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MODELS OF SHARED MOBILITY IN THE SILESIAN-ZAGŁĘBIE METROPOLIS – RESEARCH RESULTS

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Purpose: The article focuses on understanding the complexity of shared mobility activities, using a variety of perspectives and insights provided by existing publications and citizen opinions.
Design/methodology/approach: In article an attempt is made to examine the opinions of residents of the Upper Silesian Metropolis on shared mobility models, their use and limitations (survey research).
Findings: In this paper, we show the Upper Silesian Metropolis (GZM) are implementing various actions in line with the latest global trends, introducing a number of changes in urban mobility. They are mainly based on the promotion of the concept of sharing public transport services. The presented paper is an attempt to look at shared mobility from the perspective of the beneficiary/stakeholder, i.e., a person who uses shared mobility models.
Practical implications: The results of the conducted research indicate that despite many undertaken activities bringing positive effects, the Metropolis still faces many challenges identified as limitations in the use of urban mobility.
Social implications: The article identyfies the limitations of using shared mobility, and the proposal of GZM residents can be used to improve existing solutions and develop cities.
Originality/value: The publication of research results may constitute valuable material for the future activities in the field of promoting the idea of sustainable development in cities. Shows, how it transforms traditional urban transport because it has the potential to move towards social, environmental and economic efficiency through the use of technology, which enables the transition to a climate-neutral economy and zero-emission transport a may constitute valuable material for city authorities for future decision-making processes.
Keywords: shared mobility, metropolis, city logistics, city bike, e-scooters, carsharing.
Category of the paper: Research paper, Case study.

1. Introduction

More than 70% of EU citizens live in urban areas, which generate 23% of all greenhouse gas emissions from transport. Therefore, in recent years, several initiatives have been undertaken to change this unfavorable trend. Cities are taking a number of actions in line with the latest global trends, introducing a number of changes. They are mainly based on the dissemination of the concept of sharing public transport services. They are based on three pillars, i.e., sharing economy, urban mobility and ecology, while determining a new area called shared mobility. Activities implemented in this area are related, on the one hand, to mobility in cities (paying attention to air pollution, congestion, accessibility, safety), and on the other hand, to promoting an increase in the share of sustainable means of transport (public transport, active mobility).

It is observed that shared mobility has recently become a very popular issue. Interest in the issue of shared mobility has intensified over the last decate- approximately 5.2 thousand papers have been published. Scientific works in this field, most of them concerned social sciences, economics and management. There have been many domestic and foreign publications (Wright, 2021; Benevolo, 2016; Le Vine, 2015; Raviv, 2016), in which different authors and decision – makers present different approaches to the term shared mobility itself, its advantages and disadvantages.

Nevertheless, the most frequently undertaken problems include urban mobility (Kiba-Janiak, Witkowski, 2019), the impact of the urban mobility managemet tools used on environmental efficiency (Arsenio, Martens, 2016; Pisoni, Christidis, 2019), the role of public transport in balancing urban mobility (Snatos, Behrendt, 2010), smart city solutions (Lyons, 2018).

Previous publications present the tasks of shared mobility from the point of view of cities and the successes of their rulers. However, there are no publications that discuss the issues of shared mobility from the point of view of the end user – beneficiary, thus revealing a research gap.

Therefore, the article consciously ignores broad theoretical considerations on shared mobility (Płaczek, 2023), focusing on an attempt to examine opinions of residents on shared mobility models in the Silesian-Zagłębie Metropolis (GZM). For this purpose, the following research questions are formulated:

- what is the knowledge of shared mobility models among GZM residents,
- what limits the use of SM,
- what activities would encourage the use of SM.

The conclusions draw from the research may constitute valuable material for future decision – making processes, showing beneficiaries, ond the one hand, that for cities shared mobility is a real alternative to reducing social and environmental costs and improving the quality of life,

and on the other hand, that their opinions adg suddestions for implements are valid and are implemented.

2. Shared mobility

In the literature, there is not a single, universal definition of shared mobility (SM). In English it is called Sharing Mobility or Shared Mobility. In foreign literature it is defined as sharing (shared use of) a vehicle, bicycle or other means of transport. The UK government defines SM as a model that is based on shared ownership or use of a vehicle enabled by digital platforms (Wright, Castellanos, Grant-Muller, 2021, p. 326). On the other hand, the American organization SAE International describes it as the shared use of a vehicle, motorcycle, scooter, bicycle or other means of transport, providing short-term access to them when required (Wright, Castellanos, Grant-Muller, 2021, p. 326). It is more difficult to find a definition of shared mobility in Polish literature. Polish authors refer to Swedish researchers B. Nansubug and Ch. Kowalkowski. They describe shared mobility as a system based on the shared use of means of transport by passengers in order to meet temporary transport needs without transferring ownership right from the service provider to the customer (Kuźma, Połom, Żukowska, 2022, p. 8). Just like the SAE organization, they emphasize the short-term nature of the SM service. In practice, shared mobility means the shared use of vehicles such as bicycles, scooters, cars, scooters, etc. It is perceived as an innovative transport strategy that provides users with short-term access to a means of transport without the need to own a vehicle (Saheen et al., 2016, p. 120).

Shared mobility is often incorrectly replaced by the term shared transport. Transport means the movement of people, goods or information from point A to point B (Kumemer, 2023, p. 36). The word mobility is a broader concept. It is related to movement, i.e., travelling (Szołtysek, 2011, p. 5). Three types of mobility are identified: virtual mobility (e.g., telework), social mobility (e.g., promotion or social degradation) and spatial mobility, i.e., physical movement (Ciastoń-Ciulkin, 2016, p. 4). Spatial mobility is about reaching a specific destination using various available resources, which is why it is characterized by high multimodality. To meet the diverse needs of users, shared mobility includes various models of transport-related services. Fig. 1 shows examples of services provided as part of shared mobility.

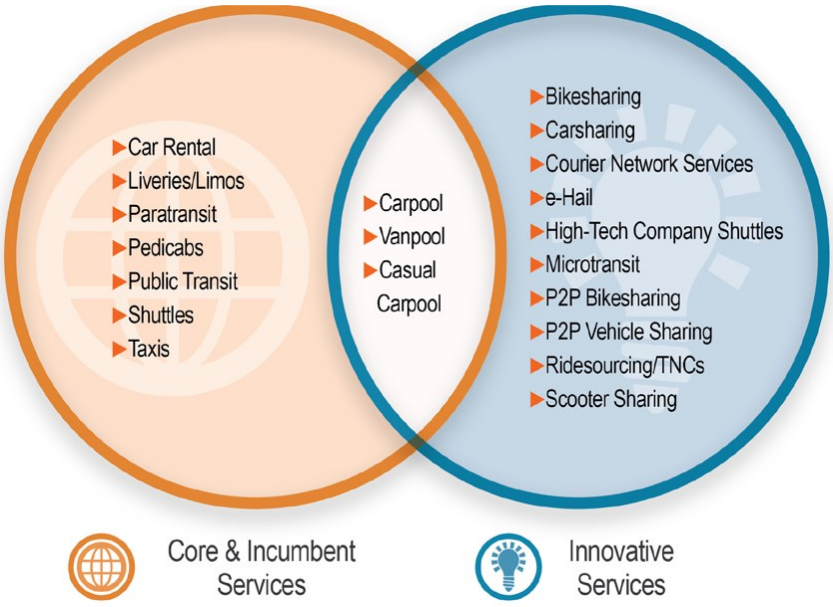

Figure 1. Services provided as part of shared mobility.

Source: Shaheen, Cohen, Zohdy, 2016, p. 10.

Traditional models of shared mobility include taxis, limousines, stationary car rental companies and public transport. With the development of technology, new innovative services have emerged, including micromobility: non-station (or area) carsharing, city bikes, a system of urban electric scooters, e-hail and ridesourcing. B2C and B2B models prevail in shared mobility, where companies provide vehicles to consumers and companies for a specified period of time for a fee.

Generally, services provided within shared mobility can be divided into five groups: 1) membership-based self-service models, 2) P2P self-service models, 3) non-membership self-service models, 4) for-hire service models, and 5) mass transit systems (Table 1). Sequential models (used by one user and then another, e.g., bikesharing and carsharing) and concurrent models (shared by many people at the same time, e.g., microtransit, carpooling, ridesplitting) are also distinguished among shared services (Transportation Research Board, 2015).

Table 1.
Models of shared mobility services

Shared Mobility Service Models				
Membership-Based Self-Service Models	Peer-to-Peer Self-Service Models	Non-Membership Self-Service Models	For-Hire Service Models	Mass Transit Systems
• Bikesharing • Carsharing • Carpooling • On-Demand Ridesharing • Scooter Sharing • Vanpooling	• Bikesharing • Carsharing	• Bikesharing • Car Rental • Casual Carpooling	• Courier Network Sevices (CNS) • Liveries/Limousines/ Pedicabs • Ridesourcing/TNCs • Taxis/E-Hail	• Public Trans-Portation • Micro and Alternative Transit Services (including Microtransit, Paratransit, and Shuttles)

Source: Shaheen, Cohen, Zohdy, 2016, p .10.

Shared mobility is changing our thinking in a tangible way. Shared mobility service models enable efficient movement around the city; they constitute an alternative to private vehicles, reduce the problem of traffic jams and lack of parking spaces, while being an attractive complement to public transport. The advantages of shared mobility determine its main goal, which is to implement the assumptions of sustainable development, i.e., reducing road congestion, air pollution, noise and improving the quality of urban spaces, limiting the space occupied by private cars on the one hand, and creating transport systems that meet the needs of all users on the other hand (Wright et al., 2021, p. 327). The continued use of vehicles that pollute the environment such as carpooling and carsharing is a negative aspect of shared mobility forms. The convenience and flexibility of these forms increases the risk that travelers will more often use these means of transport instead of choosing more environmentally friendly public transport, walking or cycling.

It is certain that the development of the idea of shared mobility, in all its forms, will finally result in a decrease in the number of cars, a decrease in emissions of harmful exhaust fumes and a significant decrease in traffic intensity in city centers.

3. Towards the Metropolis

The first step to creating the Metropolis was the creation of the Upper Silesian Metropolitan in 2006, which included the fourteen largest cities of the Silesian conurbation (https://metropoliagzm.pl/). On July 1, 2017, the association was transformed into the Upper Silesian-Zagłębie Metropolis. It became fully operational on January 1, 2018 (Zuzańska-Żyśko, Sitek, 2018, p. 68). GZM covers an area of 2553 km^2 (approximately 21% of the area of the Silesian Voivodeship. The seat and centra center of GZM is Katowice, because it is characterized by the highest concentration of metropolitan functions and has a strong position as an economic and cultural center (Dz.U. 2022, poz 1709). The executive body of GZM is the Metropolis Management Board. The area of agglomeration is distinguished in the Silesian Voivodeship by its high population density, development intensity, extensive road infrastructure network, public transport connections and large daily migration of residents between the cities of the agglomeration (Dolnicki, Majchaj, 2017, p. 75). GZM currently consists of forty – one communes, inluding:

- 13 cities with county rights: Katowice, Mysłowice, Tychy, Sosnowiec, Dąbrowa Górnicza, Ruda Śląska, Świętochłowice, Chorzów, Siemianowice Śląskie, Piekary Śląskie, Bytom, Zabrze, Gliwice,
- 13 urban communes: Mikołów, Łaziska Górne, Knurów, Imielin, Lędziny, Bieruń, Pyskowice, Czeladź, Będzin, Sławków, Wojkowice, Radzionków, Tarnowskie Góry,
- 2 urban – rural communes: Sośnicowice, Siewierz,

- 13 rural communes: Rudziniec, Pilchowice, Gierałtowice, Wyry, Kobiór, Bojszowy, Chełm Śląski, Psary, Bobrowniki, Mierzęcice, Ożarowice, Świerklaniec, Zbrosławice (http://infogzm).

Conventionally, GZM is divided into five subregions: Bytom, Gliwice, Katowice, Sosnowiec and Tychy.

The Metropolis undertakes many initiatives to improve transport and the mobility of residents within the GZM area. In 2021, it published the „Sustainable public transport plan for the area of the Upper Silesian-Zagłębie Metropolis and the communes with which an agreement was concluded on entrusting the Upper Silesian-Zagłębie Metropolis, with the municipalities` own task, i.e. acting as an organizer of public collective transport" in which it presented the directions and goals development of public transport and mobility policy, including shared mobility (https://bip.metropoliagzm.pl) and the document „Good Mobility". Both studies were intermediate stages in the creation of the „ Sustainable Urban Mobility Plan" (SUMP) of GZM. The aim of the mobility plan was to present proposals for actions, investments and modifications that could improve the mobility of residents so that they would waste less time commuting (https://www.metropoliaztm.pl). Unlike a transport plan, an urban mobility plan focuses on people and the better use of existing urban resources, not their expansion (https://umtychy.pl). The Sustainable Urban Mobility Plan provides for various types of pilots of innovative services and the development of the Mobility as a Service concept (https://metropoliagzm.pl).

4. Shared mobility in GZM

The first and oldest shering option in GZM is ridesharing. It has been unofficially present in the GZM area for many years in the form of shared rides, for example to work, study or vacation. So far, no system or dedicated platform for ridesharing users has been created in Upper Silesian-Zagłębie Metropolis. Residents use platforms with national reach (mieszkamyrazem.pl or bytheway.pl) or international platforms (Blablacar). The second form of shared mobility in GZM is carsharing. There are three carsharing operators in the Metropolis: Traficar, Panek and eCar. The carsharing service has so far developed in large cities of the Metropolis, in particular in Katowice, where all operators are present. Although you can drive the vehicle in other GZM communes, renting and returning the car is only possible in designated operator zones. Another sharing option available in GZM is the city bike system, which initially functioned as a classic bike rental in Katowice. In 2015, the first self-service stations were introduced (https://www.katowice.eu). In the following years, city bike systems were created in the following communes: Sosnowiec, Siemianowice Śląskie, Tychy, Gliwice, Chorzów and Czeladź. City bikes can be ridden in urban –rural and rural communes, but rental and return is

possible in communes where the are stations. The desire to improve the quality of like of residents and the desire to popularize bicycles as a healthy means of transport prompted the metropolitan authorities to expand and integrate systems so that every resident of GZM could use bicycles in a larger area and on the same terms (https://metropoliagzm.pl). The final stage of integration is the creation of the Metropolitan Public Bicycle Rental System (MSWRP) in GZM. The new system will enable the use of bicycles in each commune using one application and for the same tariff. The metropolis plans to create 940 stations located on average every 350-400 meters with over 8000 bicycles available all year round (https://metropoliagzm.pl). Additionally, it will be possible to rent bicycles with electric support for a long time, the so – called e- bikes. The final form of shared mobility is electric scooters. They appeared in GZM in 2019 along with the dynamic development of urban electric scooters in Poland and Europe. Currently, there are 5 operators in the Metropolis: 3 foreign operators: Lime, Bolt, Tier and 2 Polish operators: Roles and Blinkee.city. Operators currently operate only in the cities of the Metropolis, and the rental and return of scooters takes place only in a stationless system.

5. Research methodology

The aim of the study[1] was to recognize opinions about shared mobility solutions in the Silesian-Zagłębie Metropolis. The survey was conducted in the last week of April 2023 among adult residents of GZM. A total of 112 respondents participated in the survey, including 2 surveys that were invalidated because the respondents did not live in the GZM area.

The study involved 45% of men and 55% of women of various age groups. The largest percentage (57% of respondents) were people aged 18-25 (Generation Z), mostly pupils and students. The second largest group were Millennials (or Generation Y) aged 26 to 35, constituting 26% of all the respondents, whereas Generation X, i.e., people aged 36 to 50, was represented by 11% of the respondents. The fewest responses were obtained from older generations. 5% represented people aged 51-65, and 1% those aged 66+.

Respondents participating in the survey lived in 25 of the 41 existing GZM communes (Fig. 2).

[1] The study was conducted as part of a diploma thesis.

Figure 2. Representatives of the research group by GZM communes.

Source: own study.

Among the respondents, 77% of people live in core communes and 23% in outer communes. Most respondents (32%) live in Katowice city commune and other urban communes and counties: Tarnowskie Góry (7%), Tychy (6%), Zabrze (6%), Gliwice (6%), Sosnowiec (5%) and Ruda Śląska (5%). These are the communes with the highest level of urbanization, where the largest number of workplaces, universities and schools are located. These communes are where most residents settle or move around every day for work, education and consumption purposes.

Based on the respondents' particulars, it can be assumed that the average survey respondent is a young person aged 18 to 25, living in a large city, for example Katowice.

6. Research results

Promoting slogans related to sustainable development brings the expected results. We are observing how current behaviors of the society are slowly changing. Shared mobility models are widely known to society. Among the researched shared mobility solutions, carsharing is the

least known (Fig. 3). 24% of respondents do not know this model (most of them are young women, aged 18-25).

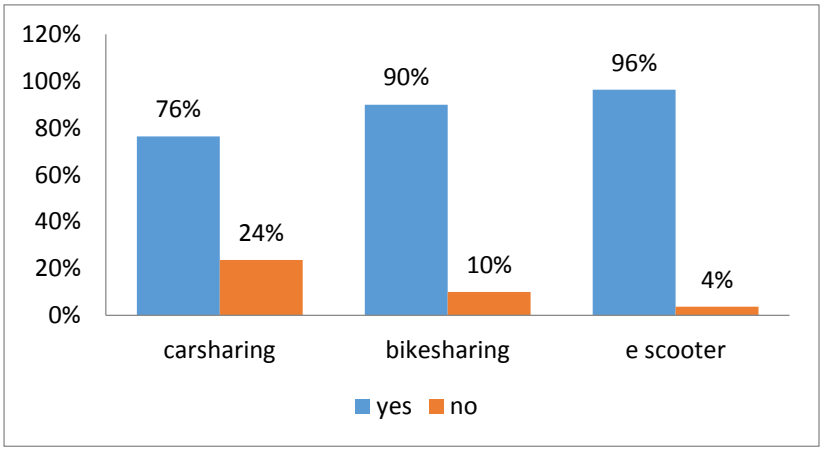

Figure 3. Knowledge of shared mobility models among GZM residents.

Source: Own study.

Urban electric scooters are the most famous model. 96% of respondents know them. Even though this model appeared the latest, it became really popular very quickly. Many people also riding private scooters can be seen on streets in the cities. City bikes also enjoy considerable popularity among respondents (90%).

Due to the presence of these sharing models in GZM, respondents were asked about the frequency of their use. Residents could select one of four answers: never, 1-2 times a month, several times a month, or once a week or more often. Respondents' answers by individual sharing models are presented in Fig. 4.

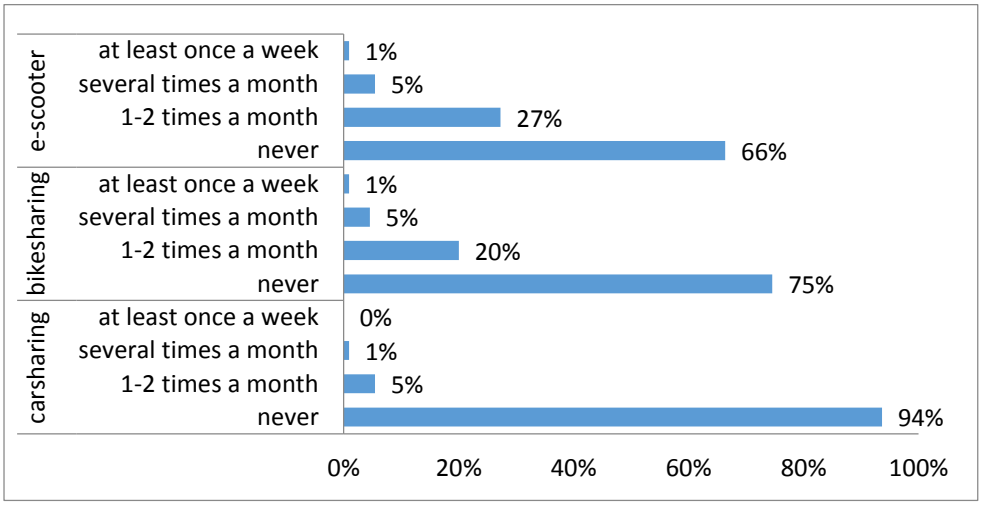

Figure 4. Frequency of use of shared mobility models.

Source: Own study.

Even though residents know sharing models, they rarely use them. Only 6% of respondents use carsharing (the least of all models). Among the users, 86% use carsharing at most 1-2 times a month, and 14% several times a month. Nobody uses carsharing more than once a week. 25% of respondents use city bikes which are in the second place. In the group of users,

79% use bikes 1-2 times a month, 18% - several times a month, and 3% - at least once a week. City scooters are the most frequently used means (34%). 81% of respondents use them 1-2 times a month, 16% - several times a month, and 3% - at least once a week. Figure 5 shows the use of sharing models by gender and age.

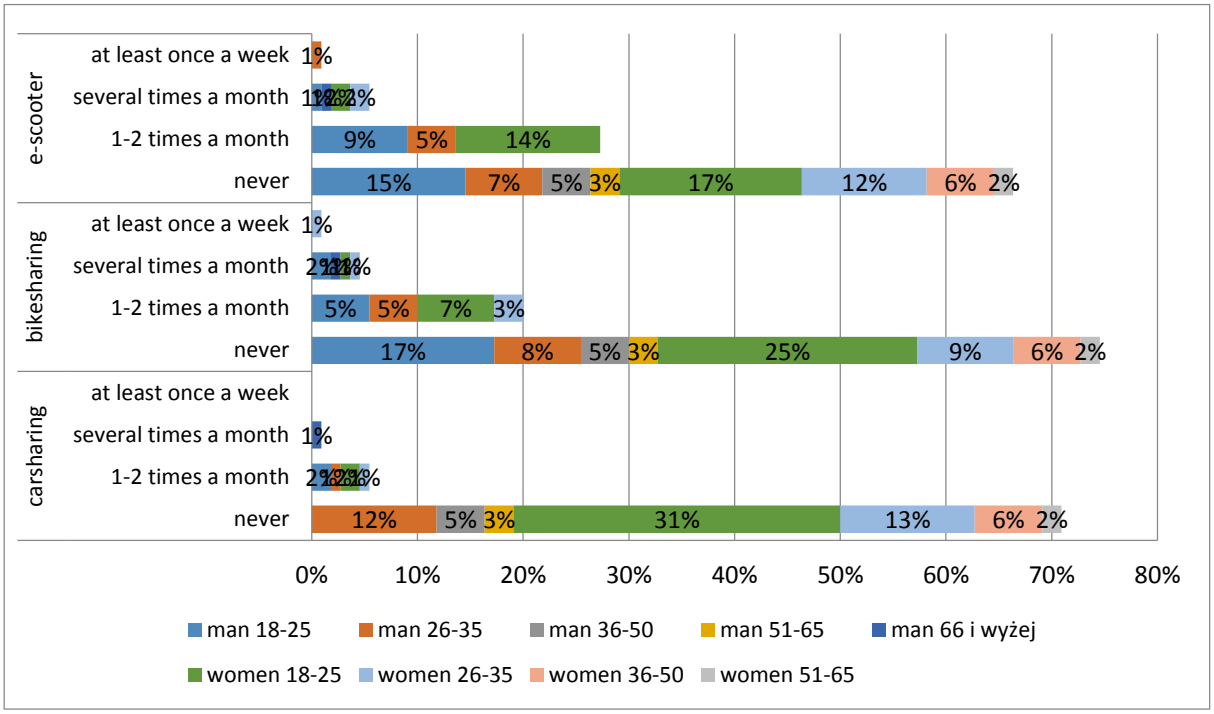

Figure 5. Use of shared mobility models by gender and age.

Source: Own study.

Shared mobility models (carsharing, ridesharing, e-scooter) are mainly used by generations Z and Y (people up to 35 years of age), regardless of gender, who have smartphones and know how to use mobile applications on a daily basis. These are people who usually have a driving license but do not own a car (for financial or ecological reasons). The vast majority of people using carsharing, bikesharing and e-scooters (over 85%) come from the core municipalities, and the remaining percentage come from the outer municipalities. This is related to the availability of entities offering this type of services and their infrastructure (cars, bicycle stations, e-scooters). In the case of carsharing in external communes, it is possible to rent a car only at the airport in Pyrzowice, and city bikes operate only in one external commune (in Czeladź). Bicycle stations in external areas are to be developed only after the Metropolitan Bicycle is created. For older people, the use of shared mobility models is associated with a considerable risk of health problems and lack of skills in using the applications.

The low level of use of all sharing models among residents of external communes is caused by the inability to rent and return vehicles in their commune. Regardless of whether the model operates in an area or station system, residents can use them only when they are in the zone of their operation, i.e., in the core municipalities. For this reason, sharing models are not

an alternative to motorized individual mobility for residents of outer municipalities, nor do they even complement public transport in last-mile transportation.

Respondents were asked to rate each sharing model using a 5-point Likert scale (where: 5 means very good, 4 means good, 3 means average, 2 means bad, 1 means no opinion). The obtained results are presented in Figure 6.

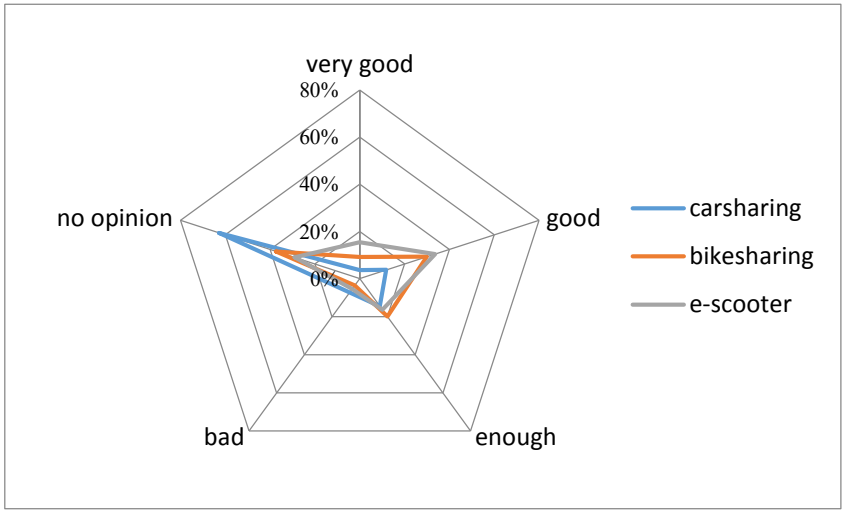

Figure 6. Evaluation of sharing models.

Source: Own study.

The overall assessment of shared mobility models is not positive. The vast majority of respondents have no opinion on this subject. The high rate of obtained responses, i.e., carsharing 63%, bikesharing 37%, e-scooter 29%, is affected by the fact that that respondents do not use the particular mobility sharing models (see Fig. 4).

Respondents most often use ridesharing and e-scooters, which is why they are highly rated. Respondents rate urban electric scooters the best. They were rated very good and good by 49% of respondents and sufficiently by 16%, whereas ridesharing was rated very good and good by 39% and sufficiently by 20%.

To understand the reasons for the low rate of use of sharing models, respondents were asked to indicate the obstacles that discourage residents from using them. The respondents could mark on the scale, at each obstacle, the extent to which they agreed with it by selecting the answers: definitely no, probably no, I don't know, probably yes, definitely not (Fig. 7).

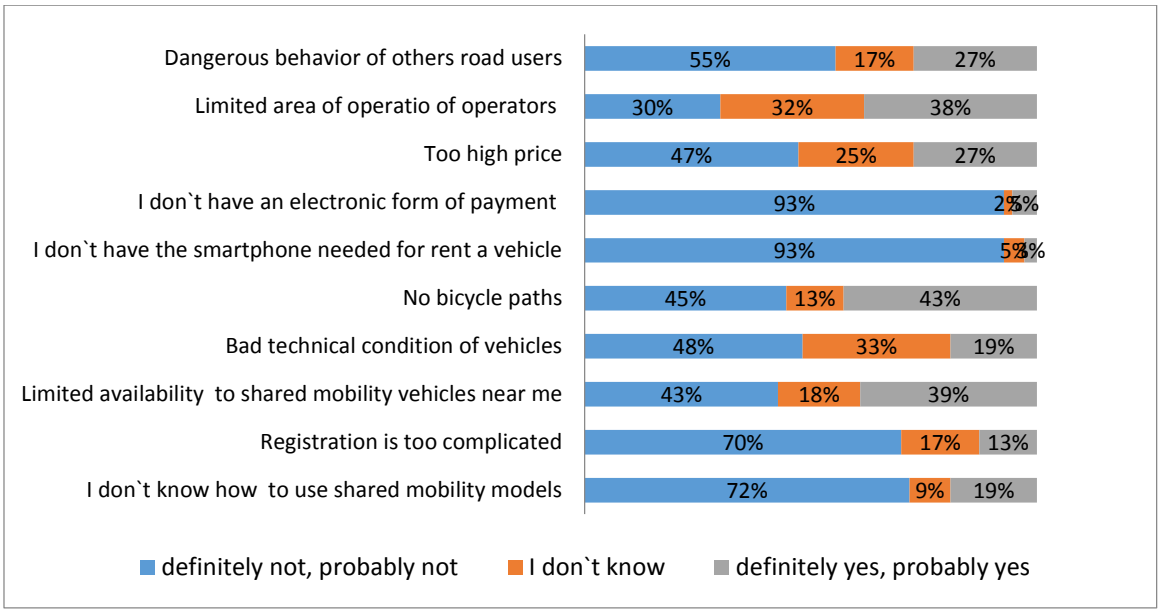

Figure 7. Obstacles to using sharing models in the GZM area.

Source: Own study.

Based on Figure 7, it can be concluded that the main reasons why residents do not use shared vehicles include:

- lack of extensive infrastructure. 43% of residents believe that there are not enough bicycle paths in GZM on which they can safely ride a rented bike or scooter;
- limited accessibility to vehicles nearby (39%) and the associated limited operating area of operators (38%). Residents of external communes face the problem of the lack of shared mobility offers in their area and the area of operation limited only to larger cities of the Metropolis;
- too high price (27%);
- fear of dangerous behavior of other road users (27%);
- the technical condition of the vehicles is poor - broken brakes, discharged batteries in scooters (19%). This answer had the highest percentage of "I don't know" answers (33%). The low percentage of users means that respondents are not aware of the technical condition of the vehicles.

For the considerable majority (93%), the lack of a smartphone and electronic payment method is not an obstacle to using sharing models. For the majority (70%), registering in the application is not too complicated.

The respondents (3% of respondents) also added their suggestions for obstacles, including:

- they prefer to travel by public transport or on foot, which allows for saving time and avoiding the problem of parking vehicles;
- sparse location of vehicles, i.e., too long distances from/to the rental point;

- they emphasized once again that the models only operate in large cities of the Metropolis, and mobility in small GZM towns is poorly developed, which makes it difficult for residents to get to larger cities;
- undeveloped infrastructure and a large number of renovations in the city (roads, bicycle routes, sidewalks) hampers moving around the Metropolis;
- in the case of city bikes, the constantly changing contractor, which forces the use of new applications is another difficulty. Additionally, there are often no bikes available for rent at stations. It was emphasized once again that bicycles and scooters are not respected by people and are often damaged and abandoned in places where they should not be left;
- there was also an opinion that the Metropolis prioritizes car traffic, which makes it difficult to use other means of transport. Less than 3% of respondents are not interested in learning about sharing models due to the lack of time, lack of need or because they use their own vehicle.

In order for the Metropolis to implement actions to increase the percentage of people using sharing models, respondents were asked to indicate solutions that could encourage residents to use sharing options (Fig. 8).

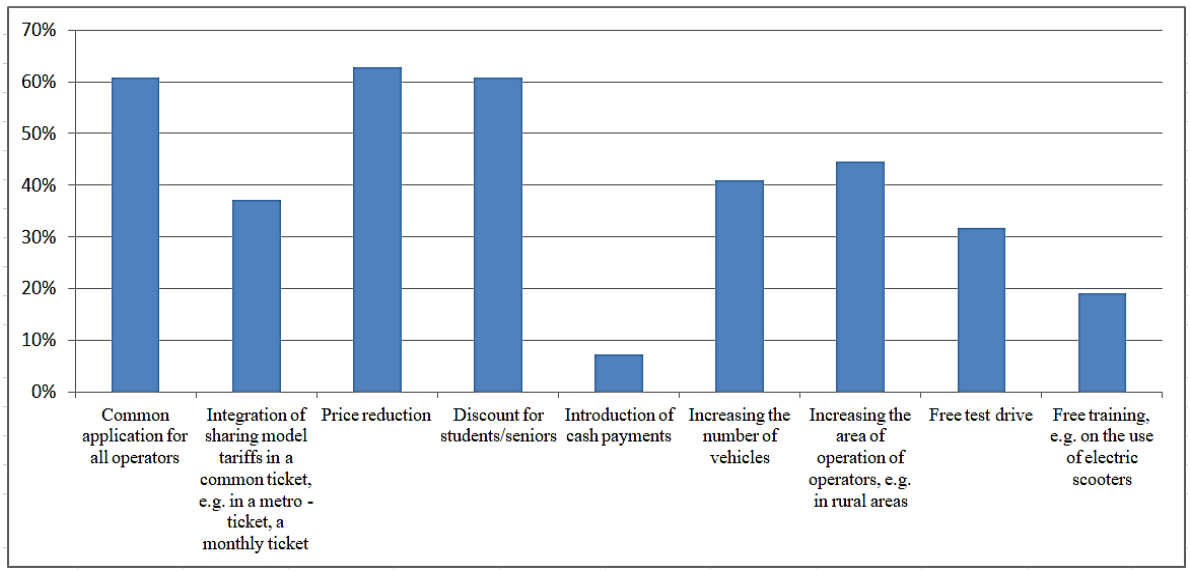

Figure 8. Solutions encouraging the use of sharing models in the GZM area (% of responses).
Source: Own study.

Most respondents indicate the need to make decisions related to price reductions (63%) and the introduction of discounts for students/seniors (61%) (these groups usually have lower incomes). Also, 61% of respondents supported the idea of creating a common application of Mobility as a Service model, which would consolidate the models of all available operators. Respondents support all activities aimed at integrating all sharing models to make their registration, reservation and payment more transparent and as simple as possible. Users would not have to install a separate application for each operator. 37% of respondents were in favor

of integrating tariffs of all sharing models into a common ticket. Further suggestions supported by respondents included increasing the operators' area of operation (45%) and increasing the vehicle fleet (41%), so that the offer was available throughout the entire GZM. Residents expect greater flexibility in the use of vehicles and the possibility of renting and giving them to each commune of the Metropolis. 19% of respondents supported the idea of free training in the use of sharing models so that users learn to use them properly and the level of road safety is higher. The introduction of cash as a form of payment was supported by 7% of respondents.

7. Conclusions

In recent years, a trend related to sustainable development in transport has been noticeable. Cities are implementing a number of actions consistent with the latest global trends, introducing a number of changes in urban mobility. They are mainly based on the promotion of the concept of sharing public transport services. For cities, shared mobility is a real alternative to reduce social and environmental costs and improve the efficiency of movement.

The results of the survey conducted among the inhabitants of the Silesian-Zagłębie Metropolis are difficult to explicitly assess as positive. In the field of shared mobility, there is a large disproportion between the core communes, where the offer is large, and the outer communes, where the offer is limited, or even scant. There are many service providers in large cities, yet the percentage of users is very low. The reason for this is the limited area of operation and lack of flexibility when travelling. As sharing models are operated by private operators (apart from city bike), the Metropolis cannot decide on its own in which area the models will operate. To solve the problem of disproportions, the Metropolis should try to negotiate with the operators and encourage them to expand their area of operation to cover the entire GZM area. When offering transport services, the Metropolis should be perceived as a whole, and not only focus on larger centers/cities.

To increase the percentage of users of sharing models in core municipalities, integration of models is needed to make their operation simpler and more transparent. Creating a common application for all sharing models is one of such solutions. Another problem is the too high price for using the models. The price for using vehicles could be reduced, for example, by creating common tariffs and introducing discounts for students/seniors. The use of sharing models also requires appropriate measures to ensure the safety of users on the street, and thus the construction of bicycle paths and more frequent vehicle servicing to eliminate defective vehicles. A part of the GZM population is still not familiar with sharing models, therefore it is recommended to take steps to inform residents about the way in which the models work, for example through free training.

Shared mobility as an element of the Metropolis's transport system is a source of change for current behaviors of the society. It transforms traditional urban transport because it has the potential to move towards social, environmental and economic efficiency through the use of technology, which enables the transition to a climate-neutral economy and zero-emission transport.

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