BIKE AS A TRAFFIC MEAN IN URBAN AREAS: A PROJECT PROPOSAL FOR A BIKE SHARING SERVICE IN LJUBLJANA

Dino Kopušar
Undergraduate student at Faculty for maritime studies and transport
dino.kopusar@gmail.com

Marko I. Valič, D.Sc.
University of Ljubljana
Pot pomorščakov 4, SI-6320 Portorož, Slovenia
dino.kopusar@gmail.si, marko.valic@fpp.uni-lj.si

Andrej Stijepić, M.Sc.
JP LPT d.o.o.
Kopitarjeva ulica 2, SI - 1000 Ljubljana, Slovenia
andrej.stijepic@lpt.si

ABSTRACT

Bicycle sharing systems (public bikes) are increasingly popular and diverse. The central concept of many of the systems is free or affordable access to bicycles for short trips inside the city, as an alternative to motorized public transport or cars, thereby reducing traffic congestion, noise and air-pollution. Furthermore, such systems are able to remove the three difficulties of daily cycling use: home parking, theft and maintenance of private bicycle. In the contribution the current trends for the bike use as a complement means to public transport are reviewed. The operation principles of such systems with their advantages/disadvantages are described. Two well recognized systems BICING (Barcelona) and VELIB (Paris) are described. A proposal for implementation of such a system in the city of Ljubljana is given. For realization of the proposal preliminary research on daily migrations were made. On the basis of the data found the number of bikes and locations of bike terminals were determined. The system requirements, technical aspects of terminals and bikes, bike distribution logistics and bike tracking system are discussed. While gathering the material for the contribution the authors became aware of plans for setting up of a system called BICIKELJ in Ljubljana. A description of this system is included.

Keywords: public bicycle, bike sharing system, bike terminal, bike distribution, public transport by bike, system BICING, system VELIB, system BICIKELJ

1 INTRODUCTION

Bike-sharing gains speed. First popularized in European cities such as Lyon, Paris and Barcelona, bike-sharing is quickly expanding around the world in places like Beijing, Montreal and Mexico City and across the USA. It has been estimated that as of 2010, there were more than 200 such schemes operating worldwide [1]. The central concept of many of the systems is free or affordable access to bicycles for short trips inside a city, as an alternative to motorized public transport or cars, thereby reducing traffic congestion, noise and air-pollution. Bike-sharing provides an environmentally sustainable and inexpensive mobility option to complement the use of public transportation, walking and ridesharing as alternatives to single occupant vehicle use. It allows individuals to have the benefits of bicycle use, when needed, without having to purchase a bike, store it, or bring it into town or on their vacations. To access bikes, residents and tourists can either use the self-service kiosks or register on the cycle website. At the bike-stations, riders swipe a credit card or key in a membership code any time of the day. When riders are done with the bike, they return it to the same or another bike-station. Bike-sharing was created for the commuter whose
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transit stop is two miles from the office, the person running a quick errand and the tourist out sightseeing. With this in mind, the bike has a cruiser-style that is comfortable for people of all sizes and biking abilities.

In recent years in the traffic and transportation system of Slovenia noticeable developments were made above all in the road infrastructure. Since there are no other competent alternatives to the classic road traffic, the use of personal cars is increasing. With development orientated in such a manner certain consequences followed, for example, increased emissions, road congestions and noise levels, overcrowded parking lots and a decrease in road safety. The Ljubljana urban region (LUR) is situated on one of the very important area traffic-wise. Above all it is a crossing of 5. and 10. corridor of Pan-European traffic network and an area with largest concentration of labor resources in Slovenia. Since public transportation is not competitive to transport with personal cars, these are being used for majority of daily migrations.

The process of suburbanization, when the hinterland areas begin to increase residentially, leads to a further increase in road traffic loads. In recent years the number of housing areas in LUR (without MOL - Ljubljana city commune) has increased whereas the number of inhabitants in Ljubljana decreased [2]. Noticeable is a drain of inhabitants from MOL areas to the neighboring communes while keeping the working place in Ljubljana. With present capacities of Ljubljana public transport (JPP) and interurban transport, the capacity of public transport services remains non-competitive to personal cars, a fact contradictory to paradigm of a sustainable transport.

In Ljubljana, the capital city of Slovenia little has been invested in modernization of the concept of the city’s traffic in recent years in comparison with trends in Western Europe. However, to be fair some shifts in this direction should be recognized, for example the unification for payments of some services (credit card Urbana), no admission of vehicles to the inner city center and setting up the park and ride parking places for migrant workers and employees. Of course every city has its own ‘soul’, i.e., concepts which proved to be good in some places do not necessarily work in others.

In any case the ideas of building advanced trolley- or even underground-lines in Ljubljana do not come into consideration. They are totally unjustified from economic point of view. Adding new bus lines is questionable too because the roads are congested with daily transit already. However, as long as this is done it would be wiser to adapt the lines to the time frames of a particular day. During peak hours the offer of services is increased, in less demanding periods smaller, more effective and economical hybrid minibuses should be used. Ljubljana is a specific city; it is too big but at the same time too small for any of technologies to be maximally exploited. On the other hand Ljubljana is a city in which bikes are used to a reasonable extent. There are a few hundred km of cycling routes with many dispositions and traffic infrastructures at hand for city to become a bike city. Therefore a bike-sharing system for Ljubljana would be of asset.

2 DESCRIPTION OF SELECTED WORKING SYSTEMS

2.1 Sistem ‘Bicing’ - Barcelona

The system BICING in Barcelona was put up in operation on March 2007 and is one of the biggest systems in Europe [3]. The system deploys 6000 bikes and 420 stations. The system is at the disposal exclusively to registered user and does not allow borrowing a bike for tourism purposes. For registration the user must pass his personal data in the BICING office or via Internet. The payment method is only direct via bank standing order. The system is rendered possible to annual subscription only with a cost of 35 € with the tariffs given in table 1.

The objective of the BICING use is for the city residents exclusively and the conditions of borrowing are adjusted so that the use of the bike is of shortest possible duration. In such a way rotation of bikes is made bigger. The bikes are on disposal all days of the year, from Sunday to Thursday from 5:00 to 24:00 (after midnight a bike return in to the terminal is possible but not the borrowing) and on Fridays, Saturdays and holidays during all night. The number of users is about
The total number of kilometers covered by Jan. 2011 was more than 103 millions. The average usage time of an individual bike was about 15 min.

<table>
<thead>
<tr>
<th>Table 1: BICING tariffs</th>
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<tbody>
<tr>
<td>subscription</td>
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<td>35 €</td>
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For ease of control all terminals and all bikes are numbered. The terminals are interconnected and managed by the control and maintenance center. There are two such centers in operation with 21 vans with possibility of an additional trailer, two of these with fixed route and 3 for fast interventions. Their duties are bike relocations and repairs with 24 h daily operating time. Every van has the capacity of 15 bikes plus additional 15 with trailer. The control center collects the data on fully occupied terminals and on damaged bikes which are then intervened to the operators. The key to a successful operation is a perfect maintenance center. Less malfunctioning bikes means less dissatisfaction, less complaints and brings about a better recognition of the trademark. A terminal station comprises a main unit with a RFID card reader and LCD interface and several steel frames assembled together. There is room for 3 bikes in one frame. On the average bike stations contain 5 frames, accepting thus a total of 15 bikes. A bike is made up of a steel frame of likeable color characteristic for the metropolis. Front and rear ends are equipped with lights which activate according to the brightness by a built in sensor. On the front a steel frame is added to carry a medium sized bag fastened by an elastic band. In order to pedal easier the bike has three gears at disposal. A terminal station with a bike is shown on figure 1 [3].

![Figure 1: A view of a BICING bike and terminal station](image)

The main problems of the systems are similar to those in other cities; vandalism, arrogance and theft. Improvements against these are being made. Some problems occurring in the earlier stages of the systems, e.g., improved logistics for bike relocations and better maintenance centers. The far largest demands for bikes are morning hours in the outside areas of the city. Therefore the relocation service makes the most transfers during night hours.

System financing is made of several sources. Yearly annual costs are about one million €. The major sponsor is a marketing company ‘Clear channel’ for which certain advertisements rights in the city have been given. An added source of funds is gained with so called green zones around the city. All of the income collected from parking is transferred to the BICING system. The smallest source of income is brought by annual subscriptions. Some important data of BICING in numbers are:

- average daily number of borrowings is 34,000 on working days and 22,000 on
weekends and holidays;
- smaller CO$_2$ emission by about 4200 metric tons yearly (a calculation based on the use of a personal car);
- the system is used by about 15% of Barcelona residents;
- the bike has been activated 32 million times up until recently;
- 70% of bike users are using the bike to go from point A to B and 30% in combination with other means of transport.

2.2 System ‘Velib’ - Paris

The system VELIB in Paris is today the largest bicycle sharing system for short travel in a city. The system deploys 1450 bike stations and 20600 bikes [4]. The inter-distance between terminals is about 300 m. The system was put up in operation in July 2007 following the model for Lyon. The price for bike-sharing are very favorable, for example the use of a bike for up to 30 min is without charge. The VELIB tariffs are given in table 2.

<table>
<thead>
<tr>
<th>Time of use (h)</th>
<th>½</th>
<th>1</th>
<th>1½</th>
<th>2</th>
<th>5</th>
<th>10</th>
<th>20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price (€)</td>
<td>0</td>
<td>1</td>
<td>3</td>
<td>7</td>
<td>31</td>
<td>71</td>
<td>151</td>
</tr>
</tbody>
</table>

Every terminal si connected with main interface through which it si possible:
- to validate a bike borrowing;
- when the terminal station is fully occupied, the main interface shows the nearest next station to lay the bike away;
- for tourist to borrow a bike because the service can be paid with a credit card as well.

Before taking use of the system one must register and to acquire a user number/card for which three choices are available: daily pass for 1 €, weekly for 5 € and yearly for 30 €. For opening an user account the user must have a credit card or a bank debit card with pin number for reason of theft safety. For this purpose in the case of failing to return the bike an amount of 150 € charged. In the case that bike is being used only one day or only one week to the user is assigned a user number with limited active time. With one year subscription the user receives a standard card with an RFID tag.

For better promotion VELIB allows for additional 15 min of use free of charge on same terminal stations. For example, if the terminal station lies on a height above see level of 60 m higher from the lowest point from the nearest terminal, a sign V+ is assinged to it. The same applies in cases when the terminal station is away in time for more then anticipated 30 min from the center. This means, if the bike was borrowed in the center and the final bike terminal station lies in a higher lying area or more distant, the user has 15 min additional time on disposal. The same applies for cases when the user is forced to look for next nearest station, due to the occupancy of the particular terminal station.

Project VELIB was created under the patronage of the city of Paris and the marketing company JCDecaux [5] which financed the whole project with an approximate value of 100 Mio €. In exchange for it received an exclusive right for advertising on all terminal stations and bikes. The city is entitled to all income earned through bike-sharing. In addition, JCDecaux pays to the city about 3 Mio € annually. Today there are about 285 fully employed in the system, most of them in maintenance and logistics. For bike transferring from full to empty terminal stations there are 23 transportation vehicles available. Vandalism and arrogance are still the major problems of the system VELIB. Some good and negative features of the system VELIB are:
- Large number of station terminals and bikes not only around the city center but also in its surrounding areas;
- Very favorable tariffs;
- Internet support to the user for survey of empty/full terminal stations;
- Mobile applications with which one can find the nearest free bike.
  - Still large number of damaged bikes due to vandalism;
  - Poor synchronization at times between terminals causing problems in reading the time usage;
  - Some instabilities with Windows operational system.

![Figure 2: Example of a VELIB terminal station and terminal interface](image)

3 PUBLIC BIKES PROPOSAL FOR LJUBLJANA

3.1 Analyses of the present state of bike traffic in Ljubljana

Ljubljana is a city in which biking is being done to a reasonable degree. There are about 200 km of cycling routes with many dispositions and traffic infrastructures at hand for city to become a bike city which however is not yet. The network of biking routes, pass ways and tracks in Ljubljana is relatively dense. However, on the surfaces intended to bike traffic only there are numerous obstacles (pedestrians, incorrectly parked cars). Although majority of the newest in- and main-roads out of the wider city center have quality bike tracks, these are, with existing older inroads and in the wider city center, too often interrupted. Further, the junctions with motorized traffic are too dangerous. There are cases where the bike tracks are made in a zigzag manner on side roads what makes a bike ride to or out of the city's center distance and time wise longer. There is only one true cycling route in Ljubljana (from zoo to the Koseze ‘bajer' in the length of 2.5 km).

The passage and throughput of bike traffic in the inner city center is problematic. The traffic regulations are not in favor to cyclists. There are quite a few streets and roads in the city center in which bikes are forbidden. In many cases restaurants are expanding their services on to the traffic areas. There are about 8000 public bike stands around Ljubljana. Their number has been greatly increased the inner center lately, however there is not enough of them at the 'intermodal points' and public offices. There are very few stands with projecting roof and no bicycle sheds. The latter are a problem (too small or inadequately arranged) in many of apartment blocks as well.

With regard to renting a bike in Ljubljana it is possible to rent a city bike near majority of hotels, at main rail station and at some central tourist points of interest. Some hotels have their own bike rental service. By majority a city bike is rented by tourist and students. In the version of today the city bike is suitable only for cruising in the wider city center first of all due to bike construction. The main bad feature of the present concept is in this, that the bike should be returned to the original place of rental. A bike could be rented in the summer and early fall days only. The number of rental places is insufficient.

From different estimates the share of bike traffic in Ljubljana is somewhere from 4, 5 to 10 %. There is no regular systematic way of measuring of the share or of its structure by age or
other reasons for the rental. A noticeable increase in the number of bikers is observed in the last few years. Possible explanation of the increase could well be all to higher traffic congestions in the inner and outer areas of the center by cars, sluggishness of public transport and consistent sanctioning of wrongly parked cars. A survey made by MOL in June 2003 [6] of more than 6000 households showed that 58 % of all travels were made by cars, only 13 % by public transport, about 10 % by bike and 19 % on foot. From yet another survey made in Ljubljana a bike as a transport mean to work or school is used by 10 % of fit to work population. Among these majority are better educated, employed in public institutions and living about 5 km from place of work, thus in the city’s center or nearby. The distribution of users by age in the group from 26 to 65 is very uniform; there is a somewhat higher share of bike users in the 18 to 25 group and much lower in the group 65 and over. Majority of those using the bike for work often use it also for visiting parks, playgrounds or going to city for errands and shopping, but rare for shopping in the bigger commercial centers on city’s outskirts. The main reason for choosing a bike is very pragmatic, it is the fastest transportation mean in the city center. Other deliberations present are health and environment protection. They are mostly disturbed by unarranged cycling tracks, fear of theft, insufficient number of parking stands and unsafe behavior of participants in traffic.

3.2 Public bike proposal for Ljubljana

While gathering the material for preparation of our proposal for a bike-sharing system in Ljubljana it was learned in mid February of this year [7], that there are some other plans for such a system. The bearer of the proposal is a private company Europlakat d.o.o., Ljubljana [8] of which one of the shareholders is also JCDecaux. As mentioned already JCDecaux has set up the first bike-sharing system in Lyon, VELIB system in Paris and more than a dozen big systems world-wise. With knowhow and technology at hand further steps in deployment of a system were happening in a fast way. The goal is to put a start up system in operation by spring 2011. The system will be a project of public-private partnership between MOL and Europlakat d.o.o., which will trade with advertising premises in exchange for system’s set-up. In view of these new developments we decided to give a summary for the Europlakat’s proposal called BICIKELJ and to continue with activities on our proposal with the aim of some guidelines for further development of the system.

To the residents and visitors to Ljubljana the system will offer a bike borrowing at a reasonable price or, in majority of cases, free of charge. The aim of the system for users is namely to borrow a bike for a particular ride and not for a certain period of time. For the use of the system services the users are first obliged to register. They have to decide on one of the two choices; week-long or annual subscription. For annual use a user pays 3 € which are entered to his account as a credit. The registration cost for week long use is 1 €. The tariffs for borrowing are: first hour free of charge, second hour 1 €, third hour 2 €, from forth hour and over the price are 4 € per hour. If a user returns the bike in the first 60 min of use, he can use the service again after 5 min. The payments for registration and dues for payable rides (rides longer than 60 min) are paid for via a bank money order. At the beginning of the subscription (week-long or annual) validity the user must submit to the tendering firm an authorization for funds transfer in the amount of 350 € as a warranty. These funds could be used by the firm in case of bike damage, fraudulent use and/or disappearance of the bike for which the user is responsible.

Initially the system will deploy 300 bikes and 30 terminal stations. When the ride is over the user returns the bike to a stand on a terminal station and so the bike becomes at disposal to other users. The terminal stations will be arranged in the wider center of the Ljubljana city by which the inter-distances will not exceed 400 m. The last terminal station in the direction Šiška will be in the neighborhood of Kino Šiška, direction Bežigrad just a little before Ljubljana Rondo, direction Moste up to the market place, direction Trnovo up to Špica and Vič up to Ilirija. All of 30 terminals on the individual station will be interconnected and connected with the main unit in the management center assuring a support to the system. On each of the terminals available will be information on locations of all other terminals and data on the number of free bike stands and bikes at disposal. In the management center all moves will be registered and peak hours when certain
stations are full or empty will be calculated. In view of the availability of this information the support service will transfer the bikes from full to empty stations as needed. The macro-location of the terminal station is shown in figure 3 [9].

The bikes used in the system will be of special concept and design. In view of the fact that they are exposed to different weather influences through all days of the year they must be endurable and resistive also to the vandalism. For these reasons the city bike is constructed from a robust, resistant frame, rubber wheels (no inner tubes pierced), lights with automatic dynamo, rear brake on the pedal, a basket in front and a lock. On figure 4 there is an example of a BICIKELJ bike and of a terminal station.

Figure 3: Macro-locations of BICIKELJ terminal stations

Figure 4: Example of a BICIKELJ bike and a terminal station

4 CONCLUSIONS

Bike-sharing is quickly expanding around the world. It has been estimated that as of 2010, there were more than 200 such schemes operating worldwide. The central concept of many of the systems is free or affordable access to bicycles for short trips inside a city, as an alternative to motorized public transport or cars, thereby reducing traffic congestion, noise and air-pollution. Bike-sharing provides an environmentally sustainable and inexpensive mobility option to complement the use of public transportation, walking and ridesharing as alternatives to single occupant vehicle use. Two of world known systems BICING – Barcelona and VELIB – Paris were presented. A proposal for a similar system in Ljubljana was given. A summary of the reasons for
investing in a bike-sharing system in Ljubljana is:

- The city is without a conceptually well designed bike-sharing system at present;
- The presently operating rental systems are intended for tourists only, operating mainly in summer months;
- There are insufficient number of bike-rental locations;
- The bikes rented must be returned to the rental place;
- There are no organized bike maintenance services;
- The share of non-motorized traffic is too low, unfavorably contributing to air pollution and occupancy of traffic ways.

While gathering the material for the contribution the authors became aware of plans for setting up of a system called BICIKELJ in Ljubljana. A description of this system was given. Some comments and recommendations for the future development of the BICIKELJ system are:

- There are several areas in which bike terminal stations should be set up, a full and founded list is being prepared;
- The city's traffic infrastructure should better conform to bike user needs;
- The system should be of closed type (registered users only);
- Full information support;
- Friendly user access with mobile phone;
- Possibility of bike reservation;
- All bikes equipped with an RFID tag (or even GPS) for better safety against theft and vandalism;
- Bike maintenance services with favorable costs for residents using their own bikes (non-system members);
- Considerations of equipping the bikes with advanced, perfected dynamos for energy self-sufficiency should of public transport system.

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