Potential Problems and Solutions Faced by Bike-sharing System in China

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Abstract: This paper studied the development of the bike-sharing system in China, the challenges that bike-sharing system facing, and proposed solutions. Shared-bicycle is a convenient and environmentally friendly option for short-distance city travel, but it faced issues such as insufficient durability, poor application software performance, theft, and intentional destruction. This paper compares the large-scale deployment and adoption of dockless bicycle systems used by shared bicycle systems in China with the small-scale deployment in the West that prioritizes user experience and sustainability through the use of bicycle parking stations. Although shared-bicycles have a positive impact on the environment, economy, and transportation in China, technical issues and low operational efficiency have hindered user satisfaction and market growth. This paper proposes a series of suggestions, such as improving the durability, software performance, and anti-theft measures of bicycles, aiming promote the sustainable development and optimization of shared bicycle system in China.

Keywords: shared economy, bicycle, bike-sharing system, market analysis, mechanical analysis.

1. Introduction

1.1. What is Bike-sharing

Bike-sharing is a bicycle travel sharing economy service. This kind of service mainly operates on campuses, subway stations, bus stations, residential areas, business districts and public services areas, providing an alternative by taxis, buses, and walk for people in short distance in urban areas,

Shared-bicycles are parked at docking stations or designated parking areas throughout the city. Users can rent bicycles by scanning a mobile APP or two-dimensional code or through coin systems. After renting a bicycle, users can ride it in the designated area to reach the place they want to go and return the bicycle at one of docking stations by paying for time or mileage.

Shared-bicycles have eye-catching paint recognition, high durability, and adjustable seats, lights, and baskets. Most shared-bicycles also include GPS positioning systems and electronic locks to avoid theft and ensure that users use them in the correct area.

The main goal of a bike-sharing system is to provide a convenient, affordable, and sustainable transportation option for the users, reduce traffic congestion, lower pollution levels, and improve the health of residents.

1.2. Rationale for The Study

Although the emergence of shared-bicycles in China can be traced back to 2007, at the beginning, shared bicycles were not very popular in China. Until around 2015, with the popularity of mobile phones in China and the development of the internet, bike-sharing, especially shared-bikes without docking stations, had developed rapidly, and seemed to spread throughout the city overnight. Although with the development of bike-sharing systems, the additional problems that shared-bicycles bring to society are not as serious as they were at the beginning, shared-bicycles still face problems such as traffic interference, lack of sufficient safety measures, low comfort, software server crashes, and intentional destruction and theft [1]. Therefore, this article aims to propose some potential solutions to these issues to help the bike-sharing system develop better in the future.

2. Background

2.1. The Differences between Chinese and International Bike-sharing System

The first difference between Chinese shared-bicycles and other western countries, especially Germany and France, is that China has a larger bike-sharing market. Almost all major cities in China, such as Beijing, Shanghai, and Shenzhen, have a huge bike-sharing system. According to 2023 statistics, there are over 1 million shared-bicycles available in Beijing alone, with an average daily usage of 3.1157 million times [2], and the total number of shared bicycles in China may exceed 14.9 million [3]. Compared to China, bike-sharing systems in western countries are usually smaller in scale and may be limited to specific cities or regions.

The second difference is the choice of docking system. In China, most shared bicycle systems adopt a dock free mode, where users can use mobile applications to rent or park bicycles anywhere within designated service areas. This makes bike-sharing system in China more flexible and easier access to potential customer groups. Differently, in Western countries, most bike-sharing systems use docking systems, where bicycles need to be rented at designated docking stations and users need to return the bicycles to these specific locations for better management and maintenance of shared bicycles.

The third difference is governmental regulations. Most western countries, such as Germany and the Netherlands, have strict regulations for the use of bicycles, such as being able to ride only on specific roads. These regulations ensure the safety of people using bicycles and ensure that their use does not affect the operation of the city. However, China does not have clear and strict bicycle regulations, and people can use shared bicycles on almost any road. Although this is beneficial for Chinese bike-sharing market, the lack of strict regulation also poses a danger to people and has an impact on transportation.

Finally, it is about cost control. Compared to western bicycles, Chinese bicycles have abandoned the comfort of bicycles and the construction of parking stations. Chinese companies chose to manufacture a large number of cheaper and more durable car models. Lower operating costs allow Chinese bike-sharing system to rapidly expand in a short period of time. However, similarly, this strategy of mass manufacturing shared-bicycles has led to frequent overcapacity issues in Chinese bike-sharing system. Many Chinese bike-sharing companies have not accurately estimated the number of potential user groups, resulting in many manufactured bikes being unused and causing resource waste. There are many cemeteries of shared-bicycles reported in China as shown in Figure 1 [4]. In contrary, the strategy of using parking stations in western countries has reduced the flexibility and development speed of bike-sharing systems, but it has enabled all shared-bicycles to be used, achieving full utilization of resources.

2.2. Impact of Bike-sharing on Chinese Society

The bike-sharing system has changed the travelling way in cities around the world, especially for cities in China. In the past decade, China has experienced the popularization and development of bike-sharing systems, which have changed people's commuting ways and brought profound impacts on Chinese economy, environment, transportation, and resident health.

2.2.1. Environmental and Traffic Impacts

After entering the 21st century, people have gradually realized the importance of protecting the environment. Most countries in the world, especially China, have started to reduce carbon emissions by promoting walking, cycling, public transportation, and electric vehicles. The bike-sharing system has made significant contributions in reducing carbon emissions and alleviating urban traffic congestion in China. The bike-sharing system provides people with a convenient and affordable alternative commuting solution, encouraging them to choose environmentally friendly modes of transportation, which conversely reduce the level of air pollution caused by cars and improve the air quality of cities. In addition, the shared bicycle system allows people to choose to drive bicycles during periods of commuting, thereby reducing the number of cars on the road and reducing the probability of traffic congestion. However, due to the lack of management for shared bicycles, randomly parked shared bicycles and many users who do not follow traffic rules have had a certain impact on traffic.

2.2.2. Economic impact

The development of bike-sharing systems has also a significant economic impact on China. These systems directly or indirectly create employment opportunities in bicycle manufacturing, maintenance, and operation, for example, most bike-sharing companies require employees to regularly recycle and maintain shared-bicycles. They have also stimulated the growth of related industries, such as bike-sharing application development and digital payment platforms. In addition, the bike-sharing system has attracted a large amount of investment, promoting innovation and entrepreneurship in the transportation sector. The economic benefits have surpassed those of bike sharing companies themselves and contributed to the overall economic development of cities and regions.

2.2.3. Health effects

The shared bicycle system not only brings people more convenient modes of transportation, but also increases opportunities for people to exercise. The use of shared bicycles can improve the cardiovascular function of users, exercise their legs, and reduce the probability of obesity, which has a positive impact on the health of citizens.

3. Technical Issues in Shared-bicycles

3.1. Analysis of Chinese Shared-bicycle Technology

In recent years, the durability issue of shared-bicycles has become increasingly apparent. A study by the China Bicycle Association in 2023 found that in major cities such as Beijing and Shanghai, over 40% of shared-bicycles require significant maintenance during the first six months of operation. This high maintenance rate is mainly due to the use of low-cost materials and high usage rates, resulting in rapid wear and tear.

The quality of mobile applications has always been a topic of concern for people. A survey conducted by the China Academy of Information and Communications Technology (CAICT) in 2024 showed that 25% of users reported difficulty in locating available bicycles due to inaccurate GPS data, while 30% of users experienced application crash during peak usage periods [5]. These technical issues have led to a decrease in user satisfaction and retention rates.

Intentional destruction and theft remain serious issues, with recent reports showing that up to 15% of shared bicycles are lost or damaged in urban areas each year [6]. Despite the introduction of more advanced locking systems, the vast size of the market makes it difficult to effectively implement and enforce security measures.

3.2. Technical Differences between Chinese and International Bike-sharing Systems

When comparing bicycle design and durability, international markets such as Europe and North America tend to prioritize user comfort and long-term sustainability. For example, a report by the European Cycling Union in 2024 emphasizes that shared bicycles in European cities such as Paris and Berlin are typically replaced every 5-7 years [7], while shared-bicycles in China only take 2-3 years. This difference is attributed to the higher quality materials and stricter maintenance plans used in the western market.

Technology integration is another area where there are differences in the international system. A 2023 analysis by the Massachusetts Institute of Technology (MIT) found that 70% of shared bike systems in the United States utilize real-time data analysis to optimize bike allocation and monitor maintenance needs [8]. In contrast, many Chinese systems focus on rapid expansion, sometimes at the expense of technological improvements and user experience.

3.3. Possible Solutions

3.3.1. Durability and Maintenance

Improving the durability of shared-bicycles is crucial for reducing maintenance costs and extending the lifespan of these vehicles. Using higher quality materials and a more systematic production process would be the most direct solution, even if it results in slightly higher upfront costs. Nowadays, most shared bicycles in China use the most common steel, and a report by the International Bicycle Manufacturers Association in 2024 suggests that changing the material of bicycles from low-cost steel frames to aluminum or alloy materials can significantly extend their lifespan [9]. In addition, implementing stricter quality control and more systematic maintenance methods during the production process, such as more frequent inspections and maintenance at centralized shared bicycle parking points in high usage areas, can significantly reduce wear and tear during use in high usage areas. However, cost-benefit analysis needs to be conducted. Improving the durability of shared-bicycles can significantly increase usage time, allowing bike-sharing companies to reduce the production of new shared-bikes. According to the data, the cost of manufacturing a bicycle is approximately between 700-1100 RMB [10]. Therefore, compared to manufacturing new shared-bicycles, maintaining existing shared-bicycles more frequently to avoid damage can reduce the company's expenses and able to get more profits.

3.3.2. Mobile Application Performance

In order to improve the quality of mobile applications, bike-sharing companies should further research big data and artificial intelligence. According to study by the China Academy of Information and Communication Technology (CAICT), integrated artificial intelligence driven predictive analysis can improve GPS accuracy and reduce lag time during peak usage periods [11]. In addition, adopting

real-time data processing solutions based on big data can ensure that applications can run smoothly even when a large number of users are using them simultaneously, thereby improving user satisfaction and retention rates.

3.3.3. Preventing Theft and Intentional Destruction

Reducing the incidence of theft and intentional destruction requires a combination of technology and community methods. In terms of technology, companies should consider making improvements in the most vulnerable locking systems and chains. At present, most shared-bicycles on the market still use external locking mechanisms and open chains. Although this design approach is helpful for maintenance, it significantly increases the probability of shared-bicycles being damaged. So, the future design plan for shared-bicycles should adopt a built-in frame lock, which is built into the rear wheels and directly locks the flywheel to prevent theft. And a chain cover that can be disassembled using specific tools, which can provide some protection for the chain structure while facilitating maintenance personnel to quickly maintain the vehicle. In terms of communities, it is possible to strengthen patrols by staff and increase the level of intentional destruction of shared bicycles and compensation amounts through the government.

3.3.4. Change the Operational Strategy

In order to narrow the gap between China and international bike sharing systems, Chinese operators may consider adopting operational strategies from European and American countries. For example, like the United States and European countries, real-time data analysis is used to help optimize bicycle delivery and maintenance plans, thereby improving overall system efficiency [12]. Alternatively, a platform-based operation strategy similar to that used in European and American countries can be adopted, where shared bicycle parking stations can be built near high usage areas such as shopping malls or subway stations. All shared bicycles must be parked at the parking station to complete the return process. To improve the management efficiency of shared bicycles and reduce the probability of damage.

4. Benefits of the Proposed Change

The proposals in this paper aim to address the technological and commercial challenges faced by bike -sharing systems, and to enhance the social, market impact, and user experience.

4.1. Societal Impact

The proposed solutions to the current problems of shared-bicycles in this paper mainly focus on durability, theft prevention, and deployment methods, which has the potential to contribute to a more sustainable urban environment. By using higher quality materials and better maintenance to extend the service life of shared-bicycles, reducing the resources consumed in manufacturing new shared-bicycles, and further reducing the carbon footprint associated with bicycle production and processing.

In addition, improving the reliability and convenience of shared-bicycles can encourage more people to choose bicycles as their primary mode of commuting. A report from the World Resources Institute in 2024 suggests that increasing the use of bicycles in urban areas can significantly reduce traffic congestion and air pollution [13]. In addition, a safer and better maintained bike-sharing system can bring safer and more efficient roads. At present, in many places in China, there is a problem of shared-bicycles being randomly placed on the roadside, which seriously blocks road traffic and has a great impact on user usage.

4.2. Market Impact

From a market perspective, the proposed changes can help Chinese bike sharing companies reduce additional expenses and losses, thereby enhancing profitability. By investing in improving durability and constructing docking stations, companies can reduce long-term operating costs and avoid overcapacity issues. For example, reducing the frequency of bicycle replacement and lowering maintenance costs can increase profit margins.

In addition, a more efficient and reliable bike sharing system can cultivate higher customer loyalty and expand the user base, which is crucial for long-term market growth. Addressing the reliability and deployment rationality of shared bicycles can enable companies to achieve higher user retention and satisfaction, thereby increasing long-term revenue.

4.3. User Experience

Enhancing user experience is the most important aspect to be addressed in the proposed change. By addressing technical issues related to mobile application performance and bicycle availability, users will benefit from a more comfortable and convenient experience. The integration of advanced GPS and AI-based prediction algorithms can make it easier for users to find an available shared-bicycle when they need it, especially during peak commuting hours when customer demand for shared-bicyle is highest.

In addition, improving the durability and comfort of shared bicycles will bring users a more enjoyable riding experience, making them more likely to choose shared bicycles as their primary short distance commuting method.

Finally, by implementing better security measures to reduce theft and intentional destruction, it is possible to ensure that there are sufficient shared-bicycles available for users to use, and to provide users with better conditions for their shared-bicycles, thereby enhancing their user experience.

5. Advocacy Strategy for Implementing Proposed Changes

To ensure the successful adoption and implementation of the proposed technical improvements to bike-sharing systems, it is essential to develop an effective advocacy strategy. This will help increase awareness among governments and companies about the recommendations in this paper, thereby supporting the better development of the existing shared bicycle system.

5.1. Target Audience

I. Government officials and policymakers: Individuals involved in urban planning, transportation regulation, and environmental sustainability initiatives.

II. Shared bicycle companies and investors: Business leaders and investors with vested interests in improving operational efficiency and market competitiveness.

III. Urban planners and transportation experts: Professionals responsible for planning and managing urban transportation systems.

IV. Residents and users of shared bicycle systems: Directly affected parties.

5.2. Advocate Information

To ensure the clarity and persuasiveness of the promotion, the core message should focus on the following key points:

I. Sustainability and societal impact: Enhancing durability and reducing environmental impact align with global sustainability goals, contributing to safer, more efficient, and cleaner urban environments.

II. Economic advantages: Addressing technical challenges enables shared bicycle companies to lower operational costs, reduce overcapacity, and increase profitability, thereby enhancing market competitiveness.

III. Enhanced user experience: The proposed improvements will result in more reliable and user-friendly services, leading to increased customer satisfaction and higher usage rates.

5.3. Publicity

Proactive engagement with stakeholders is critical for building support and facilitating the implementation of the proposed changes. This can be achieved through:

I. Pilot operations and launch events: Small-scale pilot operations and launch events can attract the attention of government agencies, industry leaders, and related organizations to further understand the research findings and recommendations in this paper.

II. Publications and social media campaigns: Promoting the research in relevant journals, newspapers, and on social media platforms allows the main target audience to learn about the potential development of shared bicycle systems. Encouraging them to voice opinions on the direction of changes will support the successful implementation of the recommendations in this paper.

III. Collaborating with influencers and organizations: Partnering with organizations, researchers, and influencers interested in urban mobility and sustainability can amplify advocacy efforts. Collaborating with major companies and institutions in the shared bicycle field can enhance credibility and broaden the reach of the proposed recommendations.

5.4. Building and Maintaining Relationships with Stakeholders

Sustained engagement is essential to maintaining momentum and support for the proposed changes. Continuously catch-up with relevant organizations, companies and individuals, updates on the progress of advocacy efforts, and offers of collaboration on pilot projects can help solidify relationships and ensure ongoing interest in the recommendations.

5.5. Continuously Monitoring the Progress of Advocacy Efforts

The effectiveness of advocacy efforts should be continuously monitored. Tracking policy changes, industry developments, and public survey results will provide crucial feedback on the impact of the advocacy strategy, allowing for adjustments and improvements as necessary.

6. Conclusion

This paper mainly explores some potential technical and operational strategy issues of Chinese bike-sharing system and proposes solutions. This paper defines shared-bicycles as a short-term rental transportation service, emphasizing their role in providing convenient, affordable, and sustainable urban transportation. Subsequently, the differences between China and international bike-sharing systems were explored, including Chinese large-scale market, dockless system, and unique challenges in regulation and cost control. The impact of shared-bicycles on Chinese society, particularly on the environment, economy, and health. Shared-bicycles can help reduce carbon emissions, alleviate traffic congestion, and promote healthier lifestyles, despite challenges such as traffic disruptions and improper parking.

In addition, there are currently technical issues facing shared bicycles in China, such as durability, mobile application performance, and theft. It compared these with international systems that prioritize user comfort and sustainability. Suggested solutions include improving the manufacturing process and materials of shared bicycles to increase durability, utilizing big data and artificial intelligence to

enhance mobile application functionality, and integrating better anti-theft technologies such as establishing dedicated shared bicycle parking stations.

The benefits of these changes have been emphasized in three key areas: social impact, market impact, and user experience. These proposals aim to create a more convenient, safe, and sustainable urban environment, enhance the profitability of bike sharing companies, and improve customer satisfaction.

Finally, this paper describes promotional strategies to facilitate the proposed changes. This strategy targets government officials, bike sharing companies, urban planners, and users. It emphasizes sustainability, economic advantages, and enhanced user experience, using tools such as pilot operations, publications, and collaboration with influencers to expand the scope of promotion and draw more attention to these proposals to help improve China's shared bicycles. Finally, continue to participate and monitor to ensure the successful implementation.

References

[1] China Bicycle Association. (2023). "Durability Issues in Shared Bicycles: A Comprehensive Study." *Journal of Urban Transportation* 12(3), 45-60.

[2] Beijing Municipal People's Government. (2023, December 25). Beijing's shared bicycle rides exceed 1 billion in 2023, with a daily average of 3.1157 million trips. http://www.beijing.gov.cn/zhengce/zcjd/202312/t20231225_3510028.html

[3] Dai, Y., Xu, L., Zhang, X., Fu, Y., & Dong, W. (2024). Promoting sustainable development: A study of China's bicycle sharing industry policies based on text analysis. *Research in Transportation Business & Management*, 52, 101085. https://doi.org/10.1016/j.rtbm.2023.101085

[4] Xinhuanet. (2018, November 13). "Nowhere to Place" shared bicycles: Photographer visits 30 cities' "graveyards" with visually impacting images - Xinhua News Agency. http://www.xinhuanet.com/politics/2018-11/13/c_1123702738.htm

[5] China Academy of Information and Communications Technology (CAICT). (2024). "Mobile Application Performance in Shared Bicycle Systems." *Technology and Society* 18(1), 102-118.

[6] Li, X., & Zhang, Y. (2023). "Vandalism and Theft in China's Shared Bicycle Market." *Chinese Journal of Public Security* 9(2), 65-78.

[7] European Cyclists' Federation. (2024). "Shared Bicycle Durability and Maintenance in Europe." *Cycling Trends in Europe* 15(4), 75-90.

[8] Massachusetts Institute of Technology (MIT). (2023). "Technological Integration in Shared Bicycle Systems: A Comparative Study." *Journal of Transportation Technology* 11(2), 125-140.

[9] International Bicycle Manufacturers Association. (2024). "Improving Durability in Shared Bicycles: A Global Perspective." *Journal of Bicycle Technology* 18(2), 55-70.

[10] Jia, H. (2024). "The Sound of Rising Prices: Where is Shared Bike Heading?" *Baidu Baijiahao*. https://baijiahao.baidu.com/s?id=1806174200291172502&wfr=spider&for=pc.

[11] China Academy of Information and Communications Technology (CAICT). (2024). "Enhancing GPS Accuracy and Mobile Application Performance in Shared Bicycle Systems." *Technology and Society* 19(1), 110-125.

[12] Massachusetts Institute of Technology (MIT). (2023). "Optimizing Shared Bicycle Systems: Lessons from the U.S. and Europe." *Journal of Transportation Technology* 12(1), 95-110.

[13] World Resources Institute. (2024). "Urban Transportation and the Environmental Impact of Cycling." *Global Transportation and Sustainability* 22(3), 145-160.