

INFLUENCES OF PUBLIC BICYCLE ON URBAN PUBLIC TRANSPORT : A STUDY ON HANGZHOU CITY, CHINA

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ABSTRACT: With the rapid progress of urbanization, urban transportation problem has become a bottleneck that limits sustainable urban development all over the world. The promotion of urban public bicycle provides a new way for the city government to achieve the goal of public-transport-prior strategy and thus solve traffic problem to some extent. The paper took Hangzhou city as an example to discuss the existing problems, and then based on the analysis of urban bicycle role, proposed some measures to optimize the development of urban public transport system.

Keywords: Public Bicycle, Public transport, Hangzhou

INTRODUCTION

The 1970's energy crisis led people to reflect on the performance of car-supported urban growth pattern, and diversified development pattern of urban public transport system got people's attention once again, accordingly public bicycle was taken into account by the city government. The concept of "Public bicycles" first appeared in the 1960's Amsterdam, Netherlands. "White bicycle" plan by Provo anarchist organization is the first documented relative plan. More accurately, this plan belongs to the "Community bikes program", whose main practice body is community unit. Inspired by the "white bicycle" plan, volunteer-main bodied public projects have been taken in dozens of communities. But due to lack of profit, it's difficult to offset costs such as facility wear. So many similar projects came to the end soon. Entering into the 21st century, Paris, Lyon, London, Montreal, Amsterdam, Warsaw, Brisbane, Beijing, Shanghai, Wuhan, Taipei, Hangzhou and other cities have promoted the system gradually.

The academia studying on public bicycles paid more attention to policy research (e.g., Wood 1993; Gong and Zhu 2008) or the linkage and transfer between bicycle and other public transport tools (Hine and Scott 2000; Michael and Yi 2001; Karel 2004). However, as China is confronted with rapid growth of motorization and energy constraint problems, it is of particular importance to study the influence of public bicycle on citizens' travel mode and the public transport system from microcosmic

viewpoint. We chose Hangzhou as our research object because it is the first city in China that brings public bicycle into urban public transport system on the true sense. Our objective is that through investigation on public bicycle users in Hangzhou, analyze citizens' behavior change and find out the reason, and thus enrich related research content.

METHODS

Setting

Hangzhou is located in the economically-developed southeast coastal area of China (Fig. 1). It is the capital

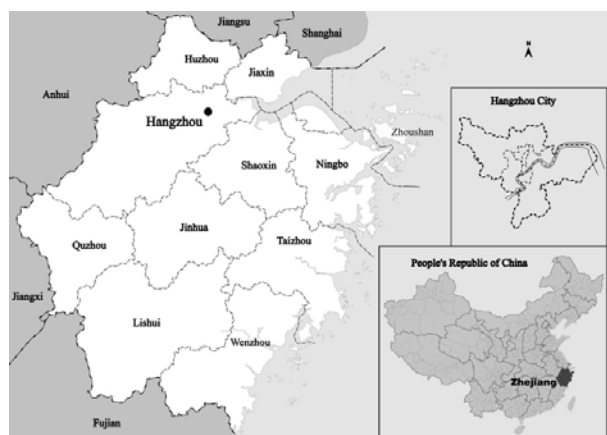


Fig. 1 The location of Hangzhou

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of Zhejiang province and is about 157km far from Shanghai.

In 2008 the urban land area is 3068 km² with a total population of 4.195 million. Urban GDP is 46.91 billion dollars and GDP per capita is 11254.7 dollars. The population density of central area is more than 15,000 persons/km². With rapid social and economic development in recent years, private car ownership is also in rapid growth in Hangzhou. The number of cars owned by per 100 households is 17.84 in Hangzhou in 2008, and the ownership is 11 in Shanghai.

Participants

From October to November in 2008 we carried a sampling survey in Cuiyuan District and Hubin District, both are places that public bicycles were promoted the earliest in Hangzhou. Cuiyuan District is a more comprehensive large-scale residential area in the western of Hangzhou, while Hubin District is the first one that provided private bike rental business near West Lake Scenic. In this survey, a total of 200 questionnaires were distributed, response rate were 100% and effective response rate were 91%. Both convenient sampling and quota sampling methods were used when we distributed the samples (Table 1).

Public Bicycle Development

Hangzhou Public Bicycle first appeared in 2005 in the private bike rent points surrounding the West Lake scenic area. Later Hangzhou government began to renovate and standardize it, and in May 2008 a trial operation of urban public bicycle system started. After one and a half year's improvement, the first urban public bicycle system was gradually formed in China on the true sense (Table 2).

Table 1 Basic situation of survey sample

Factors		Cuiyuan	Hubin
Features	Citizens of Hangzhou	97.4%	77.1%
	Tourist or temporarily deal with affairs	2.6%	22.9%
Age	18-34	76.9%	91.7%
	35-55	13.1%	8.3%
Public Bicycle	Have ever used	62.2%	78.3%
	Have never used	37.8%	21.7%

Table 2 Public bicycle system history in Hangzhou

Time	Service Points	Number of public bicycle
2008.5.1	61	2800
2008.9.16	101	4900
2008.10.1	141	6100
2008.11.20	241	8100

Date Analysis

We have adopted a combination of quantitative and qualitative methods for analysis. As for the operation and management mode of public bicycle, we used Comparative Analysis. Questionnaire survey data were divided into two regional units for statistical analysis to compare how public bicycle influenced on people's travel mode.

RESULTS

Travel Motive

Analyze the investigation result of the two districts, purpose proportion of using public bicycle for trips by respondents rank as follows: Recreation (49.6%), Work (20.3%), Visiting friends and Communication (15.7%), Daily Life (14.4%). The ratio of "Recreation" is much higher than others. We think there are mainly two reasons: First, Hangzhou is an international tour city and the famous West Lake is inside the city, when citizens want to go to West Lake the distance is within a suitable activity radius by bike. Second, let's see the scale of West Lake, its shoreline is 15 kilometers long and the area is about 49 km². If go to West Lake on foot, it requires a strong support from traditional public transportation, which is very difficult to realize because of the narrow roads around West Lake now. If go by private cars, the rhythm seems not so suitable for playing, and the traffic around West Lake is always saturated although the parking cost is high. But if we go by public bicycle, the disadvantages mentioned above can be avoided.

Travel Mode

We also inquired the respondents about the travel mode before public bicycle system has been implemented. The result in Cuiyuan District is: "Private car" (7.6%), "Public transport" and "Private bicycle" (71.2%), "On foot" (21.1%), while the proportion in

Table 3 Investigation on travel mode

Travel mode	Cuiyuan	Hubin
On foot	21.2%	17.8%
By bike	30.8%	26.0%
Public bus	40.4%	39.7%
Private car	7.6%	16.5%

Hubin District are 16.5%, 65.7% and 17.8% separately (Table 3).

After Public Bicycle System was launched, travel mode of the respondents changed accordingly. The proportion that people would like to use public bicycle instead of private car in Cuiyuan District is 46%, and in Hubin District it is 67%. However, in Cuiyuan District the proportion of uncertain whether to change is as high as 36.8%. There is a large difference between the two regions (Table 4).

Satisfaction Degree

Overall, respondents were relatively satisfied with the implementation of public bicycles. Combined ratio of “satisfied” and “relatively satisfied” in Cuiyuan District is 55%, compared with 82% in Hubin District (Table 5). But the ratio of “unsatisfied” in Cuiyuan District accounted for 18%, while in Hubin District it is 8%. We can also see large difference between the two regions. We think it’s because that in Cuiyuan District, public bicycles cannot solve respondents’ daily commuting problem at one time, the traditional public transport tools supported by them still has the problem of low punctuality, limited capacity and is difficult to transfer. So a higher degree of dissatisfaction appeared. Differences between the two regions confirmed our initial judgment that public bicycle system is an important auxiliary measure to improve urban public transport system, to achieve the goal of an effective short-distance travel and transfer between different commuting tools.

Table 4 Change of travel mode

Mode	Cuiyuan	Hubin
Instead of private cars	46%	67%
Prepare to instead of private cars	17.2%	22.1%
Uncertain whether to change or not	36.8%	10.5%

Table 5 Investigation of satisfaction degree on public bicycle

Satisfaction degree	Hubin	Cuiyuan
satisfied	17%	6%
relatively satisfied	65%	49%
general	10%	27%

In addition, respondents placed high expectation on the future development of urban public bicycle system, and the ratio of “very optimistic” is 21.3%, “relatively optimistic” is 68.7%, “uncertain” is 10.0% respectively. In the respondents who are not native Hangzhou residents, 26.1% were looking forward to launching a similar system in their home cities, 71.7% relatively hoped so, while only 2.2% didn’t care. Meanwhile, respondents proposed some suggestions to improve public bicycle system, mainly focused on bicycle comfort, lock device improvement, charge reform and procedure simplification on car rent, etc.

The Type of Operation and Management

We visited Hangzhou public bicycle operating institution— Hangzhou Public Bicycle Transport Service Co., Ltd— to investigate the operation and management on public bicycle. Judging from the cities that have already promoted public bicycle system, we can see there are mainly two kinds of operation and management manner: one is conducted by the government to entrust a traditional bus company to operate the business such as Hangzhou, the other is advocated by private capital company such as Paris (Table 6).

Apparently in the representative Paris mode, city government only played the role for advocate without any more financial support. But in the representative Hangzhou mode, the government provided necessary financial support and involved in the daily operation and management through state-owned enterprises, so it can reflect better the nature of public bicycle system as an urban welfare service facility. First, under the guidance of city government the mode can start effectively, guarantee the popularity of network and give attention to fair development in different areas to improve the operation efficiency of the system; Second, operating company has the traditional public transport system background, it can integrate factors such as site resources and advertising resources better while operation. At the same time, the government orientate the development by financial input and preferential policies, which is helpful to take consideration of social benefits when planning points and providing

Table 6 Compare of operation and management mode

City	Hangzhou	Paris
Institute	Public Bicycle Transport and Service Development Co., Ltd	Degot Company
Property	State	Private
Supporting Policy	Hangzhou Public Transport Corporation and Hangzhou Bus Advertising Company registered an operating company with 5 million yuan and the city government provided a subsidiary loan of 270 million yuan. Each service point has two billboards for advertising and one service booth for rent, besides this bicycle body advertising and rent income are all used for routine maintenance.	Degot Company paid 100 million euros for the project cost and thus gained the exclusive right to operate the 1600 city-owned billboards in the next 10 years. 12% of the rental income was used for public bicycle routine maintenance, the remaining belonged to Paris government.

employment. Furthermore, the construction of public bicycle system under government guidance is no longer business activities but urban development activities. So it is conducive to the promotion and popularization of travel patterns and thus guides the shift in the way people travel.

CONCLUSIONS AND DISCUSSION

While public bicycle is essentially a demand-oriented mode of public transport, although the demand is different in time and districts, if we could take advantage of the information system management and expand the layout area, then it will have an obvious advantage within a certain range compared with conventional buses or even taxis because of the excellence wherever and whenever you can borrow or return the bicycles. Compared to traditional bicycles the biggest difference is that, public bicycle system has the function to join in public transport system of higher level or self-drive transfer center bi-directionally. Theoretically, if site settings are sufficiently scientific and public bicycles can be fully scheduled, the most ideal pattern that combines citizens' travel into public transport system is Start Point- Public Bicycle- Bus System-Public Bicycle-Destination, or Start Point-Self driving-Transfer Center-

Public Bicycle-Destination. Obviously traditional bicycle could not be competent for such a pattern.

In China's rapid urbanization process, especially the economy-developed eastern coastal regions, the constraints on high degree of time-space compressed urbanization, land and energy factors ask that we must seek a new solution to traffic problem. Undoubtedly, the public bicycle system being promoted in Hangzhou has provided us a new way to solve the growing urban traffic problem by shifting the key point to conduct citizens' travel mode and improve the transit network. But we should realize that development of public bicycle system cannot solve the traffic problem thoroughly, its significance lies in pursue of efficient, energy-saving and sustainable "Green Traffic" development and trend conduction. The ultimate point for promotion and development of public bicycle system is to take effective implementation of urban public transport priority strategy, enhance and improve the urban public transport system.

(1) Improve and optimize urban public bicycle system actively, make it a liking bridging between different transport systems and take full advantage of different travel mode. In large or medium-sized cities, we should promote "public transit + bicycle" mode according to city size and preponderant scope by bike, make it regionalized and emphasize travel convenience by local bike, fully manifest the convenient feature of short-distance travel by bike.

(2) Promote upgrade of traditional public transport system forcefully, make scientific planning, arrange public transit points and routes rationally. In large and medium cities, actively develop large-capacity transport such as Bus Rapid Transit (BRT) and rail transit, and thus improve running performance of public transport system effectively.

(3) Emphasize planning conduct and policy support, use scientific planning to guide urban land use and population spatial distribution, avoid spatial separation, dislocation, overlap in main function areas and the following phenomena of spatial overlap, time focus and direction coincidence in traffic volume which can bring about a series of traffic problems. Improve the relevant land and finance policy, ensure urban public transport priority strategies.

APPENDIX

Handling Instruction of Hangzhou Public Bicycle

In Hangzhou, the public bicycle users must apply for public transport IC card or citizen card with the same

function. If 200 yuan is deposited in the electronic purse card to guarantee the credit and rental tariff, the card would get bicycle rental service function automatically.

Bicycle Rent

Put IC card with rental function on the device of lock zone of one public bicycle, and the green light on the interface will turn on. At the same time, you will hear buzzer sound "Di---" which indicates the lock device is open. The renter needs to take bicycle out in 30 seconds and the procedure is completed. The management system will deduct 200 yuan directly from the electronic purse as a faith deposit when you are doing such rental operation (Table 7).

Bicycle Return

Put the rented bicycle into lock device. When the green light flashes, put IC card in the lock zone card device, and you will hear the buzzer sound "Di---" which means a successful return. At the same time, the system stops time record and completes fee settlement. The renter should confirm that the bicycle has been locked.

Table 7 Charging Standard of Hangzhou Public Bicycle

Rent time	Fee
Within one hour	For free
1~2 hours	1 Yuan
2~3 hours	2 Yuan

If not, for example, bicycle is out of the lock device, thus the operation should be done one more time.

Charging Standard

The charging of public bicycle adopts segmented billing method. In the regulation, if the renters use public bicycle within 90 minutes after they use the IC card on a POS machine, the free time for rent can be extended to 90 minutes, and accordingly the billing and settlement time will also be extended.

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