

# Bike-Sharing as an Element of Integrated Urban Transport System

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**Abstract.** The following paper is meant to illustrate the use of the idea of bike-sharing system in urban logistics. In their work, the authors referred to cycling in Poland and to the Poles' attitude towards the use of the bike as an alternative means of transport in the city. The idea of self-service public bike rental system has been widely presented in the article. Further, the components of the architecture system have been discussed. The authors presented the principle of functioning of the self-service public bike rental system, called bike-sharing, as well as its transport accessibility in cities in Poland. Moreover, the authors illustrated the principle of functioning of the system by the case of public bike rental in the city of Katowice, called 'City by Bike', and in the city of Cracow, called 'Wavelo'. The main aim of the work was to present the idea of self-service public bike rental (bike sharing), its functionality and chosen examples.

**Keywords:** Bike-sharing system · Urban logistics · Urban mobility solutions · Sustainable development

## 1 Introduction

Continually increasing traffic volume connected with the dynamic development of transport, congestions of transport, tightening of ecologic restrictions or the requirements of balanced transport are only a few of those problems which currently cities must face every day [1].

Fulfilling all those requirements in the context of urban logistics is not an easy task [2]. It is because the process of creating balanced urban logistics is connected with the necessity of maintaining the balance between three main domains of balanced development: the economic, ecological and social realm [3–5].

As far as the economic and ecologic aspects are concerned, with the support of good management, the government of the city can easily create innovative and pro-ecologic transport investments. The human factor, though, seems to be the hardest one to influence on. In practice, it means encouraging the society to change their attitude towards the way they move around the cities. In other words, the change of their attitude to urban mobility and the use of alternative means of transport, and create sustainable mobility [6].

One of the possibilities of moving by the use of alternative means of transport is cycling. It is also an element of integrated transport system. Although cycling is not a new idea, in the times of smart cities, (those cities which use information and communication technologies in order to boost the interactivity and efficiency of urban infrastructure as well as to raise the awareness of inhabitants), it is possible to improve the attractiveness of mobility in the cities [7, 8].

Such action is possible by the means of the bike rental system – the idea of bike-sharing.

This article is meant to present the idea of self-service public bike rental (bike-sharing), its functionality and chosen examples, as a way to improve the attractiveness of mobility of urban logistics.

## 2 Cycling in Poland

If we perceive the bike as an alternative means of transport, we can point out many advantages of its use and prove its superiority to traditional means of transport, used in urban logistics. First of all, bike is one of the most economic vehicles, favourable to the urban transport. In terms of mobility, cycling is not only an effective way of travelling but also beneficial to health [8]. Due to shorter time of covering the distance in crowded cities and due to improving conditions of linear and point infrastructure (building of bike lines, appropriate signage, etc.), cycling is becoming more and more popular among European capital cities but in Poland as well [7].

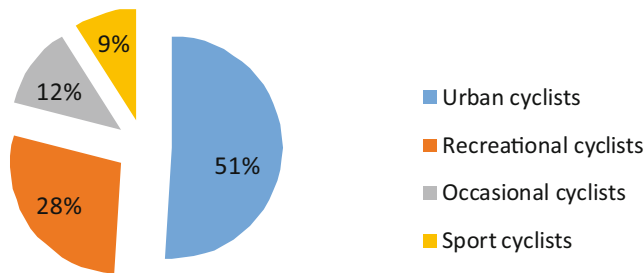
According to the report “Rowerowa Polska” [Cycling Poland] compiled from 1 May till 30 September 2016 by Allegro All For Planet Foundation, on the sample of 25000 respondents, for several years the increase in number of people using bike as a means of transport in Poland, especially in Spring-Summer season, can be observed [9]. Moreover, the examination shows that:

- 785 of respondents ride the bike every day or few times a week,
- 2/3 of respondents who are active cyclists, are drivers as well,
- Cyclists in Poland cover 60,4 km per week, on average,
- Among the cities with the biggest percentage of cyclists are: Opole, Wrocław i Łódź [9].

The research defined also the profiles of Polish cyclists. For the purposes of this article the attention was given to the profile of a cyclist using the bike in terms of the urban transport. Also the ‘urban cyclists’ are constitute the largest group among the respondents. Reaching an advantage over groups such as recreational, occasional and sports cyclist. A detailed list of profiles of Polish cyclists are presented in Fig. 1.

The research shows that a typical urban cyclist is a person who uses the bike at least a few times a week. That cyclist uses their bike as the basic means of transport. Nonetheless, they use the bike mainly to cover the distance of commute to school, university or work. On average, it is a person up to the age of 51 [9].

## Cyclists profiles



**Fig. 1.** The detailed list of profiles of Polish cyclists (Source: author's own collaboration based at [9])

Nowadays, the use of the bike on the area of many of Polish cities does not require having that means of transport on our own. Such solution is achievable due to the implementation of the concept of bike-sharing (self-service bike rental) in Polish cities.

### 3 The Idea of Bike-Sharing System

The rental of public bikes (bike-sharing, "Public-Use Bicycles", smart bikes or "Bicycle Transit"), functioning in the system of bike-sharing, is very popular in European cities. They constitute a means of urban transport which relies on temporary and chargeable rental of a bike, tandem bicycle, rickshaw or a scooter and next on returning the vehicle in any place in the city [8]. Bike-sharing is being promoted mainly in big urban agglomerations, on the grounds that it eliminates the necessity of bearing the costs of owning the vehicle [10–13].

However, bike-sharing system is not a new idea. It is claimed that it has been functioning since 1965, when the first generation of free of charge bike rental companies started to work in Amsterdam [13]. During the following years, the system evolved from free of charge offers to chargeable systems which included numerous additional services.

Apart from the possibility of renting the bike, new components of the system were gradually becoming available, which in practice meant the possibility of rental of different kinds of bikes, including electric bikes, rickshaws and scooters. The next stage was the increased number of docking stations for the bikes [11–14]. Besides those technical components, the amount of additional services offered by the rental companies increased as well, the most important of which are [15]:

- Distinct bicycles,
- GPS tracking,
- Real time availability,
- Locked bikes,
- Smart card access and others.

The proper functioning of the bike-sharing system relies on the link between such components of the system as [10]:

- The owners of the vehicles to rent,
- The users,
- The law,
- Rental,
- Organization and management of the system,
- Infrastructure of the system,
- The support of the system.

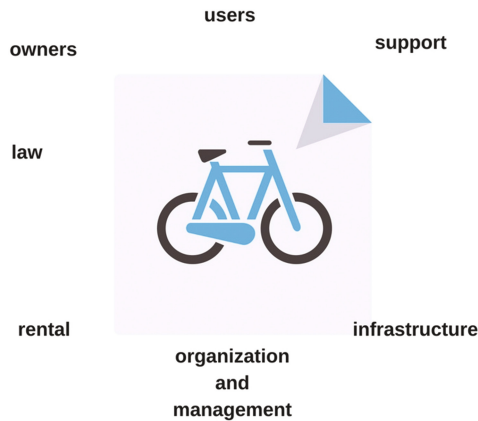
The components of the bike-sharing system are presented in the Fig. 2.

When analyzing the next components of the system, the essential one is constituted the owners of the vehicles. Among them might be some national public institutions such as local authorities or private companies which provide services to the cities [8]. The main operator of public bikes in Poland is a German chain of self-service rental companies NextBike.

Next group is represented by the users of public bikes [8]. This group includes those who according to the report “Rowerowa Polska” match the profile of the urban cyclist.

The following component of the system is the law, conditioning the rules of traveling by bike [8]. In Poland those rules are defined by the Act of 20 June 1997 – Law on Road Traffic (Prawo o Ruchu Drogowym).

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**Fig. 2.** The bike-sharing system elements (Source: author’s own collaboration based at [8])

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The rental companies are the next component of bike-sharing system. We can distinguish private rental companies, public rental companies and rental companies which function in traditional or virtual system. The latter ones have the option of booking/buying the bike for limited period of time, via the online website or specially designed mobile application [8]. An example of possibility of booking a bike by the use of mobile application of system Wavelo used in Cracow is presented in Fig. 3.

A further group of components of the system constitutes of appropriate organization and management. Those elements are responsible for the proper functioning of the activity, from the very moment of the invention of the idea of the system to its creation and implementation [8].

The last two components of the system are the infrastructure of the system, which is meant to facilitate the traffic and to ensure the proper level of road safety, and the element which is defined as the support, meaning all kind of projects, e.g.: projects fund by European Union, offering grants for the development of innovative transport solutions [8].

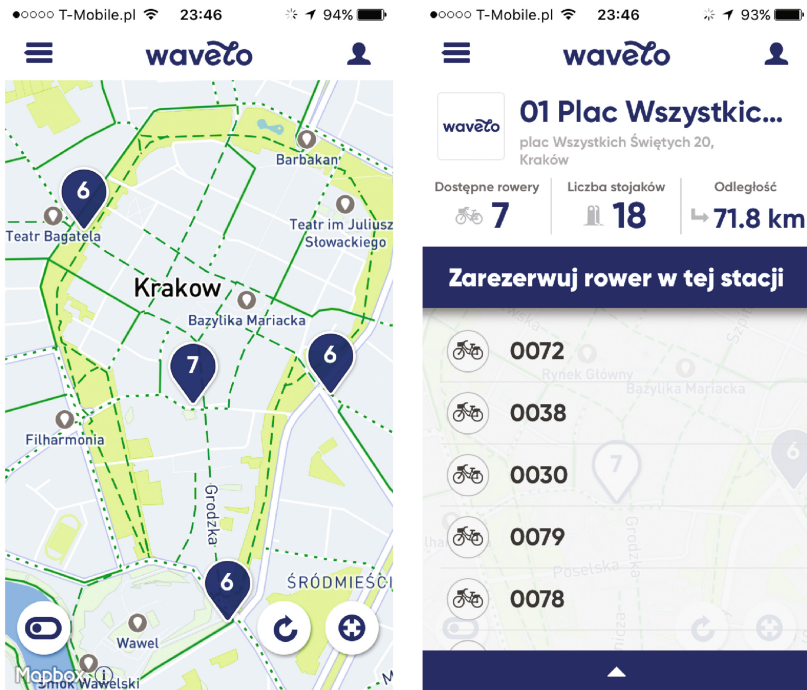
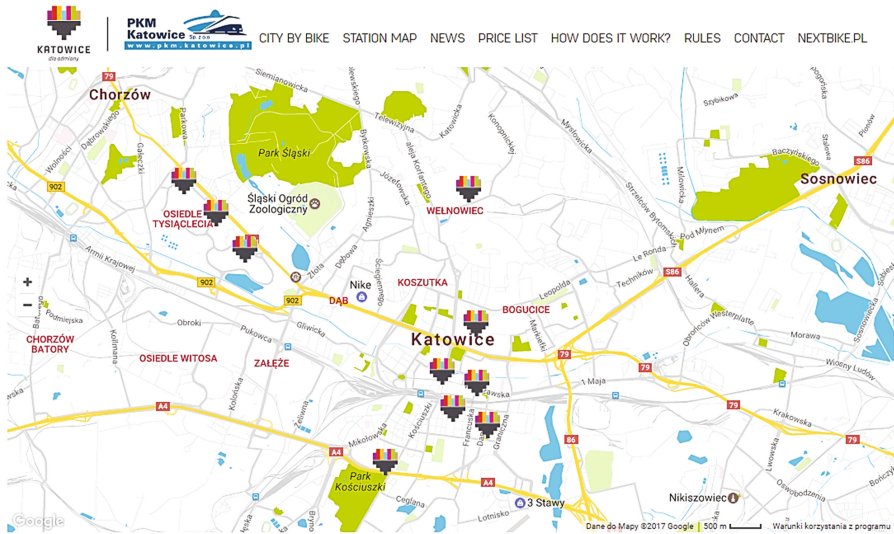


Fig. 3. Illustration of booking a bike on mobile application Wavelo

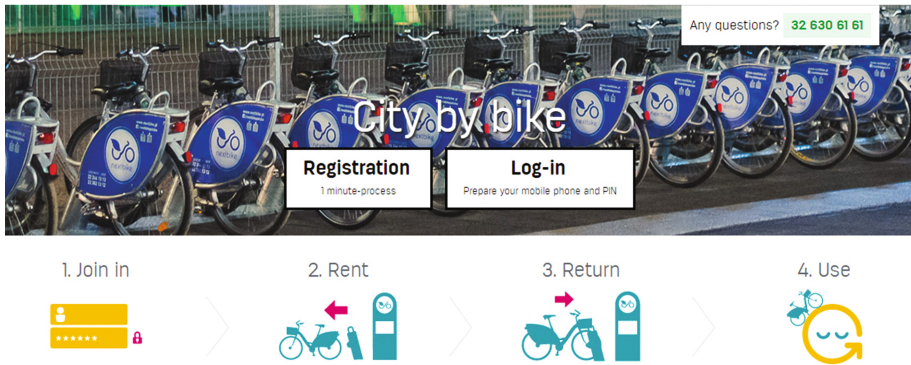
## 4 The Functioning of Bike-Sharing System - City by Bike Katowice from Katowice Case Study

The first step to use any bike-sharing system is the registration on the online website of the operator or by mobile application. In case of the system which functions in the city of Katowice, it is possible to use the City by Bike offer. The process of registration is connected with so called initial fee which activates the account in the system. The next step is to check the availability of the bikes on the map offered by the system. An example of the localization of the bikes on the map of Katowice obtained by the system ‘City by Bike’ is presented in Fig. 4.

The following step is the actual renting of the bike. It can be done by approaching the terminal and entering the phone number as well as an individual PIN code. From this moment the bike is ready to use. After the use, the bike should be left at one of the City by Bike bicycle racks and fasten by the electric lock. In case of no free racks, the bike must be fasten by a combination lock to any rack or to any other bike. The user must choose the option “return” on the terminal of the bike. Right after finishing the travel it is possible to rent another bike or the same one after the period of 3 min [16]. The use of the system is fairly intuitive and consists of four basic steps, presented in Fig. 5, and it should not cause any trouble to the users.



**Fig. 4.** Localization of public bikes on the map of the city of Katowice – system City by Bike. The places where renting the bike is possible are tagged by the sign of heart. (Source: [16])



**Fig. 5.** Operating principle of City by Bike Katowice (Source: [16])

The City by Bike system is available for users from 2015. The popularity of the system provides the amount of:

- loans,
- new registrations in the system,
- available bikes,
- available dock-stations,
- loans by the most active system user,
- daily maximum loans,
- monthly maximum loans.

These data from the beginning of the system implementation in May 2015 to October 2016 are presented in Table 1.

**Table 1.** Development of the popularity City by Bike Katowice system in 2015 and 2016 (Source: [16])

Season	2015	2016
Amount of loans	7571	38217
Amount of new registered users	2632	6549
Amount of bikes	40	88
Amount of dock-stations	3	11
Amount of loans by the most active system user	51	170
Daily loan record	139	524
Monthly loan record	1787	8490

The operator of the bikes provides 15-minute free of charge ride. However, it should be noted that the one-off initial fee will be charged. It is also worth remembering that in case of exceeding the 12-hour time of the use of the bike, a 200zł fee will be counted, and in case of a theft, losing or destroying the bike, the user will be charged a 2000zł fee [16].

## 5 Summary

In summary, according to research the idea of cycling is among Poles increasingly popular. The article, and especially the example of system operating in Katowice, shown the development of bike-sharing system in Poland over the years. The City by Bike case study presented an increase of amount of bike loans to 30 646 during one year of functioning. It could be stated that the bike-sharing is a possibility of a better dissemination of traveling with the use of bicycles as a primary mode of transport in urban logistics. The examples of the functioning of the bike sharing, show that the principle of the system is simple and intuitive for users. Moreover, the system has many additional functionalities like: GPS tracking, real time availability, Locked bikes or distinct bicycles. All these features, along with the financial benefits such as a free 15-minute bike ride are likely to increase public interest in cycling, and ultimately contribute to increase the attractiveness of traveling by bike in city traffic.

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