Analysis of the motivation of the residents of Saransk for the transition to the use of “smart bikes”

A V Maryonkin¹, A V Razumov¹
¹Faculty of architecture and construction, National Research Mordovia State University; MRSU, 68 Bol'shevistskaya street, 430005 Saransk, Russia

E-mail: alexeymaryonkin@gmail.com

Abstract. This article aims to analyze the main motives of using a bicycle as sustainable public transport. Consider the prerequisites for the introduction of “smart transport” for the territory of Saransk. More than 1000 citizens took part in the survey. The majority of respondents stated low satisfaction with the bicycle infrastructure, but are interested in the implementation of the “smart bike” system in the vicinity of the city. The analysis provides an understanding that residents are concerned about environmental issues, affordable transport and personal health. That speaks about the high potential of development of this system in the city of Saransk.

1. Introduction

Bicycles are another part of a formed urban environment and perceive life and movement differently. They represent a faster form of travel but their users still remain pedestrians. By that cyclists promote development of “smart cities” with a healthy, safe and sustainable urban matrix.

Today cyclists are an important part of city life. Everything is connected with various processes taking place in the world, such as depletion of fuel, air and ocean pollution and the deterioration of the health state of city residents. Therefore, the prevalence of cycling over the car looks reasonable and farsighted. We need cities being comfortable for cyclists and this can be achieved without much effort and expenses in most cities of the world [4].

There are already some cities which are actively developing cycling infrastructure and introducing the concept of “smart” mobility into urban life. One of these cities is Copenhagen where the tradition of cycling has never given way to automobilization progressing in the last century. The main citizens' reason for the use of bicycles is the fuel crisis in Europe in the 1970s [1]. At the moment bicycles take a significant part of urban traffic what highly reduces car traffic which is the lowest in Western Europe. The Copenhagen experience is being used as a platform for discussions about a city for elaboration a sustainable development of the territory [2].

The basic principle of the formation of the bicycle network policy is the search for a place, the development of a route through the streets with high urban activity and safety all along the route. Another important aspect of sustainable development is the green routes, designated paths in parks, urban recreation and along unused railway tracks. They work seasonally and are considered to be backup in case of overloading of the main tracks.

For the formation of a sustainable bicycle network it was decided to narrow the lanes. Most of the city four lane arteries were redesigned into two lane arteries with a bicycle lane and an extended sidewalk. Abundant landscaping has also been added what makes the environment safe for citizens.
The inclusion of cycling in the city transport system solves the problem of sustainable development of urban areas. By that the mobility issue has also been solved and it gave an opportunity to bring bicycles into city buses and subways which added variety of trips and their combining [6].

Safe traffic and coexistence with cars is the main factor for sustainable bicycle development. Trucks and buses have to have special bicycle mirrors and numerous information companies remind drivers of the need to pay attention to cyclists, especially at the crossroads [9].

Also one of the most significant factors of safe cycling routes is the volume of traffic. According to the observations it is revealed that the presence of a big number of cyclists increases the vigilance of drivers, this has a positive impact on road safety.

Cycling gradually led to the expansion of the range. Many new types of bicycles have appeared on the street including tricycles for transporting children and goods, bicycles for disabled people and taxi-bicycles. They require more space and older cyclists, so as parents transporting children by bicycles, need an increased guarantee of safety. Despite these new requests bike continues to be an excellent wheeled vehicle which takes the least place on the streets per person [12].

Till now many cities have switched to renting various urban bicycles by easy interaction with a mobile phone. The idea behind the system of “smart” city bikes is to let inexperienced cyclists to drive around the city in a relatively safe, stable bicycle environment without causing problems with storage and maintenance. The growing number of problems connected with sustainable development, climate change and health will likely lead to the situation when more and more cities will form a new culture of city life and city traffic. The development of cycling is the obvious answer to the many problems faced by cities around the world [3].

2. Sustainable development of “smart cities”

2.1. Forming “smart mobility”

The system of “smart city” in the modern world is becoming a popular topic in the development of cities resulting into both positive reviews and alertness. This article raises the question of the work of urban mobility in a “smart city”. “Smart” mobility is one of the main components of what is commonly called “smart city” in the modern world [5].

Both personal and public bicycles, as one of the types of urban transport, become to be more and more popular in the whole world [7]. The reasons for this are quite obvious. This is the democracy and availability of this type of transport, its cheapness, environmental friendliness, promotion of a healthy lifestyle and reduction of the number of cars on the roads and traffic jams in urban arteries. The state systems in the Russian Federation, in turn, do not yet offer the sharing of bicycles in necessary quantities, which can be used by citizens along with the existing transport systems, such as the metro, buses, taxis, and so on.

In the world practice the “smart bike” of public use tends to reduce car dependency and improve the environmental situation in cities. The Netherlands is a particularly clear representative of the transition to a new sustainable urban mobility where about 400,000 cyclists ride the streets every day [11].

Sustainable mobility of this system requires the acceptance of sustainable development of the required infrastructure and the tendency of reducing the number of private cars in the city [14]. Thereby, not only architects, urbanists, politicians, but also market analysts fixed their eyes on this. Marketers introduce visual advertising for the bicycles they represent, urban infrastructure, and adjust the field of view of road users.

However, this system cannot be used for each city with the same structure, it is necessary to take into account many factors, such as climate, the requests of the citizens, geography, financial situation in the region and competent promotion of sports as a way of life.

For the long-term use of bicycles of new mobility, a number of mandatory things is required: cycling routes that comply with the regulations, timely maintenance of bicycles and infrastructure,
demographic and operational conditions, safety of terminals and legal protection of the cyclist as a full participant in road traffic.

Also, the bike sharing system requires constant investment, support and feedback from users. It should be noted that after the crisis in 2008 the use of public bicycles and all other urban modes of transport increased [8]. This proves once again that the bicycle, as a public transport, is developing and has everything what is necessary for the further growth of caring residents, and with them the necessary financial and creative investments.

Urban mobility issues are major for cities due to rapid urbanization and the development of new regulatory options for a sustainable urban transport system. According to that “smart mobility” is one of the factors forming “smart city” and affects the quality of life of citizens.

The goals of “smart mobility” are formed from 6 categories: pollution decrease; decrease of traffic jams; increase of safety; reduction of noise pollution; improvement of the speed of movement; reduction of transport costs of citizens.

It is worth noting that “smart mobility” intends to help smart cities achieve their specific goals by reducing urban environmental impact and improving the quality of life of citizens. It results into impossibility of unstable mobility plan being “smart” and meeting the modern characteristics of a “smart city” [10].

The introduction of "smart" technologies in the system of urban public bicycles dispelled concerns and solved many problems, such as vandalism and theft of bicycles. And alongside this, they have increased the demand among tourists due to fast and easy control via the Internet.

But in order to be confident of success and the expansion of a sustainable “smart bike” zone, it is necessary to analyze and determine the desire and need of citizens to use urban public bicycles as a permanent vehicle.

Sources identified several barriers to the transition to the formation of a “smart bike”, they include travel time, lack of safety, heavy traffic, lack of infrastructure, weather conditions which are not preferable for driving, and terrain features. One of the main factors is the well-built system of public use of bicycles in all parts of the city, the presence of a sufficient range of “smart bikes” in areas of continuous demand and comfortable access to them. The combination of a favorable landscape and weather conditions are equally important, as well as the availability of a guarantee for a bicycle and the possibility of renting for a long period of time, what stimulates healthy and environmentally friendly means of transport.

2.2. “Smart Bikes” in Europe

In the past, European studies have already compared the impact and comparison of cyclists with those who prefer other modes of transport (for example, car, bus, skateboard). However, in addition to research, it is important to have more personal contact and interaction with citizens.

It was the modern Copenhagen city bike rental system that was the first and inspired over 600 cities throughout the world. The network of “smart bikes” has become commonplace for Copenhagen residents so much that except of stations for renting a bike, you can “pick up” the ways as well. It does not make any sense to steal “Smart bikes” because they have a peculiar design that immediately catches the eye of passersby. Already today, bicycles are equipped with electric motors, charging them from the sun or a conventional outlet. They quickly started to be in use by tourists and elderly people to travel to a fair [3].

Such European cities as Paris (1,200 stations), London (570 stations only in the central part of the city), Barcelona, Berlin, Amsterdam, Vienna are famous for their comfortable bicycle infrastructure. The introduction of “smart bikes” in Barcelona has reduced the use of cars in the city by 4% over the year. At the moment, the implemented “smart mobility” in various European cities has already become a necessary connecting part of the transport system with a human creating a comfortable environment where cyclists do not compete with cars for a place in the urban infrastructure but work together.

But the creation of comfortable conditions for using bicycles is not able to reduce the motorization of the city. For example, there is an attempt to unite the bicycle and public transport into a single
system in Spanish Seville. Passengers of the city bus station can get a rental bike for free during the whole day using their bus ticket, and students at the University of Seville have discounts of up to 100% on renting a bike during the school year.

In some places where there is not enough space on the roads, car drivers have to give way to cyclists. City authorities of Paris allowed cyclists to drive when it is red light at a number of crossroads. The statistics collected during testing over several years has shown that the throughput of crossroads has increased markedly due to this measure.

Architects together with urbanists came up with a fantastic project for the future of London – a network of elevated bicycle infrastructure over the existing railway lines with a total length of 220 kilometers. The new road junction will not have any intersections with highways, and two hundred exits from the elevated cycle highway to ordinary streets will provide convenient access to new roads. The project seems to be completely unrealistic, but it is quite feasible. It has already been supported by the operators of the railway infrastructure of Great Britain and the city transport service [29].

The most striking example of this is Ljubljana, which in a few years has become “The green capital of Europe”, making a bet on bike lanes and pedestrian zones, which serve as a kind of incentive for choosing a bicycle.

Such projects are planned in Russia as well. The Moscow Cycle Sustainable Territory “Green Ring” will connect largest green parks of the capital with public transport and embankments. The project involved the Dutch specialist in “smart” urban planning, Johan Dipens. In the project he proposes to revise urban planning completely and move to the concept of “smart city” through the introduction of sustainable development of the territory. Equipping the public transport park with “smart bikes”, providing benefits for people refusing cars, holding festivals, lectures on the subject of ecology and further development of “smart mobility” are the main points.

3. Methods

3.1. Survey of respondents
The purpose of this article is to analyze the motivation of citizens to use public bicycles in the city of Saransk, Russia. Before analyzing and identifying patterns, it is necessary to collect the initial information. This collected data will serve as the basis for any further analysis on the formation of a sustainable urban area.

In order to analyze the interest and to identify the characteristic factors of the availability of the implementation of "smart bikes" in Saransk, the research method includes a survey in social networks, statistics and questioning in the rental points of bicycles. Following the example of the program “архитекторы.рф”.

In the summer the city residents actively use bikes to enjoy their free time. The situation changes with the beginning of rains and cold snaps. Social request for bikes disappears. The survey took place in the warm season. More than 1400 residents of the city who rented bicycles were surveyed.

The survey questions included the following topics: environmental pollution reduction, joint movement of bicycles with urban and private vehicles, quality of life, economy, environmental friendliness, the desire to use the bicycle as the main mean of transport, the lack of bicycle infrastructure, the distance of possible cycling, climate, landscape, clothes for bike rides. Also there were a number of questions about the reasons that may incline a citizen to use the “smart bike” system in the near future. Each of the questions needed to be rated on a 5-point Likert scale [15].

The data collection took place in July 2018 and January 2019 in social networks and at the bicycle stations. The study was voluntary. Respondents were informed that there were no right or wrong answers. Everyone was also informed about the anonymity of the answers and that the answers would be considered together and used for scientific purposes. The average time to answer the questions was 10 minutes.
Answers from the online and print versions were combined and counted. The number of the respondents is 1,400; 560 of them were questioned online. A “snowball technique” was used to guarantee a large girth of the respondents. Each respondent was asked to send the poll to other people.

According to the survey results, it was clear that residents more often use the following types of transport: public transport, own car, walking, cycling on their own bike, and riding a public bike. The lowest result in popularity among the respondents is a motorcycle, scooter, and skateboard.

This research is important for understanding the scale of requests of various groups of the population, relying on their interests and needs it is possible to reduce the discontent and ensure sustainable development of the urban area.

3.2. Public Support
The development of “smart bikes” was supported by representatives of small trade, a number of sports organizations, students and can contribute to the formation of an attractive, comfortable and safe infrastructure. For example, residents may be directly involved in popularizing a bicycle in and around the city.

Entrepreneurs, in turn, can reduce the financial burden, stimulate the roadway and thereby increase the motivation for “smart bike” sustainability.

This also applies to improving the quality of the “green” infrastructure. Examples are public urban landscaping or gardening communities, providing access to local food products, introducing new environmentally friendly methods for building sustainable development of the territory.

In the middle lane you need to take care of winter trips, but designing heated bicycle paths can scare off the idea because of the financial component. Still premature cleaning of the coating from icing can motivate people to choose a bicycle as a means of transportation.

With the support of the public, people on bicycles can form communities, and by joint methods, through communication, continue to shape the environment on their own. Constant communication among themselves will allow us to determine where the cycling network will take place and to develop “smart mobility”.

4. Analysis

4.1. Data Received
Based on shopolog.ru statistics, the demand for the purchase of personal bicycles increased by 2 times in 2018. A total of 1,400 people took part in the survey. In the course of which it turned out that about 35% of students ride a bike. Most of these use it to enjoy the trip (60%); as a way to reach their destination - 25%; to improve your fitness - 15%. The peak of cycling activity occurs in the summer: 9% of respondents ride a bicycle very often and 31% periodically, the rest are completely uninterested in moving around the city on a bicycle. In autumn, the number of functioning bicycle rental points decreases noticeably on the streets of Saransk. Only 2% of respondents use a bicycle as a permanent vehicle.

In winter, 0–1% of respondents continue to use the bike. The sharp decrease in the number of active cyclists in the cold season is due to several factors: weather conditions 86%, lack of necessary infrastructure 78%, fear of hypothermia 63%.

Public bicycles are used for small and medium movements around the city. The average rental time is 1 hour 20 minutes, and an average of 143 trips per day in summer. The highest peak of use is from 12:00 to 18:59 pm, 67% of bicycles are used during this period of time.

39.7% of respondents answered that they get to work or study on a personal car, and by public transport 47.5% and only 12.8% get on foot. When asked about the vehicle they would prefer to get to work / study, 44.2% of the citizens spoke for the bicycle, provided that the weather was favorable. Cyclists prefer to ride in the company of family and friends 70.3%; 11.3% chose a single trip; 18.4% of respondents were indifferent.
About 57% said they never or rarely change the course of their daily cycling routes. Accordingly, the choice of route is highly dependent on the person’s habit. The most frequently chosen factors were the length and time of the required route, as well as the presence of green spaces.

Answers to health-related questionnaire questions showed that citizens more and more often think about a favorable and clean movement component. Most cyclists agree that stress can have a negative impact on health 89%, and a minority will even feel a direct effect 11%. Cyclists tend to be heavily exposed to noise 63%. Consequently, a negative impact on the body is not always perceived immediately, but has a cumulative nature. In addition, a larger number of respondents 84% stated that they are interested and will, if possible, work on reducing urban noise. Also 85% of those who completed the survey, would like to use the application to plan the route, which makes up the route individually for you, taking into account the state of your health.

In this context, an application for smartphones and inexpensive sensors for bikes prove to be reliable and smart solutions for collecting data about your health and physical activity.

The most important advantage of “smart bikes” is the simultaneous collection of objective and subjective data on place and time using geolocation. In addition, the display of effective tips indicates shortcuts, congestion and the status of the cyclist's pulse. [13].

Most citizens 64.2% approved the initiative to create a park of “smart bikes". The majority 75.7% of the participants intended to continue using the bike in the city.

The most significant factor for the citizens is “Health and the environment”. Because every meter of the path leads to individual and social and environmental benefits, which significantly improve people's health, reduces cash spending and increases the social responsibility of citizens. The health benefit of driving is weight control, reducing the risk of cardiovascular disease.

The second factor - “Social Impact” - dissatisfaction with urban public transport, and adopting for themselves as an example developed European cities that have long since switched to “smart bikes”. Social influences on citizens will set an example for others, encouraging the use of a bicycle as a factor associated with moving around the city, which leads to the optimization of a favorable social connection. The social influence factor is directly related to the tendency of users to develop sustainable practices. The behavior of people who are in society based on the principle of conformity, that is, citizens repeat what is considered normal and practiced by others.

4.2. Sharing

Sustainable transport planning emphasizes the long-term development of the city and involves the population and other interested parties to develop and find the best tools, products, efficient services and design new successful models of public “smart” urban transport.

The essence of this unifying program is that the participants are based on the exchange of experience, the purpose of which is to encourage the use of ecological, practical, quiet and healthy public transport.

The system complies with the principle of sharing bikes: people use bicycles according to their needs and with low costs of using them.

This attracts tourists and investors, and this is one of the most important conditions for the formation of a sustainable environment. As a result of the analysis of the conditions of public transport and human functioning, the key factors are: growing expectations of residents regarding the quality of life and taking part in their formation, air quality, demography and health.

The strategy of developing “smart mobility” envisages three directions: informing citizens, developing civil and social relations, and supporting cyclists' initiatives. However, in practice, the proposed actions may be selective in nature, and be considered comprehensively.

The idea of integrated planning and implementation of cycling routes, aimed at achieving long-term goals and creating a single, sustainable mobile cluster, is of concern to all who have encountered the problem of developing urban areas. Changes have occurred in the perception of the necessary tools – the strategy places an emphasis on the need to use innovative methods of consulting citizens and
introducing new tools in the framework of e-government, which in turn covers the field of mobile development for smartphones.

5. Conclusion
The collected analysis shows that residents adequately perceive the introduction of a model of a public “smart” urban bicycle. The most important factor was “Health and the environment” - the citizens are united by a sense of contribution to the development of the city, clean air and health. In addition, bicycles take up less space, which affected maneuverability and storage. Each kilometer traveled leads to individual and social benefits, because cycling is an “active” mode of transport that provides significant health benefits and, therefore, reduces the social costs of society. Financial and social benefits motivate well the choice of permanent cycling.

The second factor - “Social Impact” - refers to mobility as a sustainable practice, and includes variables associated with the use of the bike in favor of sustainability.

They are examples to others, encouraging the use of a bicycle as a factor associated with self-presentation, which leads to an optimization of favorable social relations. The “Social Impact” factor is directly related to the tendency of users to develop sustainable practices. The behavior is based on the principle of conformity, that is, citizens practice what is considered normal and practiced by others, despite their understanding of instability.

In addition, the use of a bicycle is an independent factor of behavior. That is, a person under different weather conditions has the choice of using transport, which gives an understanding of freedom.

The results also show that the bike sharing system is well received when it has a high potential for development to become part of and at the same time find its identity. However, public “smart bikes” must be constantly monitored, and its development must be targeted.

Thus, the concept of “smart bike” has the opportunity to develop in Saransk. Sustainable “smart city” can constantly develop and create new social environments with the participation of citizens and the administration.

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