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Development of bike share systems and their impact on the sustainability of urban transport. Case study of Opole Bike

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Abstract: In this article, the bike share system Opole Bike developed in the Polish city of Opole will be used as an example of the influence of bike sharing on the sustainability of urban transport. The system was implemented in this middle-sized city in 2012, and this article will provide some assessment.

Keywords: sustainable transport, bike share system, Poland
JEL: L92, O18, R41, Q01

1. Introduction

Sustainable transport concerns the ability to combine the need of society to move free and fast with essential human and ecological values, today or in a future (Hitoshi and Junichiro, 2010: 60). The rash urbanization forces more and more cities to look for new solutions by using public transport or other forms of urban communication. An assessment of the dimensional model of public transport can be made with help of the following two structures (Jönson and Tengström 2006: 46):

a) network and service structure – describes the degree of integration of the public system, i.e., how are public transport forms coordinated with each other.
b) organizational structure – describes the market structure for public transport, ranging from monopoly to full competition.

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In Central European cities, until a few years ago the bicycle was not really considered in this context. In this article it is argued that the bicycle may become one of the most efficient forms of transport in urban areas in cities in this region. This traditional form of mobility has a lot of advantages when used for short distances - both economic and social. It creates potential to make biking the basis of sustainable city transport. An example of new bike solutions which are developing in the public transport is bike share systems. From only several bike rentals in the 1960s and 1970s, currently there are several hundreds of bike share and rental systems worldwide (http://www.utilitycycling.org). Different factors have an impact on the popularity of city bikes in several cities (e.g., the size, spatial structure or degree of development). The analysis of the role of bike sharing for transport systems is based on a typical middle-sized city in Central Europe. The city under consideration is Opole, located in the south-west of Poland, where a bike sharing system was introduced in 2012. The author obtained information as the chair of a project by the student organization "oikos Opole" on bike share and rental systems in Opole. In this article it is shown why these systems are useful and how they function, and advantages and disadvantages of city bikes in context of sustainable transport systems will be presented from the economic, ecological and social point of view.

2. Need for bike share systems

A bike share system is a solution for short trips within the city to enable direct communication between strategic points (http://www.pedbikeinfo.org/programs/promote_bikeshare.cfm). It is a solution when bikes are not used on a daily base by citizens, or for commuters using public transport or tourists. Registered users have the possibility to pick up a bike in the rental station they want and return it in another station. The whole process of bike sharing is supported by a special information system, which registers all trips and shares. It ensures also the safety of bike sharing. The system saves information about who used the bike, for how long and also all problems with the hire. In practice, when we want to move between two points in the city, we need to log in at our start station. We can choose the bike we want. We go to our final destination and give back the bike by logging out from the system. An individual password, which was acquired by way of online

registration, is needed to log in/out. We can also use chip cards to register in the system, making the use of the system easier.

A fee has to be paid for the use of a bike. In the system there is a rental time, when the use of bikes is free of charges (in Opole up to 20 minutes). Assuming an average speed of 15 km/h, this the user may travel about 5 km for free, making the bike share system one of the cheapest urban transport forms for short distance travel .

Currently, systems are easier and safer than at the beginning. The first bike share systems did not function properly. The so-called "white bicycle" system implemented in the 1960s in Amsterdam collapsed when too many bikes were stolen – they were absolutely for free and no security measures were taken. The experiment with "yellow bicycle" in Paris led to a similar result. Some bikes were destroyed, found in the Seine or even in northern Africa (http://www.utilitycycling.org). Experiences from the functioning of these systems supported the development of bike sharing with automatic and informational systems. IT systems used by bike rentals reduce the likeliness that bikes will be stolen or destroyed. The reason is that the responsible person can be easily identified.

The high potential for the development of bike share systems is in accordance with the EU Transport Strategy 2050 (White Paper) and its vision of clean urban transport and commuting. The main goals are: switching to cleaner transport forms in the city and reducing CO_2 emission through increasing the importance of walking and cycling (European Commission 2011: 8).

3. Best practice in bike sharing

The basis for the implementation of bike systems is the cycling infrastructure within the city. Its quality and quantity is an important factor in supporting safe mobility, and the success of a bike sharing system. The logic is simple. When cycling is dangerous and uncomfortable, while some areas are difficult to access (e.g., cyclists have to drive on heavy traffic roads or are not allowed to drive on certain roads) it is not likely to be an attractive alternative for other modes of transport.

The largest bike sharing system in Europe exists in Paris, called Velib. There are 1450 stations with about 20.000 bikes (Advocacy Brief 2011). The system uses experiences from the first experiment in 1970 and is much safer as these 40 years ago. Velib is used not only by the population of Paris, but also by tourists. The stations are mostly located in the most attractive places in the city, providing a good opportunity to visit the city in a pleasant and inexpensive way.

Bike share systems are also popular in Vienna. There are two different systems in this city: Citybike Wien and Next Bike Wien. The first system consists of 120 stations with 1500 bikes and is located in the city center (http://www.wien.gv.at/verkehr/radfahren/service/citybike.html). The current sharing situation is in real-time presented on the internet site of Citybike Vienna – how many bikes are available in each station. This system is often used by residents of Vienna. Users in Vienna travel by the public bike about 30.000 km per day (http://www.citybikewien.at/). The second system Next Bike is used at the city edge. Working with two separate systems facilitates control, planning and use of bike sharing.

Picture 1. Bike share system Velib in Paris (left) and Citybike in Vienna (right)
Source: Paweł Drynda.

The Leipzig based company Next Bike has created the most popular system used in different cities of Europe. Except Vienna, the system is the most popular in Poland, where it is used in cities such as Wrocław, Opole, Poznań, Warszawa and Sopot. The Next Bike System in Wrocław is a good example of the popularity of this kind of transport. At the end of June 2014

about 64.000 users were registered, about 10% of the whole population of Wrocław (Gazeta Wyborcza 2014).

4. A framework for sustainable urban transport

The need for bike share systems will be analyzed on base of typical European cities. In will be shown how sustainability is interpreted in a typical transport model in Europe. For a description, the classification of transport models created by Jönson and Tengström (2006: 47) can be used (see Figure 1). This classification is based on two dimensions: network and service structure and organizational structure (explained above). The European transport model is characterized by a high level of coordinated network. It means that all forms of public transport are coordinated with each other. Each vehicle type plays another role in such systems, in order to make all means of transport complementary and create an integrated system (Jönson and Tengström 2006: 48).

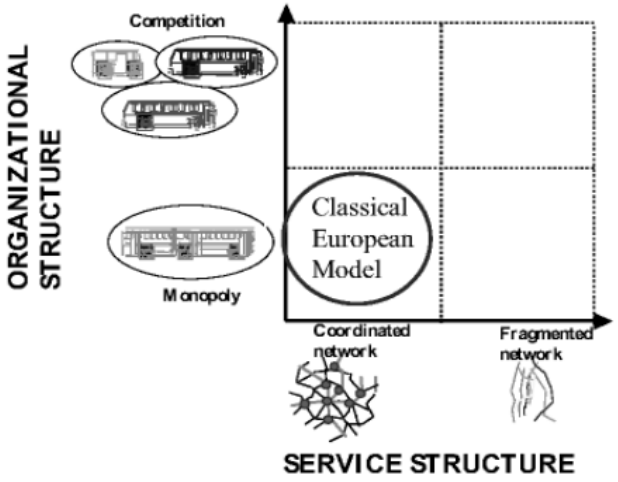

Figure 2. the European transport model
Source: Jönson and Tengström (2006: 47).

To explain what an integrated transport system means, the example of Vienna (Austria) can be used (Figure 2). Railway, short trains, subway, buses and city bikes are integrated in the system. Trains are used to connect the main points in the city and in the suburban areas. The subway is particularly used to reach of strategic points within the city center. All other objects within the city can be reached, depending of the location, by bus or by bike.

Figure 2. Transport model of Vienna
Source: http://homepage.univie.ac.at/horst.prillinger/metro/m/largemap-s-wien.html [05.08.2014].

The second, organizational dimension, describes the competition on the transport market. There is a monopoly in public transport in a typical European city. For Vienna, the company Wiener Linien is an example, being responsible for coordinating all types of vehicles. This situation has both economic and social advantages. On the one hand, each passenger can travel using only one ticket in all forms of public transport (excluding city bikes, which have to be paid separately). On the other hand, the fact that all modes of transport are managed by the same company, enables a better coordination between all forms of transport, reducing travel time.

The sustainable European transport model embraces mobility which is secure, safe and environmentally sound, and in accordance with EU policy (Golinska and Hajdul 2012: 5). Further goals are: avoiding of congestion, oil dependence, accidents, CO_2 emission and noise (Golinska and Hajdul 2012: 4). This policy creates good opportunities for the development of bike share systems, which should be integrated into the whole transport system.

5. Impact of bike share systems on urban transport

The typical west European model of public transport is highly integrated (high service structure) with a monopolistic organizational structure (Jönson and Tengström 2006: 47). Too much motorization in the city causes a wide range of problems, which challenges the sustainability of transport systems. A tool in supporting sustainability is the development of bike share systems, which, as mentioned, should be an element of an integrated public transport system. The monopolistic structure and municipal control of urban public transport is likely to facilitate the development of a bike rental system.

Bike sharing systems play an important role in the sustainability of urban transport. The importance of bike sharing systems can be assessed in the three areas of sustainable development -economy, social and ecology (environment). Some advantages and disadvantages discussed are summarized in Table 1.

	sustainability aspects		
	economy	social	ecology
positive effects	• realization of EU Strategy • development of multimodal transport • relatively low costs	• modern life style • safety and social integration • bike tourism	• CO_2 reduction • cleaner cities
negative effects	• financial support needed • costs of repair • missing infrastructure	• own bike is more reliable	

Table 1. Impact of bike sharing on sustainability aspects
Source: author's own elaboration.

5.1 Economic aspects

Profitability and compliance with the European transport strategy are the most important aspect of implementation of bike rentals in the context of sustainable transport systems. The EU strategy for sustainable transport is the main starting point. Developing cycling in the city is one of priorities in the EU Strategy until 2050. All aims were described in the White Paper, a document for transport strategy of the EU. The main postulate is to develop cycling and walking as an important part of urban transport in the everyday life. Non-motorized transport is much more popular in Asian metropolises, where walking and cycling are the most important part of

the everyday transport. For instance, in Delhi (India) only 11% of population uses a car to go to work or school, while the percentage for Beijing is only 5% (Jönson and Tengström 2006: 147).

The goal of the European White Paper is to provide a higher availability of public transport combined with a minimum level of services and the increase in the frequency of public transport (European Commission 2011: 9). Bike share systems are a solution which corresponds with this vision. It is a form of public transport which is from the spatial point of view may be more efficient than individual possession of bicycles. For example, when 100 people would use their private bike to go to work or school, then parking places for 100 bikes are needed. But when we assume that a bike rental each bike will be used for 4 persons per day, only 25 bikes are needed for 100 peoples. Thus, using bike sharing is not only an ecological transport solution reducing traffic, but also supports optimization of using this mean of transport.

Another advantage of bike rentals is that their use in combined transport reduces the last mile problem. The interface between long and short distances should be optimized and the part of individual transport reduced to minimum according to the EU strategy (European Commission 2011: 9). A good example of multimodal urban transport is the combination of rail with biking. Many people go to the work from small cities which are localized far from the city center. While the car is still a popular form of transport, its attractiveness declines due to time loss during peak hours, higher costs and negative impact on the environment. A more sustainable solution is using rail to travel to the city, in combination with urban public transport. A bike makes it possible to achieve each point in a city. However, it is not for everyone the most comfortable way transport his/her own bike by train each day, while leaving it at the railway station is related with the threat of theft (no monitored bike parking exists in Poland). Bike share systems offer an alternative. They are developed as supplementation of the complex public transport system in many countries (Newman and Matan 2012: 201). Each commuter can travel by the train, and take a bike at the railway station.

Bike rentals are cheaper than traditional forms of transport forms. In comparison with cars, bikes do not need petrol and have lower maintenance costs. According to calculation of the magazine “Australian Geographic”, the maintenance of one bike costs 1 cent/km compared to 50 cent/km for a car (Bain, 2010). The user does not have to care about any repairs or other technical problems when using a vehicle from a bike share system. Bike rentals are also cheaper compared

to bus transport. The first 15-30 min of using of the bike is normally free of charges. It is possible to get to many places in the city during this time.

Maybe the most important problem with bike share systems is their financial support. As a cheap form of mobility with low charges in order to increase its attractiveness, they have to be supported by sponsors and from public sources. Nowadays, bike rentals are not very popular yet. This makes it difficult to find sponsors, increasing the need for public financial support. Most bike share systems are financed from public money. Thus, investment and operation costs will be a long term position in the city's budget. As a consequence, bike share systems are unlikely to be able to supply bikes for all commuters. It should be used as a complement to, and generator of individual bike use.

More bikes imply an increased need for bicycle infrastructure. In many Polish cities there are not enough bicycle roads and other elements of infrastructure to make cycling easier and safer. On the one hand, this discourages cycling. On the other hand, it increases the cost of development of bike share systems due to the need to improve the infrastructure.

Another source of problems are technical issues. Bikes have to be maintained and repaired. When bikes have to be repaired often, this may disturb the functioning of the system. This is a serious problem, as the user is not the owner, and therefore may have weaker incentives to be careful with the bike. Although the identity of the users are known (they have to be registered) the identification of who damaged a certain bike may be problematic.

In the short-term bike rentals are unlikely to be profitable. When considering the long-term perspective, the balance may be positive, in particular due to a reduction in environmental costs (e.g., air pollution, CO_2 emission reduction) as well as social costs (reduced health problems due to increased use of bicycles) and cost of infrastructure (development of bike infrastructure is likely to be cheaper than infrastructure for cars).

5.2 Social aspects

A positive trend in modern life style is that more and more people seem to be interesting in sports and healthy food. It can be noticed, not only in Poland but also other countries like Austria, that people more often go walking, running or cycling after work. On one side, it is a way to keep the body fit. On the other side, it is a form of relaxation when life is stressful.

However, biking and walking are not only an increasingly popular way of spending of free time. It can be observed that more and more people use it as a mean of transport in order to go to school or to work. Biking as a transport solution is an instrument to increase peoples' quality of life.[1]

A bike share system supports this idea and corresponds with what can be considered a modern life style. It enables flexible and convenient use of bikes within the city and saves time for conservation and dealing with technical problems with a bike. Biking can have a positive impact on both physical and psychical health. What people tend to forget is that it is a mean of transport to get to work, school or the shop, while at the same time in fact doing a fitness training. In discussions on the bike system in Opole, the argument has been brought forward that in a cost-benefit analysis between bikes and other forms of transport, the fitness aspect should be counted as a direct benefit for the individual, not only in the form of increased health, but also the reduced need to go to the gym.

Biking may also create social groups. People, going to work by bike, tend to have understanding for each other and they feel integrated with other bikers. Each bike share system creates a kind of group. People, registered in and using the system, in fact create a society. They can communicate with each other and exchange experiences. Thus, a bike share system is a social platform for communication between people moving in their everyday life by bike. Research carried out by Alex Allen (Bain 2010) shows that people living in districts with less cars have threefold more friends than residents of the more motorized parts of a city. Regular use of the bicycle supports integration and a positive relationship between neighbors.

Bike transport may also improve safety in city life. This will be the case when more bikes lead to less cars, and have a lower driving speed of cars as a consequence. However, the moment when drivers are not used to bikes, the number of accidents may increase. When bike transport is integrated in urban transport policy, and traffic is slowing down, children can play on the street and people live much calmer in non-motorized part of city. Statistics display how important the safety of urban mobility is. Motor vehicles have killed more than 30 million peoples and injured more than 500 million worldwide in the last one hundred years (Jönson and Tengström 2006: 283). These numbers are not in accordance with principles of sustainable development.

[1] Mayor of Vienna Michael Häupl during the state convention, 26.04.2014: http://www.radfreunde.at/ [20.07.2014].

A bike share system can also be a good solution for touristic attractive cities. It improves the accessibility of attractive places for tourists. Use of bike sharing is, compared to bus or subway transport, easier and enables to reach each point in a city center. Thus, the tourist function of a bike rental is an extra reason for municipal support for such a system.

A question is to what extent people possessing their own bike creates competition for a bike rental system. Having one's own bike makes cycling more flexible and available. It is also better to use the bike we know and which is individually adjusted to our physical characteristics. A bike share systems may be of particular interest for cities with many students and commuters, not possessing their own bike. Another group of potential users is people occasionally using a bike, making the purchase of one's own bike unattractive. Bike rentals are a good solution for cities with low bike possession, where the example function can trigger off increased bike purchase as people may become increasingly aware of its attractiveness. However, the system is unlikely to function in each city. The conditions for success need to be assessed before investing resources in such a system.

5.3 Ecological aspects

One of the most important goals in the EU Strategy is to halve the CO_2 Emission by 2030 and to achieve CO_2-free city logistics in the largest urban centers (European Commission 2011: 10). These goals are really ambitious, but not unachievable. Popularization of bike transport is an important element for achieving these goals. The implementation of bike share systems will help to create conditions and to convince people to use bikes instead of another transport forms in city centers. According to research, it is estimated that 10 million km by bike enable to reduce CO_2 emission by 1730 tons (Bain, 2010). This is equal to the emission produced by more than 170 people in one year (the EU average is about 10 tons/person/year (http://ziemianarozdrozu.pl/encyklopedia/50/moja-emisja-co2-kalkulator)).

The use of bikes in cities not only contributes to the reduction of CO_2, but also supports the reduction of noise. Too much noise in city centers negatively influences the quality of life. Bike share systems also support a more sustainable urban planning and the creation of a spatially more attractive city. The using of this form of transport saves urban space. It is possible to park about 12-16 bikes on the parking for one car (Bain 2010), implying the opportunity to reduce

parking space by almost 93% in the theoretical case everyone would change the car for a bike. One bike station could reduce the demand for paring in urban space by 138 m2 (12 bikes - by standard size of a car parking 2.3m x 5.0m (http://www.helpster.de/parkplatz-die-abmessungen-von-stellplaetzen-beachten-sie-so_125891)). This space in city centers could be used for other purposes, such as investments or to create green space.

6. Bike share system Opole Bike

Opole is a middle-sized city in the south-west of Poland. The city is characterized by a relatively large share of the population in the non-working age, a group which is still increasing in relative size (Strategia Rozwoju Województwa Opolskiego 2012: 30). However, Opole is also a city with a high share of students – 98 students per 1000 residents (Strategia Rozwoju Województwa Opolskiego 2012: 116). This is important as students are the most important target group for using bike rentals. Also, the infrastructure and size of the city create good opportunities to promote cycling. All points in the city center can be achieved by bike within of 20 minutes. Although bike infrastructure in the form of special bicycle lanes is missing, it is developing.

The system Opole Bike started in June 2012, and was the third system in Poland (after Kraków and Wrocław). It is operated by the Leipzig (Germany) based company Next Bike. At the beginning, 10 stations with a total of 100 bikes were opened (http://www.mmopole.pl/artykul/ruszyly-opolskie-wypozyczalnie-rowerow). The investment costs amounted to 200.000 zł (almost 50.000 EUR (http://www.mmopole.pl/artykul/beda-wypozyczalnie-rowerow-w-opolu)). The location of the bike stations is shown on Figure 3.

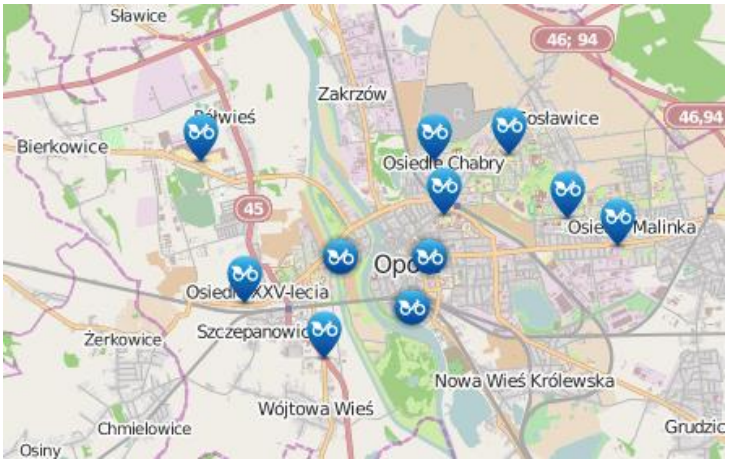

Figure 3. Localization of bike stations in Opole Bike
Source: nextbike.pl [available: 20.07.2014].

Analysis of locations helps to understand what is the mission of Opole Bike. The following groups of bike stations can be distinguished:

a) Major parts of the city (Chabry, Politechnika, Malinka, Zaodrze) – these locations are the biggest districts in Opole. The bike stations offers the opportunity to communicate between these parts of the city.
b) Student centers (Technical University – Prószkowska and Sosnkowskiego, Opole University – Oleska) – localization of the stations near to student campus is justified by the target group. Students are one of the most important groups using bike sharing. The reasons are particularly the low costs and the fact, that students rarely have their own bike in the city where they are studying.
c) The city center (Pl. Wolności) – the station direct in the center could is in fact the main bike station (see Table 2). It enables to get to the city center from each part of Opole.
d) The railway station – this station the most important station in the context of the combined transport and the last mile problem. It enables people to come to Opole by train and then using bike to get to individual points within the city. This station is also a starting point for many tourists.
e) Bolko island – the station in this green part of the city is of importance for tourism as well as citizens willing to spend their leisure time. This location is logical from the point of view of supporting cycling as a leisure time activity. While it does not really support the reduction of traffic, it is instrumental in popularizing cycling.

An additional station was opened in the shopping center "Karolinka". This may be of importance for developing the habit of cycling for shopping, as large shopping centers are rather generators of car traffic. The bike station is also a marketing instrument for the shopping center.

The price is bike rental in Opole is set at a level encouraging its use. The first 20 minutes are always free of fees. Each bike costs 2 zloty (about 0.50 EUR) for use between 21 and 60, while when exceeding use of more than 1 hour costs 4 zloty (about 1 EUR). Each person willing to use the bike system has to register on-line registration on the system operator's website, and paying 10 zloty (2.50 EUR) starting fee (Gazeta Wyborcza 2012c). The first 20 minutes of use are for free due to support from the city. During the first year, the system's costs for Opole were 215,000 zlotys (about 53,000 EUR) (NTO, 2012b). In Table 2 it is shown how much bikes were hired from each station.

Plac Wolności	10 329
Uniwersytet – Oleska	5659
Politechnika – Sosnkowskiego	5131
Niemodlińska – Spychalskiego	4415
Sosnkowskiego – Skaut	4144
Chabrów – Agawa	3336
Wyspa Pasieka	3078
Ozimska – Piotrkowska	2298
Pętla Autobusowa – Dambonia	1598
Kampus – Prószkowska	1215

Table 2. Number of hires by each station of Opole Bike in season 2012
Source: Gazeta Wyborcza Opole (2012c).

The most popular rental station is station Plac Wolności (see Table 2), localized directly in the city center. This is the main communication point of the system. A lot of people come from different parts of the city and return the bike at this station on their way to work. The next two popular stations (Uniwersytet-Oleska, Politechnika-Sosnkowskiego) are localized at university campuses or near university buildings. This fact highlights that the students are strategic group for the bike rental. It gives to Opole as a student city a good opportunity to develop of bike systems.

Already the first month from the system's start displayed the high potential for rental bike in Opole, with 2,800 registered users, and about 11,000 hires (NTO, 2012a). Also a good result was achieved in the second month. The number of registrations increased from 2,800 to 3,900 users and the number of hires increased to 14,600, an increase of more than 3,000 compared to the first month (Gazeta Wyborcza Opole 2012b). Altogether, in the first season 2012 about 4,400 users were registered, while the number of hires achieved 40.000 (NTO 2012b).

The safety of a bike rental is a very important question. Each person is responsible for the bike during its use. However, each bike is equipped with GPS (Gazeta Wyborcza 2012a), so in case of theft is easier to find it. Another problem of bike rental is damages to the bikes. Regularly baskets, lights, bells and gears are being destroyed. Each user should use the bike responsible to avoid these problems. When somebody detects any damage when willing to rent a bike, he/she should inform the customer service. Each station is visited two times per day by the technical service (NTO 2012a). Its task is to repair the damaged bikes but also to control the number of bikes at each station. For example, when most people come from the city edge to the center, there are likely to be too many bikes at the rental station in the center. The service personal transports these bikes to other stations with a shortage of bikes. General maintenance and repair takes place during the winter break from December until the end of February. During this time bikes are taken back to a magazine. This shows one weakness of the system. While it seems to be logical that during winter people do not use bikes because of the temperature and possible snow, this forces them to use another mean of transport. This issue concerns in particular students, and whether this is a real problem needs deeper research.

	March (in thousand)	**April (in thousand)**	**registration users (in thousand)**
2012	-	-	3.9
2013	2.4	5	4.7
2014	7	8	5.4

Table 3. Bike rent and user registration for Opole Bike – 2012-2014
Source: based on GazetaOpole.pl (2014),

After the successful start in 2012, 2013 and 2014 showed growth of registered users (see Table 2). About 7,400 bikes were hired altogether in March and April 2013. This is 32% less than in the first month of system's functioning (in July 2012 – 11.000 hires). Numbers are difficult to

compare, as July as a summer month makes cycling more attractive, while people may have wanted to try the bike share system because it was new. Furthermore, as people may buy their own bike, this may have also influenced the data. Only after some years, data may be compared in order to analyze trends

In 2013, 4 new stations were opened, making a total of 14 bike stations and 140 bikes (http://www.24opole.pl/11853,Kolejne_terminale_miejskiej_wypozyczalni_rowerow_w_Opolu_juz_dzialaja,
wiadomosc.html). The year 2014 showed a large increase in the number of hired bikes – in March 291% and in April 160% in comparison with the same months 2013. The number of registered users also increased to 5,400, an increase of almost 40% compared to 2012.

7. Concluding remarks

In this paper the functioning of bike share systems was discussed in the context of different elements of sustainable development. Undoubtedly, the bike rental system is an important solutions in modern urban transport in Poland. This is in accordance with the EU transport strategy, reducing CO_2 emission and resolving of the last mile problem. There are also social advantages regarding the fulfilment of human needs - people willing to be mobile while having a modern but also healthier life style. The use of bike rentals enables to match mobility, in particular in city center, with sport activity in the everyday life. From the economic point of view, bikes are cheaper that other forms of transport. This not only concerns maintenance (which does not exist in case of renting a bike), but also the cost per travel. The bike rental Bike Opole shows that bike share systems can be a good, sustainable solution in the today's transport. The number of registered users of bike rental in Opole are increasing. Bike as a mean of transport may become the most important for everyday transport to work or school, due to the relative small distance in the town, but also increasing problems with traffic jams Bike share systems have still a high potential in large and middle-sized cities in Poland and other parts of the world, where more and more bike share systems are developed.

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ROZBUDOWA SYSTEMY WYPOŻYCZANIA ROWERÓW ORAZ ICH WPŁYW NA ZRÓWNOWAŻONY ROZWÓJ TRANSPORTU MIEJSKIEGO. PRZYPADEK OPOLA

Streszczenie: W artykule poruszono temat rozbudowy sytemu wypożyczania rowerów w Opolu, jako jeden z przykładów miast gdzie następuje proces powiększania wpływu dostępności rowerów publicznych na stopień zrównoważenia transportu miejskiego. System ten został wdrożony w tym średniej wielkości mieście w 2012 roku, a niniejszy jest artykuł jest okazją do dokonania jego oceny.

Słowa kluczowe: zrównoważony transport, system wypożyczenia rowerów, Polska
JEL: L92, O18, R41, Q01