

# Prospect and Challenges of Public Bicycle Sharing System in Indian Cities

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**Abstract**—The Public Bicycle System (PBS), generally known as Public Bicycle Share System or Bike-Share, is a service provided to the everyday commuter, in which several cycles are available on the shared system. The concept of PBS is new to the people of India and requires more study in the fields of essential requirements, major infrastructural requirements, social acceptability and various challenges. In various Indian cities, Mass Rapid Transit System (MRTS), Bus Rapid Transit System (BRTS), Monorail and other modes of transport have been adopted for the main haul of transport. These modes take more time, space and are also expensive to implement. At the same time, the PBS system is more economical and takes less time to implement. The main benefit of the PBS system is that it is more environmentally friendly. PBS is being implemented in many Indian cities for public use, but various challenges are associated with this. The study aims to determine what are the basic infrastructural requirements for PBS in India, as well as to determine to what extent a Public Bike Sharing System can provide a quality and efficient service to passengers as a primary method of transportation.

**Keywords**—Public Bicycle Sharing system, sustainable transport, infrastructure, smart city.

## I. INTRODUCTION AND BACKGROUND

PBS makes a number of bicycles available for shared use to the general public. In PBS, people take a bicycle from one point (stand) and return at any other point (stand). PBS is an economical system of transport in which people are free from maintenance expenses and theft challenges [1]. PBS is a novel concept for Indians. Additional research is needed in the areas of basic requirements, major infrastructure requirements, social acceptability, and numerous obstacles.

Worldwide, there are three generations of bike-sharing systems over the past 40 years. The first PBS was introduced in 1964 in Amsterdam and was known as “White bikes” [3]. In this PBS system, ordinary bikes were painted with white color and were made present for public use. In this system, individuals had to find a bike, ride it to their destination, and leave it for the next user. But, due to vandalism, the program did not work as it was planned and collapsed.

The second generation of PBS was launched in Copenhagen in 1995. This system had come up with the improvement over the previous generation. The bikes used in the system were called “Bycyklen” or “City bikes” [3]. Solid rubber tires and wheels with advertising plates were expressly made for these bikes. With a coin deposit, these may be taken up and returned at designated spots across the center city. This system also experienced theft and vandalism due to the anonymity of the customer. After these

thefts and vandalism, in 1996, a third-generation bike-sharing system was introduced at Portsmouth University with a variety of technological improvements including electronic locking racks, telecommunication systems, smart cards, mobile phone access, and on-board computers.

## II. WORKING METHOD OF PBS

PBS has been introduced by many countries over the years. All of them are based on one or more of these systems.

### A. Categories of PBS

In the early days when the PBS system was developed, bicycles were available without any regulation. Bicycles without any registration or record released for use by anyone is an example of unregulated PBS. The best example of this type is that some colleges in India have several units of bicycles that students cannot take outside of the campus but can independently use in the campus without any registration or ownership card.

After the unregulated PBS deposit for PBS had been introduced. In this, a small deposit releases the bicycle from the terminal. The amount can only be retrieved by returning the cycle to another terminal.

Membership for PBS was also introduced after the deposit system. In this type of PBS, bicycles are made available for the user with membership for that facility. In this system, bicycles are provided either by manually run hubs or at self-service terminals in urban areas. Individuals, who are officially registered with the facility, validate themselves with a membership card (smart cards) via mobile phone, or other IT methods at any of the terminals or hubs to retrieve out a cycle and return it to another hub.

### B. System Components

Without bicycles, the PBS system could not be considered, which provides seamless experience of access-egress within the transportation system. In PBS, the bicycle must-have traits that are adaptable and one-of-a-kind to enable flexibility, along with ease of use. It must be designed considering the use of commute by people from all age groups, gender, size and economic class. It must also be considered while designing the bicycle that it must have an identity to represent PBS of a particular city. A bicycle that can be used by a variety of persons, including ladies dressed in traditional Indian garbs such as sarees or salwar suits, while also being appropriate for a corporate lady wearing a suit.

The station for PBS system is also an important factor for its function. The design of PBS stations may vary according to the

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factors like fleet size, city, urban area, location in the city and available resources. The most common location for a PBS is either on the street's edge, at transit stations, in market places, in densely populated areas, and so on. It must be designed as an open structure, with just a shelter, which, in some situations, can be totally hidden by minor structural changes if necessary. They must be provided with docks, shelter, terminals and facilities like a food plaza, private parking and kiosks. Auxiliary PBS stations can compromise with many things for cost and space efficiency. Shelter materials must be low-cost and long-lasting, and there must be space for advertising on station panels and backlit advertisement panels. The integration of the station and the roadway must be approached carefully. Docks and terminals are also an important part of PBS. A dock is a multifunctional structural unit where bicycles are parked. It supports and secures bicycles when are not in use. Dock with the terminal is a crucial component of automated systems. The dock releases a bicycle when the user's smart card is swiped. The terminal is the central processing unit for each station. They provide an interface between the user, the dock and the control center. Terminal for ease can communicate via hard-wiring to the dock and via wireless communication with the control center. Terminals should have some facilities which are as follows:

- User-specific subscription.
- Information based on user card.
- Balance being used and left in the account.
- Type of subscription.
- Bicycle availability.
- Station capability.
- Information about the user's most recent rides.
- Calories burned or CO<sub>2</sub> saved while seated.

All of this information must be presented in a variety of languages, including international, national, and regional. Also, the operational flow matrix (Fig. 1 & Table I) is followed in the proper functioning of the PBS system.



Fig. 1 Illustration of the use of PBS System

TABLE I  
OPERATIONAL FLOW MATRIX OF A PBS SYSTEM

Fetch for Kiosk	User searches for the nearest kiosk on the mobile app
Trip	<ul style="list-style-type: none"> <li>• User Check-In</li> <li>• The user selects a bike from the drop-down menu on the Kiosk and takes it out</li> <li>• User makes the Trip</li> <li>• User Parks the cycle back at any dock either knowing the location or by searching it on a mobile app and automatically checks-out</li> </ul>
Report for Accident	<ul style="list-style-type: none"> <li>• If possible, the user sends a message to the control room from a mobile app with a registered mobile number after he/she met an accident</li> </ul>
Report for Mechanical/ IT Fault in Cycle	<ul style="list-style-type: none"> <li>• User message the Cycle-ID by QR/Barcode/Number to the control room to report for maintenance of cycle</li> </ul>

### III. PBS AND INDIA

The use of a cycle is not new in India for commuting from one place to another. In earlier times when there were no bike-share programs, people were using their own bicycles for their daily commuting. But for comfort and to save time in their daily commute people started using public transport. These days when public transport, as well as private transport, is putting adverse pressure on the climate, and their implementation and maintenance are expensive, we need green transport to ensure the climate is free from pollution. PBS systems are being implemented worldwide and becoming successful. India has also implemented PBS in some of its cities.

India is experiencing the successful implementation of a city-wide or urban-level public bicycle sharing system. Numerous local, institutional and neighborhood-scale pilot initiatives have been done for the implementation of PBS in some cities. Few Indian cities have already implemented and some are considering and planning to develop large-scale public bicycle sharing systems for their residents or its integration with the urban public transport system. There are many proposals for PBS in numerous cities across India.

A report from CSE India, claims over 10 cities will have bicycle sharing programs as per the announcement of support from the Ministry of Urban Development [2], [6]. The report focuses on the success of the "Cycle Chalao" project in Pune with 25 stations and 300 bicycles in the fleet, and which won the DBOOT award from PMC.

#### A. Prospects for PBS in India

India is a developing country, and private automobile ownership is steadily expanding in metro and tier-II cities. It is increasing congestion on the roads and also emissions from the motorized vehicles are putting adverse pressure on the environment. In this situation, PBS is one of the favorable options for public transport for short trips. Also, PBS provides a cost-effective and handy form of transportation for short trips as an alternative to more expensive motorized modes of transportation. It bridges the gap in public transportation for first and last-mile connectivity [4]. It is environment-friendly because the emission is zero from this system. It reduces the use of motorized vehicles which harms the environment. It reduces the number of vehicles on the road by catering to short trips through PBS which helps in reducing the number of active vehicles on the roads [2].

In the Indian context, PBS in local cities requires a fundamental IT system. Also, people in developed cities are already aware of some components of the automated systems like Metro trains, BRTS and other means which require IT components such as smart cards, terminals to recharge and balance check, locate the station, and fare structure. PBS, in addition, adds validation of the user to this with the complete registration process to ensure the safety and security of bicycles and RFID technology along with GPS for the tracking and use of bicycles. As a result, GPS and RFID embedded in bicycles, transaction terminals, control center, central fare administration system with easy online recharge, web-based registration, and mobile app/SMS-based information dissemination are all essential IT components for the PBS.

### B. Challenges in Indian Cities

The biggest challenge for PBS in India is the availability and quality of cycling space on the road. It is challenging to implement a PBS plan on an urban level in most of India's car-oriented metro cities, where it is tough just to park a car or walk. Car owners are not ready to share their street space with bikers. Urban Local Bodies (ULBs) and development agencies are hesitant to invest in PBS since it may fail. Cycling enthusiasts in big cities express the most dissatisfaction with the quality of cycling environments in our cities, claiming insufficient shade and infrastructure for dedicated cycling tracks. If any infrastructure exists, they are either still and no one uses them or get encroached by motorcyclists riding in the lane or parking at many places. Also, thefts and vandalism are significant challenges to the proper functioning of the PBS in India. User identification and security amount can be taken to secure the bicycle use. When it comes to civic sense, many cyclists refuse to wear a helmet and ignore traffic signals. In many cities, motorcycles intrude on bicycle lanes, making cycling risky. This can be overcome with the sanitization of all types of traffic users.

### IV. SUCCESSFUL PUBLIC BICYCLE SHARING SYSTEM IN INDIA

Under the Mission, smart cities in India are supposed to build and supply high-quality IT-enabled core infrastructure as part of its mission, resulting in an acceptable quality of life for city people. The Indian government is focusing on efficient urban mobility and public transportation in which PBS is being opted for every big and medium-size cities [6]. To develop a sustainable transport system some of the cities in India have already started implementing the PBS system for its public use and experiencing success in this.

Mysuru, a cultural and heritage city with a population of 1.2 million, is the first city in India to implement the Trin Trin public bicycle sharing system [5].

For a small fees users have access to 450 bicycles for lease from 48 docking stations located across the city. Users must first become members by paying Rs 350, which includes a refundable deposit, to acquire a PBS smart card with which they can retrieve a bicycle from the docking station.



Fig. 2 Dock and terminal of PBS of Mysuru "Trin-Trin"

Smart City Bhopal has launched a public bicycle-sharing program to encourage bicycling and give first and last-mile connectivity to the BRT. The city is home to India's first

completely automated fully integrated public bike-share system, which has shown a very promising start; within 15 days of its launch, over 10,000 people had signed up exclusively through their mobile phones. Women made up more than half of the participants. Weekend usage has been exceptionally high, particularly among youngsters and families. Moreover, there are already requests for more bike-share ports in areas not currently available.

The prominent features of this program are:

- A total of 12 kilometers of dedicated bicycle tracks have been built.
- Around 50 places have been established throughout the city where bicycles are stored and from which one can rent a bicycle.
- There is a public bicycle-sharing app where users may register, choose a suitable bicycle-sharing plan, and pay for it.
- Public bicycle-sharing is also available without registration, where one can hire a bicycle for an hour or half an hour by making direct/on-site payments.



Fig. 3 Young women riding public bikes in a designated bike lane in Bhopal

### V. DISCUSSION AND CONCLUSION

In the smart cities initiative, the government is very keen to develop the PBS system for the first and last-mile connectivity with its integration to the primary mode of transport. Bhopal and Mysuru are successful examples of this [5]. So, the bike-sharing system must be viewed from a broader perspective to achieve a comprehensive transport system that meets the mobility needs of all, along with boosting up the environment and sustainability. A bike-sharing system should be promoted among the commuters for its success. PPP mode can choose to implement the PBS for the transport system. ULBs and other government officials should promote and provide adequate infrastructure for the safe functioning of the PBS.

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