Innovations Shaping Smart Mobility. Tri-City Case Study

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Abstract

The 2020s are predicted to be a decade of transformation for urban mobility. Innovations in the transport sector continue to introduce new opportunities to enhance travel experiences in the cities. This is facilitated by business models that offer a range of new mobility services that provide flexible options to meet travel needs. Good mobility for citizens and businesses greatly increases the attractiveness and competitiveness of cities. The purpose of this paper is to explore the innovations shaping smart mobility in modern agglomerations taking as a case study Tri-City (Gdańsk-Gdynia-Sopot). A survey in the form of a questionnaire was created to study how smart mobility looks in the eyes of the local community. The study was conducted among a randomly selected group of respondents. The results provide some interesting conclusions. The Tri-City community is not fully aware of the fact that there are a lot of smart mobility solutions available within the area. The paper is based on the available literature sources and statistical data, as well as on the survey research study.

Keywords: innovations, smart & sustainable mobility, agglomerations

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Introduction

As the world rapidly urbanizes, city leaders and planners need to manage transport systems strategically, to ensure the changing needs of city dwellers are met. Thus, it is crucial to manage and plan the growth of the city supporting economic growth and competitiveness and by aiming for social cohesion and environmental sustainability (Malik and Jasinska-Biliczak 2018). While transport behaviors change, the number of vehicles on streets grows resulting in congestion, an increased number of accidents, exhaust and noise emissions and, consequently, a lowered quality of life.

The 2020s are predicted to be a decade of transformation for urban mobility. Innovations in the transport sector continue to introduce new opportunities to enhance travel experiences in cities. This is facilitated by business models that offer a range of new mobility services, such as ride hailing, car sharing, bike sharing and Netflix-like vehicle-subscription models, that provide flexible options to meet travel needs. The purpose of this paper is to investigate the innovations shaping smart mobility in modern agglomerations taking as a case study Tri-City[1]. First, the megatrends influencing the current local development, with a special emphasis on the mobility issues, have been presented. In the second part, survey research results have been analyzed in order to explore how smart mobility solutions are perceived by the local community.

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1. Tri-City is a metropolitan area in Poland consisting of three cities: Gdańsk, Gdynia and Sopot, as well as minor towns in their vicinity, situated adjacent to one other, in a row on the coast of Gdańsk Bay, Baltic Sea.

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1 Megatrends and other processes influencing the mobility in the agglomerations

In 2050 people living in cities are to constitute 2/3 (66%) of the global population. The data confirms the assumptions that contemporary cities are facing a challenge related to keeping the balance of resources and strengthening development which would improve security and the quality of life for numerous citizens.[2] In the European Union more than 60% of the population lives in urban areas. Almost 85% of European Union GDP is generated there. Cities boost the economy, attract investors, new jobs are established there; that is why cities play an important role in the economy (Jasińska-Biliczak 2014). Unfortunately, urban transport is responsible for about a quarter of CO_2 emissions from transport. The gradual phasing out of "conventionally-fueled" vehicles from the urban environment is a major contribution to significant reduction of oil dependence, greenhouse gas emissions and local air and noise pollution (Burns 2013). Fully Electric Vehicles (FEV), for public and private transport, can contribute significantly to the lowering of the current pollution levels.

The local development remains under the influence of current megatrends — economic, environmental/climate, social, technological, geopolitical — examples of their emanations are as follows:

- economic
  - sharing & digital economy
  - e-trade, consumer needs redefinition
  - new business models
  - crowdsourcing
  - uberization
  - virtual market
- ecological/climate
  - climate changes and catastrophes
  - decarbonization
  - energy storing
  - renewable energy
- social
  - migrations
  - demographic changes inequality
  - aging population
  - exclusion (including digital one)

- technological
  - cybersecurity
  - artificial intelligence
  - cloud computing
  - hydrogen economy
  - GPS
  - ITS, platooning, connected/automated vehicle, tracking&tracing, drones
- geopolitical
  - globalization
  - poverty
  - nationalism
  - terrorism

These megatrends shape today the largest changes of development factors and vehicles, determining the most important directions of their impact, changing the course of the development trajectory, including the local one, also in relation to the issue of mobility. At least six forces are expected to further disrupt the urban mobility landscape. From self-driving vehicles and the sharing economy, to vehicle electrification, mobile computing, the Internet of Things and Blockchain technologies, each of these trends is quite significant on its own (*Digital Innovations…* 2018).

The mass adoption of motor vehicles (the "automobility transition") was one of the major socio-economic transformations of the 20th century (Geels 2012). Over the 80 years in which the car has "wound itself inextricably into a large part of our affairs,"[3] (Buchanan 1963), much research has been undertaken about the evolution of the socio-technical systems that have facilitated mass car ownership, and how the economy and society have been transformed by automobility (Urry 2004, 2008), from the sheer distances travelled in everyday activities to the location of economic

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2. See: World Urbanization Prospects. The 2014 Revision. United Nations, Department of Economic and Social Affairs, Population Division, 2015, New York, (ST/ESA/SER.A/366), [@:] https://esa.un.org/unpd/wup/publications /files/wup2014-report.pdf.

3. See: Traffic in towns. A study of the long term problems of traffic in urban area. Reports of the Steering Group and Working Group appointed by the Minister of Transport by Colin Buchanan (Chairman of Working Group) and Geoffrey Crowther (Chairman of Steering Group), H.M.S.O., 1963.

activity, the operation of the housing market, the structure of retailing and differential access to educational and health opportunities. Alongside these huge gains in prosperity and quality of life, however, came the well-known negative externalities of mass car use, such as congestion, crashes, poor air quality, physical severance, social exclusion and inactivity/obesity, which the state has often struggled to manage effectively (Docherty, Marsden, and Anable 2018).

In the early 1990s the phrase "smart city" was coined to signify how urban development was turning towards technology, innovation and globalization (Schaffers et al. 2011). The World Foundation for Smart Communities advocated the use of information technology to meet the challenges of cities within a global knowledge economy. However, the more recent interest in smart cities can be attributed to the strong concern for sustainability, and to the rise of new Internet technologies, such as mobile devices (e.g., smart phones), the semantic web, cloud computing, and the Internet of Things (IoT) promoting real world user interfaces. The concept of smart cities seen from the perspective of technologies and components has some specific properties within the wider cyber, digital, smart, intelligent cities literatures. It focuses on the latest advancements in mobile and pervasive computing, wireless networks, middleware and agent technologies as they become embedded into the physical spaces of cities. The emphasis on smart embedded devices represents a distinctive characteristic of smart cities compared to intelligent cities, which create territorial innovation systems combining knowledge-intensive activities, institutions for cooperation and learning, and web-based applications of collective intelligence (Komninos 2002, 2008).

Contemporary imaginings of "Smart Mobility" describe a transition of equivalent reach and significance to that of "automobility," focusing on a range of positive changes to how we travel around. Proponents of the "Smart Transition" outline a vision of the future in which mobility will be framed as a personalized "service" available "on demand," with individuals having instant access to a seamless system of clean, green, efficient and flexible transport to meet all of their needs.[4] Accompanied by the widespread adoption of connected and automated vehicles (AVs) (Fagnant and Kockelman 2015), it is argued that the "Smart Transition" will bring huge gains in safety, and the costs of transport to the user will be lower because the capital stock of the mobility system, primarily infrastructure and vehicles, will be used much more efficiently. There will be much greater consumer choice as new models of shared ownership of mobility assets, real-time aggregation of data and peer-to-peer mobility matching reduces the grip of large monolithic providers on the supply of transport (Docherty, Marsden, and Anable 2018). Most visions of "Smart Mobility" are not blind to the role of the state, but instead see it as a relatively passive facilitator of innovation. In its review of the future market for intelligent mobility, the UK's transport innovation platform identified the role of the state in the transition as shown in table 1.

Tab. 1. Role of the state in smart mobility transition

State level	Action
National Government	• Fund research and development activities and skills development. • Focus on filling the gaps in provision of reliable, fast, and ubiquitous connectivity. • Establish a data exchange mechanism and mandate open data where appropriate (e.g., in rail franchises). • Create a central ticketing platform and multi-modal marketplace and encourage multi-modal integration to support expected advancements in dynamic pricing and timetabling. • Foster cross-industry collaboration to unlock value from Intelligent Mobility.
Local Government	• Encourage and support new business and participate in experimentation with new Intelligent Mobility solutions in private and public transport. • Shift focus towards procuring against challenges rather than procuring for solutions. • Push for integration and innovation in public transport (e.g., demand responsive services).

Source: IM Traveller Needs…, op. cit.

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4. See: IM Traveller Needs and UK Capability Study. Supporting the Realisation of Intelligent Mobility in the UK. Study by Philip Wockatz and Philipp Schartau, Transport Systems Catapult 2015, [@:] https://ts.catapult.org.uk/wp-content/uploads/2016/04/Traveller-Needs-Study-1.pdf.

There will undoubtedly be a transition to smarter mobility futures which will have a significant impact on the role of mobility in society. New actors, networks and technologies are already fundamentally challenging the extant regime and how transport is governed. This is not a debate about state versus non-state actors but instead about the role the state takes within these new networks to steer, facilitate and also reject different elements of the mobility system (Docherty, Marsden, and Anable 2018). State power in the transport domain is weak in many places, especially those such as many North American and European cities where the private car is already the overwhelmingly dominant form of mobility and in which the state has little or no existing role in the "belief system" about how mobility should be distributed beyond building as many roads as possible.

Meanwhile, planning has become an increasingly complex task, and planners (as well as policy makers) are faced with many, often contradictory demands: maintaining a high quality of life while also creating an attractive environment for businesses; restricting traffic in sensitive areas while not curbing the necessary movement of goods and people; ensuring mobility for all while being confronted with financial constraints.[5] In addition, there are wider issues to be addressed, with regards to public health, climate change, oil dependency, noise and air pollution, etc. Particularly in urban areas—centers of economic activity and home to an increasing share of Europe's population—addressing these issues is a complex matter (Przybyłowski 2018).

In order to increase participation, modernization and building infrastructure in cities are important, as well as increasing gradually the integration of all transport means and forms. At the same time campaigns and active promotions affecting the transport habits of urban traffic users are becoming increasingly important. Today much attention is paid to information policy and the improvement of an active mobility image as an important means of urban transport. There are good reasons to put mobility at the heart of Smart Cities policies:

- With Sustainable Urban Mobility Plans, Urban Mobility has the framework for integrated planning. New approaches to urban mobility planning are emerging as local authorities seek to break out of past silo approaches and develop strategies that can stimulate a shift towards cleaner and more sustainable transport modes.
- In all modes of transport, and for both transport of goods and passengers, electrification is happening. This brings—with the advantages such as clean air, energy independency, etc.—also a set of challenges (deployment of charging infrastructures, links with shared mobility).
- Urban transport is a key area for the transition towards the sharing economy. Both public (public bicycles, shared cargo-bikes, etc.) and private initiatives (ridesharing applications, car sharing, peer to peer parking apps) see the benefit of making better use of urban transport assets (Vancluysen 2016).

Also, transport is an endless source of interesting data. The traveler is becoming more and more connected. Vehicles are connected, public transport users check in and check out with smart cards, cyclists and pedestrians use apps to monitor their movement. These data are becoming increasingly available through open data portals of cities.

2 Smart mobility solutions in Tri-City—survey research results

As Tri-City residents use most often cars during daily trips, the authorities encourage them to move around the agglomeration in a more smart and sustainable mobility. They promote intermodal solutions, by building more and more parking lots for bicycles and passenger cars at railway stations, so that travelers may leave their vehicles and can switch to public transport. Public transport, cycling and walking have been promoted for several years. Moving around the agglomeration is constantly improving, also thanks to the ITS system Tristar.

The conducted research was aimed at exploring the mobility pattern of the Tri-City residents and checking whether they are aware of the existence of innovative, smart mobility solutions in the agglomeration. The study was conducted among a randomly chosen group of 100 people aged

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5. See: Quantifying the Effect of Sustainable Urban Mobility Plans. By H. Lopez-Ruiz et al., European Commission Joint Research Center, 2013, doi:10.2791/2187.

from under 18 to over 51 years, including students, workers, unemployed and retired/pensioners (Rahn 2018). The largest number of respondents have heard about the promotion of car sharing (84%), the introduction of integrated ticket tariffs in public transport (77%) and the promotion of cycling (73%). The option regarding the metropolitan ticket has been the most popular among people using public transport. Few respondents have heard about the plans to implement projects popularizing pedestrian traffic, because 65% indicated a negative response and 54% when it comes to integrated traffic system implementation. More than half of respondents have heard about intermodal solutions, such as Park & Ride and Bike & Ride, which indicates that their awareness concerning this issue is growing (fig. 1).

Despite the fact that the Tri-City area is largely covered by Traficar car-sharing system, 61% of the surveyed population have never used this form of mobility (fig. 2). People who have had this opportunity are 18–36 years old and most of them are working or studying. This may be due to the fact that Tri-City society is considered to be aging and most people have not even heard about such methods of traveling. Very few people use intermodal travel solutions. People who indicated that they move mainly by car as a driver, prefer reaching directly their destination, rather than switching to public transport and thus using the Park & Ride system (Rahn 2018).

Nowadays, there is an increasing number of smartphone applications that are to facilitate everyday life. In Tri-City, it is also possible to use such solutions, because several applications are available in this area, including four that are to help move people. One of them is KomPas: the user can find the current agglomeration train (SKM) timetable or receive messages regarding possible delays or obstacles on the tracks. These applications can be classified as innovations that can be included in the concept of smart mobility. The older people participating in the research study indicated that they have never heard of such solutions. People using their own cars usually use the City Park App as a helpful solution, because it makes it easier to pay for parking, without the necessity to search for a parking machine. However, the most popular application is Jakdojade.pl, because 38% of respondents consider it to be helpful and 36% think it is even very helpful (fig. 3).
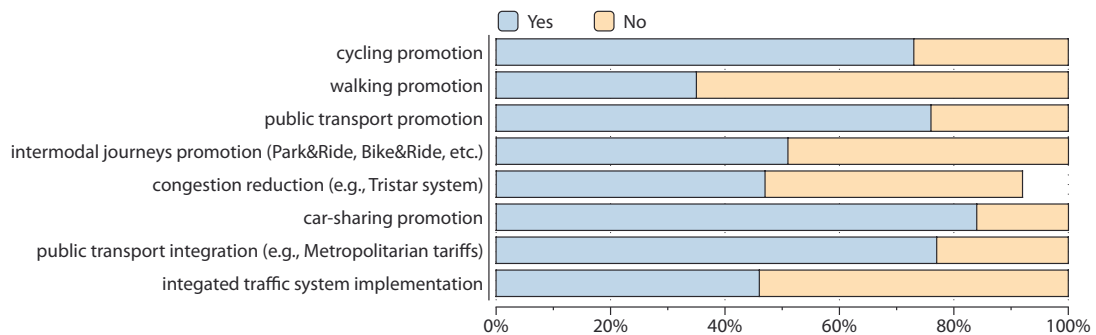

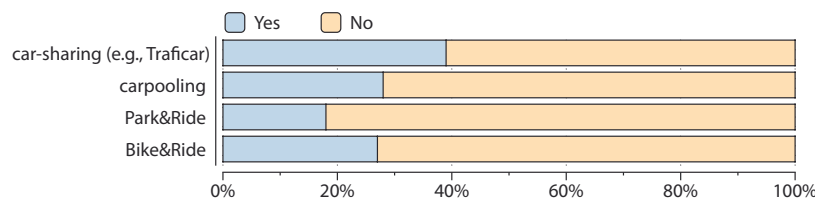**Fig. 1.** Awareness regarding smart mobility projects implemented in the Tri-City

Fig. 2. Tri-City resident preferences regarding the innovative forms of mobility
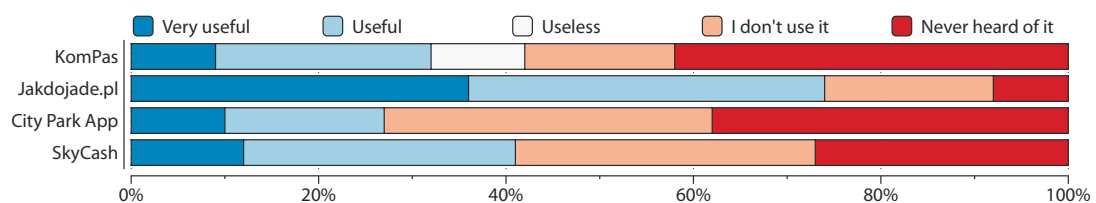

Fig. 3. Mobile applications evaluation related to mobility in Tri-City

An additional advantage of this application is that it can also be used in other Polish cities. The KomPas application is the poorest in the eyes of the respondents — only 9% consider it to be very helpful and 23% as helpful. KomPas was the only application where respondents marked the answer "useless" (10%).

The results clearly show that the Tri-City community is not fully aware of the fact that there are a lot of smart mobility solutions available within the Tri-City. This may be due to the fact that this area is inhabited by an aging society that does not know about or use mobile applications facilitating mobility around the agglomeration.

Conclusions

Smart and sustainable urban development is the current priority. The contribution of this paper consists of presenting the importance of smart mobility solutions that are in fact crucial for facing current urban transition. When analyzing the results of the conducted study, it can be concluded that despite the fact that the Tri-City is moving in the right direction, when it comes to smart mobility, there are still many challenges to face in this field. In the Tri-City area, there are many available tools that shape smart mobility in practice. City authorities are increasingly promoting various types of actions, but despite the growing awareness of residents regarding, among others, travelling by other means of transport than a car, the share of the latter is unfortunately constantly increasing. Initiatives taken in favor of urban mobility may help in shaping the future of the contemporary society, putting the main focus on the citizens' needs and the principle of sustainable development. Best practices implemented already in many western European cities can be a good guidance for smart mobility scenarios in Polish agglomerations. These actions aim at focusing citizens' attention on the need to improve air quality, decrease congestion in the city's main streets, and invest in one's health and physical condition, which increases the level of quality of life, and in turn provides the city with considerable economic benefits.

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