



Smart Solution of Traffic Congestion through Bike Sharing System in a Small City

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Abstract

Bike sharing system as mode of public transport is very popular in the world. This smart solution can be described as answer to an increasingly frequent traffic congestion and parking problems in many cities all around the world. This issue is beginning to relate to some cities in Slovakia as well. Bicycles address traffic congestion as they form a valid substitution for cars on short trips, contribute to the use of public transport by providing effective last-mile connectivity and simply take up less space on the road. As the system of shared bicycles works from 2016, it is relatively new in Slovakia. This is a reason why this system still has some problems and deficiencies that need to be optimized. Presented paper focused on the city of Nitra, which is currently struggling with the issue of traffic congestion. The main aim of paper is to point out the opportunities and constraints arising from the concept of shared bicycles in the conditions of city of Nitra. Our proposals and recommendations are based on the opinions of the citizens of Nitra obtained from conducted marketing survey (625 respondents – citizens of Nitra). The results of the survey have brought important insights into improving the strategy of shared bicycles, focusing on attractiveness for citizens, and ultimately, urban transport solutions.

Keywords Bike sharing · Citizen · Traffic congestion · Transport

1 Introduction

The definition of a smart city is continuously evolving as discoveries emerge that improve our standard of living.

Transport and mobility should be knowledge-based, with smart parking, traffic sensors and car sharing apps. The factors that define intelligent cities and form the basis for analysis and Smart Cities Index creation are as follows: smart parking, smart building, urban planning, wi-fi hotspots, car sharing, services, waste disposal, education, smartphone penetration, traffic, environment protection, business, ecosystem, living

standard, public transport, citizen participation, 4G LTE, how the city is becoming smarter, clean energy, digitalization of government, Internet speed, cyber security [1]. For our study, we chose factor – transport as one of the key points of the Smart city platform in the condition of the city of Nitra.

Traffic congestion is a vexing problem felt by residents of most urban areas. Despite centuries of effort and billions of euros worth of public spending to alleviate congestion, the problem appears to be getting worse. Despite the exasperation that traffic congestion causes, most people know surprisingly little about it or what can be done about it, and much of what is stated in the media is oversimplification [2].

Bike sharing systems have in common that they are adding a highly individual form of low-carbon transit in cities that are continuously looking for measures to become more liveable and maintain their attractiveness for citizens and businesses [3].

With bike sharing systems popping up all over the world, it's about time we look critically at the role these systems can play in a city's urban fabric and transportation system. While bikes have been an integral part of the modal mix in many cities for years, they served a similar purpose to automobiles: exclusively personal mobility. Bike sharing has altered that paradigm, essentially creating a new mode of public transit [4].

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Using a bicycle for commuting to school, work, or errands (even if just short distances) can improve physical and mental fitness, reduce problems with parking/traffic congestion, and lower carbon emissions [5].

The city of Nitra has got the ideal conditions for development of bicycle transport on a daily basis as it is not a very large city by square kilometers and the marginal residential areas of the city are not several kilometers far from the center. Public bicycle is a solution that improves not only the city logistics in the field of traffic management, but in itself it is also logistically challenging endeavor. Planning the network, managing large number of bikes and stations in the city system, including the transport of bikes between stations as well as providing logistics solutions for equipment servicing are a few of many challenges [6].

Whether cycling facilities are available in a workplace reveals an employer's attitude towards modes of commuting. The presence of cycling facilities, such as secure storage, showers and changing rooms, makes cycling more attractive [7]. In the Netherlands a tradition and positive attitude towards cycling, as well as good bicycle facilities, have led to the highest bicycle rate in the world. In addition, the national government encourages further bicycle commuting by providing tax benefits and enhanced facilities such as 'bicycle highways' [8]. Many studies have been carried out aimed to commuting, in particular into the role of the car [9, 10]. However, bicycle commuting has so far got only limited attention. Available research found that the weather conditions and climate, socio-economic aspects, travel distance and attitudes towards cycling explain individual's bicycle mode choice [11, 12].

Rates of cycling to work vary significantly from one urban area to another. Many factors influence the choice to cycle to work. Some are part of geography, such as terrain and weather. The insights indicate further need for closer collaboration between promoters of commuter cycling and wider urban disciplines to shape effective, low stress routes in the heart of cities [13].

As more and more cities add programs, it is important to more concretely define bike sharing as a mode of public transportation. Cities around the world are cash-strapped, leading many to a lose-lose dilemma of higher quality service covering a smaller portion of the population versus lower quality service covering a larger portion. One of the beauties of bike sharing as public transit is that it is indescribably cheap [4].

2 Material and methodology

The aim of the presented paper is to point out the opportunities and limitations that result from the concept of shared bicycles in the conditions of city of Nitra. Arriva bikes stations are

located mainly in the city centre and thus their location has the greatest use especially for tourists. Through marketing research, we want to find out what people think of the use of Arriva bikes system and gain important information for the full use of bicycles by the residents themselves. In order to achieve the formulated aim of the paper had been collected and used primary and secondary sources of information. Marketing research was conducting in the period from May 2018 to December 2018. The questionnaire was evaluated by contingency tables, which were prepared in XLStat; graphic representations of the obtained data were created subsequently. When processing of individual underlying data and formulating conclusions of the paper were used methods of analysis, synthesis, induction, deduction and the comparative method. For the purposeful evaluation of the assumptions and hypotheses we used the following statistical tests: Kolmogorov-Smirnov test, Levene's test and Bartlett's test.

The questionnaire was processed in Google Forms and people were asked to fill in on social networks (in groups where the inhabitants of Nitra were exclusively associated) and via emails. Some questionnaires were filled in printed form by personally meeting just at the bicycle stations. In the research outcomes were involved totally 625 citizens of Nitra of which 56% were non-registered citizens and 44% registered citizens (Table 1). Some of the processed questions are presented in the paper.

3 Results and discussion

3.1 Why is bike sharing project necessary in the City of Nitra

Some of the major strengths of the City of Nitra are: existence of strong potential of industrial and agricultural capital goods, sufficient and qualified work force, universities and a research center in Nitra, sufficient space for potential development, built highway connecting Nitra with Trnava and the rest of Western Slovakia and the EU and possibilities of cross-border tourism development in region. Thanks to its favorable geographic conditions, many foreign investors have come in the city and have developed large companies (especially Jaguar Land Rover) providing a lot of opportunities for new jobs. As an unemployment in the Nitra region is low, it caused arrival of huge amount of people to the city, both living or transiting through the city. This situation graduated to traffic congestion with unstoppable growth. Combination of these people with a high number of students from two universities and high frequency of tourists lead to situation which need to create better solutions to real urban problem. Because of its strategic geographic location, it became one of the most important centers for business, culture and education in Slovakia in the past times as well as today [14]. Nitra is a well-known location

Table 1 Characteristics of Respondents

	Category	Absolute frequency	Relative frequency	
			Registered	Unregistered
Gender	Female	330	33%	20%
	Male	295	11%	36%
Age group	15–19	81	9%	4%
	20–25	180	11%	17%
	26–35	183	13%	16%
	36–45	95	7%	8%
	46–55	59	3%	7%
	56 and more	27	1%	4%
Economic activity of respondents	Employed	322	21%	31%
	Unemployed	5	0.5%	0.3%
	Student	255	19%	21%
	Maternity leave	32	3%	2%
Education	Retiree	11	0.2%	2%
	Primary education	77	9%	4%
	Secondary education	383	23%	38%
Urban area	University education	165	12%	14%
	Chrenová	81	3%	10%
Urban area	Dolné a Horné Krškany	31	0%	5%
	Drážovce	20	0%	3%
	Janíkovce	41	2%	5%
	Klokočina	136	3%	19%
	Mlynárce	42	1%	5%
	Párovce	93	8%	7%
	Staré mesto	154	23%	2%
	Zobor	27	3%	1%

of fairs as well as a modern center of industries. Every year a wide range of social, cultural and sports events attract a multitude of visitors. [15] Nitra covers an area of 100.45 km² (38.8 sq. mi). Nitra is currently the 5th largest city in Slovakia with a population of 78,559 (as of 01/02/2019).

3.2 Travelling in Nitra

It was the first city in Slovakia that offers to citizens and visitors discovering the new adventure in the city – the green Arriva bike. It is a new, modern and environmentally friendly way of transport around the city thanks to first bike-sharing service in Slovakia [15]. City of Nitra has launched bike sharing as a supplement of public transport. It is a joint project of City of Nitra and company Arriva which operates public transport in Nitra. The aim of city authorities is to promote city mobility with an emphasis on cyclotourism and bicycle sharing in order to make cities more accessible, improve the traffic situation and increase passenger interest in urban public transport [16].

Arrive bike appeared on July 28th 2017. From that time residents of Nitra and visitors of the city could use 70 shared bikes at 7 stations [17]. The following figure shows individual station locations (green circles) that are located in the very centre of the city. We marked the center area with a red circle. In the marginal residential areas of the city there are no stations which could be fully utilized by residents on the way to the city center. The blue circle captures the marginal parts of the city. This picture displays a lot of reserves in the coverage of Arriva bike stations (Fig. 1). The red circle represents a circle of 2 km and the blue circle represents a circle of 12 km. New bicycle locations are proposed to be based on respondents' replies recorded in Table 3. Locations were determined in individual sections based on the frequency of alternation of the population due to shopping, recreational, work and sports opportunities. This picture shows the proposal of the new bicycle stations, marked with the yellow circle, as the current placement stations (marked with the green circle) represents a lot of reserves in the coverage of Arriva bike stations (Fig. 1).



Fig. 1 Analysis of current and proposed placement of shared bicycle stations. Source: Own processing

3.3 Registration and renting a shared bicycle

Registration for using shared bike is free of charge. Users can register via webpage www.arrivabike.sk or via mobile app Arriva bike (for android and iOS). For one user registration up to 4 bicycles can be rented at a same time.

The payment is executed automatically via credit card, after finishing the rental. Each registered user can use not only bike sharing system of Arriva bike in Slovakia, but can use all the schemes of bike sharing system operated by Nextbike all around the world. Regular fare of Arriva bike in Nitra is 0.50 € for 60 min and 3 € for 24 h. Annual subscription is 25 €. In order to return the bike, the user has to lock the bike at one of the 7 stations and confirm return via bike computer [18].

Bike sharing in Nitra is interesting and popular. One year since its launch, it has got almost 8700 users and 20,000 bicycle rentals [15].

3.4 Questionnaire research outcomes

In the introductory part of the questionnaire, we asked the respondents what kind of transportation they use the most often in the city. We noticed certain differences in responses between registered and non-registered citizens (Fig. 2). The highest percentage of registered citizens use a bus to move around the city, while the bus is used by only 21% of unregistered citizens. Registered citizens as the second most frequent kind of transportation use the bicycle (23%), followed by car (21%). The car is the most popular kind of transportation in the city of Nitra, used mainly by unregistered inhabitants, as 58% of respondents marked this option. Only 6% of unregistered users use the bicycle. Registered and

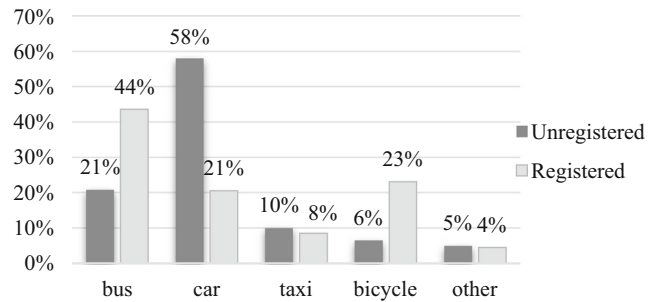


Fig. 2 What kind of transportation do you use the most often in the city of Nitra?. Source: Own research and processing

unregistered citizens use taxis and other kinds of transport with the same extent without any significant differences in their responses. Respondents were given the opportunity to mark and give their own response to the most commonly used kind of transportation, where the majority marked the motor scooters and electric scooters (this option was especially indicated by respondents aged 15–19).

In relation to the assessment of this question, we have formulated *Assumption 1*, where we assume that there exist the preferences for the most frequently used kind of transportation in the city, and these preferences vary by registration status.

H_0 : There do not exist the preferences for the most frequently used kind of transportation by registration status.

H_A : There exist the preferences for the most frequently used kind of transportation by registration status.

For evaluation was used the nonparametric Kolmogorov–Smirnov test. This test is used in situations where a comparison has to be made between an observed sample distribution and theoretical distribution. We carried out the analysis, the results are shown in Table 2. Since the calculated value is greater than the critical value, hence we reject the null hypothesis and conclude that there exist the preferences for some kind of transportation.

Following the common questions for both registered and unregistered people, we have asked the unregistered citizen the question: Why haven’t you used the system of shared bicycles – Arriva bikes yet? The asked question has given us the answers on which areas we need to focus on in order to achieve greater use of bike sharing (Fig. 3). Regarding this question, respondents had the option to mark 1 to 3 different

Table 2 Results of Kolmogorov – Smirnov Test

Kolmogorov–Smirnov test	
D-stat	0.351
D-crit	0.169
D-stat > D-crit	
The result is significant at $p < 0.05$.	

Source: Own processing, XLStat

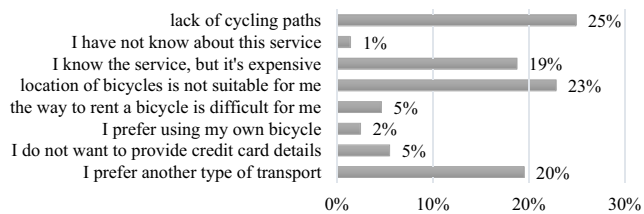


Fig. 3 Why haven't you used the system of shared bicycles – Arriva bikes yet?. Source: Own research and processing

responses. The most important reason why the service is not used by respondents is a lack of cycling paths, which accounts for up to 25% of the respondents' answers. Inappropriate location of bicycle stations was marked by 23% of respondents and 20% of marked responses represent the preference of another kind of transport. The least marked answers were the lack of information about the service (1%) and the preference of using own bicycle (2%). A complicated way of using bike sharing was represented by 5% of the respondents' answers as well as unwillingness to provide the credit card information for payment. By setting a more favourable price for bike sharing service and creating new cycle paths, as well as more logical placement of bike stations all around the city and enhance the number of these stations, we will contribute to reducing or eliminating three reasons why respondents do not use the service of bike sharing in the city of Nitra. The most difficult reason to influence is the priority of citizens to use the other kind of transport. Here is suitable to focus on greater awareness among the citizen, mainly about the ecological aspects, speed and efficiency of such transport as well as its side effect in the form of reduced traffic density in the city.

When questioning the use of Arriva bikes, respondents have the option to mark up to 3 different options. The most frequent answer was that up to 52% of all responses use the shared bicycles in city of Nitra during their leisure time (Fig. 4). Regarding the age of the respondents, up to 18% of them marked option of using the shared bicycle as way of transportation to school. When using the Arriva bike for active sport we received only 12% of all possible answers. Totally 11% of responses consisted of using bike sharing on the way to work and the least marked answer, i.e. 7%, is using Arriva bike for shopping. From all answers regarding the question of

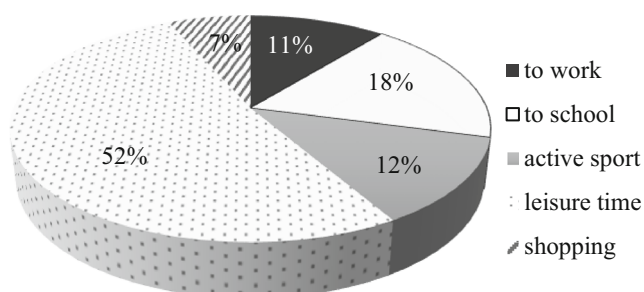


Fig. 4 For what purpose do you use Arriva bikes?. Source: Own research and processing

purpose to use the Arriva bikes, could be seen tremendous potential for using the shared bicycles for riding to work and to school.

The following question provides very essential information for our research, as we want to find out the frequency of using Arriva bikes by the citizens of Nitra. The results are not optimistic as the use of bicycles is occasional for the majority of registered respondents (79%). Only 8% of respondents use bicycles a few times a month and 5% respondents a few times a week. As a daily mode of transportation were Arriva bikes marked by 0% of respondents. The option "other" was marked by 8% of respondents, most respondents stated that they have tried this service just once. This question is related to the answers of unregistered users and reasons why they do not use the service of shared bikes (Fig. 3), which outlined three most important reasons: the lack of cycling paths, not suitable location and preference of another type of transport and formed up to 68% of all the above-mentioned reasons.

Respondents could, once again, marked 1 to 3 options when answering what are their reasons for using Arriva bike system (Fig. 5). This question offered us an important knowledge about motivation of people to use bike sharing system. The collected findings will help us to state a further strategy of disseminating and promoting this kind of transportation. The most common answer, up to 30% of all responses, was the physical activity and healthy lifestyle. Ecological side of shared bikes were accounted for 25% of all possible answers as the most important reason for using the shared bikes. The favorable price and other unspecified reason accounted for only 2% of all possible answers.

When questioning how far respondents ride Arriva bikes, up to 65% of respondents said they use the bicycles within 2 km, 31% of respondents use the bicycle for a distance between 2 to 4 km and only 4% of respondents ride Arriva bikes over 4 km. The results of this question are due to the insufficient coverage of bicycle stands, which also confirms the answers to following question below. As can be seen in Fig. 1, the stations are located within 2 km circuit.

The following question was related to enhancing the number of shared bicycle stations, providing us the specific suggestions to improve the current location of bicycles and thus their actual use. Up to 98% of all respondents would welcome to enhance the current number of bicycle stations. This result can be considered as the most important priority in redefining

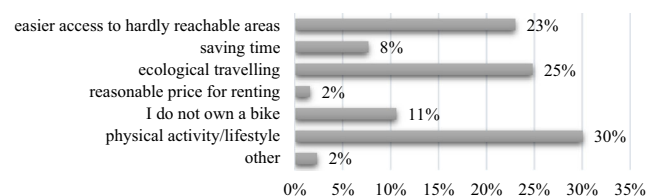


Fig. 5 Why do you use Arriva bike system?. Source: Own research and processing

Table 3 Residence of respondents and placement of the new bicycle stations

Placement of the new bicycle stations									
Residence of Respondents	Chrenová	Dolné and Horné Krškany	Drážovce	Janíkovce	Klokočina	Mlynárce	Párovce	Old Town	Zobor
Chrenová	14	8	7	6	18	3	4	0	0
Dolné a Horné Krškany	0	0	0	0	0	0	0	0	0
Drážovce	1	0	1	0	0	0	0	0	1
Janíkovce	8	4	2	13	5	0	4	0	3
Klokočina	15	7	5	1	18	1	2	0	5
Mlynárce	3	2	1	0	6	8	2	0	2
Párovce	36	14	16	8	37	2	41	0	2
Old Town	78	34	47	23	97	18	47	12	47
Zobor	3	6	8	1	16	1	3	0	19

the current strategy in connection with addressing the urban transport issue. By summarizing the free answers and following analyses on the map of city of Nitra (Fig. 1), we can say that the majority of respondents have largely marked as the most strategic places for bike sharing stations in the residential areas in the suburbs of the city of Nitra. The only ones who were satisfied with the number of shared bicycle stations were the inhabitants of the Old Town. Those respondents who would welcome more bicycle stations, could in the following question: “Specify a specific location”, identify 3 options of locations suitable for the new bicycle stations. They were chosen from all urban areas. The aim of the question was to find out whether the selection of new stations depends on the respondent’s residence. At the same time, we found out whether the respondents are interested in several urban areas by marking all three options (see Table 3).

For the above-mentioned reason, the following hypotheses were formulated:

H_0 : There does not exist a dependence between the residence of respondents and the choice of placement of new bicycle stations.

H_A : There exists a dependence between the residence of respondents and the choice of placement of new bicycle stations.

Dependence analysis was performed through the Levene’s test (Table 4) and the Bartlett’s test (Table 5), which ensured the objectivity and relevance of the results.

Based on the results shown in Tables 4 and 5, it can be stated that the p value is less than the alpha significance level = 0.05, i.e. we reject the zero hypothesis and it means there exist the statistically significant dependence between the residence of respondents and the choice of placement of new bicycle stations. At the same time we can say that the most satisfied with the number of bicycle stations in the place of residence were the respondents from the Old town due to the current coverage by bicycle stands. We can conclude that our Assumption 2 expressing a dependence between the residence of respondents and the choice of placement of new bicycle stations – was confirmed.

The aim of the question (*If Arriva bike stations were in the residential areas of the city, would you also use the Arriva bike on routes longer than 4 km?*) was to identify the interest of respondents in the use of Arriva bike even for longer distances. The question followed the idea of expanding the number of stations and offered us an idea of what the respondents really want. From the results it can be stated that 86% of respondents would use the extension of stations for longer distances than 4 km.

The last question mapped the situation regarding travel ticket, as we think that the offer of the current permanent ones is insufficient or badly set. The half year ticket (30%), month

Table 4 Levene’s test

Levene’s test / Two-tailed test	
F (Observed value)	2.683
F (Critical value)	2.089
DF1	8
DF2	63
p value (one-tailed)	0.013
alpha	0.05

Source: Own processing, XLStat

Table 5 Bartlett’s test

Bartlett’s test	
Chi-square (Observed value)	38.572
Chi-square (Critical value)	15.507
DF	8
p value (one-tailed)	< 0.0001
alpha	0.05

Source: Own processing, XLStat

ticket (27%) and week ticket (25%) have the greatest preference, although these tickets are not currently available. In our opinion, single ticket is especially interesting for tourists as well as a day ticket. The smallest preference received an annual ticket of only 3%. Price policy is not set properly, since all bicycles are thoroughly serviced during the winter from December to February, so people can use them only from March to November. It means that the annual ticket is not convenient and should be replaced.

4 Conclusion

The number of urban smart bike-sharing programs is growing all around the world as well as in the cities in Slovakia. This concept enjoys great popularity especially in the Nordic countries. As it is still being improved and enriched by further technical innovations that offer new functionalities, cities are gradually adopting a bicycle sharing system as a step towards urban smart strategy with a positive effect on the environment. In our study we focused on the city of Nitra, which is currently struggling with the issue of traffic congestion.

Based on opinions of Nitra citizens we wanted to point out the opportunities and constraints arising from the concept of shared bicycles in the conditions of city of Nitra. Outcomes of marketing survey showed that among the most important reasons why the service is not used by respondents is a lack of existing cycling paths at the first place, which accounts for up to 25% of the respondents' answers and inappropriate location of bicycle stations (23%). Up to 20% of all unregistered respondents' answers belong to option, that people express that they prefer another type of transport. These findings were crucial for us as it allowed us to go deeper into the issue.

If we want this system to contribute to improving the traffic situation in the city, it is necessary to reassess and extend the location of bike stations to the marginal residential areas of the city which are the most inhabited. We proposed a layout of the new deployment of stations in the city where we doubled them and placed them in strategic locations in individual urban areas according to the respondents' requirements and statistical analysis.

From our survey it is clear that 98% of all registered respondents would welcome to enhance the current number of bicycle stations what can be marked as the priority in redefining the current strategy. By strategic placement into residential areas of the city, bicycles would have much better use (to work, to school, for shopping). Nitra's advantage is that the peripheral parts of the city are not very distant from the centre, what means that the journey by bicycle from marginal part to the centre cannot last very long. We suggest for the beginning stage that by splitting existing stations into smaller stations, which decreases availability but

increases the accessibility, ridership can be increased by high percentage – with the same number of bicycles. The results connected with the frequency of using Arriva bikes by the citizens are not optimistic as the use of bicycles is occasional for the majority of registered respondents (79%). Surprisingly none of respondents use Arriva bikes daily. For a deeper analysis of the results of marketing research, we formulated two assumptions – all of them were confirmed.

Nonetheless, the success of bike sharing systems depends on other aspects, such as station accessibility and of bike-availability. These findings again underline the call for optimizing bike sharing system in condition of city of Nitra in order to develop a reliable urban transportation infrastructure with minimization of traffic congestion. The development towards smart cities promises interesting opportunities for sustainable innovation and collaboration between public and private parties.

References

1. EasyPark Group, <https://easyparkgroup.com/smart-cities-index/>, last accessed 03 Jan 2019
2. Wachs M (2002) Fighting traffic congestion with information technology. *Issues Sci Technol* 19(1):5–15
3. Finch and Break, <https://www.finchandbeak.com/1108/smart-cities-smart-transit-bike-shares.htm>, last Accessed 12 Sept 2018
4. The City Fix, <http://thecityfix.com/blog/bike-sharing-the-newest-mode-of-public-transport/>, last Accessed 13 Sept 2018
5. Keene, D., McDonald, P.: Bicycle commuting: improving personal and global well-being—one revolution at a time (2018), https://digitalcommons.spu.edu/common_learning/dcl_2018/dcl_2018_events/1/, last Accessed 05 Jan 2019
6. Cichosz M (2013) IT solutions in logistics of smart bike-sharing systems in urban transport. *Management* 17(2):272–283
7. Abraham JE et al. (2002) Investigation of Cycling Sensitivities. In: Transportation Research Board Annual Conference, pp. 1–12. Washington, DC
8. Heinen E, Maat K, Van Wee B (2013) The effect of work-related factors on the bicycle commute mode choice in the Netherlands. *Transportation* 40(1):23–43
9. Dargay JM, Hanly M (2007) Volatility of car ownership, commuting mode and time in the UK. *Transport Res Part A: Policy Pract* 41(10):934–948
10. Susilo YO, Maat K (2007) The influence of built environment to the trends in commuting journeys in the Netherlands. *Transportation* 34(5):589–609
11. Parkin J, Wardman M, Page M (2008) Estimation of the determinants of bicycle mode share for the journey to work using census data. *Transportation* 35(1):93–109
12. Rietveld P (2000) Non-motorised modes in transport systems: a multimodal chain perspective for the Netherlands. *Transp Res Part D: Transp Environ* 5(1):31–36
13. Cervero R, Denman S, Jin Y (2019) Network design, built and natural environments, and bicycle commuting: evidence from British cities and towns. *Transp Policy* 74(1):153–164
14. Bárta V (2016) Nitra: Ako si Ťa pamätáme, 1st edn. AB Art Press, Slovenská Ľupča

15. City of Nitra Homepage, <https://www.nitra.sk/>, last Accessed 27 Sept 2018
16. Nitra 24 Homepage, <https://nitra.dnes24.sk/v-nitre-uz-funguje-zdielanie-bicyklov-stala-sa-tak-prvym-mestom-na-slovensku-275985>, last Accessed 28 Sept 2018
17. Záborský J (2018) Prvé dojmy z bikesharingu. *Trend*. 39(27):52–53
18. Arriva Homepage, <https://arriva.bike/portfolio-item/arriva-bike-standoviste-c-5305-mestsky-park/>, last Accessed 28 Sept 2018

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