

**Tomasz Stoeck**

dr inż.

Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Wydział Inżynierii Mechanicznej i Mechatroniki

Katedra Eksploatacji Pojazdów Samochodowych

tstoeck@wp.pl

DOI: 10.35117/A\_ENG\_20\_03\_03

**Availability of sharing services in Szczecin**

**Abstract:** The article presents the problem of implementation sharing economy services in relation to the urban transport system. Basic information related to this concept and the principle of its operation was discussed, with particular emphasis on economic, ecological and social aspects. The analysis considered the growing role of unmanned rental shops of various types, whose development and functioning influences the change in communication preferences of Szczecin residents. The research part compares travel times of available vehicles on a selected test section. The presented conclusions and observations can be helpful in modernizing current or implementing completely new initiatives in the field of providing modern means of transport. They are to guarantee public availability in a precisely defined area and a relatively short time of use, and at the same time be adapted to the needs of a given agglomeration.

**Keywords:** Sharing services; Urban transport; Communication preferences

**Introduction**

The progressing urbanization and the increase in the number of inhabitants of large cities create a number of transport difficulties, which result from the increased demand for the transport of people and goods. The negative effects of car traffic affect both the natural environment and society. They are mainly associated with the consequences of road accidents and collisions, congestion of communication routes, excessive use of fossil fuels, climate warming, pollution (air, water, soil), emission of vibrations and noise, and limitation of the land area [6, 7]. The recollection of problems is especially felt in the city centers, which are the predominant travel destination due to administrative and cultural functions, as well as the concentration of service, commercial and public facilities. Nevertheless, for many years it has been the most dynamically developing branch of transport in Poland [20]. In addition to a number of other advantages, it allows door-to-door transport without the need to change the means of transport, which in many cases has a key impact on the choice of transport preferences. There are also social factors, expressed in high flexibility and adaptation to the individual needs of the user, as well as economic ones, related for example to the low price of road access or the attractive price of vehicles on the secondary market [2]. As a result, the implementation of the concept of sustainable development, i.e. a doctrine that assumes a balance between the aspirations of all residents, including non-motorized ones, encounters a number of difficulties. Despite this, the desire to ensure the required balance between the elements shaping an efficient transport system means that various types of innovations are introduced in cities. They are aimed at reducing the number of vehicles powered by combustion engines in built-up areas, along with promoting and disseminating alternative modes of travel. They should not only complement the existing public transport and be integrated with it but also guarantee low costs of use and maintenance in good technical condition. One of the possibilities is the effective implementation of the sharing economy, i.e. the collaborative economy or the sharing economy.

### Supporting the urban transport system with sharing services

A collaborative economy is a general term for the consumption of goods and services through activities such as renting, swapping, or trading. For this purpose, online platforms and social networks are used, which facilitate the sharing of resources between individual entities: suppliers (private persons, enterprises), intermediaries (liaison officers), and consumers (users) [12, 17]. The contemporary popularization of this idea is therefore the result of not only interactivity based on new technologies, but also an increase in the IT competence of users. A special role in this process is played by the development and mass dissemination of mobile devices that allow you to perform the required activities at any place and time, without the need to use a personal computer. This approach forces a departure from classical organizational models, built around the division of material and human resources, towards an economic system based on the networking of individuals and communities [3]. However, the collaborative economy works best in local environments, as goods are available not only in terms of digital coverage but also purely physical. For this reason, urban agglomerations favor sharing consumption, given their limited space and high population density [16]. At the same time, it is convenient from the practical point of view, as it allows the introduction of various tariff systems, tailored to the needs of an individual customer.

Sharing services include public vehicles or other means of transport that are automatically rented and used by users in a given area and at a specific time. Their exemplary breakdown depending on the distance traveled is presented in Figure 1. It can be seen that the market potential for common micromobility may include all passenger journeys shorter than 8 km [11]. Therefore, this group includes low-speed vehicles, including those powered by muscles - bicycles (so-called bike-sharing) and other, mainly electric, vehicles, which were not included in the Act of June 20, 1997. Road traffic law [18], e.g. rides, skateboards, two-wheelers, scooters, mini scooters, etc. In the literature on the subject, it is most often referred to as Personal Mobility Device (PAM) [4, 5]. Their classification may, however, present some difficulties, as they have various functions and areas of application. Despite this, in the near future, the Ministry of Infrastructure plans to amend the existing regulations in order to regulate the legal status of these means of transport.



1. Division of means of transport-sharing due to distance

Source: own study based on [11]

In the case of longer distances, scooters and cars are usually taken into account, hence their sharing systems are called scooter- and car-sharing, respectively. They take similar forms of rentals, i.e. in the closed model, special docking stations are used, and in the open model - users pick up and return vehicles anywhere but within the operator's zone of operation. Their booking and searching are carried out using specially dedicated mobile applications, coupled with the GPS satellite navigation signal (Global Positioning System). A

less popular alternative is the peer-to-peer option, in which private car owners rent them to selected people at a time when they do not use them themselves [8].

Over the last few years, other methods of the economy of cooperation have been developed, and not all of them are assessed in a clearly positive manner. An example is ride-sourcing, a travel sharing solution. With this approach, the users of the internet platform offer a ride with their own vehicle, reaping financial benefits. On the one hand, it is an interesting proposition that eliminates the need for solo driving, serving the unmet demand for fast, flexible and comfortable mobility in urban areas. However, it should be noted that it is in contradiction with the shaped taxi industry, where drivers are required to comply with a number of legal regulations, e.g. complete training and passing an exam, confirmation of health qualifications (including psycho-technical tests), running a business, adapting a car, etc. Moreover, ride-sourcing services somehow compete with public transport, contributing to increasing traffic congestion during peak hours, but also threaten public safety and the consumers themselves, additionally exposed to non-transparent pricing practices [10].

### ***Transport-sharing in the metropolitan area of Szczecin***

The urban structure of the city is characterized by a bipolar system, oriented on both sides of the Odra river, therefore there is a need to ensure an efficient transport system between the left and right bank of the city. As it ranks third in Poland in terms of area, long-distance transport is of particular importance [15]. Despite the fact that there are a number of difficulties related to the disproportion of vehicle traffic in individual districts, the lack of adaptation of the road and street network or few bridges, the demand for using public transport has not increased for several years [14]. For this reason, it would seem that such a vast agglomeration would be an ideal basis for the development of car-sharing services. Unfortunately, no company or association currently offers vehicle rental in this system. It does not mean, however, that such attempts were not made. At the end of 2018, the Lithuanian operator CityBee began operating on the local freight market, providing a pilot of 7 Fiat Ducato vans. Their location, booking, and the opening were possible from the level of the mobile application, as well as payment after the end of the rental [26]. Nevertheless, after a few months of operation, the zones within the administrative borders of Szczecin were liquidated, and the service was completely terminated. The probable reason for this state of affairs should be seen in the high competition from taxi carriers, as well as the rich offer of rental companies operating in a traditional way.

The above-mentioned situation is in no way improved by the peer-to-peer model, as the number of offers from private persons is selective, so it is difficult to treat them as a viable alternative to other means of transport. Single cases can be found using internet portals, e.g. Locomoto, Mobilrent (Figure 2). The necessary condition is registration in the system and filling out a form in which the owner enters up-to-date information about his vehicle, its parking place, and the requirements for the rental itself, e.g. time and cost of the service. The whole process is convenient from the practical side as it takes place without intermediaries, which greatly facilitates the relations between the interested parties [27]. An additional advantage is a possibility of renting several cars (passenger cars, vans) at the same time. Therefore, it should be assumed that in the coming years this type of formula will gain in importance, as is the case in other Polish cities, e.g. Warsaw, Poznań, Kraków.

**Wynajmij samochód od osoby w pobliżu**

data odbioru   data zwrotu   miasto: Szczecin   **szukaj**

Wyszukiwanie zaawansowane

**Polecane samochody**  
Tu i teraz

- CITROËN C4 (B7) 1.4 VTI 95**  
Szczecin / zachodniopomorskie  
250.00 PLN
- FIAT PUNTO / GRANDE**  
Mielec / podkarpackie  
250.00 PLN
- NISSAN PRIMERA (P12) 1.8**  
Warszawa / mazowieckie  
80.00 PLN
- LAND ROVER RANGE ROVER**  
Warszawa / mazowieckie  
600.00 PLN

## 2. Examples of private car rental offers on Mobilrent

Source: own study based on [27]

Scooter-sharing, introduced by EcoShare and Hop.City in the first half of 2019, is much more popular in Szczecin. Despite the fact that these operators are completely independent of each other, they offer similar service conditions in an open model. First of all, the return zones practically overlap with each other, covering the central estates of the left-bank part of the city. The users have at their disposal scooters with a different external appearance, but almost identical technical parameters (Figure 3, Table 1). Due to the electric drive, these are ZEV vehicles (Zero Emission Vehicle), that is, emitting no pollutants from the on-board energy source, which is in line with the concept of sustainable development [9]. Moreover, the activities related to their location, booking, commissioning and parking are similar, requiring the use of a specially dedicated application (Figure 4). However, it is worth emphasizing that in the registration process a copy of the ID card should be provided, and in the case of people born after January 19, 1995, a driving license of category AM or higher [19].

**Tab. 1.** Selected technical parameters of EcoShare and Hop.City scooters

Parameter	Unit	EcoShare	Hop.City
Range	km		70
Speed	km/h		45
Capacity	kg	150	160
Drive type	-		electric
Engine power	W		3000
Installation voltage	V		72
Battery capacity	Ah		30 (lithium-ion)
Charging time	h		4-6
Durability	cycles		800
Type of display	-		liquid crystal

Source: own study based on [22, 23]

a)



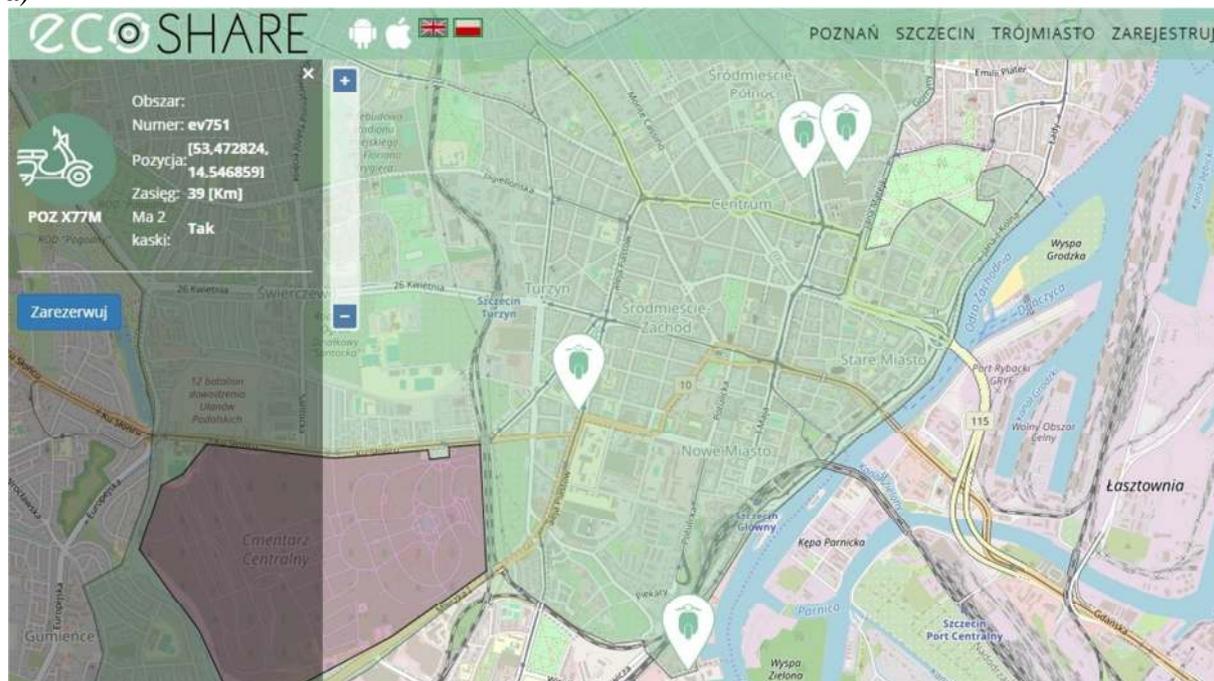
b)



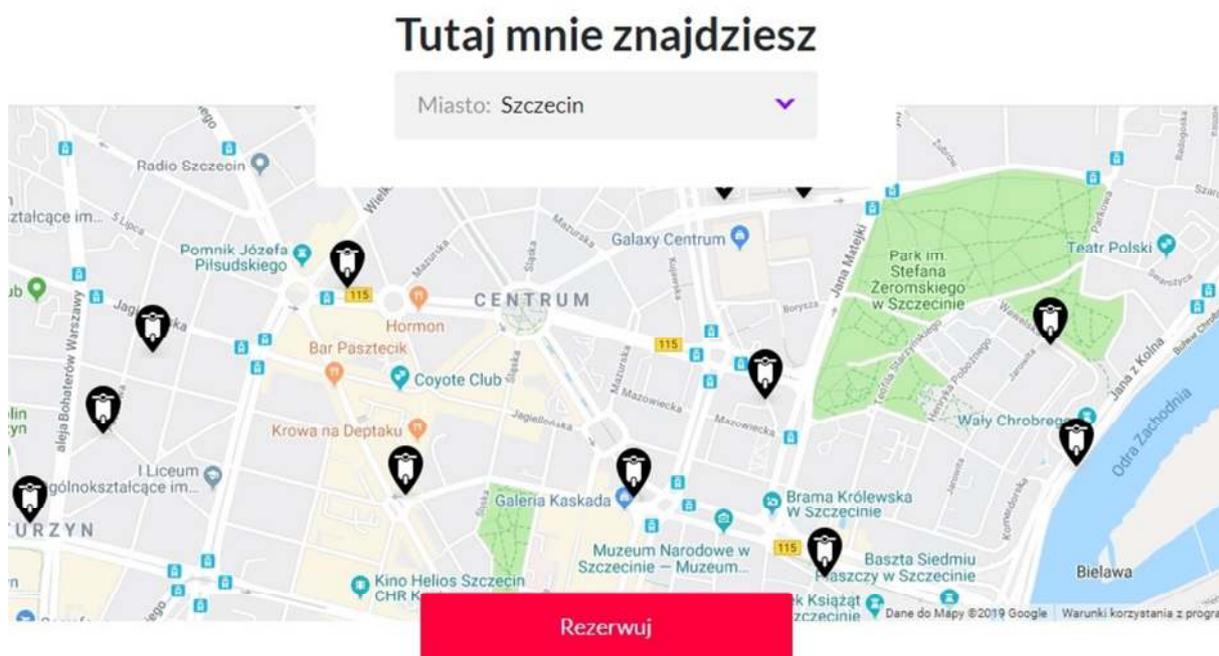
3. Electric scooters parked in the return area: a) EcoShare, b) Hop.City

*Source: own study*

a)



b)



4. Locating and booking scooters in applications: a) EcoShare, b) Hop.City

Source: own study based on [22, 23]

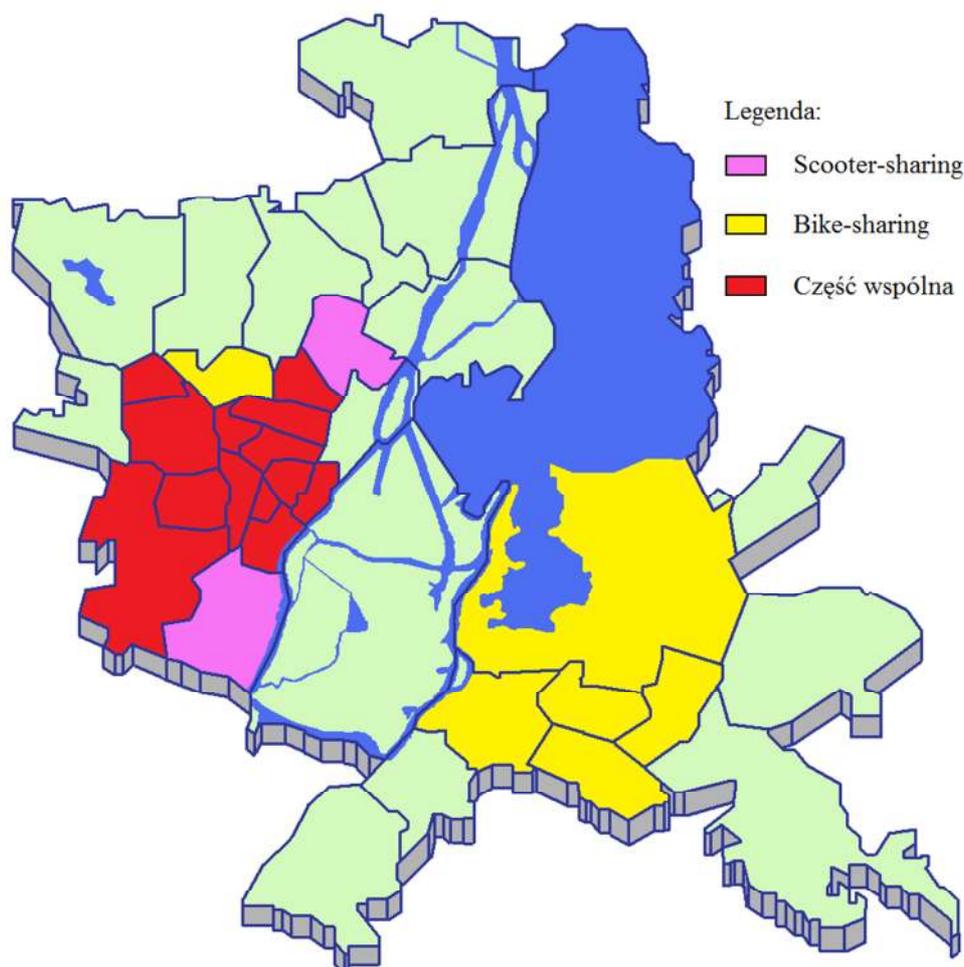
At present, it is difficult to indicate which of the rental options will be preferred by residents in the near future. The factor determining preferences may be the cost of services, the calculation of which is summarized in Table 2. Taking into account the presented data, the Hop.City offer seems to be more advantageous, mainly due to the unit price per minute of driving. An interesting idea was also to provide monthly subscription fees, which the other operator does not provide at all. Nevertheless, EcoShare was the first company in Poland to introduce a dual billing system that allows you to rent a scooter on the basis of a prepaid account or a direct fee, charged for each ride from an assigned credit card [22].

**Tab. 2.** Summary of costs for scooter- and bike-sharing services in Szczecin

Expense	EcoShare		Hop.City			Bike-S
	Minute plan	Maximum fee	Minute plan	Daily subscription	City subscription	Minute plan
Prepayment (balance)	30 zł (10 zł)		10 zł	89 zł/month	59 zł /month	20 zł (10 zł)
Ride	0,69 zł	69zł / day	0,49 zł	0,45 zł	0,39 zł	* 1 zł / 21-60 min
Stop	0,09 zł		0,10 zł	0,10 zł	0,10 zł	-
Entry fee	3,00 zł		2,00 zł	-	-	-
Bonus	-	No other costs	-	20 min	100-160 min	0-20 min

\* - minimum period of paid rental

Source: own study based on [21, 22, 23]



### 5. Sharing service areas in Szczecin

Source: own study based on [21, 22, 23]

The oldest and definitely the most developed form of local transport-sharing is Szczeciński Rower Miejski (SRM) "Bike-S". Since 2014, the system has been operated by the Real Estate and Local Opportunities Company, which cooperates with the external operator Nextbike Polska S.A. Rentals are carried out in a closed model with a total of 585 vehicles and 87 docking stations [21]. They are located on both sides of the Odra River, mainly within

densely populated central housing estates, which is their unquestionable advantage (Figure 5). Other reasons for the popularity of SRM among residents and tourists include factors that can be perceived in various aspects:

a) legal

- no driving license is required for adults,
- no need for additional equipment (helmet, pads, etc.),

b) functional

- the simple registration process, possible to be carried out in a convenient way for the user, including through a mobile application, internet portal, telephone contact with a consultant, and a payment card at the terminal,
- a transparent price list of rentals, identical for the normal and family tariff, in which the charging time is divided into hourly periods, excluding the first 20 minutes of driving,
- a large selection of payment methods (traditional, electronic),

c) useful

- easy parking at self-service terminals,
- location of docking stations near commercial and service buildings and public utility buildings,
- reaching places difficult to reach for other vehicles,
- minimizing the problem of traffic congestion,
- possibility of renting 2-4 bikes depending on the selected tariff,

d) safety

- safety using roads and pedestrian and bicycle routes completely separated from traffic, constituting the vast majority of routes intended for this means of transport,
- keeping vehicles and terminals at docking stations in good technical condition,
- monitoring of rentals,
- the use of anti-theft security systems,

e) ecological

- limiting the consumption of fossil fuels, because only muscle strength is used to drive
- no noise, vibration, and pollution from the street level,
- lower infrastructure wear compared to other vehicles,
- development of green and recreational areas,
- promotion of a healthy lifestyle,

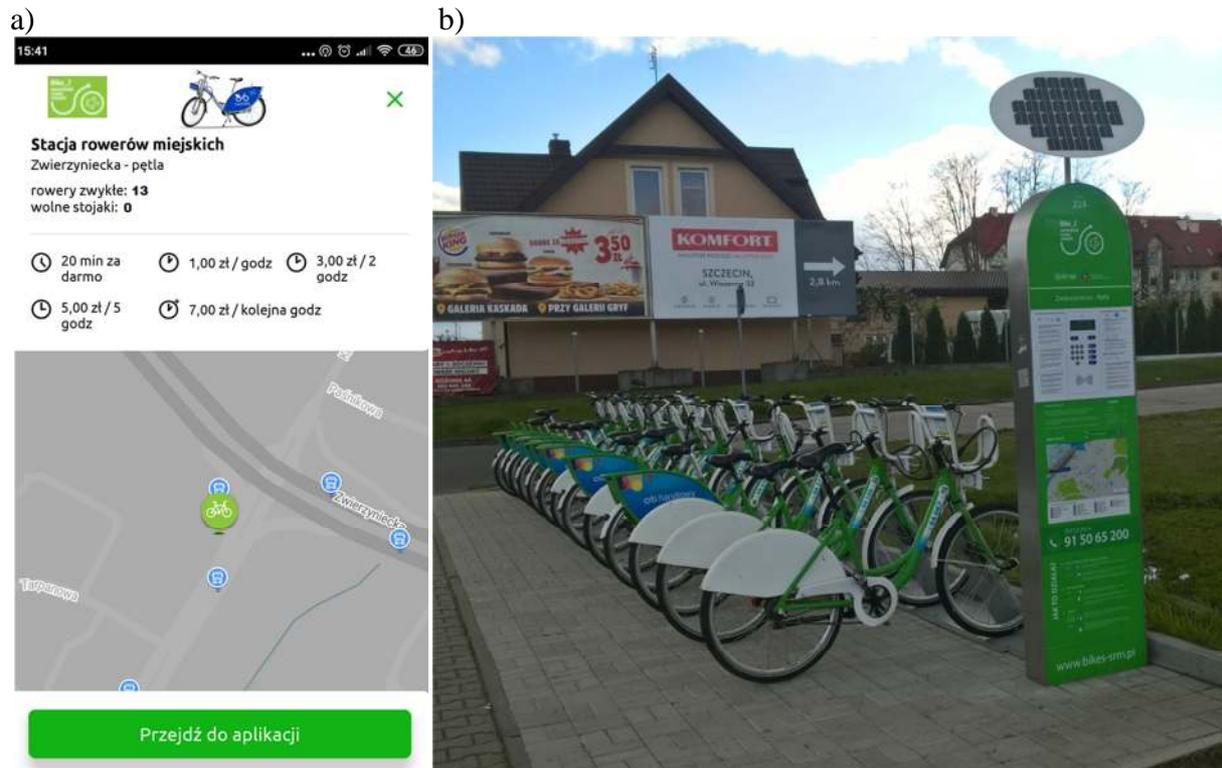
f) effectiveness

- 24/7, fast and convenient way to get around the city (excluding the winter period),
- complementing public transport,
- traffic calming in the very center.

g) economics

- free service on short journeys,
- cheap vehicle servicing,
- low costs of creating and maintaining road and stop infrastructure.

The presented values made the project of maintenance-free "Bike-S" rentals socially acceptable and have enjoyed an avalanche of registered users since its launch. It is also an element integrating the city transport system, additionally supported by the development of modern technologies. An example is the Take & drive mobile application, which locates all vehicles offered as part of sharing services. With regard to the closed model under consideration, information is also presented on the docking stations, the number of available bicycles, free stands, and the list of fees (Figure 6). The selection can be made from the main screen, which connects directly to the operator's portal. The program also shows the nearest public transport stops, timetables updated on a regular basis and the time of delays, read based on GPS satellite data. At present, it covers the largest cities in Poland [25].



6. "Zwierzyniecka-loops" station: a) location in the Take & drive application, b) general view  
*Source: own study based on [25]*

### Comparison of available means of transport on the selected route

Measurements of travel times were carried out on a 7.8 km long test section connecting the central city estates located on both sides of the Odra River, whose starting point (A: Peasant Battalions - Gryfińska SST) and end (B: Port Gate) were docking stations "Bike- S "(figure 7). They are located at public transport stops, being available to users of the surveyed means of transport. The analysis takes into account the situation of normal and maximum traffic volume. A rating scale from 1 (worst) to 5 (best) was also adopted, and then weights related to the above criteria were determined. After assigning the number of points, the final calculations were carried out.



7. Test section with marked start (A) and end (B) points  
 Source: own study based on [24]



8. Traffic jam in front of the Długi Most during the test drive  
 Source: own study

The data presented in Table 3 show that the selected route was traveled the fastest by a passenger car. It was a vehicle powered by a classic Opel Meriva combustion engine, which was rented from a private person on a peer-to-peer service. Unfortunately, the efficiency of the main communication artery of the city, located along the national road No. 10, has already been used to a large extent. Moreover, it is limited by the preferences for public transport, including the separate PAT bus and tram lanes, which generates additional difficulties in front

of the Long Bridge (Figure 8). The situation is exacerbated by drivers looking for an alternative to Trasa Zamkowa im. Piotr Zaremba, where almost complete paralysis of road traffic is observed during peak hours. As a result, the test drive time, presented as the arithmetic mean of three measurements, increased more than 2.5 times.

**Tab. 3.** The results of measurements of travel time by available means of transport

Starting point	Mode of transportation	Travel time without difficulties [min]	Travel time with difficulties [min]	End point
A: Batalionów Chłopskich - Gryfińska SST	Car	9,2	24,9	B: Brama Portowa
	Electric scooter	12,6	13,2	
	Tram	14,4	14,8	
	Bus	18,3	18,7	
	Bicycle	26,1	26,1	

Source: own study

**Tab. 4.** Assessment of connections according to the adopted criteria

Mode of transportation	Travel time without difficulties [min]		Travel time with difficulties [min]		Weight [%]
	Points	Weighted average	Points	Weighted average	
Car	5	1,50	2	0,60	30
Electric scooter	4	1,00	5	1,25	25
Tram	3	0,60	4	0,80	20
Bus	2	0,30	3	0,45	15
Bicycle	1	0,10	1	0,10	10
Final weighted average (max 5)		3,50		3,20	

Source: own study

The mentioned problems do not concern the users of other means of transport. In the case of the EcoShare electric scooter, the factor having the greatest impact on the results obtained was the maximum speed, which according to the regulations in force may not exceed 45 km / h [18]. Therefore, the information provided on the company's website should be considered a marketing activity as the rental vehicles would lose their approval certificate. It should also be noted that at present they do not constitute an alternative for the inhabitants of Prawobrzeże, as no housing estate in this district has been included in the return zone. Of course, operators assume that it can be lowered, but parking, loading, and servicing are only performed within it. In this matter, bike-sharing services have a definite advantage, while people traveling the discussed distance face completely different difficulties. They relate to the safety of passage on the bicycle path, along which there are, among others: design and execution errors (breaks in the track, obstacles in the gauge, breaks, faults caused by high curbs), poor condition of the surface (sandiness, unevenness, losses of asphalt and cubes) paving, exposed manholes), inappropriate technical parameters (maladjustment of traffic lights, blurred horizontal signs). In addition, its course is extremely burdensome for cyclists, as it requires overcoming very steep climbs, avoiding improperly parked cars as well as crossing tracks and exits from the property [1, 13].

The tracks of the Szczecin Fast Tram (SST) are separated from the road and street network almost along the entire test route, with the exception of the aforementioned bridge crossing over the Oder, the so-called bottleneck. As already mentioned, the introduction of a point PAT (along Gdańska, Energetyków, and Wyszyńskiego streets) means that public transport vehicles use the same space, as well as a break at the same stops. As a result, their travel times are practically in line with the timetable, regardless of the traffic intensity (Table 4). It is worth noting that the bus communication between the left and right bank of the city is served only by fast lines, which is an additional incentive for travelers. Due to the above factors, more and more drivers use the Park & Ride car park at the Hangarowa stop.

### Summary

The sharing economy influenced the development of urban transport systems in just a few years. The scope of its impact is very different, as the service of the same operator may be popular in one city, while it will be withdrawn from another. At the same time, it is difficult to assess how the models developed today will function in the future, taking into account the constant technological progress and the changing needs and expectations of society. Partly, they result from the expansion of the digital economy, which has revolutionized virtually all spheres of human activity, and thus the ways of meeting the needs of. It turns out that material goods in the form of products are systematically pushed out of the consumer market in favor of a specific offer addressed directly to the user. An example of this is sharing services, ensuring efficient movement around the city, but eliminating the need to own any vehicle. In relation to Szczecin, their further expansion is possible and advisable, but requires the fulfillment of a number of postulates, the most important of which are:

- creating separated or closed areas for the needs of PAM personal mobility devices,
- improving the cohesion of the existing bicycle network and opening new sections,
- launching the "Bike-S" docking stations outside central housing estates,
- extension of the return zones for electric scooters, in particular to the Północ and Prawobrzeże districts,
- construction of further car parks ensuring connection with the city infrastructure, e.g. Park & Ride, Park & Go, Bike & Ride, etc.,
- increasing the number of open access points that enable wireless connection to the Internet in the Wi-Fi standard,
- making the car rental offer available in an open or closed model and introducing amenities for their users, e.g. using PAT, preferential parking fees, etc.

### Source materials

- [1] Abramek K.F.: *Ruch rowerowy w Szczecinie*. Zeszyty Naukowe Uniwersytetu Szczecińskiego. Problemy Transportu i Logistyki 10 (600), 2010.
- [2] Fajczak-Kowalska A.: *Zrównoważony rozwój transportu i jego implikacje dla kolejnictwa*. Studia Prawniczo-Ekonomiczne LXXXV, 2012.
- [3] Kauf S.: *Ekonomia współdzielenia (sharing economy) jako narzędzie kreowania smart city*. Zeszyty Naukowe Politechniki Śląskiej. Organizacja i Zarządzanie 120, 2018.
- [4] Kim J., Sato K., Hashimoto N., Kashevnik A., Tomita K., Miyakoshi S., Takinami Y., Osamu Matsumoto O., Boyali A.: *Impact of the face angle to traveling trajectory during the riding standing-type personal mobility device*. MATEC Web of Conferences 161, 2018.
- [5] Litman T., Blair R.: *Managing personal mobility devices (PMDs) on nonmotorized facilities*. Victoria Transport Policy Institute, Victoria 2017.
- [6] Miłaszewicz B., Rut J.: *Zrównoważony rozwój transportu miejskiego – szanse i ograniczenia*. Logistyka 6, 2014.

- 
- [7] Motowidlak U.: *Rozwój transportu a paradygmat zrównoważonego rozwoju*. Studia Ekonomiczne. Zeszyty Naukowe Uniwersytetu Ekonomicznego w Katowicach 337, 2017.
- [8] Olejniczak M., Mendakiewicz A.: *Analiza wykorzystania systemu car-sharing i jednoosobowych samochodów elektrycznych w transporcie miejskim*. Różne oblicza logistyki. Zbiór prac studentów. Wydawnictwo Uniwersytetu Łódzkiego, Łódź 2018.
- [9] Sawant S., Prajapati D.: *A review on zero emissions vehicles*. International Journal of Mechanical Engineering and Technology 8 (2), 2017.
- [10] Shaheen S., Chan N., Rayle L.: *Ridesourcing's impact and role in urban transportation*, Access Magazine 51, 2017.
- [11] Shaheen S., Cohen A.: *Shared Micromobility Policy Toolkit: Docked and Dockless Bike and Scooter Sharing*. UC Berkeley Recent Work, 2019.
- [12] Standing C., Standing S., Biermann S.: *The implications of the sharing economy for transport*. Transport Reviews 39, 2018.
- [13] Stoeck T.: *Analiza rozwoju i bezpieczeństwa komunikacji rowerowej na terenie Szczecina*. Przegląd Komunikacyjny 5, 2018.
- [14] Stoeck T., Abramek K.F.: *Prognozowanie sprzedaży biletów komunikacji miejskiej w Szczecinie*. Autobusy - Technika, Eksploatacja, Systemy Transportowe 8, 2016.
- [15] Stoeck T., Gołębiowski W.: *Obszary dysfunkcji systemu transportowego Szczecina w ocenie mieszkańców*. Przegląd Komunikacyjny 5, 2013.
- [16] Szołtysek J.: *Ekonomia współdzielenia a logistyka miasta – rozważania o związkach*. Gospodarka Materiałowa i Logistyka 11, 2016.
- [17] Turoń K., Czech P.: *Transport miejski z wykorzystaniem usług typu „sharing”*. Komunikacja Publiczna 3, 2018.
- [18] *Ustawa z dnia 20 czerwca 1997 r. Prawo o ruchu drogowym* (tekst jednolity: Dz.U. z 2012 r., poz. 1137 z późn. zm.).
- [19] *Ustawa z dnia 5 stycznia 2011 r. o kierujących pojazdami* (tekst jednolity: Dz.U. z 2019 r., poz. 341 z późn. zm.).
- [20] Zielińska E.: *Ocena wypadkowości na polskich drogach*. Autobusy – Technika, Eksploatacja, Systemy Transportowe 6, 2019.
- [21] <http://bikes-srm.pl>.
- [22] <http://ecoshare.pl>.
- [23] <https://hop.city>.
- [24] <https://nextbike.pl>.
- [25] <https://takeanddrive.eu>.
- [26] <https://www.citybee.pl>.
- [27] <https://www.mobilrent.pl>.