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**CONTEMPORARY SOLUTIONS FOR CITY LOGISTICS
- A CASE STUDY ON TRANSPORT IN POZNAN**

ABSTRACT

Background: One of the paradigms of contemporary management is sustainability – striving for balanced economy and respecting ecological and societal aspects. Sustainability is included in strategies of individual companies, regions and countries. The following paper presents implementation of sustainable approach to city logistics by promoting resources (means of transport) sharing to decrease congestion and pollution. The goal of the research was to present the potential of contemporary solutions for individual transport in the cities based on Poznan example. The range of solutions is introduced, the level of their implementation is identified. The results of the research are presented and discuss to show growing importance of shared mobilities for population of large cities.

Methods: The research methodology benefits from different perspectives, it encompasses the perspectives of stakeholders involved in the transportation process. The stakeholders are identified as users of shared means of transport and providers of shared mobility services. The methods used include the two-stages survey conducted among potential and actual users of shared means of transport and the interview conducted with representatives of companies providing shared mobility services. The results of the survey and interviews are used to characterize the shared mobility market in Poznan.

Results: The results of the research can be used by decision makers to decide on further development of the solutions aforementioned. Entrepreneurs can use the results of the research to enter the market of shared mobility providers or adjust their offer to requirements and expectations of clients. Authorities of cities willing to introduce or expand their offer in the shared mobility area can benefit from benchmarking the solutions presented.

Conclusions: The research was recognize the phenomena of growing popularity of shared mobility solutions in cities, find its drivers and potential drawbacks. The phenomena was described, however the research presented had limited range and scope and can be the motivation for formulating research questions concerning detailed and systematic presentation of shared mobility aspects.

Keywords: city logistics, individual transport, smart city, shared mobility

INTRODUCTION

According to Merriam-Webster dictionary, a city is „an inhabited place; a place larger than a village or town: a large, prominent or important center of population: a relatively permanent and highly organized center having a population with varied skills, lacking self-sufficiency in the production of food, and usually depending on manufacture and commerce to satisfy the needs of its inhabitants.” There are many definitions of the city, showing its multi-faceted character, including the one by United Nations [UN 2012], presenting two perspectives:

- detailed level/urban agglomeration: “population contained within the contours of contiguous territory inhabited at urban levels of residential density”
- extensive level/metropolitan region: “includes both the urban agglomeration and additional surrounding areas of lower settlement density that are also under the direct influence of the city”;

and the one by OECD [Dijkstra, Poelman, 2012], stressing dynamics of city development, according to the scheme:

1. Selecting all grid cells exceeding 1500 people/km² (1000 in the US and Canada) (ignoring administrative borders).
2. Clustering of bordering HD cells and defining ‘urban centre’ as clusters containing at least 50 000 inhabitants.
3. Incorporating municipalities (Eurostat’s local administrative level 2) with 50% of their population within the urban centre into communes.
4. Urban Audit Cities - only for European cities: considering political links, confirming that $\geq 50\%$ of inhabitants live in the urban centre and $\geq 75\%$ of inhabitants of the urban centre live in the (Urban Audit) city.

All the definitions of the city refer to its complexity and its interpretation as the system in which elements of various character are linked. The link is physically realized by transport operations enabling city inhabitants reaching facilities in which they learn, study, work, entertain or benefit from multiple services (healthcare, administration and others). The way city transport is organized strongly influences well-being of individual city inhabitants and overall city performance [Browne et al. 2013]. Public transport (also known as public transportation, public transit, or mass transit) is defined as transport of passengers by transport operators (public or private) available for use by the general public, typically managed on a schedule, operated on established routes, and that charge a posted fee for each trip [White P. 2016, Taniguchi et al. 2013]. Public transport usually relies on subway systems, buses, trams, nevertheless there are also specific solutions (such as water trams) used in the cities as well. Public transport is an alternative for individual transport, realized by individual city inhabitants with their own means of transport.

The higher population density in city, the more transport operations are performed leading to increased traffic, congestion, air pollution and noise which negatively affect comfort of living in the city. To minimize these negative phenomena city authorities strive for implementation of organizational solutions (limiting speed in the city centers, limiting available parking spaces, introducing fees for entering city centers and many others) and technical solutions (f.ex. buses with electric or hybrid engines). Some of the solutions listed are perceived as limiting transport opportunities and accessibility of city space. The authors believe that the idea of shared mobility is a complementary strategy for cities consistent with sustainability paradigm, providing individual mobility, accessibility without destroying ecological balance of city ecosystem. Hence, shared mobility meets the sustainability goal, resulting in minimization of air pollution, traffic, congestion and noise and in the same time providing accessibility of destinations and flexibility.

Considering potential benefits emerging from shared mobility implementation, the research question for the paper was: Is shared mobility the solution well-recognized among city inhabitants? To answer the question the idea of shared mobility was introduced and the research on recognition and acceptance of shared mobility in Poznan was carried. The research results were introduced to prove that shared mobility has a potential to support implementation of sustainability paradigm in cities by reducing traffic and consequently, pollution, promoting healthy lifestyle and eco-attitude.

SHARED MOBILITY CONCEPT

Although the beginnings of the idea of shared mobility can be traced back to the period after World War II [Hamari et al. 2015, Matzler et al. 2015], its greatest growth has been noticeable since the 1990s due to the growing importance of environmental issues and development of information technology, in particular the Internet, websites and mobile technology [Nelson and Shaheen 2016]. It is thanks to devices that facilitate the flow of information in the form of smartphones, tablets or laptops connected to the Internet that people around the world have started using services that allow shared mobility in a transport context [Cohen-Blankshtaina and Rotem-Mindalib 2015]. Shared mobility is a very comprehensive concept, taking into account the variety of services that fall under it [Nelson and Shaheen, 2016, Pfrommer et al. 2014], as presented in the Figure 1. Shared mobility includes the idea of Sharing a Vehicle, and Sharing a Passenger Ride. Sharing a Vehicle should be understood as sharing vehicles that are not owned by any user. Among the shared vehicles the following can be distinguished: cars (Car sharing), motorbikes (Motorcycle sharing), scooters (Scooter sharing) and bicycles (Bike sharing). In the Sharing a Passenger Ride, three subgroups can be distinguished: organization of joint journeys between drivers and passengers traveling in the same direction (Ridesharing), which depending on the type of vehicle is called Carpooling or Vanpooling, organization of services on demand (On - Demand Ride Services) and organization of commuting to people living in cities to workplaces located in suburban areas, as well as to people living in suburban areas commuting to work in the city center (called Microtransit). Among the on-demand services, service connecting drivers through mobile devices that make available seats in their private car to passengers traveling in the same direction (Ridesourcing), a service that allows passengers traveling in the same direction to travel together and share the fees (Ridesplitting), and a taxi service which, unlike other on-demand services, uses taxis instead of private cars (E-hail) can be distinguished [Jina et al. 2018].

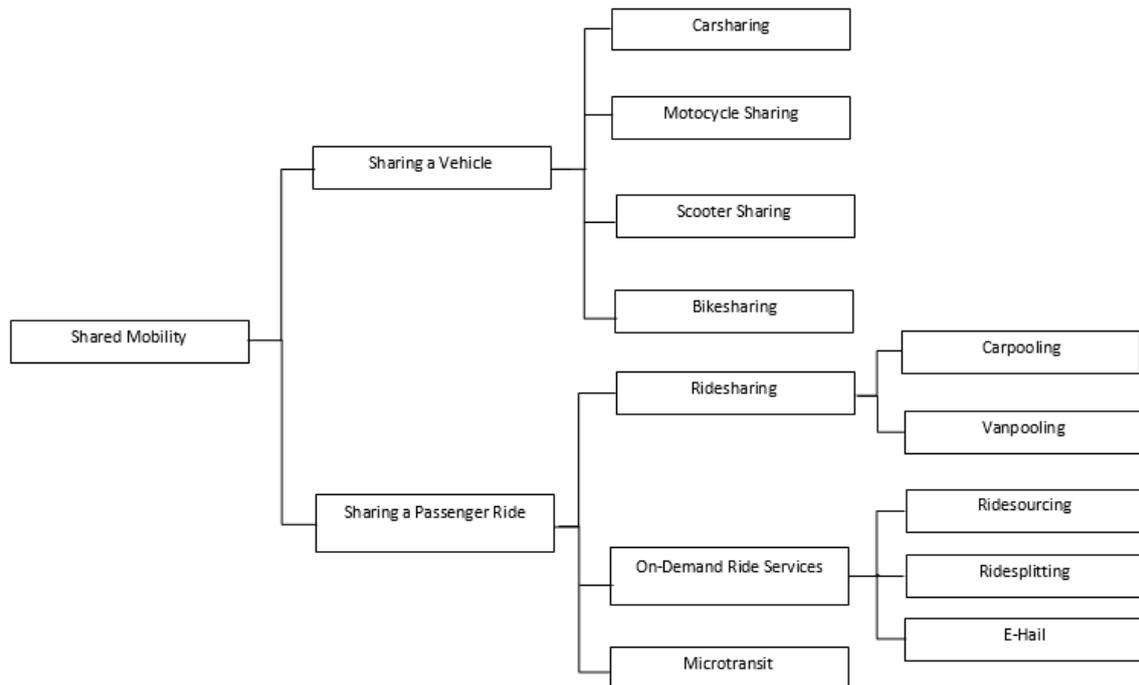


Fig. 1. Shared mobility aspects

Source: [Jina et al., 2018]

Shared mobility options and implementation are presented and discussed in the next chapter on the example of city of Poznan.

RESEARCH BACKGROUND AND METHODOLOGY

Poznań is among the oldest and largest cities in Poland. The city's population is over 500 thousand people, but conurbation with Poznań County and several other communities is inhabited by almost 1.1 million people. The Poznań Metropolitan Area (PMA) is inhabited by 1.3–1.4 million people and extends to such satellite towns as Nowy Tomyśl, Gniezno and Września, making it the fourth largest metropolitan area in Poland [Local data bank, 2019], and perfect object of the research. The research was designed to recognize perception of shared mobility by its stakeholders in Poznan. There were the following groups of stakeholders identified:

- city authorities,
- shared mobility providers,
- city inhabitants.

City authorities in Poznan strive to limit congestion and pollution by using numerous organizational solutions to decrease number of vehicles in the city, especially in the city center. They support public transport and are open to implementation of shared mobility options. Poznan was one of the first cities in Poland benefiting from shared bicycles and scooters.

Shared mobility providers entered Poznan with their solution, expecting profits from their business activity. They were asked mostly about the current status and potential of shared mobility from business perspective.

City inhabitants were asked on their recognition and opinion on shared mobility.

There were three research stages. The first was recognition of shared mobility options in Poznan. The results were used to design the second and the third stage of the research.

The second stage was the assessment of the use of shared mobility options in the Poznań city system was performed with survey among city residents. The survey was carried out from January 4, 2019 to February 10, 2019 in two forms: paper and electronic, to reach the expected number of respondents. The paper questionnaires were addressed to primary and secondary school students as well as members of Poznań senior clubs. The electronic form of the surveys was designed for students and working people. The survey was developed with the Interaktywnie.com platform, which enabled sharing of survey sheets on social networks and online forums.

The survey was conducted on a group of 360 people living in Poznań. 144 people responded electronic surveys and 216 people completed paper sheets. When determining the research sample, tools from the scientist.org site were used, which made it possible to identify a representative group, reflecting the real degree of use of alternative forms of communication. The respondents were divided into 7 age groups: 0 - 16 - elementary school students, 17 - 20 - high school students, 21 - 26 – university students, 27 - 35 - doctoral students and working people, 36 - 45 and 46 - 65 – working people, as well as the age range over 65 - retirees.

The survey consisted of 16 questions, including 15 closed questions and 1 open question. The first question concerned the use of alternative forms of public transport, i.e. cars for minutes, city bikes, city scooters and electric scooters (identified in preliminary shared mobility market analysis). This question allowed identifying people who actually have ever used at least one of the above-mentioned forms of communication to whom the remaining questions from the survey were addressed. The respondents who have never had the opportunity to use any form of shared mobility were asked to specify the reason, as well as to indicate the age range and gender. Other questions were addressed to people using alternative forms of communication.

The third stage of the research included interviews carried with representatives of companies providing shared mobility services. They were asked to characterize their business and its dynamics, to identify potential of shared mobility and its growth. Companies providing different services were interviewed, including car-sharing, bike-sharing and scooter-sharing services providers. Public transport companies were not interviewed, however reports and research on

customer satisfaction were analyzed. Poznań has an extensive public transport system, widely used and appreciated by commuters (opinion based on Raport on client of public transportation services satisfaction report), consisting of buses (both urban and suburban) and trams, including Poznań Fast Tram system, and both urban and suburban buses. The main railway station is Poznań Central Station. Railway transport supports commuters inhabiting the metropolitan area.

ETHICAL ISSUES

Before completing the questionnaire and starting the interview, all respondents were informed that the results of the research would only be used to assess the current degree of use of alternative forms of communication. It should also be added that before starting the survey, none of the respondents had contact with the questions contained in the survey.

RESEARCH RESULTS

The research results of the survey prove that city inhabitants are familiar with shared mobility options and use them:

- City bikes are the most popular among the respondents, used by 55% of the respondents, the second most popular vehicle are cars for minutes, which are rented by 48% of the respondents, the least popular are electric scooters and electric scooters used by 28% of the respondents.

The reasons for not benefiting from shared mobility (its drawbacks) are easy to overcome:

- The most common reason for not using alternative forms of communication is the loss of time to locate, rent and return shared vehicles, high rental costs for cars for minutes and electric scooters, as well as low technical condition of bikes and frequent breakdowns,

Generally, shared mobility users are satisfied with the services provided:

- Most respondents positively assess the use of alternative forms of communication (cars per minute - 49% of respondents are rather satisfied and 34% definitely satisfied, city bikes 54% of respondents are rather satisfied and 27% definitely satisfied, as far as city scooters are concerned, as many as 49% said that they are rather satisfied, while in relation to electric scooters 39% of respondents are rather satisfied and 26% are definitely satisfied),
- Most respondents (39%) said that the availability of city bikes at stations is high, however, it is worth noting that slightly less, because 31% of respondents had difficulty assessing the availability of vehicles,

- Respondents are largely satisfied with the applications needed to use alternative forms of communication (49% for cars per minute, 52% for city scooters and 46% for electric scooters,
- 46% of respondents rate the ease of finding cars by minute at a very high level, while in the case of electric scooters and scooters this factor is rated at a good level by 43% and 44% of respondents,
- The technical condition of the car for minutes is assessed by the majority of respondents (48%) at a very high level, the most numerous group of respondents (34%) assess the technical condition of the bikes as low, but it is worth noting that slightly less, because 28% of respondents have difficulty assessing technical condition, while a significant proportion of respondents (53% - city scooters and 49% - electric scooters) assess the technical condition of vehicles as high,

The most important reasons for using shared mobility options (its drivers) are the cost and convenience, as their users do not have to own their own means of transport:

- In the case of cars for minutes, it is difficult to clearly determine the assessment of the costs arising from the use of this type of vehicles, most often respondents (27%) of the respondents stated that the costs are low, but slightly less, because 25% of survey participants said that they believe the costs are high and 18% said that the costs are moderate, it follows that the respondents' opinions are very divided,
- Many respondents (43%) assessed the cost of using city bikes as very low, and 27% as low,
- Most respondents assess the costs of using city scooters (28% - as very high and 27% - as high), but it is worth noting that for 24% the costs are moderate,
- Mostly respondents stated that the costs of using electric scooters are very high - 41% and high - 29%,
- Among the most practical benefits of renting cars for minutes were: no need to own a car - 70% and driving comfort - 52%,
- According to respondents, the most practical benefits of using city bikes are: free 20 minutes of use, and for PEKA card users 30 minutes (78%), availability of the service in the evening and night (52%). According to the respondents (9%), the least practical benefit turned out to be the availability of different models of bicycles, this is due to the fact that most often students and people who do not have children use bikes,

- No need to own a scooter - 63%, the ability to leave the scooter anywhere (with respect to law restrictions) - 56%, and no need to have a driving license (in the case of an electric scooter) - 49% are the most practical benefits of using city scooters,
- The possibility of leaving the scooter anywhere (of course legally allowed), the availability of electric scooters throughout the year, as well as environmental protection are the most practical benefits of renting an electric scooter according to 53%, 50% and 48% of respondents,

What seems interesting is that respondents do not stress ecological aspects of shared mobility, even though the authors believe that contribution of shared mobility to pollution decrease and traffic limitation is significant.

Presenting the results from interviews and secondary data sources analysis on several companies providing shared mobility services in Poznan provides additional perspective to the results of the survey.

- The data obtained from Click2go (shared cars) shows that the largest percentage of users, as much as 70% are people between 18 and 34 years of age. People who rent cars are mainly men - 65%. At the end of 2018, the company recorded 290 trips each day. Usually, the average length of trip by shared car lasted 15 minutes. In addition, the available data shows that cars are most often rented in the mornings and afternoons, constituting 37% and 32% of all rentals respectively. The least frequently rented cars are between 10 and 15, which is when most people are at work, at school or at the university. These vehicles are also of little interest after 8pm. These differences between interest in vehicles at particular times of the day may be due to the fact that, as Click2go recalls, vehicles are mainly used during commutes and on the way home from work.
- Every year Poznań City Bicycles are becoming more and more popular according to the statistics on the website. The 2017 season lasted 9 and a half months (from March to mid December), while in the 2018 season the vehicles were available for rent from March to the end of November. In 2017, vehicles were rented 11,058,000 times, and in the following season the number increased to 1.65 million trips. Comparing both seasons, you can also notice an increase in users compared to the previous year. At the end of 2017, 100,000 users used the application. users, and a year later the number increased to 150,000. City bikes were usually used for short journeys of 16 minutes and 14 seconds on average.
- Compared to the alternative forms of transport discussed above, electric scooters Blinkee.city are not so popular. The summary of the season, which ended on November 28, 2018 carried out by Blinkee.city shows that the average time of vehicle use by Poznań

residents is 12 minutes. In total, the inhabitants of Poznań traveled 248,180 km, renting scooters 42,643 times.

It should be noted that data collected by companies providing shared mobility services include a broader group of people, and also usually pay attention to issues that were not addressed in the survey.

CONCLUSIVE REMARKS

In this paper research results were obtained with analysis of responses by survey and interview respondents. Most importantly they show that shared mobility is the solution more and more often used by city inhabitants as they see the potential it offers in terms of travel speed, cost, availability of destination spot. That proves that shared mobility already plays an important role, though as mentioned before it is not commonly perceived as supporting sustainability of cities (not among the users, however, city authorities see the potential of shared mobility in this context). Shared mobility is trendy, especially among young people, which proves their social and ecological awareness. Using shared bicycles not only contributes to general improvement of condition of city ecosystem (which is also the benefit from using electric cars and scooters) but also improves overall fitness of individual users [Nieuwenhuijsen et al. 2018], making it even more sustainable as social perspective is included. Shared mobility is complementary to organizational solutions used by city authorities to decrease traffic such as limiting parking zones, introducing high parking fees and fees for city entrance. Shared mobility contributes to decreased car traffic by using alternative means of transport and, consequently it limits congestion, however the research conducted does not precisely answer to question to which extent. That aspect could be the reason for further research by authors and would certainly add a quantitative perspective to the qualitative description of the phenomena offered by the hereby paper.

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