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Smart Mobility: Opportunity or Threat to Innovate Places and Cities?

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1 INTRODUCTION

The concept of the "smart mobility" has become something of a buzz phrase in the planning and transport fields in the last decade. After a fervent first phase in which information technology and digital data were considered the answer for making mobility more efficient, more attractive and for increasing the quality of travel, some disappointing has grown around this concept: the distance between the visionarypotentialthatsmartness is providingis too far from the reality of urban mobility in cities. We argue in particular that two main aspects of smart mobility should be eluded: the first refers to the merely application to technology on mobility system, what we called the techo-centric aspect; the second feature is the consumer-centric aspect of smart mobility, that consider transport users only as potential consumers of a service.

Starting from this, the study critics the smart mobility approach and applications and argues on a"smarter mobility" approach, in which technologies are only oneaspects of a more complex system. With a view on the urgency of looking beyond technology and beyond consumer-oriented solutions, the study arguments the need for a cross-disciplinary and a more collaborative approach that could supports transition towards a"smarter mobility" for enhancing the quality of life and the development ofvibrant cities. The article does not intend to produce a radical critique of the smart mobility concept,denying a priori its utility. Our perspectiveisthat the smart mobility is sometimes used as an evocativeslogan lacking some fundamental connection with other central aspect of mobility planning and governance.

Main research questions are: what is missing in the technology-oriented or in the consumers-oriented smart mobility approach? What are the main risks behind these approaches? To answer this questions the paper provides in Section 2 the rationale behind the paper;Section 3 provides a literature review that explores the evolution on smart mobility paradigm in the last decades analysing in details the "techno-centric"and the "consumer-centric" aspects. Section 4proposes an integrated innovative approach for smart mobility, providing examples and some innovative best practices in Belgium. Some conclusions are finally drawnin Section 5, based on the role of smart mobility to create not only virtual platforms but high quality urban places.

2 BEYOND THE SMART MOBILITY PARADIGM

Different approaches to mobility systems and mobility planning have been developed and described within the transport and land use literature. The first one is defined "conventional mobility" planning and it focuses on the physical dimensions and on traffic (and in particular on the car) rather than on people: it is large in scale, rather than local, it is forecasting traffic and it is based on economic evaluation. In synthesis, the conventional approach "is based on the premise that travel is a cost, and that travel times should be as short as possible" (Banister, 2008). In other words, traditional transport planning aims at improving mobility, especially for vehicles, and may fail to adequately consider wider impacts.

In opposition to this, the sustainable mobility paradigm arose (Banister, 2008) which strengthens the links between land use and transport. The sustainable mobility refers to the broad subject of transport that is sustainable in the senses of social, environmental and climate impacts and the ability to, in the global scope, supply the source energy indefinitely. It is aimed at the ultimate goal of mobility, which is accessibility (Litman, 1998). In this sense it aims at improving access while simultaneously at reducing environmental and social impacts, and at managing traffic congestion, to reduce the need to travel (less trips), to encourage modal shift, to reduce trip lengths and to encourage greater efficiency in the transport system. The shift from conventional mobility to sustainable mobility involves moving from an idea of transport system performance, primarily evaluated based on speed, convenience, and affordability of motor vehicle travel (thus favouring automobile-oriented improvements) to a more comprehensive, multimodal system of evaluation that considers a range of modes, objectives, impacts and improvement options (Litman, 2013).

Another approach to overcome the conventional mobility planning has been proposed and applied. It can be defined as the "city as a place" paradigm, and has been proposed within the urban design literature and practice. According to it, the city and the transport system have to be embedded first at the small scale, looking at the quality of the urban places in small contexts. The attention here has been directed to the people and the places of the city (Gehl, 2013). The paradigm that follows the principle of New Urbanism is a set of development practices to create more attractive, efficient, and liveable communities. Accordingly, the community has to have a marked activity centre. Special attention is paid then to protecting the public realm and creating quality public spaces, including sidewalks and paths, parks, streetscapes and public buildings. This helps create more community identity and cohesion, leading to stronger and healthier communities. In synthesis, emphasis is on the creation of quality of life and urban sense of spatial definition.

Finally,a third approach has been proposed as an opposition the "conventional" mobility planning: the smart mobility approach. With this term, academic research and industrial applications refer to the potential of optimizing existing city infrastructure, services,and urban behaviour through the deployment and utilization of digital networks. The smart mobility approach, and its evolution, as described in the following section, is in fact mostly based on the application of new information technology for the innovation of transportation systems and it has been quite fashionable in urban and transport planning domains and in the policy arena in the last decade. According to some studies, the smart city and the consequent smart mobility concepts are no just limited to the diffusion of ICT, but it looks at people and community needs (Batty et al., 2012). Nevertheless, as explained in the following paragraphs, some important links with other aspects of mobility planning are still missing.

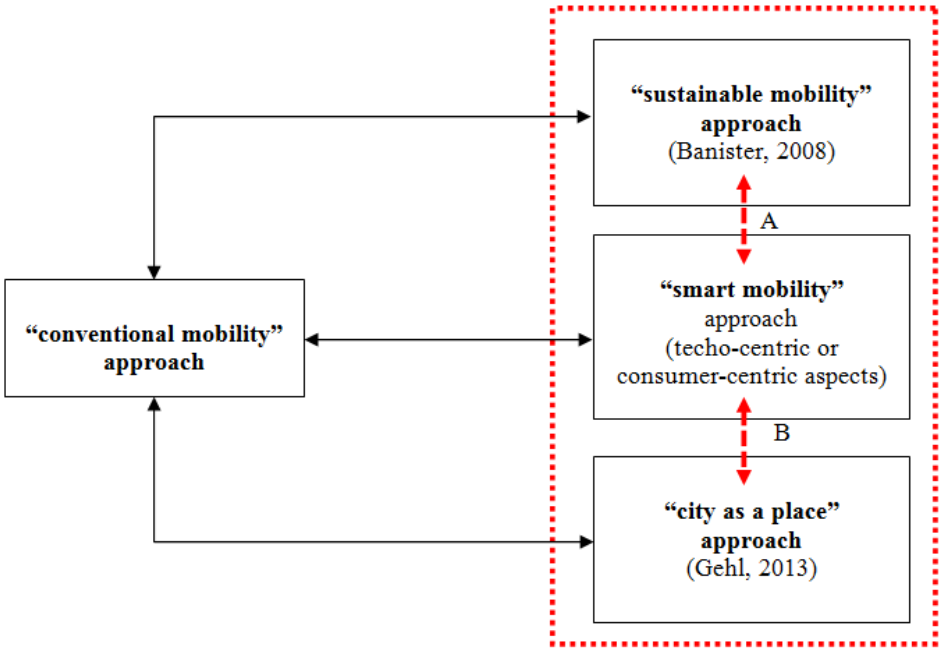

Fig. 1: The approaches on mobility planning and their missing links

Starting from the definitions of the different approacheswe want to provide insights on the weak or missing interrelations within them (Figure 1) and to analyse potential area of cross borders. Our main argument is that arrows A and B in Figure 1 that describe respectively the interrelations between smartness, sustainability and quality of places should be strengthen both in theory and in practice. In fact as stated by Lefevre, executive director of the New Cities Foundation, the smart city (and in particular the smart mobility) seems to have lost its contact with humans: "if you type smart city on your image search engine, the first human being appears on the page number eight. The first hundred or so images are sci-fi renditions of cities that will probably never exist". The same happens by searching "smart mobility" or "smart transport". In literature and in practice there is a gap between the smart approach, sustainability and quality of lifer approaches, and we argue that in most case the paradigm shift is occurring directly from the "conventional mobility" approach, towards the smart mobility one, by apply new technology to infrastructure of by spreading real time information a transport system that instead would need better other solutions. In other words, the concept of smart transport as synonymous with innovative technological or consumer-centric solutions

should goes beyond this. Technology and infrastructure are central, but they only go so far without coordinated planning and vision. Truly smart urban mobility systems leverage technology to improve quality of life and inform decision-making. Above all, these systems are socially, environmentally, and financially sustainable.Furthermore,smart strategies are not related in many cases to a more comprehensive goal of sustainability and quality of life in cities. In other terms, innovation in mobility has to include sustainability and quality of life planning goal in its applications ain practice.

In this general framework, in the following paragraphs we examine the links between the smart mobility concepts and the other described: the "conventional approach", the "sustainable mobility" approach, and the "city as a place" approach, stressing the missing crossovers in theory and practice of the three concepts. We will argue this issue with the help of practical applications of smart mobility into practice, with a specific selection of examples from the Flanders region in Belgium.

3 THE EVOLUTION OF THE SMART MOBILITY CONCEPT

The term smart or intelligent mobility appeared at the beginning of the Nineties in order to point out at a city with a mobility system more and more dependent on technology and on innovation. Within the "smart city", studies have defined it in many different ways (for a complete and updated list see Albino et al., 2015).

Despite the difficulty to account for the multiple meanings attributed to the concept and the many different approaches in current urban planning literature, we focus on two main aspects, described in the following paragraphs. The first is a "techno-centric"approach based on the application of information technology to transport infrastructure, and the second one is a "consumer-centric" approach, based on the idea of providing new mobility products for transport users, considered as consumers.

3.1 The techno-centric smart mobility

The techno-centricaspect of smart mobility is characterized by a strong emphasis on the "hardware" and, namely, on the idea that ICT infrastructure represents the keystone for building up the Smart Mobility. According to this approach, ICTs represents the keystone for building up the Smart Mobility, relate the infrastructure of smart cities to their operational functioning and planning through management, control and optimisation (domain of both large and small ICT companies).

The techno-centric approach, largely widespread in the early 2000s and mainly focused on the technological aspects, provides a vision of smartmobility as capable of maximizing its efficiency thanks to a large and widespread use of ICT. Such a vision, which has been largely sustained by multinational companies, leaders in the sector of ICT manufacturing, focuses on infrastructural innovation. The techno-centric approach is still largely widespread, but even the vice-president of CISCO has recently pointed out that something should be changed. He stated indeed: "we are crossing the threshold to put internet-based tools to work in cities (….) technological devices are merely tools that can make our life better only if they are put in the hands of users who understand and can make the most of them" (Elfrink, 2012).

We will use some examples from the Flanders context to better describe thisaspect and the applied strategies.

3.1.1 "Techno-centric smart mobility" practices in Belgium

The first example consists in the ITC traffic controller of Antwerp. The project consists in the replacement of the current systems that for 35 years have been co-ordinating the signalling and automatic braking of Antwerp's pre-metro network. The new installations will organize the flow of trams more quickly and precisely, while increasing safety by constantly checking the speed of trams and braking automatically if necessary. The main difference from the actual system is that the future technology will be able to modify traffic lights times, and thus the roads capacity in real time and will have the ability to adjust its decision-making in the case of unexpected situations. The intelligent traffic lights will also be able to inform users of the traffic that is queuing at each junction in real time.Based on optimization principle and real time information, this intelligent technology, applied in the mobility field, could be able to reduce the time wasted in traffic jams at junctions by 64%, with a consequent reduction of economic losses, emission of greenhouse gases and traffic aggression. Another aspect will be the increasing safety for cyclist and pedestrian.

Another example of the "techno-centric smart mobility" is the "smart road" and the "road network sensing", which already have some pilot applications in Flanders. The"smart road" consists in incorporating

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technologies into roads for the generation of solar energy, for improving the operation of autonomous cars, for lighting, and for monitoring the condition of the road.An application in Flanders of this strategy is the project “Vebimove”. The project started with the creation of a traffic sign database created in 2008 on the initiative of the Government of Flanders. The project usesa database to set up sustainable route navigation and mobility optimisations for Flanders. For this use the data are converted into an ITS compatible form.The aim of this route navigation is to encourage sustainable driving behaviour (safe, low consumption, etc.) and combines various ITS applications, for example astandard route navigation or a Smart Speed Control, which consists into a smart in-vehicle system, which ensures that more road users respect speed limits. Another application is dynamic route information, thanks to which the driver is advised about the optional speed or route depending on the situation along his route (e.g. when approaching a queue the system advises the driver to reduce his speed). Other examples are traffic viability criteria, which provide additional information so that the surrounding area experiences as little ‘nuisance’ as possible (e.g. advise the driver to avoid areas around schools at certain times of the day)The dynamic combination of traffic sign information with structural information can contribute to optimising traffic flow. User cases can be introduced in several industries, which may benefit the efficiency of cargo flows, distribution channels, service organisations, insurance companies, etc. (http://www.vim.be/projects).

The last example of the “techno-centric smart mobility” is the driverless car. Following the leader Netherlands industry in this sector, some first pilot example of self-driving cars are also running in Flanders. An autonomous car, also known as a driverless car, self-driving car and robotic car, is an automated or autonomous vehicle capable of fulfilling the main transportation capabilities of a traditional car.Some experiment going on in Belgium regards only some aspects of a complete driverless car, as for instance the Fully Assisted Parking Aid system led by the automotive industry who is working on a fully automated parking and charging system for electric cars. The future development of these technology applied at the individual vehicles, are based on sharing information obtained from other vehicles in the vicinity, especially information relating to traffic congestion and safety hazards. Vehicular communication systems use vehicles and roadside units as the communicating nodes in a peer-to-peer network, providing each other with information.

Some risks are referred to this aspect. By increasing the quality of driving, or the efficiency of the road systems, the car demand and use will increase as well. In other term a new possible car euphoria could spread in cities. Some disadvantage consists in the risk that they will increase car ownership and car use because it will become easier to use them and they will ultimately be more useful. This may in turn encourage urban sprawl and ultimately total private vehicle use. Others argue that it will be easier to share cars and that this will thus discourage outright ownership and decrease total usage, and make cars more efficient forms of transportation in relation to the present situation.Another issue regards the implication on sustainability and quality of places in cities. Do optimization techniques and technologies has a direct impacts on these issues? Cities that employ optimization techniques have reported improvements in energy efficiency, water use, public safety, road congestion. However, optimization has its limits. For instance, the improvement of traffic flow in most cities can approach 10% based on current Smart Cities approaches such as sensing the road network, predicting the demand, and controlling traffic signalling.

3.2 The consumer-centricsmart mobility

The consumer-centered aspectof smart mobility is characterized by a strong emphasis on the human side and it has been largely widespread in the second half of the 2000s; according to such an approach, the human component represents the crucial element for building up a smart mobility system: technologies, more and more widely available, are intended as “enabling tools”, but insufficient to make “smart” an urban context, only by themselves.In practice, this idea has been applied, by considering innovations (infrastructures, vehicle and services) at looking at people, seen as end-consumers of a service, reflecting their individual needs. Applications furthermore are aimed at again optimizing consumer’s mobility behaviour through the ITCs (behavioural aspects), but without considering other more comprehensive central goals.

In other terms, while the techno centric approach is mainly focusing on the supply side, the consumer centricfocuses on the demand side of transport system, but with the limit of looking at transport users more at consumers of a service, than as citizens.

3.2.1 "Consumer-centric smart mobility" practices in Belgium

Within this category, we can count the numerous mobility applications developed for users information, which are spreading for the data and information sharing within the mobility system users.In Flanders are in fact numerous the different software that many public or private stakeholders are designing and that are targeting to mobility.One example is the CONNECT app that offers detailed insights on multimodal mobility and travel purpose. The behavior of participants is monitored through the CONNECT smartphone app, which samples location, transport mode and purpose with control of the participant. The CONNECT web-based survey, used to broaden the reach or to approach participants which are more difficult to follow for long periods (e.g. tourism), has a user-friendly interface to quickly gain insight on people's behavior and polls not only for survey questions, but reads in actual multimodal trajectories of people in a weekly agenda (Gautama et al. 2014).Another example is the APP YOUR RATE application, that allowscollecting valuable users' assessments about home to work routes, which will be turned into maps allowing bikers to select the best route to work. This application is related to the "Bike to work", an initiative of the Fietsersbond and Cracq to support employers who wish to give their employees incentives to cycle to work, whether or not in combination with public transport or a car (http://move2.ugent.be/index.php/en/)

Another example on consumer-centric smart mobility are software could be used to increase mobility sharing, is the Velo bike sharing system in the city of Antwerp, which count more than 2000 registered users; make an extensive use of new information system. In detail, the Velo website is used to manage the registration. Further a wap cell phone application is being used for ordering day and week tickets. A digital map on the Velo website shows where operational, empty or full stations are. If a user arrives at a full station, he or she can scan their card to see where the nearest station with empty spots is located. (www.velo-antwerpen.be).

Finally, another case of consumer-centric smart mobility is the driving behaviour campaign run within the project Belgian ISA-trial (Vlassenroot et al. 2007). To analyse the impact of an eco-driving course on fuel consumption and driving behaviour a data-logging device has been developed to monitor people's driving behaviour.

Passenger cars were equipped with an on-board logging device that logged the position and speed of the vehicle by means of a GPS tracking system as well as real time electronic engine data extracted from the Controller Area Network (CAN). The CAN data included information on mileage, number of revolutions per minute, position of the accelerator pedal and instantaneous fuel consumption. Data gathered over a period of 8 to 10 months for 10 different drivers during real-life conditions enabled an individual drive style analysis.

This aspect has a stong "human" component than the previous one, as it is directly designed for the people, who are recognize to have a key role in the "functioning" of the smart city system. The problem with this aspect is the risk of a higher separation from the physical planning. Furthermore, with all this flows of information, will people be able effectly to change the quality of their travel and in general of their daily life? Will this strategies have an impacts of the transition towards a sustainable living enviroment if those are still not coordinated with urban planning and design measures?

4 TOWARDS A SMARTER MOBILITY

4.1 A smarter integrated approach for mobility

In the debate on smart cities and in detail on smart mobility, next to the attempts of definition and declination of the concept of smartness, a series of studies to formulate new approaches and methods have been conducted.

In the previous paragraphs two different aspect of the smart mobility approach have been described and what emerge in both cases is the gap between the"smartness" and sustainability and quality of life aspects. Starting from this,we here want to stress the need of a new integrated approach, characterized by an emphasis both on the quality of life that a Smart Mobility have to ensure through the integration between technological and social innovation and on the capacity of cities "to create the conditions of a continuous process of learning and innovation" (Campbell, 2012).

We refer in particolar on the definition of smart city proposed by the British Standars Institution (PAS, 2014) whichmention "an effective integration of physical, digital and human systems in the built environment to

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deliver a sustainable, prosperous and inclusive future for its citizens". In this definition three aspect are crucial:

(1) the integration between physical and digital;

(2) the focus on the local context: the smart city is not described as a "perfect" end-state for cities, taking into account the importance of the specific local context: "all cities are different: the historical, cultural, political, economic, social and demographic context for each city is different; as is the legacy of business processes and technology implementation from which it starts".

(3) the centrality of "citizen" (including residents, businesses, visitors and commuters to the city) which are not just users of services, but have a specific and active role in the transtion.

This approach combines the previous visions, looking at smart mobility as a system capable uf using ICT in an extensive and intelligent way, in order to improve the overall urban performances and, above all, the quality of life of citizens.

Among the main elements that characterize the integrated approach to the Smart Mobility, it is the awareness that enhancing through ICT the performance of individual sectors (from transport to energy, from constructions to urban safety, etc.) does not necessarily result in the building up of a smart mobilty: "a smart mobility should be viewed", indeed, "as an organic whole – as a network, as a linked system. In a smarter mobility system, attention is paid to the connections and not just to the parts" (Kanter and Litow, 2009). Furthermore, the idea that a smart mobility represents the final goal of a virtuous path – along which investments are addressed to achieve a sustainable growth, in economic and environmental terms – aimed at improving the quality of life of citizens and based on the involvement of settled communities – is currently more and more widespread.

The smart city framework (SCF) (PAS, 2014) also refers to these concepts and distils current good practices into a set of consistent and repeatable patterns that city leaders can use to help them develop and deliver their own smart city strategies. The SCF infact dedicate a specific focus on:

- make current and future citizen needs the driving force behind all city spaces and systems;
- integrate physical and digital planning;
- identify, anticipate and respond to emerging challenges in a systematic, agile and sustainable way;
- create a step-change in the capacity for joined-up delivery and innovation across organizational boundaries within the city.

As in the previous paragraphs, we decribe this integrated approach with the help of two best practices in which it is stronger the interrelation between the techology, the human, the sustainable and the quality of life aspects selecting some examples from the Belgium context.

4.1.1 "Smarter integrated mobility" practices in Belgium

A first example of a smarter and integrated approach for mobility planning is the Brussel Mobili2014 initiative. To get people dreaming about tomorrow's mobility, Brussels Mobility launched an exploratory initiative with Mobil2040, a forward-looking and multidisciplinary study undertaken by the consultancy offices Technum (Tractebel Engineering) and Espaces-Mobilités. Mobil2040 delivers a very 'refreshing' vision of mobility, with a people-first approach.The Mobil2040 vision is described through different themes. "Spaces and Places" is looking at spatial development, sharing of public space, a 'local city', car-free areas, new places for working and communicating: these are just a few of the avenues explored by Mobil2040 in terms of spaces and places.Another theme is instead focusing at "data and Information", explaining the powerful potential of data for supporting urban policies and offering users multimodal and multifunctional information.The main strength is that all the themes are strictly interrelated and the different component of smartness are connected one to the other (http://www.mobil2040.irisnet.be/en/7-themes-to-consider-the-mobility-of-the-future.html).

Lab of Troy is another example of smarter and integrated approach for mobility planning in which technology has no role, but still innovation is central in the governance process.Lab of Troy was born in Ghent and it is an independent network of collaborating citizens, businesses, governments and organizations. Lab of Troy gains practical experience and show that structural changes are possible.The Living Street is an

experiment developed by Lab of Troy in which residents take their road construction and conversion into their dream street. Together by temporary (part of) to the street was made temporally car-free and the place dedicated before to parked cars has been used as space for greenery, meeting and living together. Along with volunteers from the Lab Trojan network, inhabitants provided street furnishings, coupled with less car use, in order make life in the city more comfortable and durable. Furthermore, during the test period, to be less dependent on the car inhabitants tried alternative modes of transport, for example electric bicycle for commuting displacement, cargo bike, home delivery or shared cars. The initiative and the practical organization of the temporary living street lies primarily with enthusiastic street residents and volunteers from the Lab of Troy. They were supported by different companies and organizations that participate to the goals of the experiment. The city council and the various city services are a key partner to realize the project, and to lead in the right direction.The purpose of this experiment is to demonstrate and experience that a different approach to the street and public space is possible. An interagency working group ensures that the necessary lessons can be drawn from this experiment. Experiences that can help players regime like the city in the development of their policy frameworks around. The design of streets and parking area contribute to the transition to a climate-neutral city.The first edition of the pilot project ran from 1 June to 30 June 2013. The second edition took place in May, June, September and October 2014 (http://www.leefstraat.be).

5 FINAL THOUGHTS

The study give some insigths on the debate on the smart mobility. It provides through a set of selected applications in Belgium the evolution of the concept of smart mobility through a more techno-center towards a consumer centered one. Solutions to the mobility problem are seen in technological fixes and high tech solutions, such as alternative fuels, intelligent transport systems, integration of information and communication technologies and means of transportation etc. In the face of the outlined challenges of current mobility regimes, mobility scholars tend to see potential solutions in new technologies and their combination, e.g. smart mobilities systems.

This study argues that these solutions are not complete and that smart mobility is beyond technology or consumers. Our final thoughts are then stressing that a new concept of smart mobility is necessary that would address the positive, integrated, and sustainable future, as the one described in Figure 2(British Standard Institution, 2014).

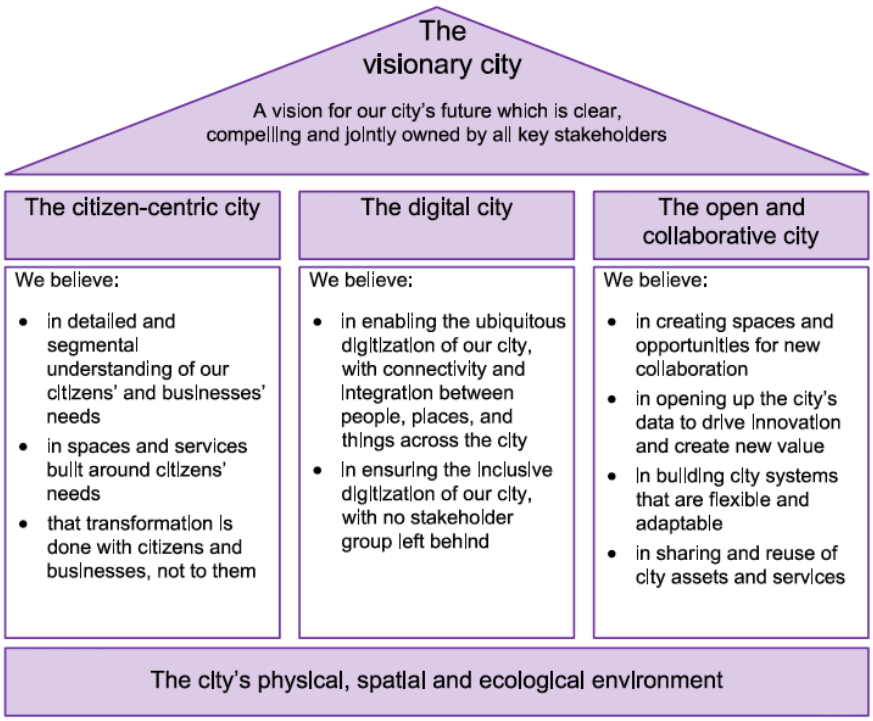

Fig. 2: The visionary city and the integration between the citizen-centric, the digital city, and the collaborative city (source: British Standard Institution, 2014)

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With regards to the goals, the new smarter approach should aim at quality of life that a Smart Mobility has to ensure through the integration between technological and social innovation (Moss Kanter and Litow, 2009) and sustainability (Banister, 2008). The new approach should develop a holistic and system-level perspective on smart sustainable cities that follow an integrative approach towards complex problems leveraging Big Data analytics and strategies related to planning, zoning, and public policy. For urban mobility are then necessary more integrated approaches that would make the best use of technology. Urban transportation requires more than technology ans a new cross-disciplinary and collaborative approach is necessary in order to support planning, transition and implementation of a 'smart mobility' for quality of life and sustainable urban mobility. The solution should extend beyond technology, but we should still value the indispensable role of it. Smart mobility should integrates technologies, systems, infrastructures, and capabilities, where this innovation is a means, not an ends. The emphasis on human infrastructure highlights social learning and education. Towards more progressive smart cities, mobility system should start with people from the human capital side. A smart mobility solution is not just about using less energy or making use of ITC, it is about being able to function as an integral part of a larger system that also regards participation, urban and space quality, human capital, education and learning in urban environments (Siegele, 2012).

With regards to the governance aspects, one key element is the interactive and participatory process to commit "citizen" and not just "users" to a "smarter" mobility paradigm. The open and active involvement of people and stakeholders would be far more effective. Thus, broad coalitions should be formed to include specialists, researchers, academics, practitioners, policy makers and activists in the related areas of technology, transport, land use, urban affairs, environment, public health, ecology, engineering, green modes and public transport. It is only when such coalitions form that a real debate, smarter mobility can take place. There must be a willingness to change and an acceptance of collective responsibility. It is crucial to create conditions for a continuous process of learning and innovation.

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