THE CHALLENGES OF DOCKLESS CYCLING IN THE CITIES OF SE EUROPE: THE EXAMPLE OF BANJALUKA

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ABSTRACT

In the familiar context of urban pollution and traffic jams, technological evolution again offers possible solutions for solving these problems. One of the new trends of urban mobility is the introduction of so-called dockless bike-sharing system, as an upgraded version of the previous mode of bike-sharing. The paper focuses on its implementation in the cities of South East Europe (SEE) and the selected case of Banjaluka.

The dockless bike-sharing system involves locating (via embedded GPS device) and renting the closest bike in a service area, while not being limited by a specific home location and fixed stations. Nonetheless, dockless bike-sharing operators encourage bicycle drop-off near predetermined spots. This mode of transportation is quite new and requires further improvement since its has been noticed that users often leave their bicycles in extremely awkward positions, while the number of stolen bikes has been increased too. Therefore, the legislation which would support this system needs to be adjusted and updated in accordance with its specificities. However, there are numerous advantages related to cheaper infrastructure, greater availability and accessibility achieved by the simple use of a smartphone and a credit card. Consequently, the application of the dockless bike-sharing system might contribute to the reduction of motor traffic, air pollution, and a greater use of bicycles. Considering this, the case of Banjaluka will be analyzed and the recommendations for the introduction of this system will be presented.

KEYWORDS _ *dockless bike-sharing, mobility, environmental awareness, efficiency*

INTRODUCTION

Since 2015, the fourth generation of bicycle-sharing schemes (*dockless bike-sharing*) has had the predominant growth in the world of bicycle-sharing systems. While the third generation is rooted in Europe and the USA, the precipitous growth of the fourth-generation has been launched in China, by Ofo and Mobike companies. In 2017, the cities in the USA and Europe also started its application. Over time, several names have been used to describe its main feature - e.g. dockless, free-floating or stationless. This system provides a possibility of picking up and leaving bicycles at any place, within the designated urban zone. According to the European Bicycle Manufacturers Association (EBMA), in 2019 the dockless system also appeared in the cities of Austria, Belgium, the Czech

Republic, France, Germany, Italy and the United Kingdom, with oscillating numbers of both bicycles and operators (EBMA, 2019). However, it is not present in the SE Europe, except in Tirana (Albania), which introduced it in 2018 (Mobike, 2020). Unfortunately, after only seven months of operation, the operator reduced the service area, and already at the beginning of 2020, the system in Tirana stopped working. The official position of the service provider is not available, but it is assumed that the number of realized rides was not at the level of cost-effectiveness, while at the same time the number of damaged bicycles was high. This condition also illustrates a low level of environmental consciousness in other SEE countries, especially regarding the activities of local authorities. Meanwhile, this system has created hundreds of thousands of new jobs in China, illustrating their commitment towards reducing the use of fossil fuels in transportation sector (Sun, 2018).
The dockless bicycle system is relatively new, especially in SEE, and its capabilities have not been fully tested. In many cities, the system functions independently, simultaneously complementing and competing with the third generation system. When it comes to Banjaluka, apart from the favorable geomorphological conditions, additional engagement in the field of development of bicycle traffic is noticeable. Although modest, this engagement has a slight upward trajectory, following the European trends. A link to this could be also found in one of the topics launched for the Banjaluka's application for the European Capital of Culture 2024 - "Return to Europe through the discovery of a new narrative" (Banja Luka 2024, 2019). The good functioning of the existing third generation bicycle rental system provides the basis for its upgrade in the form of the next generation.

SYSTEM FEATURES

If we consider all pros and cons of dockless system, we can highlight its availability, flexibility, efficiency and affordability as positive characteristics. On the other hand, the negative features include the appearance of scattered bicycles, the so-called "zombie" bicycles, occupied sidewalks and exposure to vandalism. Since the system relies primarily on the use of smartphones (for locating available bikes, payment, malfunction reports, inappropriate parking, etc.), the elderly population does not find it handy enough. The scope and manner of use are regulated through several parameters, and one of them is the adoption of appropriate legislation, both at the state level and the level of local communities. However, it is not enough to pass legislation or even build infrastructure. It is necessary to promote, learn, and work toward the culture of using bicycles as a form of transport, and to involve the whole society in the process. Technological, ecological and social aspects of its application are quite important, especially if we keep in mind that the use of bicycles in many environments (including ours) is associated with lower social status, although this is not the case in the Netherlands or Denmark. This implies that awareness and mentality need to change.

_ Figure 1: Obike dockles bike sharing system (photo by Laura Laker), London. Retrieved from https://www.bbc.com/news/technology-50946871 (accessed on May 20, 2020)

Dockless bike-sharing system belongs to the type of shared micromobility. Some studies show that this form of transport could represent 8-15% of all trips up to 5 miles (Shaheen & Cohen, 2019). They also indicate that the application of dockless bike-sharing system can contribute to increased mobility, reduce the emission of greenhouse gases (GHG), reduce car use, develop economy, but also improve health. According to the same study, the main users of shared micromobility (including dockless micromobility) are:

1. Highly educated (faculty and/or postgraduates)
2. Younger adults (from 21-45 years of age)
3. Families without children
4. Families with middle and higher pay income and
5. Users living in densely populated urban areas, often with limited motor traffic.

By combining the features of the third and fourth generation systems, a hybrid system has appeared. It combines the possibilities of (1) renting bicycles at a fixed station and leaving them anywhere in operational area; (2) renting anywhere and leaving them at a fixed station, (3) renting and leaving bicycles at a fixed station; (4) picking up and returning bicycle anywhere within the space provided for its use (Yanocha et al., 2018). According to the same source, the advantages and disadvantages of the system are divided into those concerning the city and the user. Therefore, the main advantages of dockless bike-sharing systems are reflected in smaller initial investments, the flexibility of the number of bicycles, and GPS data, which are the basis for planning the system and cycling infrastructure. When it comes to users, the main advantages are the flexibility and usability of the system. On the other hand, the disadvantages of the system are the impact on public space (primarily the occupation of sidewalks) and unevenness (bicycles can be concentrated in city center or around attractions), while for users the downside could be the high cost of use for regular users, a model of payment only per ride, and limited access to bicycles. If we compare the third and the fourth generation of bike-sharing, it could be noticed that the third generation relies on fixed stations and government funding, while the fourth generation appears as a product of private capital based on the use of smartphones and high-speed internet. In some cities (for example Beijing), the driving time of 60% of users of this system is up to 10 minutes, while in 91% it ends within 20 minutes. Also, it was noticed that the most frequent use is in the period from 7:00 to 9:00 and 17: 00 - 19:00 (Sun, 2018). Similar behavior was detected in other countries. These data indicate that the dockless bike-sharing system is mostly used for shorter rides (to and from work, other regular daily activities). Considering the prevalence of bike-sharing systems in the United States, there are at least 70 smaller or larger cities where the 4th generation system coexists with the 3rd generation (Zamir et al., 2019). According to some research (Wergin & Buehler, 2017), the users of *dockless bike-sharing* show slightly different paths and habits compared to users of *station bike-sharing*. The directions of movement of occasional users are more diverse, as well as the places of picking up and leaving bicycles, while regular users show a greater attachment to a certain pattern. The *dockless* system is consistent and complementary to the conventional one, and its users often emphasize recreational goals (Zamir et al., 2019).

GENERAL CONTEXT

SOCIAL LEVEL

Private entrepreneurs (operators) in the field of mobility have changed the way people move in the city. For short and spontaneous journeys, new forms of mobility, such as dockless bike sharing, represent a new and sustainable opportunity. Despite the success in many cities, the docking bike system did not develop evenly, because some local administrations simply did not have the will or ability to finance it. Recognizing an opportunity, private companies have offered a fourth-generation bike-sharing system, i.e. the dockless bike-sharing. Therefore, enterprising sections of society have initiated and implemented a system that can contribute to the reduction of all types of pollution, reduce user stress and thus affect the lives of people in urban areas. Recently, as a supplement to

the system, electric scooters without stations (dockless e-scooters) have appeared, next to bicycles or instead of them (London, San Francisco etc.). The costs, as well as the regulation of the system, are mostly an open issue. There is no doubt that both sides in the process must provide, but also make some profit. Cities should enable the development of these systems as an addition to public transport, and/or alternatives to motorized transport, but also as a concrete and acceptable resolution for the "first and last mile" of public transport users (train, bus). Investments are relatively small in the long run, especially comparing them to the conventional modes of transport. The role of cities is to use the potential of interested private investors while preserving the public interest. In the area of SEE, which has a socialist legacy, the acceptance of a healthy private initiative is always questionable, as well as a balanced symbiosis between private stimuli and often sluggish administration. Also, the turbulent socio-economic and political events of the transition period conditioned the functioning through formal (but not essential) procedures, often directed by subjective and/or unethical decisions. In such condition, the phenomena that contribute to a better quality of life, but do not bring enormous profits, rarely represent a priority for government officials. However, the diffusion of technological and social innovations is inevitable, in spite of possible obstacles and delays. Therefore, some authors provide guidelines for the future (Yanocha, 2018):

1. Cities should and must plan new bike/sharing systems, taking into consideration their needs and capabilities, planning steps, and set goals. In the meantime, it is necessary to work on new infrastructure,
2. Sharing data on rides, bicycle parking, the number of users, all for planning purposes, maintaining order on streets,
3. Inclusion of bike-sharing systems in the public transport system, by introducing a shared subscription (examples LA, Montreal, Mexico City). This kind of symbiosis should be a competitive alternative to the comfort of a private car,
4. Respecting the rights of everyone to these services, regardless of social status. City policy should regulate and equalize the need for profit, but also the need for service. The service should be available to everyone and everywhere, as realistically as possible.

From a social point of view, the focus should be on the last two guidelines. The public transport system (train, bus) represents a small society itself. It is a place of socialization, but also its rationalization. By integrating users of public city transport and users of the public bicycle system, we are working on the homogenization of society, which is more responsible towards itself and natural resources. Simultaneously, the use of individual motor vehicles in urban areas is decreasing. The policies of the city should be the policies of society, those that articulate its needs and rights. In this particular case, the cost-effectiveness of the dockless system will not be the same and sufficient in all city zones, but it is the job of city administration to eliminate potential differences at all levels. The bicycle-sharing system, referring mainly to the 3rd generation, began to function in Chinese cities with a slight delay compared to the European cities, but its development was much faster. Today, Hangzhou has the largest bicycle rental system in the world (Zhai et al., 2019). In 2015, OFO installed a dockless bike-sharing system in the university campus, and from there, its dizzying expansion in China has begun. This example directly indicates which social groups should be targeted when aiming to set up and develop this type of public transport system. The dockless system could be an excellent addition to the 3rd generation of public bicycle systems, adding new quality and capabilities at the user level, although complicating the process at the organizational and administrative levels. It should come as no surprise that certain aspects or elements within this system are intertwined, and their boundaries are often unclear. Consequently, the problem of dockless bike-sharing system could be reduced to several main elements:

1. Effective management of public space
2. Nurturing fairness and accessibility
3. Improving system planning and implementation
4. User protection
5. Education of users, and continuous popularization of the system among users.

The use and general choice of the dockless bicycle system are influenced by the needs of users,

the possibilities of the system, infrastructural adaptation, but also social acceptance. Therefore, it is necessary to continuously work on its popularization and integration into society. The area of SEE still does not perceive bicycle transport as modern and competitive, relating bicycles to poverty. Therefore, the education of users, potential users, but also those who are not, is an important factor in creating an environment for the acceptance and development of all public bicycle systems. Popularization should contain elements of modern marketing, advertising, use of social networks to inform the widest possible social circle about the system and its benefits, but also "learning by model" where those who exercise power would show an example by using the *dockless* system and potentially increase the number of users.

ECOLOGICAL LEVEL

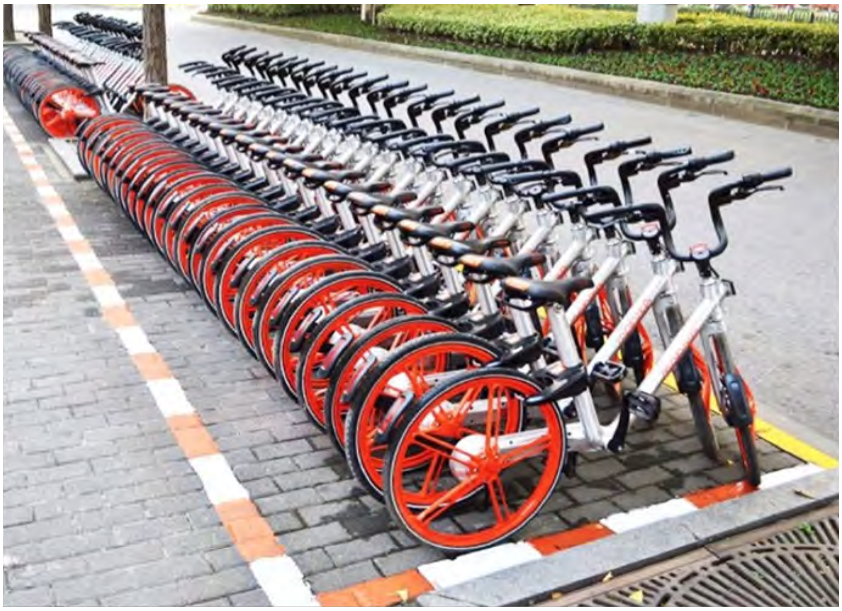
Based on the above, it is only a matter of time before cities, primarily larger and congested ones, will develop this type of transport to some extent. Therefore, the sooner the step is taken, the better. The cities will reduce pollution and harmful emissions and the residents will get more diverse and efficient public transportation. Also, the omnipresent use of smartphones supports the assumption that the dockless system will have users accustomed to a completely electronic way of operating bicycles. The cities of SEE, such as the surrounding cities of Zagreb, Novi Sad, Sarajevo, already have public bicycle systems with fixed stations, which could be upgraded to the fourth generation.

_ Figure 2: NSbike sharing system (photo by Parking servis, Novi Sad), Novi Sad. Retrieved from https://www.parkingns.rs/bicikl (accessed on May 20, 2020)

The evolution of bicycle sharing has gone from "manual" bicycle sharing within the community, to sophisticated sharing supported by modern information technology. Nowadays, cities in China have the largest share of bike sharing systems in the world, making a significant shift from previously dominant car use. While the third-generation (fixed station system) was used and developed in the EU, the fourth generation has been expanding in China since 2015, transmitting the model around the world (e.g. Mexico City). The dockless bike sharing system is a tool for achieving long-term goals in reducing pollution. As a by-product of its use, a lot of data from GPS on bicycles will appear. They should be available to public institutions in order to provide a better insight and planning of infrastructure and mobility strategies (ECF, 2017). One of the most important things to plan for is bicycle parking. Although free, it could threaten other aspects of city life.

_ Figure 3: A pile of dockless cycles in Beijing, Mobike and Ofo (photo by Sam Shead, BBC), Peking. Retrieved from https://www.bbc.com/news/technology-50946871 (accessed on May 20, 2020)

For this reason, dockless bicycle parking stations can be determined virtually, with the help of so-called geofencing technology, but also physically, by outlining parking spaces, or simply by placing "combs" for bicycles. The dockless system does not search for a station, does not require return to fixed place, but encourages users to park them in the proposed places. Within this, there are two types of bicycle security - one which involves locking with a cable for a fixed object (fence or similar), and the other which involves locking with a system installed on the rear wheel of a bicycle. The possibility of arriving exactly at the targeted place, stimulates the users of the dockless system to use this type of transport more, reducing the use of a personal car.



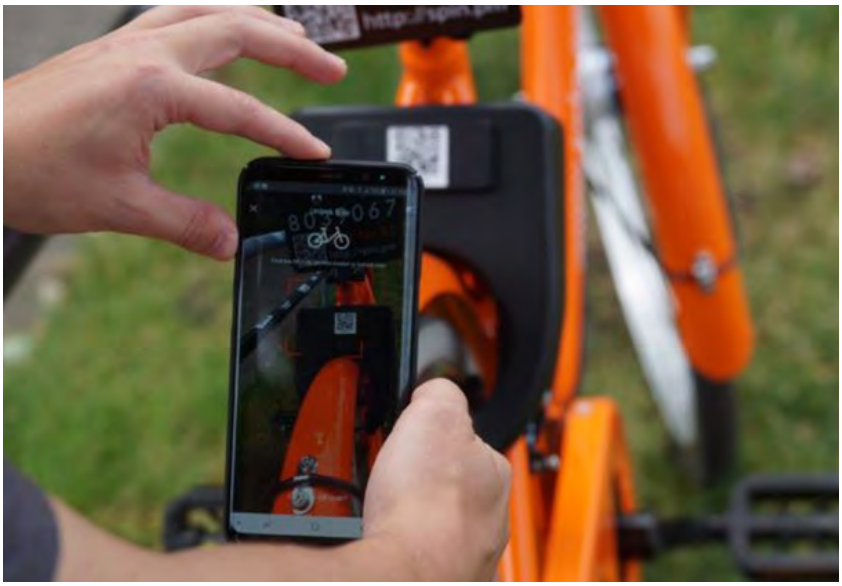
_ Figure 4: Mobike dockless bike parking example (photo by Mobike). Retrieved from https://altaplanning.com/dockless-bike-share/ (accessed on May 20, 2020)

Some documents state that the Greater Manchester region in the UK uses a dockless bike-sharing system to achieve a goal in which the share of bicycle travel will go up to 10% by 2025, reducing pollution (Yanocha et.al, 2018). The target percentage of cycling in Singapore is as high as 75% by 2030, and dockless bikes play a significant role in achieving this goal. Given the current pandemic of Covid-19 virus, it should be noted that this situation has greatly highlighted the possibilities of using bicycles in urban areas, so in some countries an intensive work has been done in order to increase the number of cyclists - either legislatively or regarding the physical transformation. By reducing human movement - primarily motor transportation - the environment has shown signs of recovery in a short time, which also highlights the positive effects of dockless bicycles.
In any case, regulation and communication between all parties involved are necessary. Consequently, dome companies require that bicycles should be tied to a "rack" or other elements of urban furniture, which largely prevents bicycles from being discarded at undesirable places.
The pollution of urban space is certainly not a desirable outcome of the dockless bicycle rental system use, so the planned parking spaces should be provided by the city, for all bicycles (e.g. in a car parking space). One of the biggest challenges in regulating the operation of this system is rebalancing, which is essentially the transfer of bicycles from one place to another. Rebalancing involves hiring a service vehicle that collects the bikes and redeploys them according to the operator's plans. The lower the need for rebalancing, the smaller the carbon footprint of the system, and thus its negative impact on the environment.

TECHNOLOGICAL LEVEL

Regardless of the undoubted positive effects of micromobility, it is necessary to regulate the area, set restrictions for designated areas of use (geofences), define locations allowed for parking bicycles, impose obligation to tie them to the fence or urban furniture and define the allowed usurpation of space, primarily sidewalks. Some cities have established their own rules, or guidelines for the dockless bike sharing system. Those in force in Seattle are reflected in the fact that bicycles are left in parts of pedestrian zones which are under urban furniture or city greenery, and widths are greater than three feet (approx. 90 cm). This also means that bicycles are left - tied in a "racks" or "staples" wherever they do not block pedestrians, or left in marked zones whose size is usually equal to the size of a car park (Shaheen & Cohen, 2019). It is also necessary to limit the number of bicycles, and some estimates say that their optimal number is between 10 and 30 per 1000 inhabitants (Yanocha et.al, 2018). The number of bicycles that can be recommended to circulate in the system depends on the city, population mentality, infrastructure or geomorphology. Smaller fleets of 500 bicycles are recommended to get the system up and running (Bordenkircher & O'Neil, 2018). The instructions from London say that bicycle parking is one of the most important items of this system, so in London is forbidden to park them less than 2m from the intersection, on the sidewalk whose effective width is less than 2m, but also in some specially designated areas (Transport for London, 2018).
It can be said that the 4th generation bicycle-sharing system has the potential to attract a larger number of users, and to supplement the existing public transport system (Transport for London, 2018). London aims to have 80% of all travel by foot, bicycle or public transport by 2041, and the 2018 code describes the term dockless bike as a pedalless bicycle, bicycle with pedals and an electric bicycle that uses a "cloud" or smartphone applications for unlocking and locking (Transport for London, 2018). When it comes to electric dockless bikes, LIME ones are present in both Europe (Milton Keynes) and the US (San Francisco). The electric bicycle industry is growing, and we can take the Netherlands as an example, where one in three purchased bicycles is electric (Wakefield, 2018).
One of the insufficiently researched areas related to the dockless bicycle-sharing system is the prediction of bicycle availability at the observed locations. Research on this topic is based on the principle of network or on the principle of distance (van der Meer, 2019). This system is both a supplement to the 3rd generation, but also a competition. In London, during the 36 weeks since the introduction of the 4th generation, there was a 20% reduction of the number of rides in the already

existing system (Li et al., 2019). On the other hand, building the appropriate infrastructure is a direct incentive to increase the number of users, as shown by some research on bicycle highways (Cycle Superhighways) in London (Li et al., 2018). Stationless bicycles started operating in London in 2017, including several operators such as Ofo, Mobike, oBike and Urbo. By the end of 2019, London had at least five dockless bike schemes (Li et al., 2019). There are many factors influencing the choice of one or another system, such as the rental price, terrain configuration, technical characteristics of bicycles, etc. During 2019, an innovative version appeared in London - dockless e-bike system, whose effects will be visible in the future. The start of the dockless e-scooter system in Cologne, Germany, has been announced for 2020 by Spin, owned by Ford (Ford Media Center, 2020). For the necessary regulation of the dockless system, an "electric fence" (geofence) is used, i.e. GPS regulation of the areas of use and parking of bicycles. Depending on the configuration of terrain, GPS service can also be inaccurate (Wergin, J. and Buehler, R., 2017). RFID (radio frequency identification device) or bluetooth signals are also used for this purpose (Zhang et. Al, 2018). All users who ride and/or leave dockless bicycles outside the defined area pay extra money. An electric parking fence can hold up to 100 bicycles on average, and the economic viability of this system is only possible with the protection and respect of bicycles. The same authors state that if the level of vandalism is excessive, the question of system sustainability arises (Zhang et al., 2018). The applications used in the dockless bicycle system enable finding the bicycle, paying, but also warning if the user leaves the intended zone.



_ Figure 5: Unlocking dockless bike using smartphone station (photo by Todd Bishop), Seattle. Retrieved from https://www.geekwire.com/2017/testing-new-breed-bike-sharing-pitted-spin-vs-limebike-streets-seattle/ (accessed on May 20, 2020)

Each way of communication in the system must take into account the specificities of local communities. Different local government units also have different acts that regulate areas important for the public bicycle system. In 2019, London had a total of seven bicycle-sharing system operators, three of which are dockless (O'Brien, 2019). This example reveals that parking bicycles should be avoided along water surfaces, considering that vandalism is especially expressed there. Parking bicycles with the dockless system is quite free, but that does not mean they can and should be parked everywhere, in a laid position, or interfere with life in a city. Since the system is still new, many pilot projects are trying to explore what the optimal solution is, suggesting parking on a marked "island"

or within the space allocated for bicycle parking - hub centric model. Operators should transparently announce the position of each bike, refreshing that information every minute. City authorities should mark public positions for parking (leaving) bicycles, as well as prohibited parking spaces. According to the ECF (European Cyclists' Federation), these bikes are accessible via smartphone and credit card, parked everywhere or in marked places, and their location is detected visually or with the help of GPS. As already mentioned, many operators limit the areas of bicycle use, and in order for the system to function in accordance with the life of a city, the parking strategies are necessary, as are infrastructure construction strategies. Operators must invest additional effort in assembling, rebalancing and servicing bicycles, and synchronize with local governments (ECF, 2017). This means ensuring a good flow of information between operators and authorities. The fast-growing system of the 4th generation should be accompanied by adequate control, law enforcement, and infrastructure development. The system development should ultimately contribute to reducing the number of car journeys, and the system itself should provide every user with comfort and safety (ECF, 2017).
Dockless bicycle-sharing system combines the function of bicycle and payment, which was partly the function of a terminal (dock, station), and one of the advantages of the system is that the size of a bicycles fleet is not limited by station capacity (Shen et. al, 2018). According to Shen and others, used bicycles of the dockless system are mostly located next to public transport stations and thus represent a solution for "last mile" travel. The dockless system is easier to expand compared to the 3rd generation since it offers a lot of data on the movement and number of bicycle rides, directions, distance traveled, ride duration, etc. Cities must always be involved in the regulation of the dockless bicycle-sharing system, participating as a corrective factor that encourages the positive sides, but also discourages and reduces negative phenomena (Bordenkircher & O'Neil, 2018). According to these two authors, an important aspect is reporting of malfunctioning or any problem. If the operators do not respond within ten hours, the city authorities take on the obligation to solve a problem. Of course, they charge service from operator. This aspect is not alone, but it is an example of a potential relationship between operators, city authorities and problem solving.

THE DOCKLESS CYCLING IN BANJALUKA

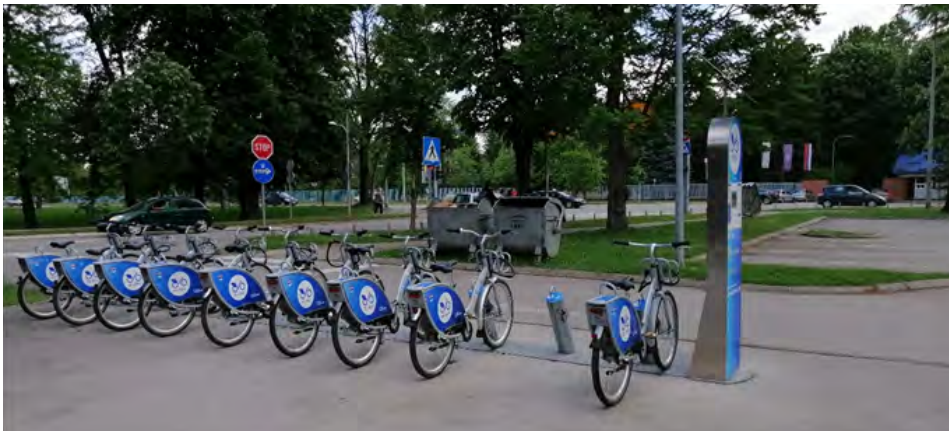
Except the example of Tirana (even for a small period of time), there is no bicycle-sharing system of the fourth generation Southeast Europe. Therefore, its introduction is a challenge, which was also recognized in Banjaluka. There are many questions - how and in what way this idea should be promoted, how its implementation should be planned, conducted and regulated? The emergence of a dockless bicycle-sharing system in Banjaluka would help increase the total number of bike rides, with minimal investment, without a need to build fixed stations. With the existence of the 3rd generation, the preconditions for the emergence of a hybrid bike sharing system have been created. Given the limited infrastructure and the relatively small current number of potential users, the future of the dockless public bicycle system in Banjaluka could be reflected in relying on the existing third generation, but also in supplementing the existing one. Today, it has 5 user terminals with 36 bicycles (City of Banjaluka, 2020), over 1100 subscribers within around 200000 inhabitants, and it is growing. According to the data that can be obtained in the local administrative bodies, the average number of daily rents during the working day is 60-70, and the largest number of them is realized between 7 and 8 AM, and 4 and 5 PM. Having in mind all the above, with the potential introduction of the dockless system in Banjaluka, one percent of the existing bicycle rides of the station system would belong to the stationless system, but the total number of rides would increase, which should be imperative. The conditions for the installation of the fourth generation are similar to the previous one. The existence of an internet connection on the territory of the entire city, together with widespread smartphones, meets the basic technical and technological requirements.
Declaratively, the authorities of Banjaluka intend to equip each larger settlement with one station for the third generation public bicycle system, and for 2020 it has been announced that one or two new stations will be set up in one of the city areas. This part of the system represents a significant share

of investment and the city might not be able to finance new terminals. Therefore, the system with dockless bicycles could be perceived as a supplementing option, with a minimal investment. The resulting hybrid system could reconcile the features of both systems, providing a better transport service of public bicycles. Consequently, Banjaluka could follow several steps of implementation:
1. The initial step in the introduction of the fourth generation should include the campus of the University of Banjaluka, as an institution with a target group for the use of this type of transport. The university campus (Vrbas) has a significant number of potential users, and represents a node with good infrastructural preconditions.
2. Investing in new infrastructure, primarily in densely populated urban areas. The first phase of the introduction of the dockless system would include a part of the city within a radius of approximately 2.5 - 3.0 kilometers from the city center. It should be noted that Banjaluka has a longitudinal urban geometry, with maximum distance of 12 kilometers (south - north).
3. The establishment of a single record at the city level, which would contain graphic, numerical and textual representations of all existing and planned bicycle paths and lanes. Information on the number, duration and length of rides through public bicycle systems of the third, as well as (to-be-introduced) the fourth generation of bicycle-sharing systems. This database should include the issue of parking, and all data should be available to institutions and individuals involved in planning or research of urban development.
4. It is necessary to perform partial or complete integration of public city transport with bicycle-sharing systems, with special emphasis on mastering the "last mile" using dockless systems. Within this, a joint subscription for these two types of transport should be introduced, and the obligation to install external bicycle racks should be introduced on public city transport vehicles. The introduction of bicycles inside vehicles (buses) should be also formally enabled.
5. Funding of the public bicycle system and its supplement in the form of dockless bicycles, should be regulated through a public-private partnership, or a completely private investment with respect to general and detailed norms governing the area, following the example of the cities cited as examples. The city must balance the need for profit and the need for affordable and quality public transport services for as many citizens as possible. This can be done through sustainable transport subsidies, which must be provided as an item in city budget.
6. Provide parking for public bicycles of the fourth generation in the vicinity of all important public facilities, increase the price of car parking in the central city zones, and redirect a part of collected money to bicycle infrastructure.

_ Figure 6: Nextbike sharing system with docks – 5th station (photo by Milana Piljak) Banjaluka

CONCLUSIONS

Based on the provided information and the conducted analysis, it can be concluded that the future of the fourth generation public bicycle system is not fully guaranteed since it depends on many factors. The system could function well in communities with a higher degree of emancipation, social, environmental and technological awareness, but the support of governmental structures is needed. If the dockless system does not function independently and sustainably, it can always rely on the achievements of the third generation public bicycle system, and as a supplement able to provide a better choice for users of public transport in urban areas. The problems of urban life are always layered and intertwined, so the possibility of introducing dockless bicycles in Banjaluka depends on several factors. Focusing on users with the developed sense of environmental and health benefits provided by this transportation mode would be beneficial, along with appropriate logistical steps. The introduction of the fourth generation public bicycle system, would add a new quality to the entire public transportation, traffic congestion would be reduced, as well as air pollution and car noise. If we take into account that about 17,000 students study at the University of Banjaluka (University of Banjaluka, 2020), and that there is a terminal of the third generation bicycle-sharing system near the Vrbas campus, it is clear that it represents a good environment for activating and developing a dockless system.



_ Figure 7: Nextbike sharing system with docks near university campus (photo by Mladen Milaković) Banjaluka

The distance of this location from most important historical, cultural, traffic and other objects is between one and one and a half mile, which completely fits into the category of cycling trips of medium distance. It is certain that there are other locations in Banjaluka with good potential for the development of dockless systems, but as a starting point it is enough to dedicate one, to initiate the first period of system implementation.

For the development of this system, as well as that of the previous generation, it is necessary to invest in bicycle infrastructure, including parking lots (canopies) for bicycles. There is also a need for increased interest in this topic from all professions involved in the urban planning process, such as traffic engineers, especially from the aspect of system implementation in the city traffic system. This thought can refer to the specific case of Banjaluka, but also to other cities. The general suggestion is that activities should be monitored during the use of bicycle-sharing system, and special attention should be given to the redistribution of bicycles and their proper parking, with a ready institutional and operational framework for preventing and reducing the impact of vandalism. The dockless system of public bikes should serve Banjaluka as one of several tools that will improve living conditions in the city, influencing its urban characteristics in a positive sense, making it user-friendly and accessible to all.

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