CASE STUDY

How Barriers and Motivators can Affect Mashhad Citizens' Usage of Bicycle Sharing System: A Qualitative Approach

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ARTICLE INFO

Article History:
Received: June 20th, 2017
Accepted: September 24th, 2017
Available Online: October 1st, 2017

Keywords:
Bicycle Sharing System
Mashhad
Qualitative Approach
Thematic Analysis
Barriers and Motivators

ABSTRACT

The purpose of the present study is to identify the motivators and the barriers of using Mashhad's Bicycle Sharing System. Bicycle sharing systems (BSS) are carried out in different ways, so each system has specific features and conditions. The authors of this paper have used a qualitative approach with a thematic analysis method for an in-depth analysis of the motivators and barriers of Mashhad's BSS. In this respect semi-structured interviews were conducted with three groups of users, non-users and experts. The number of the participants was 12, 18 and 8 individuals for each group respectively. In choosing the user and non-user participants, different districts and occupations have been kept in mind. Also, in the interviews with experts and managers, snowball sampling has been adopted. After reaching theoretical saturation, the factors have been categorized into 7 different groups of themes, including "cultural", "environmental", "economical", "policy-making and planning", "functional", "infrastructure" and "comfort". The results show that the complicated sign up process, lack of access to docking stations and lack of awareness about the program are the barriers of using Mashhad's BSS among non-users. For users, program inefficiency and limited service hours were identified as barriers and environmental and health benefits as motivators. Finally, specialists and managers have pointed to factors such as policy-making, raising awareness, cultural education, improving infrastructure, more funding and modern planning to encourage the general public to use the BSS system.

How to cite this article
Jahanshahi D, Kharazmi OA, Ajza Shokouhi M. How Barriers and Motivators can Affect Mashhad Citizens' Usage of Bicycle Sharing System: A Qualitative Approach. Stud. Archit. Urban. Environ. Sci. J., 2018; 1(1):29-38. DOI: 10.22034/saues.2018.01.04

INTRODUCTION

One of the urban sections that is impacted by urban growth and increase in population is urban transportation system. The spatial expansion of the cities, changes in lifestyle and increased commute distances have forced urban planners to take measures to improve transportation systems in big cities. However, it seems that developing countries are facing severe problems in transportation [1][2]. Urban transportation systems have to be in sync with the fast pace of changes in cities and increasing demand for more efficient transportation systems [3]. Urban transportation is responsible for 23% of carbon emissions in the world, and it is estimated that by 2050 this amount will be doubled [4]. It is also estimated that developing countries will be responsible for 89% of these carbon emissions until 2030 [5]. Thus the growing concerns about climate change induced by use of fossil fuels in transportation has led to a general interest in alternative and sustainable transportation systems, such as BSS

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[6]. Public bicycle sharing systems (PBSS) have been around for half a century, and they have become more and more popular in recent years [6]. These programs are considered as sustainable transport systems, which could replace conventional transportation systems and minimize environmental issues. Bicycle sharing systems are non-motorized transportation programs that facilitate short distance travels without the need to purchase a bicycle. Citizens can rent a bike from one station for a short distance travel and deliver it to the same station or another station within the program [3] [7][8].

Using shared bicycles as a means of transportation has a lot of benefits which if fully understood, could motivate people to use them. Among these benefits are more transportation alternatives [6], replacement with unsustainable and conventional transportation systems [9], reduced private vehicle use [10], convenient travelling and reduced traffic [11], reduced air pollution [12], reduced noise pollution [13], lower oil costs [14], increased physical activity [15], affordability [16], less costs and complications compared to other transportation modes [6], solving the "Last Mile Problem" (travelling a short distance for which there is no option except BSS) [9], reduced travel time compared to other transportation modes for distances less than 6 kilometers [15], less needed space for travelling and parking [13], more freedom in choosing speed and travel routes [16], lack of concern for maintenance and protection against theft [10] and filling cultural and economic gaps [15]. Cycling has a lot of cultural aspects, in his book titled "In Praise of Bicycles" Mark Auge has mentioned cycling as a philanthropic act [17].

The first BSS in Iran was established in Mashhad in 2012. Mashhad is a metropolis in northeastern Iran. It is the capital of Khorasan Razavi province, and has a population of 3,134,408 with an area of 352.3 square kilometers. It has a dry climate [18]. As a result of increased population in the last decade from 2,399,503 to 3,134,408 citizens, increased number of car trips from 3893932 to 6245396 trips per day, increase in the trip growth rate from 1.62 to 2 trips per a day [18][19], and increased gasoline and natural gas consumption in the last 5 years [18][20], it is obvious that considering sustainable transportation systems is vital. Accordingly, in 2012, a BSS was established in Mashhad as the first bicycle sharing program in Iran. Today the program has about 2,300 bikes and 128 working stations, which offer 10 hours of service a day. Mashhad's bicycle sharing system lacks RFID and GPS systems. Initially smart cards were used, but since a smart system was not launched they were removed. Lending and delivering of bikes is done by station operators. The amount of charge is calculated by the smart cards.

Different programs are differently received by people in different countries. Bicycle sharing systems are not any different, they may be welcomed or dismissed by the target audience. The current study is trying to point out the reasons behind potential interest and lack of interest of citizens in the BSS in Mashhad. There have been few studies on this subject which is not very surprising considering the fact that such programs are new in Iran. Alaeidini and Fayezi analyzed the achievements and challenges of the experimental BSS in Tehran, taking into account factors such as accessibility, awareness, safety, traffic relief, public satisfaction and cultural education. They concluded that the program has been successful in attracting users but has shortcomings like poor advertisement, lack of cultural education, lack of traffic signs and low quality bikes and routes [21]. In an study done by Malekhosseini et al in district 8 of Tehran, factors such as lack of general public interest in cycling, social stigma associated with riding a bike and the short length of bike lanes were identified to be discouraging factors, while waste of time in public bus and subway stations and convenient routes were pointed out as motivators [22].

Among studies done outside Iran, a lot of studies can be mentioned which analyzed factors such as citizen attitude toward BSS [7] [23], factors contributing to awareness about BSS [24], spatial statistics for evaluating accessibility [11], motivators and barriers of use [25] and effects of natural and constructed environment on interest in BSS [26]. All above mentioned studies have used a quantitative approach to analyze the relevant factors. Among studies with quantitative approach, Fishman et al analyzed the barriers and motivators of BSS programs in Australia in 2012. They studied 3 focus groups which included Infrequent and non-cyclists (no bicycle riding over the past month), regular bicycle riders (ridden a bicycle at least once in the past month) and CityCycle members. They concluded that factors such as safety are of major importance for all 3 groups. They recommended more accessibility, spontaneous sign-up process, 24/7

service hours, and greater incentives to sign up new members and casual users.

In this paper the authors intend to use qualitative approach to investigate and identify barriers and motivators of Mashhad BSS taking into account 3 groups of non-users, users and experts.

MATERIALS AND METHOD

Mashhad bicycle sharing program

Mashhad's BSS started out in 2012, it currently has 128 docking stations and around 2300 bikes. Only male users older than 15 are given service. Based on an agreement between Mashhad Municipality and the beneficiary firm, the program serves from 6:30 to 16:30 (10 hours). In the agreement it was established that the goal of the program would be reaching 150 stations and 3000 bicycles in future. The stations are not automatically operated, all of them are handled by operators. After submitting some personal information and a telephone number the renting process can be completed. There is no charge for signing up, however a 2.500.000 Rial fee must be paid to guarantee returning of the bike. After the first 30 minutes of use which are free, the user is charged 2000 Rials per hour. All of the bikes are the same size and there are two models. The difference between the two models is very small. Figure 1 contains the details of the docking stations of Mashhad's BSS.

Qualitative Approach

In this study, the authors intend to investigate and analyze the barriers and motivators of using Mashhad's BSS. With respect to the intention of the authors to find out about the reasons behind interest and lack of interest of citizens toward Mashhad's BSS, a qualitative approach has been used and semi-structured interviews were conducted. The authors believe that with this method, more in depth results will be reached. For this purpose a qualitative approach and a thematic analysis method have been adopted. The interviews have been conducted in a parallel fashion, and continued until data saturation was reached.

Thematic analysis method is widely used for studies with qualitative approach, and it is applicable to a wide range of subjects because of its flexibility. This flexibility enables scholars and researchers to apply

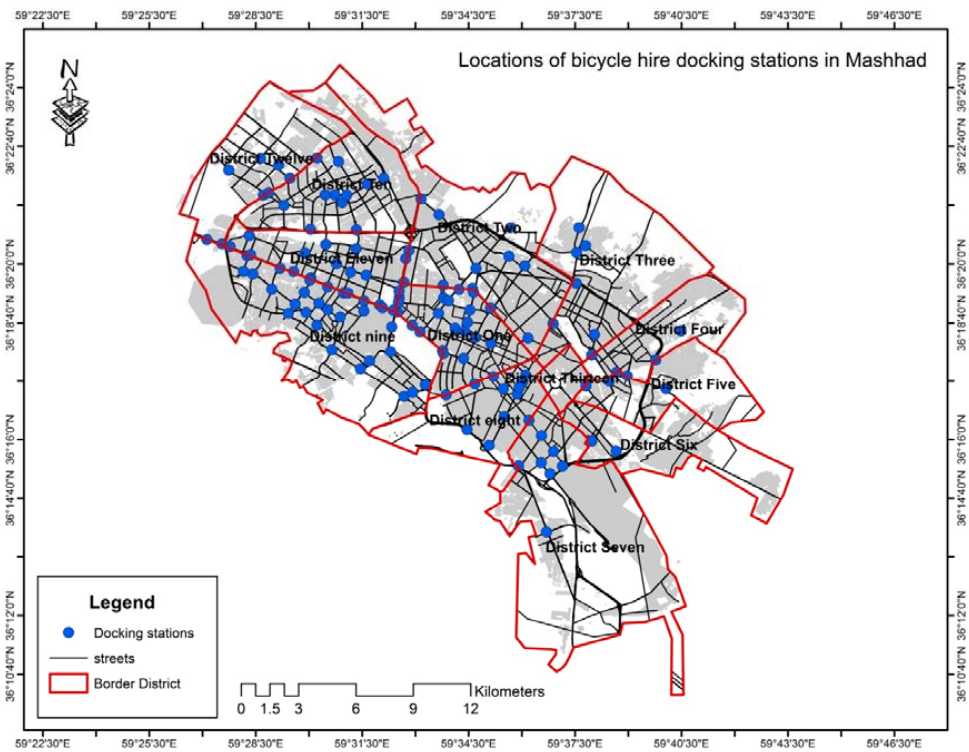

Fig 1: Spatial distribution of bicycle sharing docking stations in Mashhad

multiple theories to this process for different subjects [27]. This method can be used for large data sets. Using this method enables researchers to contribute to previous studies. Also it makes interpretation of themes supported by data more convenient [28], and it facilitates categorization based on data [29].

For conducting interviews, the authors chose 3 major groups:
First Group: Non-users of the program.
Second Group: Frequent Users of the program.
Third Group: Experts and planners who were aware of different aspects of the program.

Since the chosen groups were reluctant to be arranged into focus groups, the interviews were conducted individually, and in case of the group of experts, Snowball Sampling was used. Eventually the interviews led to theoretical saturation after interviewing 18 non-users, 12 users and 8 specialists and managers. The age range of the interviewees was from 19 to 63 years old. Non-users were chosen from different districts, also users were chosen from people who use different stations. The experts and managers were chosen from those who had been involved with the program in a theoretical or an operational context.

The semi-structured questions that were asked in the interview were as follows:
- How much do you know about Mashhad's bicycle sharing program?
- In your opinion what kind of people use this program for their short distance travels?
- What are the reasons for your lack of interest in this program?
- What are the motivators that encourage you to use this program?
- What should be done in order for you to use the program?

RESULTS AND DISCUSSION

In the interviews the authors have tried to include different districts and people from different occupations among users and non-users. The specialists and managers have been interviewed using the Snowball Method to reach theoretical saturation. Most of the users were people with academic education. With the age range of 21 to 38, most of the users were young. Non-users were mostly employees and shopkeepers in different districts. Regarding the interviews with specialists, since the understudy program was not well known by everyone, the interviewees were chosen mostly from specialists and technicians directly involved with the program. In addition the relevant authorities were interviewed as well, including urban traffic authorities, traffic police and managers of relevant NGOs. After the interviews were conducted and theoretical saturation was reached, the data went through thematic analysis stages, including familiarization with data, generating initial codes, searching for themes among codes, reviewing themes, defining and naming themes, and producing the final report. Then the themes and sub-themes of the factors mentioned by the groups, were categorized into 7 groups of "cultural", "environmental", "economical", "policy-making and planning", "functional", "infrastructure" and "comfort" (Fig 2). The results show that all 3 groups think lack of proper infrastructure is a major barrier for the success of the program. Lack of awareness about the details of the program is prevalent among non-users. The themes and sub-themes mentioned as barriers and motivators by the groups will be discussed below.

Cultural

Weak Advertising

Bicycle Sharing Systems are considered new technological programs in developing countries and there is not enough awareness about them between the citizens in these countries. One of the responsibilites of the planners of an urban program is to attract citizens by raising awareness and advertising. The group of experts and non-users in this study believed that there is not enough awareness about the program. A significant number of non-users were totally unaware of the function, working hours and general facts about the program, they had different interpretations and assumptions about it. Some of the experts believed that one of the reasons behind lack of interest in the program is lack of awareness among the general public.

"I had no idea the program has started working, I thought it was not started yet".
(Male, 39 years old, non-user)

"A lot of citizens ask me about the program, they have different understandings about it".
(Male, 38 years old, expert).

Bad Driving Habits, Health Concerns.

One of the factors that affects public attitude about bicycles is safety. Citizens care very much about safety, and do not want their lives endangered. Driving habits

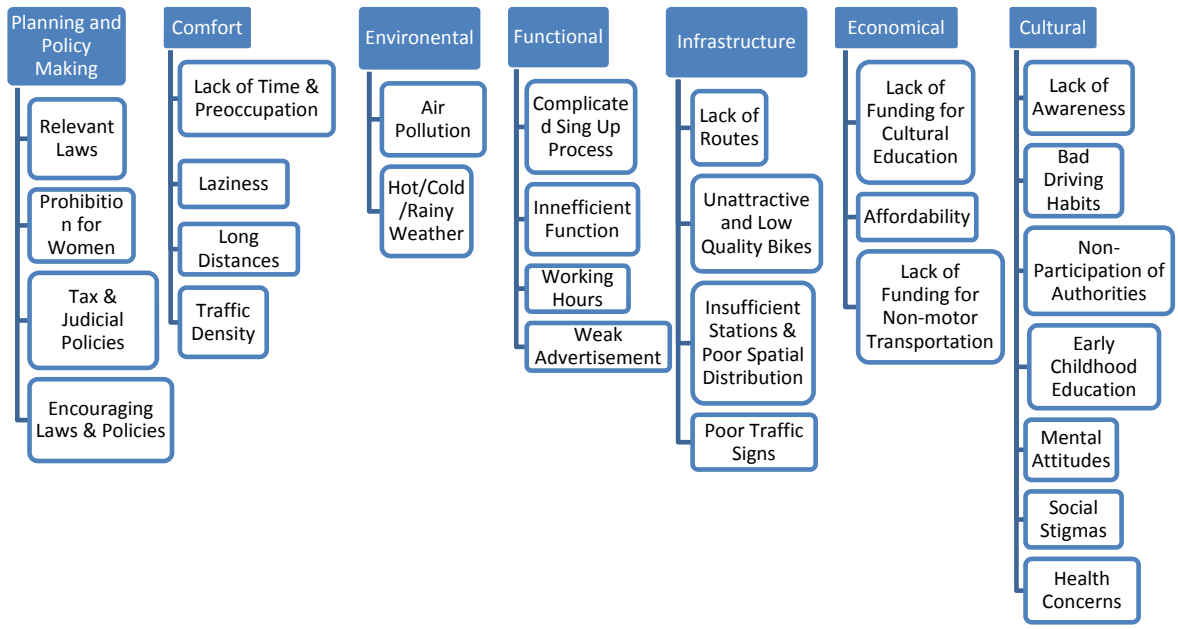

Fig. 2: themes and subthemes.

in a society could affect people's oppinions about cycling significantly. On the other hand cycling is a beneficial and healthy activity. In fact people who ride bikes are affected by this conflict between health benefits of cycling and dangers associated with bad driving habits. This danger is a major barrier based on the opinions of all 3 groups. Health benefits associated with cycling is one of the major motivators, experts believe that the users of the program care about their health.

"People drive very dangerously in our neighborhood, and I prefer not to cycle in such a neighborhood. I won't let my children do it either".
(Male, 54 years old, non-user)

"Sometimes when I think about how bad people drive and the possible dangers, I prefer not to use bikes"
(Male, 25 years old, non-user)

Non-participation of Authorities, Social Stigmas, Mental Attitudes, Early Childhood Education

One of the factors that affect how BSS programs are received is people's attitudes toward riding bikes. Attitudes can differ in different cultures, resulting in different outcomes. A lot of the non-users thought that riding bikes hurts their social image and didn't think of it as an option. By contrast some users associate riding bikes with intellectualism, since it has major environmental benefits. Some of the non-users have pointed to non-particioation of authorites and thus concluded that the program must not be worthy of trying. Experts believe that such attitudes could be changed by early childhood education and cultural education.

"How do they expect us to use it if they don't use it themselves?"
(Male, 39 years old, non-user)

"When I use this program I feel good about myself, because I feel like I'm doing something about the environment. And this gives me a good feeling througout the day".
(Male, 26 years old, user)

"The education system in the country does not educate children about such matters, and we cannot expect them to be responsible and thoughtfull about the environment in future"
(Male, 44 years old, expert)

Economical

Affordability

BSS programs are known as affordable transport modes worldwide [6]. In fact the incomes of such programs are mostly from advertisement and renting

billboards, and using the programs is almost free of charge. One of the reasons that most users mentioned for using the program was saving money and reducing costs.

"Since I started to use the program I have managed to reduce a significant amount of transportation costs".
(Male, 38 years old, user).

Cultural Budgets and Funding Non-motorized Transportation

Execution and maintanance of a BSS is not only dependant on billboard ads, such programs need funding and aids from governments to improve non-motorized transportation systems. The important point is that a good BSS depends on a lot of different aspects, including bike lanes, cultural education and sufficient funding.

"There is no specific organization responsible for cultural education for using BSS programs, most of the measures are superficial, or done on an impractical scale".
(Male, 36 years old, expert)

Infrastructure

Lack of Routes, Lack of Traffic Signs for Cycling

Proper urban infrastructure is one of the necessities for launching a successful program in a city. By the increasing growth of technology and use of private vehicles, cities have transformed greatly. In the past cycling was much easier even without traffic signs, but today there is an essential need for safe routes and relevant traffic signs. A lot of non-users have mentioned that lack of infrastructure is one of the main reasons for their non-participation. This factor has also been mentioned by the two other groups. Many users have said that availability of stations and bike lanes on their usual travel paths has been one of the reasons for their participation.

"I really cant cycle if there is no special bike lane, for me lanes are necessary. So that I can ride my bike with peace of mind"
(Male, 51 years old, non-user)

"One of the reasons that encouraged me to use the program is that there is a special bike lane on my way to work"
(Male, 27 years old, user)

"I think the main reason behind lack of interest in the program is that there are not enough safe and continous lanes. People naturally care about safety, its their first priority"
(Male, 51 years old, expert)

Unattractive/Low Quality/Unsafe Bikes, Lack of Equipment

The unattractive appearace of the bikes and their low quality has been identified as a significant factor. People consider it discouraging for different reasons. Some of the non-users consider it insulting, and believe it hurts their social image. Others consider it damaging to their businesses. There are individuals who have safety concerns and believe that the bikes are not safe. There have been complaints about the fact that the sign up conditions are too complicated specially considering that the bikes are low quality and unattractive. The users rarely complained about the appearance but they did believe that the low quality of the bikes is discouraging. Some experts believed that the appearance of the bikes is not so bad, yet they emphasized necessary equipment and proper and timely maintenance.

"The bikes are low quality, and since they lack the standards, daily use can be dissappointing"
(Male, 26 years old, user).

"The bikes don't look very good, they are not suitable for somebody with my social status, I'm ashamed to ride these bikes".
(Male, 52 years old, non-user).

"Bicycles of similar programs in other countries are not that different in terms of equipment and quality, but they are regulary checked and repaired"
(Male, 43 years old, expert)

Insufficient docking stations and poor spatial distribution, long distances between origin and destination

The spatial distribution and effective planning for availability of docking stations for everyone is one of the crucial aspects of BSS programs. Some of the non-users complained about lack of access to docking stations, specially in the districts with poor spatial distribution. On the other hand, availability of docking stations and easy access to them has been pointed as a motivator among users. One of the experts believed that since funding and planning only covers limited stations, simple bike stands can be used in different places, if the bikes are equiped with special locks.

"There are no near stations on my way to work".
(Male, 36 years old, non user)

"Sometimes I want to ride a bike to other destinations than my usual, then I realize there are no docking stations near my destination"
(Male, 24 years old, user)

Function of the Bicycle Sharing Programs
Complicated Sign Up Process, Function of the Program, Poor Advertisement

Convenience is an important factor to get people to use new technologies and instruments, people seek comfort and peace of mind, and they will dismiss inconvenient systems. Many of the non-users have mentioned that the complicated sign up process has been a discouraging factor for them. Also most of the experts believe it's one of the main reasons that people do not start using this program. The function and poor advertisement of the program has been mentioned by the users as a major barrier for the success of the program.

"Sometimes my whole trip takes 5 minutes but I have to wait 10 minutes for calling the operator and waiting for arrangements to be made. The system doesn't work automatically and conveniently".
(Male, 25 years old, user)

"I have faced closed station and have been stood up a bunch of times. I'm dissapointed by the function of the program".
(Male, 27 years old. User)

"The sign up conditions are kind of insulting considering the quality of the bikes and the level of service".
(Male, 38 years old, non-user)

Service Hours

Successful BSS programs mostly offer their services 24/7. The service hours should cover different needs of all groups of people. All 3 groups have mentioned the limted service hours as a major barrier. Some of the non-users said that with regard to their work hours it's practically impossible for them to use the program. Many users said that they cant use the program at night or late afternoon because of the limited service hours. Expert think that the service hours should be extended to make the program more practical, which would result in more users, which is the best way to make people aware of the program.

"I always use the program on my way to work, but when I return the service hours are over".
(Male, 21 years old, user)

Environmental
Air Pollution, Cold/Hot/Rainy Weather

The climate of different areas affects the amount of BSS use. For instance in European countries these programs are out of service in winters[12]. Mashhad's Climate could negatively affect the function of the program due to frigid wheather in automn and winter. Also in summer the hot weather causes more perspiration while cycling, which could be frustrating. These factors have been mentioned as temporary reasons by the groups. Some of the non-users have mentioned air pollution and the side effects of excercising in such circumstances as their reason for not using the program.

Comfort
Lack of Time, Laziness, Long Distances between Home and Workplace, Traffic Density

Many non-users have mentioned laziness, preoccupation and disinterest as their reason for not using BSS. Long distances between home and workplace was another reason. On the other hand some of the users reffered to the heavy traffic as a motivator and said that they could save some time by using bikes.

Planning and Policy-Making
Relevant Laws and Regulations, Prohibition of BSS for Women

It can be said that people assesss the realiability of public and urban services by the existence of relevant laws and regulations, and their acknowledgement. In the conducted interviews all 3 groups believed that there are no clear laws in case of conflict between cars and bicycles, and this leads to safety problems and concerns. Another important factor is the prohibition of BSS for women. A lot of experts believe that this prohibition not only has banned half of the citizens from using the program, but also has negatively impacted men's use as well.

"Me and my wife wanted to cycle from home to work or a subway station, but since my wife can't use the program I wouldn't use it either".
(Male, 32 years old, non-user)

"There are no specific laws about dealing with cars, I often get into arguments and conflicts with car drivers"
(Male, 29 years old, user)

Tax Policies and Judicial Policies.

Some of the experts believed that besides cultural education and infrastructure, effective policy-making such as increasing the costs of using cars or banning cars in certain urban areas can help the program significantly. Some of the experts believe that in some societies such programs should not just rely on cultural education, they should be accompanied with regulations and surtax.

CONCLUSIONS

The success of a BSS is measured by the percentage of people who use it. These programs are considered new transportation modes in countries that are just starting to launch them. A lot of measures should be taken for these programs to succeed. In this respect, understanding the obstacles can help urban policy-makers greatly. For this purpose, the authors of this paper have tried to deeply analyze the barriers and motivators of Mashhad's BSS with a qualitative approach. After undergoing thematic analysis process, the data was categorized into 7 groups: "Cultural", "Environmental", "Economical", "Policy-Making and Planning", "Function", "Infrastructure" and "Comfort", which correspond to the different themes mentioned by the interviewees.

From the cultural aspect poor advertisement and lack of awareness have been emphasized by the experts. When faced with new technologies and systems, people need to be educated and informed about them, otherwise the new system cannot be expected to succeed. It is important to note that lack of awareness and knowledge about the function of the program will result in a lot of problems. For example, in many interviews long distances between home and workplace was mentioned as a discouraging factor. While BSS programs are not necessarily supposed to be used for the whole journey, they can be used for travelling "the last mile" which refers to the distance between home/workplace to a subway/bus station. Of course "Limited service hours" is another important factor that affects the use of the program. After being informed about the function of the program, many non-users stated that if they use the program they will face complications since the program is out of service by the time they want to get back from work, so they prefer to use cars.

Another important factor that has caused concerns among all 3 groups is bad driving of the citizens. In fact a lot of non-users prefer not to use the program because they have safety concerns. It is important to notice that existence of safe and comfortable bike lanes in the city, and the feeling of safety are closely related. Analyzing the interviews shows that one of the differences between users and non-users was in accessibility to bike lanes on their usual routes. A lot of users have stated that they would not use the program on other routes which do not have bike lanes. Concerns about bad driving habits were also reported in a 2010 study in Chattanooga, United States [30].

From an economical viewpoint, affordability of BSS programs has been an effective factor in attracting users. People who do not have economic concerns can be motivated by a change in their attitude towards the social stigmas associated with cycling, environmental reasons and early childhood education. Moreover, proper planning and creating integrated transportation which leads to more convenient urban traffic can be encouraging for the citizens to use the program. Therefore more funding for cultural education, supportive policies and assigning more budget to non-motor transportation can be very effective.

The findings show that the performance of a BSS program significantly affects the interests toward it. Complicated sign up process has been stated as a discouraging factor by most non-users. This factor was identified as the most important factor in a study by Fishman et al in Brisbane, Australia [31]. On the other hand the citizens have not been well informed about the sign up process, so it sounds more complicated than it actually is.

The performance of the program has gradually changed from mechanized to manual, which has been considered annoying and time-consuming. All 3 groups believed that limited service hours are to blame for lack of interest as well.

In a quantitative study in 2014, Fishman analyzed the motivators and barriers of a BSS in Australia. Lack of easy access to docking stations has been one of the reasons for non-participation of non-users [25]. Considering that limited number of docking stations and lack of easy access to them has been mentioned by the non-users and the fact that users have stated that bike lanes have been important motivators, these issues must be addressed. Considering the planned 150 stations and keeping in mind 128 available stations, it is important to carefully plan for the locations of the new stations so that there is a balanced spatial distribution.

Yet the standards of spatial distribution must not be sacrificed for building equal stations in all areas [32]. Some of the docking stations in Mashhad only serve the purpose of covering all urban areas, and are not practical considering their distance to other stations.

In conclusion with regard to the outcomes of the study, factors like building more bike lanes, facilitating the sign up process, extending the serving hours to accommodate more people, educating children about cycling and its benefits from early ages in schools, educating citizens about BSS programs and their function, use of BSS programs by celebrities and authorities and broadcasting it to remove social stigmas associated with cycling, creating a spirit of cooperation between citizens for routing and locating the stations through official websites, including bicycle regulations in relation to motor-vehicles in driving manuals for more awareness, improving the appearance of the bikes for attracting more people, assigning certain spaces for carrying bikes on public transportation vehicles such as buses, urban trains, etc, policies for popularizing bikes such as banning cars in certain areas, putting up more bicycle signs in the streets, acknowledging the right of bike riders by the drivers of motor-vehicles and adding a bonus fee to the smart cards of citizens who use the program regularly for motivating them can significantly improve the performance of the program.

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