Bicycle Hire Scheme (BHS): Is it Possible to Implement in Dhaka City?

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Abstract: The purpose of this research is to understand the possibility of having Bicycle Hire Scheme (BHS) in Dhaka city, Bangladesh. BHS available and operating in different cities of other countries were studied and relevant documents were reviewed to understand the salient features of the scheme. With understanding the critical aspects of the BHS scheme in other cities, the implementation process and tasks required for BHS was assessed with the existing conditions in the case study area of Dhaka city. A detailed BHS scheme for the case study location was prepared and SWOT analysis of the proposed scheme was done. Questionnaire surveys of existing bicyclists in Dhaka were also conducted to understand their opinions about proposed BHS for the case study location. The results might be helpful for Dhaka as well as for other cities to assess whether BHS would be feasible and act as a guiding principle for implementing BHS.

Keywords: Bicycle hire scheme (BHS), SWOT, cycling, docking station, NMT, transport.

1. INTRODUCTION

Bicycle Hire Scheme (BHS) is a system where bicycles are strategically placed in a closely spaced network of stations and offered for public use. BHS serves as an alternate mode of public transport in which people have access to cycles that can be used across a network of closely spaced stations (ITDP, 2013). The system provides point to point active travel for short distance trips without the need to own bicycle. The BHS enable bicycles to be picked up at any self-serve bicycle station and returned to any other bicycle station, which makes bicycle-sharing ideal for point-to-point trips (New York Department of City Planning, 2009). For instance, an individual can check out a bike from one station with a smart card or other form of identification for a short trip (usually between 30 minutes to an hour) and return it to the same docking point or another docking point within the network (Mateo-Babiano, 2015). Bicycle sharing as a concept has been available in different countries for the last 50 years (Meddin, 2015). The BHS is also termed or called as Public Use Bicycles (PUBs), Bikes Hiring, Smart Bikes, Bicycle Sharing Schemes (BSC), etc.

Bicycle is considered as one of the alternative transport modes to reduce transport problems (Dey et. al. 2014). The potential benefits of bicycle are: flexibility, easy availability, and lower cost (TRIPP, 2008). Bicycles are inexpensive to build, buy, ride and maintain than other privet vehicles. More than 500 cities in about 49 countries now-a-days have advanced bike-sharing programs with a combined fleet of over 500,000 bicycles (Larsen, nd.). The purpose of introducing BHS for different cities is not same. For example, Paris introduced BHS in 2007 to attract more tourists by ensuring a safe and convenient mode for them. ITDP (2013) has specified that BHS may solve the “last mile” problem of transit passengers who need to travel from the station to their destination, may help developing tourism, meeting

pollution targets or targeted modal splits of the city, and even generating employment. Ricci (2015) claims that BHS provides benefits to users through improved health, increased transport choice and convenience, reduced travel time and cost, and improved travel experience.

Annual demand of bicycle in Bangladesh in 2014 was about 500,000 pieces which is about 40% more than the previous three years (Prothom Alo, 2014); reflects the growth of bicyclists' and increasing interest of adopting bicycle. However, the total number cycles or the proportion of cycle trips in Dhaka is yet very low. For instance, even though half of the trips (about 51%) in Dhaka city are on non-motorized modes, bicycle is very low (only 2%) as the rickshaws is most dominant (49%) (STP, 2005). Rahman (2009) mentioned there are many reasons why the bicycle trips in Dhaka is very low. However, bicycle is one of the cheapest forms of urban transport - only one quarter the cost of bus travel per passenger/km and one-tenth the cost of rickshaw travel (Rahman, 2013). Moreover, compared to cars bicycles take very little road space per passenger, affordable, and pollution free (environment friendly) (STP, 2005). Therefore, bicycles in Dhaka city could play a very positive role in solving urban ban transport problems. Moreover, there is a good potential to encourage people for using bicycle and having a BHS in a BHS in Dhaka city could lead to numerous social, environmental and economic benefits.

2. OBJECTIVES AND METHODOLOGY

The main purpose of this research is to understand the possibility of implementing BHS in Dhaka city. The specific objectives are:

- To review BHS available and functioning in other cities around the world; and
- To assess the possibility of implementing a BHS in Dhaka city.

This research is based on both primary and secondary data. A qualitative approach was followed for the analysis. To achieve the first objective (existing scenario of BHS in cities around the world) - BHS in six different cities were selected and studied. The cities were selected in such a way that it covers both the developed world (e.g. Europe and USA) and developing word (e.g. Asia). A list was prepared for the cities in different countries of Asia, Europe and America where BHS is functioning. From the list, two cities from Europe, one from North America, one from South America, and two from Asia were selected. The selected cities are London, Paris, New York, Hangzhou, New Delhi and Buenos Aires for the detailed study. The detailed study and review of BHS in these six cities provided detailed information particularly related to existing condition, planning guidelines, cost and marketing policy of the system. After having a thorough understanding about the BHS in these cities, a case study was conducted in Dhaka city to assess the possibility of having a BHS and the potentials of the system.

The case study in Dhaka was done in Uttara Residential Area (see Figure 11 in Section 5.3) Sector 1 to 14. Required data were collected through a primary survey conducted during July-August 2017. A field observation was performed to prepare a checklist inventory of existing bicycle infrastructure in the case study location. A total 50 bicyclists' were selected for in-depth interviews. Beside the interviews of cyclists', detailed discussion with transport professionals and policymakers were done. Convenience sampling technique was followed for selecting the cyclists' and policymakers. A pre-determined questionnaire was used to guide the interviews.

Collected data were analyzed to explore the possibility of implementing BHS in the case study area of Dhaka city and performed the SWOT analysis including the prospective demand for cycle use, public perception about the scheme and initial cost may require for implementing the BHS in case study area of Dhaka city.

3. CONCEPTUAL GUIDELINES OF BHS

Existing literature on the subject reveals that BHS around the globe has witnessed four stages of change (see Figure 1). The first generation of BHS was introduced in Amsterdam (Netherlands) in July 1965 (Shaheen et. al. 2010); were afflicted by theft, vandalism, unregulated users to pay a deposit and return the bike to a fixed location. On the other hand, the second generation was regulated through a deposit system where bicycles were unlocked with a coin deposit and refunded on bicycle's return (Shaheen et. al. 2010); first introduced in La Rochelle (France) in 1993 (ITDP 2013).

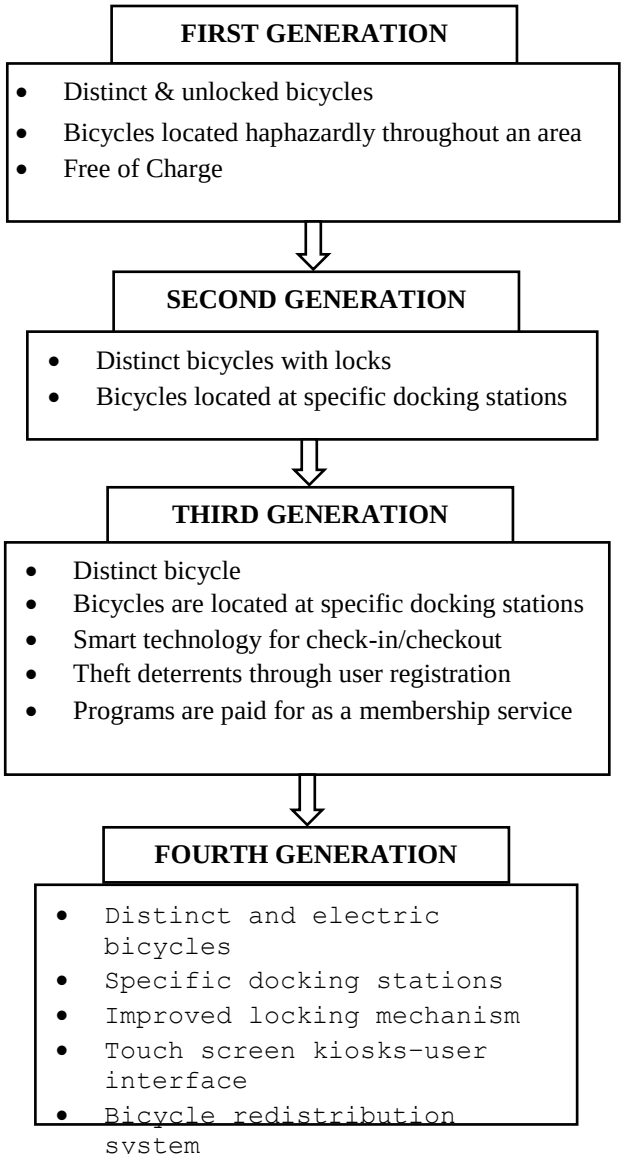

Figure 1. Characteristics of BHS in different generation
Source: Shaheen et al. (2010); Edited by Author

The third (or current) generation scheme incorporated advanced technologies for bicycle reservations, pickup, drop-off, and information tracking to combat vandalism and theft through the use of GPS technology and secure docking stations (Shaheen et.al. 2010; ITDP, 2013). The 3rd generation BHS first opened in Rennes (France) in 1998 (Shaheen et. al. 2010; Parkes, 2011). Midgley (2011) introduced the concept of fourth generation BHS which may integrate newer technologies such as power assisted bikes, solar-powered docking stations and use of smart phone applications for real-time updates.

Based on the performance of existing systems of BHS across the globe, ITDP has developed planning and design guidelines or characteristic for the best-used and most efficient systems. According to ITDP (2013) and the Sustainable Urban Transport Project (SUTP) in India (2016), the eight guiding elements for BHS are:

i) Coverage Area: 10 sq. km with around 10-30 bikes for every 1,000 residents.
ii) System Size: Dense areas or cities require bicycle-to-population ratio of a minimum of 10 to 30 bikes per 1,000 residents to meet the demand. Most successful medium and large systems have 2 to 2.5 docking stations for each bike in service.
iii) Station Guideline: An ideal station density is 10 to 16 stations per sq. km. (14 stations per sq. km is equivalent to 36 stations per sq. mile or one station in every 300 m).
iv) Station Placement: Typical options for station location are on-street parking spaces or vacant space in roadside landscaping strips or areas beneath flyovers and foot over-bridges or private property near large commercial and housing developments.
v) Bicycle Guideline: The bicycle should be designed to 'universal design' but customized bicycle, strong but light weight frame with adjustable seat, secure and low maintenance cost.
vi) Docking Style: The docking stations could be different type, as Midgley (2011) categorized, Fixed-permanent or Fixed-portable or Flexible.
vii) Intelligent Technology Systems (ITS) and Payment Mechanisms: Use of modern ITS for different purposes such as smart cards to lock or unlock bicycles in docking station, GPS device in bicycles to track the location, Radio Frequency Identification Device (RFID) on the users' smart card to allows making payments, relevant control center and mobile app or website portals.
viii) Redistribution Process: Monitoring of bikes and redistribution to ensure availability of bikes in all stations.

4. BHS IN DIFFERENT CITIES AROUND THE WORLD

In the last decade BHS have significantly grown in prevalence and popularity to include over 800 cities across the world and a global fleet exceeding 900,000 bicycles (Meddin, 2015). Following sub sections provide brief summary about the BHS functioning six cities.

4.1. BHS in Paris (France)

Paris has introduced Vélib' (refer 'bike freedom') – third generation BHS - in July 2007 and almost 7,000 bicycles were initially provided, distributed in 750 automated rental stations with 15 or more bicycles parking station (Koning and Kopp, 2014). Now Vélib' has 1451 stations distributed in every 300m throughout the center of Paris and each station has 15 or more bikes (Bikeoff, 2008). Bikes are conceived and improved for user's safety and comfort.

About 20,600 bicycles are available around the city and each bicycle has automatic front and rear lights for operating more efficiently at night (www.Vélib'.paris.fr). Each station is now equipped with up to 70 bike posts where the bike posts are equipped with a locking system, luminous indicators, audio signals and a card reader (Bikeoff, 2008). A robust technology is being used (Figure 2) to protect virtual data as well as the physical infrastructure (Midgley, 2011). The rental stations use the Microsoft Windows operating system with a touch-sensitive screen. There is a key card reader for the registered users. The maintenance staff of the system travel around the city using 130 electrically assisted bikes (Bikeoff, 2008).

Paris's bike-share franchise contract is held by SOMUPI, a JCDecaux/Publicis partnership. The program is run and administered by JCDecaux (Anderson, 2007). Imboden (2017) stated that Paris is not usually known as a city of bicycling, however, Mayor Bertrand Delanoe is trying to change that perception. A deposit €150 is charged by the credit/debit card to protect against the bikes not being returned. Fee €1.70 is charged per day whilst it is €8 for a week (Imboden, 2017).

4.2 BHS in Hangzhou (China)

Hangzhou BHS started in May 2008 with 61 stations and 2,800 bicycles (Shaheen et. al. 2011). Now with some 3,000 serving points (or stations) and nearly 70,000 bicycles it is the largest BHS system in the world (Sustainable Transport in the City with Bikes, 2014). Stations are available within 100m distance throughout the city (Babian, 2015). Some of the stations are open from 6:30am to 8:00pm whilst some are open for 24 hours; and each docking point is secured with camera to avoid theft (Sustainable Transport in the City with Bikes, 2014). Cycles easy to handle and low cost for production with card based payment system is used for this scheme (Hangzhou Public Bicycle - ESCI KSP, 2016). Hangzhou Government and the CPC Hangzhou Municipal Committee have established Hangzhou Public Bicycle Service Development Co. Ltd. to integrate or coordinate the BHS with Hangzhou Public Transport Group Co. Ltd. (Toggenburger, 2016).

The Hangzhou government invested 180 million Yuan ($26.35 million) to launch the BHS, and 270 million Yuan ($39.53 million) in discounted loans (Hangzhou Public Transport Corporation, 2016). The local government spends 60 to 70 million Yuan annually for maintenance and operation of the system (Radio 2014).

Figure 2. Payment mechanisms (robust technology)
Source: www.Vélib'.paris.fr

Figure 3. Hangzhou Bike Sharing Station
Source: www.guangzhouaward.org

4.3 BHS in New Delhi (India)

New Delhi Municipal Council (NDMC) provided 50 bicycle sharing stations across central Delhi in October 2009 to provide pollution free last-mile connectivity to the commuters (The Hindu, 2015). Delhi Metro Rail Corporation (DMRC) and Delhi Integrated Multi-Modal Transit System (DIMTS) provided bicycles for hire at a handful of metro stations and bus stops (DMRC, 2018). DIMTS introduced 'Planet Bikes' at eight stations along the BRT corridor from Moolchand to Ambedkar Nagar and 'Rent-a-Bicycle' has only three stations operate at Saket, Neb Sarai, and Vishwavidyalaya (ITDP, 2015). BHS stations are located only at adjacent to BRT/metro stations but not in other areas (DIMTS, *nd*). NDMC designed the Delhi BHS in two different phases. The first part of BHS corridor stretch is 5.8 km with 5 stations considering about 1 km coverage area for each station whilst the second part of the stretch is 8.7 km (Halder, 2017). The station is designed with roof (Figure 4); however, maintenance of the cycles and stations are poor (Goswami, 2017).

Figure 4. Shade at station (Goswami, 2017)

Figure 5. Locked station (ITDP, 2015)

On the other hand, of the 17 stations in the second stretch, 14 stations follow the cycle rental[1] whilst three stations have cycle sharing[2] system. Stations were constructed on Build-Own-Transfer (BOT) model and in each station there are 10 to 20 bikes (ITDP, 2015). An attendant is responsible in each station for managing the bicycles of respective station (DIMTS, *nd*). There are two types of docking style: manual and automated; the docking point has no lock (as seen in Figure 5). There is a set up for a centre of operations control using ITS and payment mechanisms (ITDP, 2015); however, no technology is being used to track the bicycle (DIMTS, *nd*). Delhi BHS received very good media coverage; almost all the media houses published a positive story about the BHS. Mainly the government of India has designed and financed this scheme, though local government could play pro-active role in tendering process to compare cost and service facilities (Dhingra and Kodukula, 2010).

4.4 BHS in London (United Kingdom)

London BHS (also known as 'Santander cycle' or 'Boris bike') was introduced in 2010 with collaboration of the Greater London Authority, Local councils, Transport for London (TfL) and Santander Bank (Lathia et. al. 2011). The scheme was outlined to achieve 400% increase of bicycle ride for London by 2025 (Mulholland, 2017). London BHS was first started with

[1]The scheme is operated by a private bicycle rental company for longer trips/usage and the bikes are rented or returned in single location.

[2]A technology-based self-service system operated by public transportation service provider where users can collect the cycle in one location and drop off in another location.

6,000 bikes and 400 docking stations across the city (Mulholland 2017), and then expanded in 2014 to the West of the city with more than 2,000 bicycles (Lathia et. al. 2011).

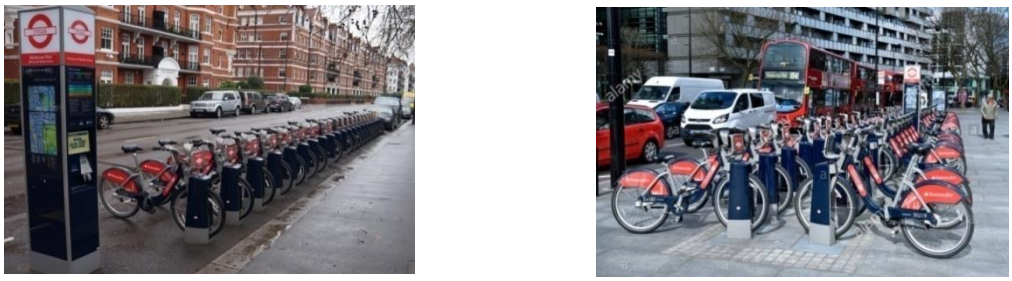

Figure 6. Linear station (Left) and double-row station (Right) (Source: alamy.com)

Coverage of the BHS spans approximately 17 sq. miles (44 sq. km) (Santander cycles, 2017). There are 1900 docking points and fixed system concept (portable modular stations) and the distance between each docking station is 300-500m (Santander cycles, 2017). Stations are two types: single row station and double row station (Figure 6). In each docking station there are 27 docking points (Mulholland, 2017), 15 or more bikes/spaces (Center for Public Impact, 2017), and one payment and registration terminal (Mulholland, 2017). Bicycles are sturdy and designed to be used each day for 10 to 15 times. When the bicycle is on move, the dynamo-powered front and rear LED lights of bike do flash and stop the flashing after two minutes of stopping the ride (Santander cycles, 2017). The payment is done by debt or credit card (Santander Bikes: Taking London up a Gear, 2017) and the redistribution van has electric redistribution buggy.

4.5 BHS in Buenos Aires (Argentina)

Buenos Aires BHS (known as Ecobici) was first opened in Buenos Aires (Argentina) in 2010 with only 72 bicycles and three manually operated stations to discover the best of beautiful (EcoBici: Buenos Aires Bike Program, 2017). The government took this initiative to solve the transport problems and attract tourists in Buenos Aires. Now Ecobici has 3000 bikes available for the service and 29 stations distributed in every 650m throughout the city (EcoBici, 2017). Stations are two types - manual and automated (Figure 7) – and they are strategically interconnected with bike lanes of 130 km known as *bicisendas* (Aurelia, 2015). "The most 'human' bike-sharing system in the world lives in Buenos Aires" (2017) stated that stations are actually iron cages where bicycles are stored, with no locked terminals. Each station has 15 or more bikes; an attendant records the users' information and helps with checking in or out the bike, including payment (EcoBici, 2017).

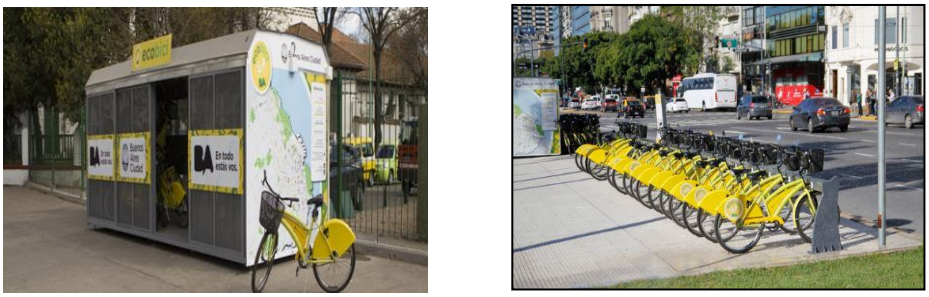

Figure 7. Manual (left) (BA Ciudad, 2013) and automated station (right) (algopasabuenosaires.com)

Throughout the process, ITDP Argentina has supported the growth of the Buenos Aires BHS. After initial guidance based on sharing international best practices, ITDP continued to assist with system design and advised on the tender and other technical documents (ITDP 2015).

4.6 BHS in New York (United States of America)

New York BHS (also known as 'Citi Bike') was first proposed in 2008 by the New York City (NYC) Department of Transportation (DOT) and operated by former Metropolitan Transportation Authority (NYC Department of City Planning, 2011). Funding for this BHS was provided by Citigroup (Kaufman, et. al. 2015). This is the nation's largest bike share program with 10,000 bikes and 600 stations in 55 neighborhoods across Manhattan, Brooklyn, Queens and Jersey City (Citi bike, 2017). Bicycle is designed with a unisex step-through frame and multiple reflectors or self-powered LED lights are visible when riding at night (www.citibikenyc.com). Bicycle docking stations are placed 1,000 feet apart or a walk for 3-4 minutes (Urbica, 2016). By using smart phone apps it is possible to find out the stations with open docks or available bikes (Holloway, 2012). Each station exhibits bike deliveries via rebalancing (Hess, 2017); dozens of rebalancing teams shuttle bikes between full and empty stations using big box trucks, sprinter vehicles, and bicycle trailers (Kaufman, et.al. 2015). The membership of the scheme grew nearly 30% in a year due to a combination of techniques applied by 'Motivate' such as digital advertising, street teams, direct mail and special events to engage residents, create a sense of excitement and draw more participants into bike share (NYC Department, 2009).

4.7 Evaluation of BHS in Selected Cities

Among the BHS in six cities, as discussed above, Paris is first adopted this scheme in 2007 to make user friendly to the tourist and promote tourist. Hangzhou BHS was designed as a large scale initiative to promote BHS for solving last-mile transit problem as well as increasing employment opportunity. Though the standard coverage area is 300 – 350m (ITDP, 2013), this may change with size of total population and density of population. Previous discussion reveal that European cities (e.g. Paris, London) promoted BHS with maintaining similar factors such as ITS, system operation, bicycle features, and station etc. New York BHS designed similar context which is adopted in Paris BHS. Buenos Aires 'Ecobici" has promoted both manual and automated docking station which might be useful for developing countries like Bangladesh.

Delhi BHS was developed based on the BRT line - cycle lane and stations beside BRT line - is quite different from other cities. Though initially solved last-mile transit problems, create obstacles to drop the cycle in the destination. The comparison of BHS in different cities is shown in Appendix Table 1.

The analysis shows that all the cities have adopted 2nd or 3rd generation BHS the positive role of government was remarkable. However, it is often challenging for the government in financing, marketing, operating, and maintenance of the scheme. Even though the Hungzhau BHS is operated by own financing and marketing of the government, undoubtedly needed involvement of both public and private sector for success. Nevertheless, it can be concluded that it is a rudimentary challenge for developing country cities for adopting BHS based on experience from the Global North.

5. BHS IN DHAKA: RESULTS FROM THE CASE STUDY

A case study was conducted in Uttara model town, a planned residential area, in Dhaka city.

5.1. Cyclists and Cycling Trips

Most of the cycle trips of the respondents are for short distance; for instance, 42% are within 2 km and 33% are 2 to 4 km whilst only 4% are for longer distance. Almost 33% of the cycle trips are for work whilst 29% are for educational purpose. Most of the cycle users consider that cycle ride is cheaper than other modes, safer than motorized vehicle, and they are able to avoid traffic congestion. Figure 8 shows the reasons for using cycle as a travel mode for short trips.

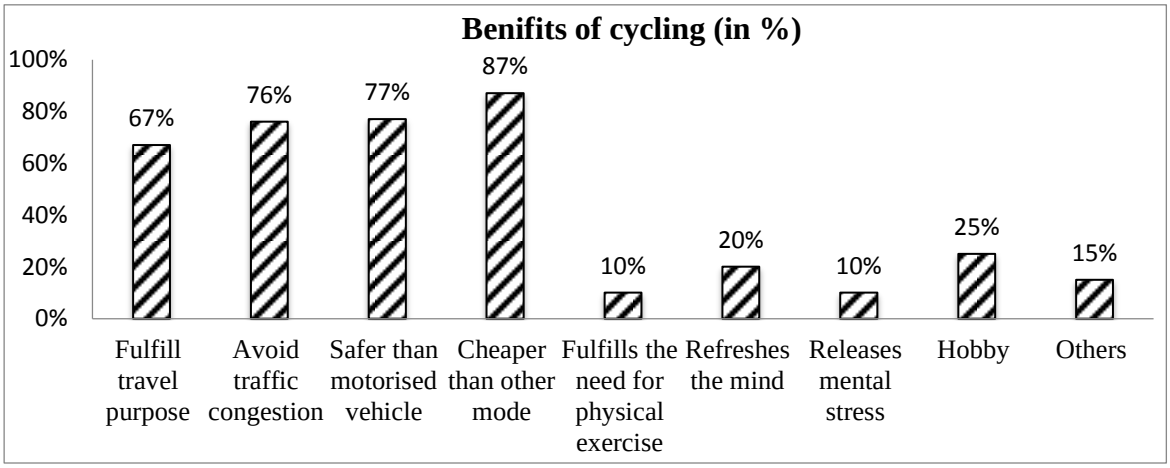

Figure 8. Benefits of cycling (Field survey, 2017)

However, almost 96% of the cyclists are dissatisfied with the existing infrastructure facilities for cycling. The major causes for dissatisfaction are, as shown in Figure 9, are: mixed road use (82%), lack of parking facilities (73%), insufficient road space (68%). This indicates the facilities for cycling in the study area is very poor.

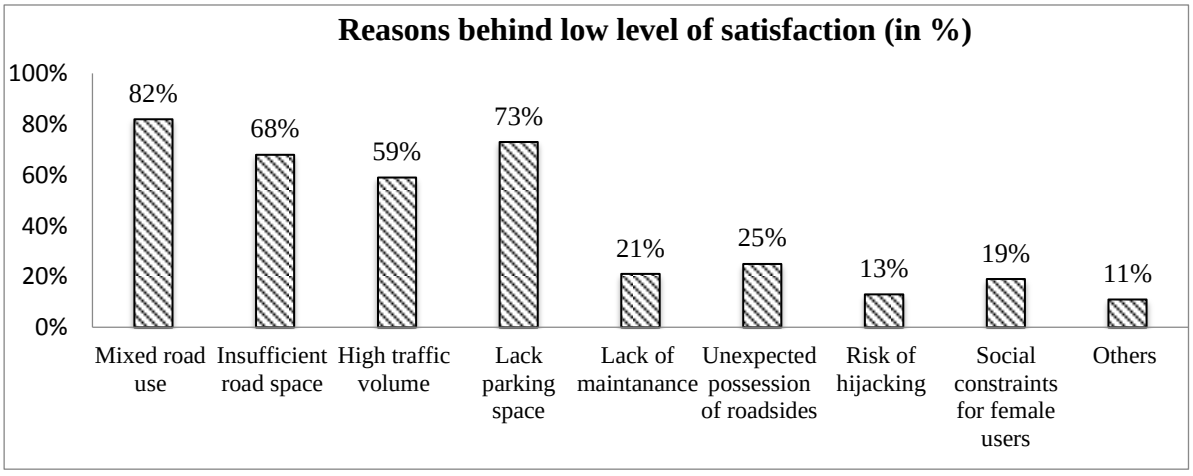

Figure 9. Reasons behind low level of satisfaction (Field survey, 2017)

5.2. Road Type and Cycling

Roads in Uttara residential area are mostly very wide compared to other parts of the city, they are smooth and well furnished with street furniture (Figure 10). Roads are three types in terms of width, as shown in Table 1.

Table 1. Type of roads and width

Type of Road	Width (feet)
Primary	80-100
Secondary	60-80
Tertiary	25-40

Figure 10. Width of a typical road in Uttara R/A

However, during the field observation a number of vehicles were found parked in carriage way parallel to the footpath. There is no separate space provided for cycle parking and therefore cyclists often face many problems. Nevertheless, 13% of the respondents are satisfied with the existing infrastructure whilst around 87% are willing to use the BHS as a paratransit if it is available. Most of the respondents (57%) reported that they are willing to pay Tk 20 for an hour whilst some of them (12%) mentioned Tk 10 and the remaining mentioned Tk 30 for an hour for using BHS. Intelligent technology payment and locking system could be used by applying card or smart phone apps. Almost 76% of the respondents are willing to pay by mobile app and the remaining 24% are willing to pay by card for hiring bicycle. To prevent cycle theft, certain options would require validating the identity of the bicycle users. For doing this, 49% of the respondents suggested for using mobile app whilst the use of general packet radio service (GPRS) and radio- frequency identification devices (RFID) are mentioned by 7% and 2% respectively.

5.3. Comparing Dhaka's Cycling Feature with Selected Cities

Though there are some barriers for cycling such as absent of cycle lane and inadequate parking space, warm and humid weather condition, absent of modern technology & IT in transport system, political problems etc. in Dhaka city, there are much potential to promote BHS. Despite having similar problems as in Dhaka, many other cities in developing countries such as in Delhi and Buenos Aires have already implemented and operating BHS successfully. Furthermore, weather condition is almost similar in Dhaka and Delhi. Delhi BHS and Buenos Aires BHS are docking stations designed with roof/shade because of weather condition (to protect from rain, storm, sun) whilst most of the docking stations in London, New York, Hangzhuo and Paris are without a shade or roof. Almost all the cities have BHS are with separate bicycle lane. However, in Dhaka there is no separate bicycle lane - which is a major drawback for promoting bicycling in Dhaka. Nevertheless, there are a few cities where BHS is implemented and bicyclists share the road with other traffic (operate in mix traffic environment). Supporting IT system for operating, maintenance and payment of BHS are involved with technical aspects which may not be possible to cope with the users in Dhaka very easily and quickly. Nevertheless, adopting BHS in Dhaka will provide opportunity for reducing pollution and traffic congestion of the city, provide transport access to many people and play an important role in last-mile transit services, and promoting green mode or sustainable transport for the city.

5.4. Proposed Planning Guidelines for BHS in Dhaka

Despite having some limitations or obstacles, there are potentials for BHS in Dhaka city. This section outlines the proposed model or guidelines for BHS for the case study location - Uttara R/A - in Dhaka city.

Coverage Area: A total 50 docking stations are proposed for the study area so that each station will cover/serve approximately 1 sq. km. This is similar to the Delhi BHS where 1 sq. km area is covered by a station. Considering to the population of the area (BBS, 2011), each station will cover/serve around 3,598 persons within 1 km.

Station Design: Figure 11 shows the proposed station locations for the study area. Key parameters considered for identifying the station location are:

- Close to the recreational places (e.g. park, play ground);
- In front of educational institutions (e.g. school, college);
- In the market or close to shopping places; and
- In the places where usually many people gathers.

Figure 11. Proposed locations for docking stations in the case study area

Design of the docking station is proposed as similar to the design of Centre for Green Mobility (2015) as shown in Figure 12. Major features of the station area:

- with shade/roof to provide shelter against rain;
- each station with a minimum capacity of 15 bicycles;
- size of the station will be determined based on available space in the selected area;
- strategically important few station will have a small operating room.

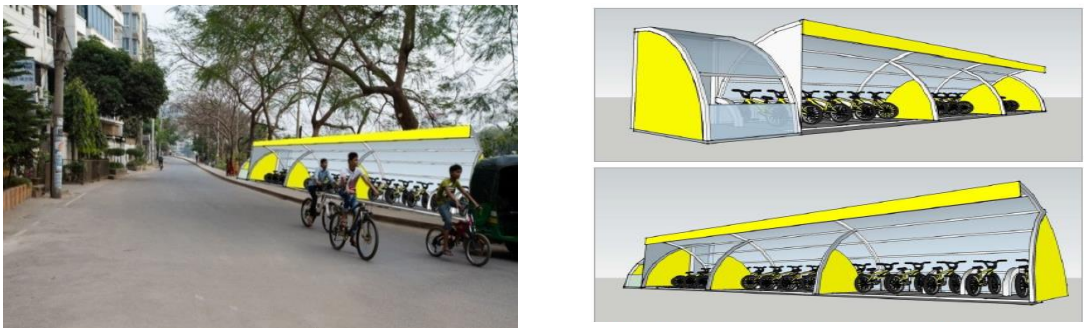

Figure 12. Proposed design of docking station for the study area (left), adopted from Centre for Green Mobility (2015)

Number of Docking Station and Bicycle: According to Each station will have, as suggested by ITDP (2013), 15 cycles and thus 22.5 docks and a total 750 cycles for the scheme in study area. All the bicycle docking stations will automated station.

Bicycle Guideline: Bicycles will be with Unisex frame and adjustable seat positioning. Other specifications are:

- Alloy material for the frame to avoid effect of the changing weather conditions.
- GPS enabled bicycles (placement of GPS has to be done while manufacturing the bicycle) to avoid vandalism.
- Light load carrying front basket.
- Rear and front lights to make the bicycle more utilitarian.

Redistribution Process: Three redistributing vehicles are proposed so that each of them could serve 3-4 stations.

ITS and Payment Options: Two payment options are proposed: one for visitors (occasional users) and other for regular (annual) users, as suggested by Shams (2018). The process of proposed payment system is mentioned in Figure 13. Visitor will be able to use bicycle with mobile applications. With the mobile app they would able to check the availability of cycle in any given station and could send text massage for hiring a cycle. User will receive a pin number and according to user choice mobile operator will deduct money. User will require two tasks (give NID number through bar code reader and give pin number according to the massage) before unlocking a bicycle. On the other hand, annual user need to be registrated with NID number, passport size photo and a deposit of Tk 300 per year. Every registered member must have a pin number unlocking the docking station for a collecting cycle.

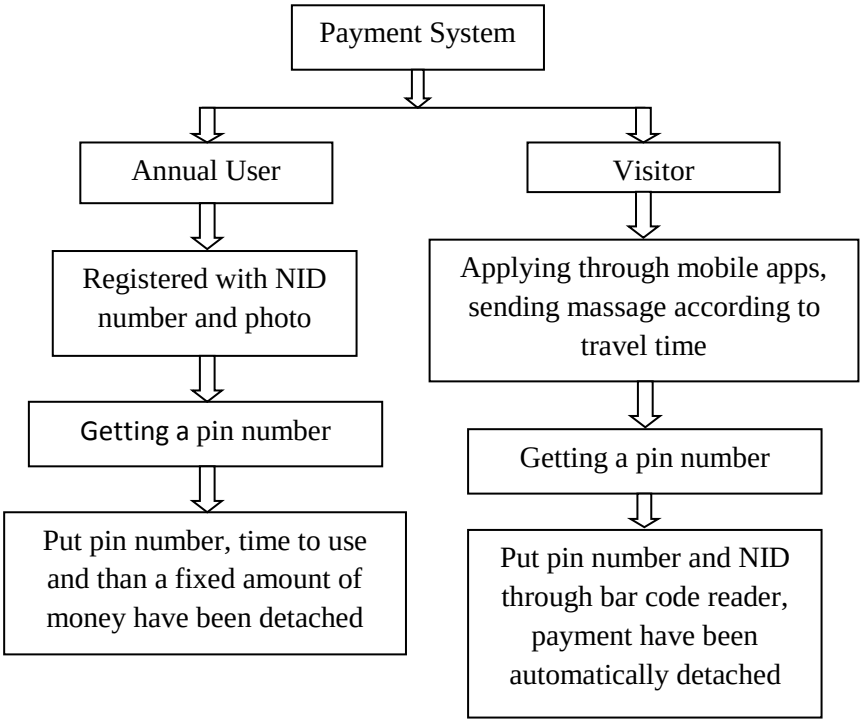

Figure 13. Proposed payment process for the study area (Source: Shams, 2018)

Operational Model and Marketing of BHS: BHS operations in different cities usually run on different business arrangements between the government (or local government), operator (business entity or private sector) and the advertising partner depending on the local context, technical capacity available to run the system, the government's experience in PPP projects, etc. Dhaka North City Corporation (DNCC) could play an important role as an operating authority as well as maintaining the committee for BHS in the study area. Private organization (e.g. IT developer, advertising partner, financing partner etc.) could play a vital role for implementing and managing the BHS.

A well planned and designed bicycle share system requires befitting identity and good promotion for better and successful implementation. Therefore, the BHS in Dhaka need to work on:

- Colorful texture with name logo and tag line;
- Involvement of communication media; and
- Political influence to support the scheme.

5.5. SWOT Analysis for Implementing BHS in Dhaka

For implementing BHS (the guidelines mentioned in Section 5.4) for the study area, it is important to understand the strengths, weakness, opportunities and threats of this scheme. Table 2 shows different aspects of SWOT analysis. There are sufficient road space in front of the schools, parks and play grounds and places where people usually gather in the study area for providing docking stations. Once the people are informed about the scheme, they are willing to use the bicycle service. The BHS would be very helpful for the tourists for visiting different historical place in Dhaka very easily. However, the main challenge for operating BHS is presently absent of cycle lane and lack of space for parking. Absent of separate cycle lane may increase the likelihood of accident occurrence. Even though many modern ICT gadgets are available and people of the city are using those, yet a little is using these for

cycling or travelling. There is a lack of government initiative to improve cycle condition of the city. Cost of cycle required for BHS is comparatively higher than the conventional one.

Table 2. SWOT analysis for implementing BHS

STRENGTH	▪ 73% of bicyclists are feeling safe of using cycle (Source: Field Survey, 2017). ▪ 33% user use cycle for working and 29% user use for educational purpose (Source: Field Survey, 2017). ▪ 87% of bicyclists are willing to adopt this scheme (Source: Field Survey, 2017). ▪ Sufficient road space for station in front of park, open space or gathering place (Source: Field Survey, 2017). ▪ Having sufficient materials (cycle, station equipment etc.) for adopting this scheme. ▪ Available internet access and smart phone for all. ▪ User usability for utilize with mobile application. ▪ Smart National Identification Number (NID) for all. ▪ Easily visit historical place.	▪ Lack of strategic plan for implementing BHS across individual agencies. ▪ Lack of separate cycle lane (Source: Field Survey, 2017). ▪ Absence of government initiatives for making separate lane for bicycle. ▪ Unwillingness of using cycle among higher middle and higher class people (Source: Field Survey, 2017). ▪ Lack of cycling friendly environment and infrastructure. ▪ BHS Vs Conventional cycle. ▪ Lack of parking facility (73% user feel unsafe). ▪ Unawareness about using IT system.	**WEAKNESS**
OPPORTUNITY	▪ Efficient space for designing station ▪ Generating large quantity of employment ▪ Decreasing travel cost and time ▪ Reducing traffic congestion and dependency on motorized transport. ▪ Getting easily accessible mode for the user. ▪ Quick, easy and environmental friendly ▪ Making people self dependent for transit ▪ Easy to adopt smart phone based payment system. ▪ Integrate with BRT line ▪ Use Smart NID for avoiding theft. ▪ Make easily access for tourist.	▪ Inappropriate knowledge about using information technology (e.g. GPS, RFID, Smart card etc.) ▪ Weather in the study area is not conductive to cycling too much. ▪ Possibility of stealing cycle ▪ Required large amount of investment cost and funding for implementation ▪ Increased number of road accident because of having no separate bicycle lane. ▪ Absence of political support ▪ Challenge to use docking station to pick cycle to all class people.	**THREAT**

Nevertheless, there is opportunity to help the middle and lower-income group people by BHS as this would able saving their money and time for travelling. This is clearly evident, as the field survey data showed, lower and lower middle-income people mostly travel by cycle. Moreover, BHS would able to provide last-mile services to the transit users (construction of BRT and Metro is on-going) if they are integrated properly.

6. CONCLUSION

BHS serves as an alternate mode of public transport where people have access to cycles that can be used across a network of closely spaced stations. Today many cities around the globe have BHS. Larsen (nd.) stated that more than 500 cities in 49 countries host advanced BHS

with a combined fleet of over 500,000 bicycles whilst Meddin (2015) mentioned that at present there are BHS in over 800 cities across the world and a global fleet exceeding 900,000 bicycles. BHS has existed for almost fifty years but only in the last decade they have significantly grown. However, yet there is no BHS in Bangladesh.

The enormous growth in BHS all over the world in the past ten years has done a great deal to encourage the bicycle as the mode of choice for urban commuting (ITDP 2013). Many countries in the world have adopted this scheme with positive experience. With knowing the experience of adoption process and existing condition in other cities, some features and context could be merged with the context of Dhaka city that make positive circumstances to adopt this cities. This paper provided a detailed discussion on the possibility of implementing BHS scheme in Dhaka city.

Results from the case study and SWOT analysis reveal that Dhaka city has potentials for BHS. However, there are several challenges which need to be addressed before introducing BHS. It was found that most of the bicycle users are very willing to use BHS if this is available. BHS would able to reduce many transport problems in Dhaka city such as pollution, congestion, etc. and thus contribute to make transport of the city sustainable and help the city to be livable.

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APPENDIX

Table 1: Comparison of BHS in Six Different Cities

System	Paris	Hangzhou	New Delhi	London	Buenos Aires	New York
BHS project name	Vélib'	Hangzhou public bicycle	Green bike	Santander bike	Ecobici	Citi Bike
Purpose	Tourist attraction	Last-mile traffic	Promote sustainable transport	Reduce traffic jam & pollution	Promote tourism	Promote eco-friendly transport; mode switch to cycling
Station coverage	300 meter	100 meter	-	300-500 meter	650 meter	1000 feet
Coverage area	Whole city	Whole city	5.8 km (1st phase); 8.7 km (2nd phase)	Whole city	Whole city	55 neighborhood
Number of stations	1451	3000 (initially 61)	5 (at BRT) & 8 (at Metro station)	1900	200	600
Number of bike	2,600	70000 (initially 2800)	3800	Started with 6000	3000	10000
Free hire time	30 min	1 hour	-	30 min	1 hour	45 minutes
Usage fee	After free period, €1 (1st hour), €3 (1.3 hour), €7 (2 hour)	After free period, $0.15 for each hour	Rs 10 for 4 hours & Rs 5 for additional hour	After free period, £2 for every 30 min	Free of cost	$12 per day
Membership fee	-	$ 30	Rs. 100	£90	Free of cost	$163
Bill payment system	Debt or credit card	Smart card	Integrated smart card /common mobility card	Debt or credit card	Registration card	Smart card
User interface technology	Yes (smart card readers at station)	Yes (smart card readers at station)	Yes (smart card readers at station)	Yes (smart card readers at station)	Some stations manual & some automated	Yes (smart card readers at station)