SOCIAL BARRIERS AND TRANSPORTATION SOCIAL EXCLUSION ISSUES IN CREATING SUSTAINABLE CAR-SHARING SYSTEMS

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Abstract. Currently, increasingly car-sharing systems are implemented in the area of urban transport systems. This type of development brings many benefits to cities and operators providing services, but above all, following the principles of sustainable development, it should improve society's quality of life. With this in mind, it is particularly important to monitor users' opinions on the services offered and take into account the problems and complaints reported by them. Monitoring opinions on services may contribute to the improvement of the quality of services, but most of all contribute to eliminating transport barriers related to the use of car-sharing services. This study aimed to identify transport barriers, accessibility issues, and transport social exclusion reported by users of car-sharing services. The purpose is to present the phenomenon of social exclusion in car-sharing services based on the Church's conceptual framework. The article identifies seven main categories of social exclusion, including economic, physical, geographic, spatial, fear-based, time-based, and facility-access barriers related to the use of car-sharing services. Moreover, the article includes presentation of remedial measures limiting the phenomenon of transport, social exclusion and barriers, consistent with the principles of sustainable development. The article supports operators who want to create services better suited to the needs of the society. It is also a response to a research gap dedicated to transportation social exclusion and aspects of responsible business in the car-sharing industry. The work supports eliminating the phenomenon of social exclusion and the pursuit of creating socially and environmentally responsible car-sharing services.

Keywords: car-sharing; social exclusion in car-sharing; barriers to using car-sharing; sustainable car-sharing services; corporate social responsibility

1. Introduction

Nowadays, due to the efforts of cities to achieve a sustainable level of transport and the trend of the sharing economy in urban transport systems, increasingly short-term vehicle rental services are emerging. One of the services defined by users as the most comfortable and the possibility of resigning from owning a car or limiting its use are car-sharing services (Cervero, 2020). Car-sharing, as a model consists of short-term car rentals offered by operators in urban areas (Midgley, 2011). Its concept is similar to car rental systems, with the difference that cars can be rented for less than an hour (Cervero, 2003; Cervero & Tsai, 2004). Car sharing is one of the possibilities that fit into the idea of the sharing economy and that can fit into Sustainable Development Goals (SDG) (COM 288, 2016; United Nations, 2021). In line with this idea, business models are based on the use of popular online platforms for the short-term use of services or goods (COM 288, 2016). Although car-sharing is a new concept for many cities and often described as innovative, the first written references in the literature date to 1948 (Doherty et al., 1987). However, a significant and, above all, more permanent development of car-sharing began in 2000, when players providing typical business services to short-term vehicle rental companies appeared on the market (Shaheen & Cohen, 2020). The decisive development of the car-sharing market is visible in the years 2014-2018 (Shaheen & Cohen, 2016; Shaheen & Cohen, 2020). Despite the earlier domination of the popularity of the system on the European market, the most intensive increase in the number of registered users of car-sharing systems and the number of rented vehicles was recorded on the Asian market (Shaheen & Cohen, 2020). Compared to 2009-2014, the number of registered users in Asia increased by 2275% (Shaheen & Cohen, 2016; Shaheen & Cohen, 2020). In turn, the number of available vehicles increased by 431%. Detailed data on the number of users registered in the systems in Europe, Asia, and North America were presented in Figure 1.
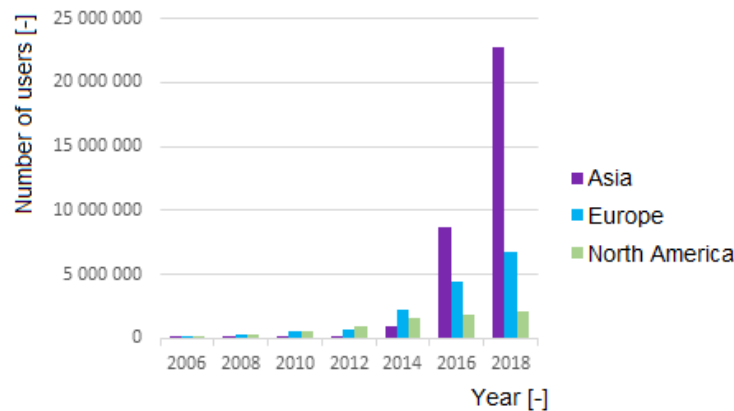

Figure 1. The number of users using car-sharing systems in Europe,
Asia and North America in 2006-2018

Source: own study based (Shaheen & Cohen, 2016; Shaheen & Cohen, 2020)

The most recent data indicate that vehicle-sharing service systems are now operating in 59 countries worldwide (Movmi, 2020). They are offered by 236 operators and available in 3128 cities (Movmi, 2020). Statistics estimate that in 2025 the vehicle fleet will grow from the current 380,000 available cars to nearly 7.5 million, and the global car sharing market will be worth more than $ 11 billion (Global Market Insights, 2018). Due to the fact that car shared mobility service systems are developing very dynamically, both in terms of the growing number of operators, vehicles, and users, there are also increasingly problems related to their proper and, above all, effective functioning in cities (Bieszczat & Schwieterman, 2012).

The proper functioning of systems is related to many groups of factors. Car-sharing researchers focus mainly on aspects related to economic and technical, transport, environmental, and legal problems (Balać et al., 2019; Ferrero et al., 2018). However, due to the correct implementation of the assumptions of the sustainable transport policy and modern mobility, it is particularly important to pay attention to the issues concerning the proper fulfilment of the requirements set by the society and adjusting services to their needs (Chatterjee et al., 2013; Andryeyeva et al., 2021). It would seem that car-sharing services are to increase transport accessibility, eliminate the need to have funds for the purchase and maintenance of a vehicle, and give society equal access to the use of a modern form of mobility (Firkorn & Müller, 2011). Despite the noble idea, there are many comments from the public that may constitute barriers to the development of services, which affect their incorrect development (Carmen et al., 2021; Tuominen, 2019), and, as a result, bring about services that are not fully related to the implementation of the assumptions of sustainable transport development. Therefore, the aim of this study was to identify transport barriers, accessibility issues and transport social exclusion reported by users of car-sharing services. Moreover, the article includes a presentation of remedial measures limiting the phenomenon of transport, social exclusion, and barriers, consistent with the principles of sustainable development.

The article supports operators who want to create services better suited to the needs of society. It is also a response to a research gap related to the aspects of transportation, social exclusion connected to sustainable development and responsible business issues in the car-sharing industry. The work supports eliminating the phenomenon of social exclusion and the pursuit of creating socially and environmentally responsible car-sharing services.

2. Theoretical background

Sustainable transport policies challenge cities with a set of guidelines that aim to improve the transport condition of urban transport systems while striving to improve the quality of life of their inhabitants (Benevolo, 2016). From the point of view of society, all changes in the sense of sustainable transport should aim to increase transport accessibility, introducing changes in the structure of urban travel to increase their effectiveness and efficiency and eliminate transport barriers (Jimenez, 2018). These aspects relate to two main concepts, which are transport accessibility and social exclusion.

Transport accessibility is one of the important aspects of perceiving the environment for humans (Spiekermann & Neubauer, 2002). It is the main product of the transport system, which determines the advantage of the location of a given area over the other one (Spiekermann & Neubauer, 2002). The transport accessibility also is directly related to the flow of people, goods, and funds - the greater the availability, the better the potential conditions for the society and the economic market (Spiekermann & Neubauer, 2002). That is why the transport accessibility is one of the main factors in the transport planning process (Spiekermann & Neubauer, 2002). It identifies places for the easiest, cheapest, and most affordable movements of society (Spiekermann & Neubauer, 2002).

The second aspect closely related to accessibility issues is transportation social exclusion. In that case, the phenomenon is connected to the mobility dimension (Kenyon et al., 2002). Research indicates that insufficient access to transport makes the society impossible to meet their social needs fully (Kenyon et al., 2002; Mackett & Thoreau, 2015; Preston & Rajé, 2007). Transportation social exclusion is related to seven main areas, which are economic, physical, geographic, spatial, fear-based, time-based, and facility-access aspects (Church et al. 2020). They are identified by Church et al. and are called "Church's social exclusion framework (Church et al. 2020). Each type of exclusion was characterized and presented in Table 1.

Table 1. Social exclusion in transport

Exclusion type	Description
Economic	Limitations directly related to travel costs, the ratio of public services to private services. Moreover, the costs of business trips and travels determine the possibility of using other means of transport than the employee's vehicle.
Physical	Barriers related to the physical and mental difficulties of the society. They include barriers related to movement dysfunction and mental and educational barriers related to learning difficulties and difficulties in communicating in each language.
Geographic	Barriers related to the unavailability of a given transport service in a selected area, spatial isolation of some communities or district. These barriers affect the disruption of the labour market and the fair competition and free market in each area.
Spatial	Barriers resulting from the implemented local transport policies or the lack of them, related to, e.g., parking decisions, speed limits, traffic restrictions in specific places, etc.
Fear-Based	Fear of using specific means of transport, incompletely understood principles of operation of services, fear of the spread of infections and diseases in means of transport, mental fears, e.g., related to the lack of parking space, etc. Moreover, concerns about the lack of proper equipment of the vehicle or its condition.
Time-Based	Issues related to the travel time and all aspects affected by it, e.g., difficulties with the division of duties, childcare, etc. to be able to carry out a given trip longer. In addition, timetables or barriers with the possibility of accurately planning the time of arrival of a given means of transport.
Facility-Access	Barriers are related to the limited access to full use of vehicles through their inadequate equipment, etc.

Source: author's own collaboration based on (Church et al., 2000)

The framework proposed by Church is a scheme that can be used to define social barriers for any transport service (Church et. al, 2000). Its development has a chance to identify possible solutions that may serve to reduce transport problems in a given industry and, as a result, create a sustainable, socially responsible transport service (Church, 2000).

Analysing the approach to accessibility and social barriers in car-sharing systems, only single literature items were found. For example, the authors Meleen et al. indicate that the main problems in the development of car-sharing systems are architectural and infrastructural barriers that prevent the efficient functioning of the systems (Meeleen et al., 2019). They also indicate that there is a problem with integration with public infrastructure and municipal transport management systems (Meeleen et al., 2019). This statement is confirmed by Tchorek et al., who consider the lack of adequate access of system operators to the public realm to be the main barrier (Tchorek et al., 2018). In addition, Cass et al. focus on aspects related to spatial access (Cass et al., 2005). In turn, the authors of Tuominen et al. consider economic issues to be the main barrier (Tuominen, 2019). This sentence is confirmed by the authors of Carmen et al. who indicate that the services are used by high-income people from urban areas (Carmen et al., 2021). At the same time, they indicate that owning a company car is one of the main barriers to the development of car-sharing systems (Carmen et al., 2021).

While issues regarding barriers to car sharing services appear in the literature, issues related to social exclusion are not popular among scientists. During conducting a literature analysis taking into account leading databases of scientific articles such as Web of Science, Scopus, Springer Link, or Google Scholar, no articles that would be strictly devoted to transport or social exclusion in car-sharing services were found. What is more, also the idea of applying the Church framework concerning car-sharing systems has not yet been demonstrated in any scientific article. and social exclusion issues connected to sustainable development were not found in in the current research. Therefore, due to the fact that the current car-sharing systems are required to make them more sustainable and socially responsible (Baptista et al., 2015; Hartl et al., 2018; Roblek et al., 2021), the author decided to fill the research gap and conduct her own research on social exclusion in car-sharing services.

3. Research objective and methodology

Due to the recognition of a niche in research related to accessibility and social exclusion concerning car-sharing services, it was proposed to conduct research based on the analysis of opinions regarding users of individual car sharing services systems available in Europe. The proposed research method was the Desk Research analysis, i.e., a method that boils down to analysing the records of available data sources, including their compilation, mutual verification, and processing. The Desk Research is a method that based on the use of existing (secondary) data (Kiecolt & Nathan, 1985). It is one of the analytical methods for nonreactive research (Babbie, 2002). The most important advantages of the Desk Research method include (Babbie, 2002; Bednarska, 2015; Hofferth, 2005):
- easy access to data,
- low cost of performing analyses compared to performing own research or generating reactive data,
- the ability to perform analyses on large samples if data is available,
- no influence of the researcher about the study,
- wider possibilities of comparing different research results concerning the same or a similar research area,
- enriching the existing inference mechanisms on a given topic.

Critically approaching desk research as a research technique, it is necessary to point out the limitations in the form of the possibility of comparing and combining data, as well as performing complementary analyses using various data sources (Babbie, 2002; Bednarska, 2015; Hofferth, 2005). It is also worth mentioning that when performing Desk Research analyses, particular attention should be paid to the credibility of the data (Babbie, 2002; Bednarska, 2015; Hofferth, 2005). Therefore, it is important to use data published by verified organizations, government, organizations or websites with a good social reputation (Hofferth, 2005). In addition, it is also important to check that the data is up-to-date (Hofferth, 2005). For example, in the case of social research, data may be published after a certain period of time associated with the need to prepare relevant reports, which in turn may make the results outdated, especially if the answers are concerned, for example, new technologies that change very quickly over time.

For the purposes of this article, the Desk Research were performed on the Google Play database related to mobile applications for car rental in car-sharing systems (Google Play, 2020). One thousand opinions were analysed regarding 74 mobile applications concerning systems operating in Italy, France, Spain, Germany, and Poland. The use of data from such a large application provider as Google made it possible to conduct research on a large research sample. Moreover, the researched database was placed on a socially credible portal. During the research, the focus was on unflattering comments to be able to indicate the barriers present in the systems. The study looked at user feedback in 2020, what means that the data was therefore up to date. The study considered opinions on systems providing various forms of car-sharing service station-based car-sharing, and free-floating car-sharing When analyzing opinions on the use of car-sharing services, the focus was on the analysis of comments on the main issues related to the process of using car-sharing services, i.e., registration in the system, vehicle availability, infrastructure availability, user friendliness, fees, rental management from the user's point of view and

affordability.The obtained data were classified according to the seven main areas of social exclusion presented in Table 1.

The main limitation of the method used was, in contrast to the questionnaire surveys, the inability to obtain data on detailed information on respondents issuing ratings for car-sharing systems. The database does not have access to data usually determined in the demographics part of the survey, i.e., age, place of residence, wealth, or education. Despite this, Desk Research's analysis made it possible to conduct research with a large research sample. Moreover, they were people associated with car-sharing services. By carrying out classical research, it would be a very difficult and costly task to acquire a research group related to car-sharing services at the level of several European countries.

4. Results and discussion

Analyzes were conducted on 74 applications related to the operation of car-sharing systems in 5 European countries. A detailed breakdown of the number of applications from individual countries is presented in Table 2.

Table 2. Data on the analysed car-sharing systems

Country	Number of applications	Types of car-sharing systems	
		Station-based	Free-floating
France	13	8	5
Germany	16	11	5
Italy	28	16	12
Poland	8	-	8
Spain	9	4	5

Source: author's own elaboration.

From the point of view of gender, the received opinions were mostly expressed by men - 85% were male responses, which proves representativeness due to a very small percentage of women using car-sharing services in the world. During the analysis, 1000 negative opinions related to social barriers in car-sharing systems were identified. Subsequently, they were segregated to indicate the most frequent areas of complaint. 5 main areas of complaint have been identified regarding the system's maintenance, system's technology, system's policy, system's infrastructure, and local policies. Each of the areas of complaints was defined in Table 3.

Table 3. Definition of areas of complaint related to the functioning of car-sharing systems

Area	Description
System's Maintenance	Any issues related to the condition of the fleet of vehicles offered in the system.
System's Technology	All issues related to the application and technical requirements of the system towards users.
System's Policy	All issues related to the regulations for the use of services and price lists.
System's Infrastructure	All issues related to the availability of the system and the infrastructure necessary for the proper functioning of the system.
Local Policies	All issues related to local requirements and regulations that legally bind the functioning of car-sharing services in a given area.

Source: author's own elaboration

The percentage of each area of complaints reported by users was also defined. A detailed distribution of the answers is presented in Figure 2.
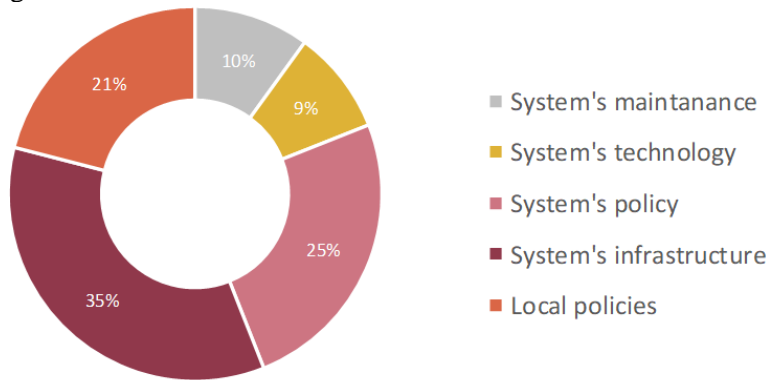

Figure 2. Percentage distribution of individual areas of complaints concerning social barriers in car-sharing systems.
Source: author's own elaboration

Then, for each of the five groups of complaints, complete statements of the most frequently repeated answers regarding barriers to the use of car-sharing systems were defined. A total of 20 most frequently typed social barriers related to car-sharing services have been defined. Table 4 presents the individual barriers concerning the groups of complaints and the number of replies provided by the respondents.

Table 4. Social exclusion in transport

No.	The defined social barrier of carsharing system	Complaint's area	Number of responses
1.	Too long distance to available vehicles (first/last mile)	System's infrastructure	84
2.	Too large area without the possibility of renting a vehicle - excluded district.		81
3.	Too few vehicles in car-sharing fleets and too little choice of vehicle types in fleet.		57
4.	Not enough charging stations for electric vehicles		48
5.	Lack of available vehicle in peak hours		41
6.	No additional equipment for transporting children (child seats)		23
7.	There are no dedicated vehicles, e.g., for the elderly with mobility limitations, or for parents who want to store a stroller in the large trunk of the vehicle conveniently.		16
8.	Too high cost of renting a vehicle	System's policy	75
9.	Too little price flexibility of journey fares (settlement per km or min)		69
10.	Too many formalities related to the rental process i.e., checking the technical condition of the vehicle, e.g., its cleanliness, equipment, and external conditions - the need to document the condition by taking photos, filling in additional questionnaires.		58
11.	No possibility of transporting animals.		28
12.	Limited working hours of stationary customer service offices.		20
13.	Areas without the possibility of returning / renting vehicles, i.e., at some railway or bus stations, offices, etc.	Local policies	99
14.	Areas excluded from parking (stop function) due to the lack of electronic payment for parking.		84
15.	Problems with the availability of parking spaces and operation zones at public facilities.		27
16.	Insufficiently charged electric vehicles.	System's maintenance	34
17.	Poor technical condition of vehicles.		66
18.	Too complicated registration process from a technical point of view, i.e., requiring access to the phone camera, connecting a credit card, etc.	System's technology	36
19.	System errors related to the inaccurate functioning of the GPS and the indication of vehicles that are not actually in a given place.		33
20.	Application errors, logging out, unnecessary notifications, and advertisements are displayed.		21

Source: author's own elaboration

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Subsequently, the reduced opinions on social barriers in car-sharing were compared to the Church framework, taking into account the 7 main areas of social exclusion in transport. Moreover, for each of the groups of exclusions, the option of social transition has been proposed, which may affect the problem of a given exclusion, presented in Figure 3.
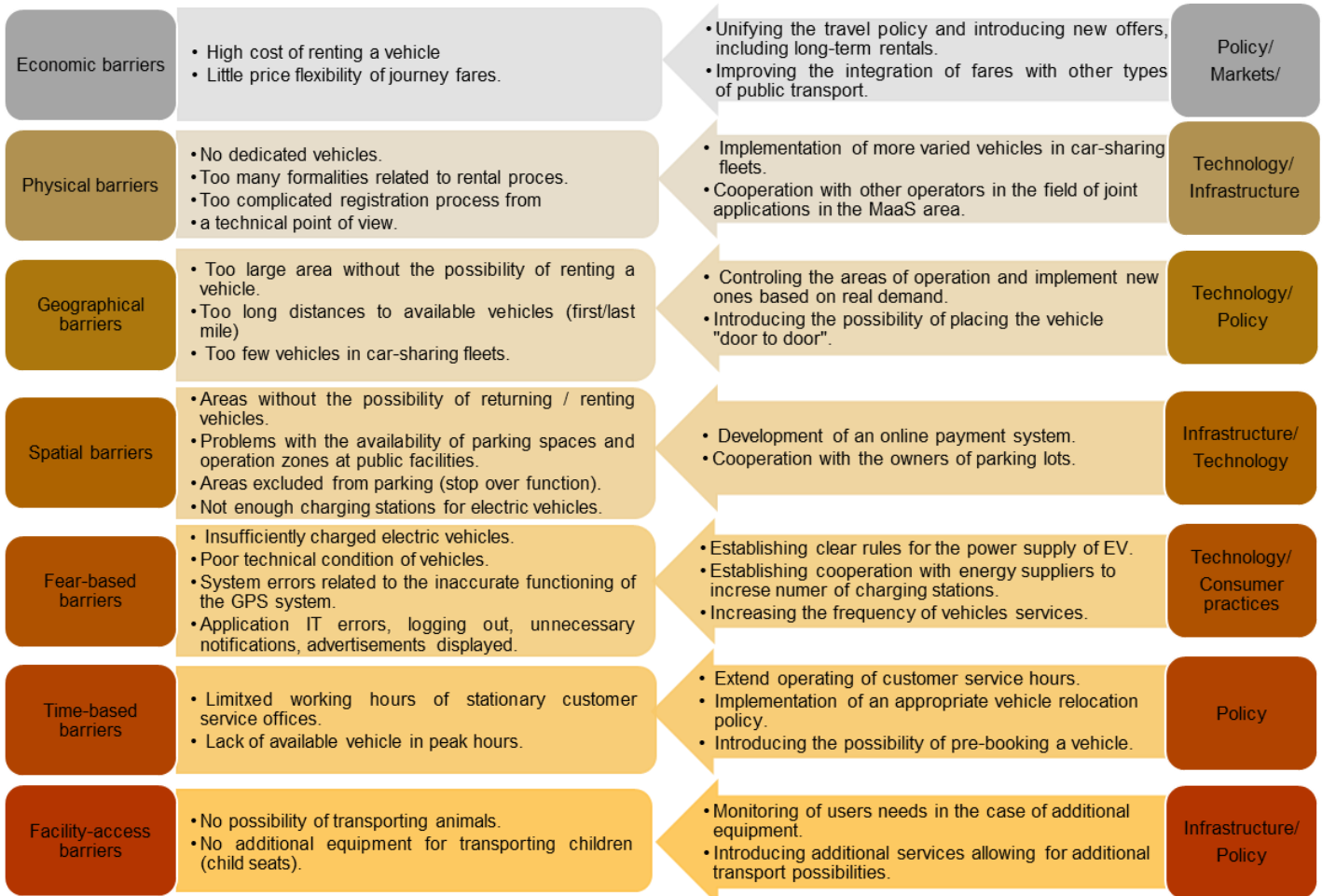

Figure 3. Social exclusion and possible socio-technical transitions in car-sharing systems

Source: author's own elaboration

5. Discussion

Based on the results obtained, it should be stated that the Desk Research analysis was successfully applied to obtain data on transport barriers and exclusions in car-sharing services. Moreover, the conducted study allowed for the first use of research on car-sharing Church's framework.

Moving on to the detailed analysis of the results, it should be emphasized that, most interesting conclusions of the study is that exactly the same opinions apply to all types of car-sharing systems, i.e., station-based and free-floating. Such a conclusion would indicate that users are not concerned with the type of business model of the system's operation but their specific functionality. Interestingly, most of the research related to the management of car-sharing systems focuses mainly on business models. Therefore, the conclusion is an important guideline for

operators, but also for scientists, to notice when developing the concept of sustainable car-sharing systems that service models may not necessarily match the specific consumer needs, which was confirmed by this study.

Moreover, it is worth noting that the people who expressed their opinions were mostly men. Admittedly, this conclusion is fully supported by the real imitation of care-sharing services by women, which is very inconsiderable (Benner, 2018). However, from the point of view of creating sustainable car-sharing systems, it is worth focusing on maintaining a balance of the appropriate diversity of customers and directing activities towards the appropriate promotion that would ensure the interest of the entire society. This barrier is closely related to the 5 SDG – "Achieve gender equality and empower all women and girls" (United Nations, 2020).

Next, it should be noted that the issues related to the infrastructure offered in the given systems turned out to be the leading social barriers. To eliminate the problems of the appropriate number of the fleet, its appropriate adjustment and distribution, it is suggested to carefully monitor the users' demand for journeys as well as to introduce additional services, such as the possibility of booking a vehicle in advance, as well as the possibility of delivering the vehicle directly to the customer, i.e., "door to door" service.

The second important barrier is the issues related to the appropriate policy of the operators. Price lists and regulations, and issues related to users' liability for offenses or possible damage and destruction of vehicles deserve special attention. A particularly important improvement, also from the economic point of view, is creating cooperatives of car-sharing services on public transport. Car-sharing has the chance to become a first-mile or last-mile transport, and further travel can be continued by public transport.

Users also point to the overly complicated process leading to the rental of the vehicle. Then the solution may be to propose graphic instructions containing instructions for renting a vehicle. It is also important that all promotional campaigns are conducted so that they allow to reach the message not only to young people but also to people who have concerns about using car-sharing services. These activities also perfectly fit prosocial activities as part of the corporate social responsibility strategy.

Attention should be paid to issues relating to the proper condition of vehicles and their maintenance. The research shows that cars with car-sharing systems are in poor technical condition. They often lack equipment tires that are not adapted to weather conditions and do not have regular daily inspections. From sustainable development point of view, these issues are particularly important because they directly affect environmental impact (United Nations, 2020). It should be emphasized that vehicles with sharing systems are often used only for one season; successively they end up in legal or illegal scrap yards, creating an additional environmental hazard (Yixin, 2017). Carrying out appropriate inspections of cars could increase their use in systems and extend the life cycle of the product and service.

In addition, the issues related to the operator's green fleet, i.e., all references to electromobility, should be taken into account. Importantly, at the moment, most of the world car-sharing market will be replaced by vehicles with a conventional fleet. Users' opinions in the field of electric vehicles indicate a high demand in this matter. From the point of view of operators' business practices, it is an important point to consider. Any action taken in this area will have a chance to translate into the achievement of 11. SDG. - "Make cities and human settlements inclusive, safe, resilient and sustainable".

Importantly, the sustainable development of car-sharing services is influenced not only by operators, but also by local authorities and local market conditions. Research indicates that the most important barriers are the inability to park, start or finish a rental in specific public places, mainly near the railway station or public administration facilities. What is more, the appropriate level of service availability from the point of view of cities may also be improved thanks to the introduction of online payments for parking lots, which, unfortunately, is not yet common

everywhere. What is more, it is also important to create own policies regarding the possibility of subscription payments for parking lots for sharing vehicles, arranging parking spaces for them or privileges, e.g., the ability to move in places excluding traffic for other vehicles. These issues mainly result from the lack of developing appropriate policies that would consider the services of new mobility such as car-sharing. Therefore, it is worth emphasizing that without the appropriate support of local governments in the field of car-sharing services, it will not be possible to obtain a fully sustainable and socially responsible system, because it will be possible to achieve 10. SDG - "Reduce inequality within and among countries".

Conclusions

Summarizing, the conducted research allowed to achieve the intended work goal by identifying transport barriers, accessibility issues, and transport social exclusion reported by users of car-sharing services. It has also been confirmed that both the Desk Research and Church framework analyses can be applied to issues related to car-sharing services. The conducted research complements the existing research gap concerning transport exclusion of social exclusion in car-sharing systems.

The conducted research indicates that in current car-sharing systems, users encounter social barriers. These barriers are related to the five main areas of operation of car-sharing systems and are directly related to transport and social exclusion. Furthermore, exclusions are related to the two most popular business models of the car-sharing system, i.e., station-based and free-floating, and that they are present in leading systems, regardless of the operator's country of operation.

The social barriers and exclusions in car-sharing presented in the text were referred to sustainable development and corporate social responsibility issues. It was pointed out that many barriers concern the mismanagement of car-sharing systems. Therefore, a conclusion is drawn that if management systems were implemented in individual systems, taking into account the assumptions of corporate social responsibility, many currently existing problems could be eliminated.

From a practical point of view, a prepared list of transport barriers and exclusions as well as the proposed remedial actions with a list of good practices that can be implemented by car-sharing service operators during improving or optimizing their car-sharing services in a user-oriented manner with taking into account the principles of sustainable development. What is more, the presented list also supports other scientists and managers in the processes of modelling transport systems or analysing car-sharing services in terms of socially responsible activities. The article also points to the niche in literature in the field of research on social aspects, and especially social exclusion in car-sharing services, which may be a valuable indication during developing research plans and projects by other scientists.

In subsequent works, the author wants to analyse barriers extended to systems operating outside of Europe. Then it will be possible to obtain an interesting solution by comparing the functioning of car-sharing systems from the point of view of their relative functioning in the eyes of users.

Summing up, focusing on the indicated advisory activities has a chance to bring better functioning of car-sharing systems and obtain sustainable transport and socially responsible systems that are complying with the 12. SDG – "Ensure sustainable consumption and production patterns".

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