

Teaching Case Study Based on Virtual Simulation Experiment

Rui Wang

Shandong University of Finance and Economics
Jinan, China

Abstract—Virtual simulation experiment teaching is a new teaching mode, which enables students to participate in virtual simulation experiments in person, which provides a new idea for the training of logistics management professionals in colleges and universities. The teaching case investigates the current situation of shared bicycles and various factors affecting the development of shared bicycles. It uses virtual simulation experiments to model and simulate its system planning, find problems and hidden dangers, and then compare the optimization schemes to provide the optimal improvement strategy. The corresponding department maintains the stability of the shared bicycle network system so that it can operate efficiently and continuously.

Keywords—virtual simulation; case study; experiment teaching; the shared bicycle

I. INTRODUCTION

Experimental teaching and case teaching are important ways for higher education institutions to improve the quality of personnel training. They can effectively train and improve students' practical ability and ability to discover, analyze and solve practical problems [1-2]. In the current construction of first-class universities, logistics management majors for practice are offered in the undergraduate education stage. Targeted learning and training during the learning phase of the classroom will greatly improve the quality of school education and save social resources. Because of this, based on the urgency and importance of the design of teaching cases for virtual simulation experiments has become increasingly prominent. The rich case resources are equivalent to the practice of diversifying students. Relying on the well-built case base, the case teaching can be carried out flexibly and variably according to professional characteristics and training objectives, so that students can complete a variety of abilities in the classroom.

II. THE SHARED BICYCLE SYSTEM

A. The Use Characteristics of Shared Bicycles

At present, some shared bicycle operators do not adopt scientific and reasonable methods in site planning such as site selection and site capacity, but mainly through experience and investigation. Therefore, the site is not properly positioned, and some sites cannot. Adapt to the needs of service users or the accumulation of excessive supply of vehicles. Characteristic

analysis of the shared bicycle coverage area can help decision makers to more accurately predict user needs and analyze the characteristics of demand in different time periods in order to make a good network system.

1) Use crowd characteristics

a) Age characteristics

Through the statistics of user data in Jinan area of several shared bicycle apps, the paper finds that the young adult population is the main force of the car, and the number of users between the ages of 12 and 58 accounts for 80% of the total number. Although sharing bicycles benefits people's travel, its characteristics have led some special groups to be destined to enjoy it. Therefore, it must be fully considered when sharing the user needs of bicycles in the forecast area. Therefore, it is necessary to investigate and collect the age distribution of the regional population in order to accurately predict the user needs of the region.

b) Characteristics of income level

Among the many shared bicycle user groups, the paper used the anonymous questionnaire method to understand the salary level of 150 volunteers, divided into five levels below 4,000 Yuan, 4000-5800 Yuan, 5800-7600 Yuan, 7600-9400 Yuan, 9400. Classified above the Yuan. Analysis of the sample data found that nearly 50% of the user's salary is between 4000-5800 Yuan, and high-income people such as paying more than 10,000 people accounted for only 6%. Although the sample size is not large, it also has a certain representativeness. It is obvious that the salary of users who use shared bicycles is mostly at a low level. Therefore, the amount of bicycle input can be increased in the vicinity of ordinary residential buildings and office buildings to adapt to the traffic of such user groups demand.

2) Lease behavior characteristics

a) Total amount of lease

The climatic factors have a significant impact on public transportation, and the restrictions on shared bicycles are very significant. In addition to the harsh weather such as wind and sand, hail, rain and snow, shared bicycles can be used. At the same time, the amount of bicycles used at midnight is far less than the bright daytime. Therefore, the total rental amount of shared bicycles will change periodically with time. The amount of rented cars during the day is higher than that of nights. The rented cars on working days are higher than the rest days, and

the rented vehicles in bright weather are higher than the rainy days.

b) Lease time distribution characteristics

Different time periods, user needs must be different. Analysis of the survey data can be concluded that the peak hours of work-time rental on workdays are 7-9 points, and the peak hours of off-duty rentals are 17-19 points. This phenomenon is called "tidal phenomenon" [3]. The number of car rentals on the rest day is more and more stable, and the main time for renting a car occurs at 9-20 o'clock. By grasping the rental time distribution, it is possible to estimate the vehicle demand of residents at different time points. It is easy to analyze the problem of shared bicycle network travel and formulate corresponding optimization strategies.

c) Lease duration characteristics

This paper uses the survey method to collect information on the use of two hundred Jinan shared bicycle volunteers. The historical travel data can be found that 60% of the average car rental time is within 25 minutes, and the number of users who rent a car within one hour is up to 100. Ninety-six. Sharing bicycles did solve the problem of people's "last mile".

B. Analysis of Factors Affecting Shared Bicycle Demand

1) Deterministic factor

a) Urban economic development level

The development of any system depends on the level of local economic construction. The level of urban economic development determines factors such as financial subsidies, investment, urban transportation development, road environment, residents' consumption levels and travel habits. It is the development of shared bicycle systems and even the entire city. The basis for the development of the transportation system.

b) Urban function layout

The impact of urban functional layout on dispatching needs is mainly reflected in the nature of urban land use and the size of the city. Under normal circumstances, cities divide the jurisdiction according to the nature of land use, such as residential areas, commercial areas, industrial areas, tourist attractions, etc., different functional areas not only generate traffic demand internally, but also generate a large amount of traffic between areas. Travel, this is also the source of scheduling requirements. The size of the city determines the urban population, which determines the number of potential users, which is critical for the determination of scheduling demand.

c) Road conditions

Urban roads are the basic hardware for the shared bicycle system to operate. The perfect non-motor vehicle lane helps to share the safe and efficient development of the bicycle system. Good road conditions ensure the residents' riding environment and attract more residents to choose to use shared bicycles. On the contrary, the absence or occupation of non-motor vehicle lanes and poor road conditions can seriously damage the residents' riding experience and allow residents to choose other modes of travel.

d) Natural conditions

Natural conditions mainly include conditions such as topography, elevation and climate. In general, cities with flat terrain generate more cycling demand, while mountain areas have less demand. Similarly, high-altitude areas have strong UV rays and thin air, which is not conducive to the use of non-motorized vehicles, so there is less demand for cycling. In addition, climatic conditions are also an important factor influencing the demand for bicycle scheduling. When the weather is too cold or too hot, dimly lit, rainy days, etc., the comfort of the bicycle will be reduced, which will greatly reduce the probability of residents choosing bicycles. Choose regular bus and rail transit as a travel tool.

2) Uncertainty factor

The factors affecting the uncertainty of shared bicycle demand can be divided into five categories: the user's socioeconomic factors, the user's travel characteristics, and the price. Vehicle placement and security of use. The socioeconomic factors of the user refer to the age, occupation and income level of the group. The user's travel characteristics include travel distance, travel purpose and travel time. The price is the deposit and rent of the shared bicycle, the deposit or the deposit free, and some offers can attract users. The vehicle placement position intuitively reflects the network scheduling efficiency and service level of shared bicycles, and is also an important factor to attract users. The safety of use is one of the most important factors for users to consider. Good cycling quality and scientific riding precautions can improve the riding experience and attract more users.

III. TEACHING CASE

A. Case Summary

Since the initial birth of the shared bicycle, after experiencing explosive development, it has entered a mild platform period, and its convenience and problems have always caused controversy [9]. As a low-carbon and environmentally-friendly green travel mode, bicycles are becoming more and more popular today. Large-scale bicycle investment has adapted to the growing user demand, and has also led to a large number of bicycles being idle, and randomly stacked in public space, occupying limited social resources. The case investigates the current situation of shared bicycles and various factors affecting the development of shared bicycles. It uses virtual simulation experiments to model and simulate the system, find problems and hidden dangers, compare the optimization schemes, and provide the optimal improvement strategy to the corresponding departments. Maintain the stability of the shared bicycle network system so that it can operate efficiently and continuously.

A. Case Resources

There are 5 sites in the selected area of the thesis, namely, Hang Lung Plaza Station, Guihe Shopping Center Station, Huaneng Building Station, Si Li Street Community Station, and Shandong Water Resources Department Station. Since Hang Lung Plaza is only one street away from the Guihe Shopping Center, it is very close to each other, so it is regarded as the same site in the modeling analysis.

The number of frames at each site in the area and the initial vehicles at the time of modeling are shown in Table I.

TABLE I. NUMBER OF FRAMES AND INITIAL VEHICLES AT EACH SITE

Site	Abbreviation	The number of frames	The initial vehicles
Guilue Shopping Center Station	N1	55	44
Si Li Street Community Station	N2	45	36
Huaneng Building Station	N3	60	48
Shandong Water Resources Department Station	N4	42	34

B. Case Analysis

At the beginning of the construction of the shared bicycle site, the core area with high population density and high frequency of transmission will be preferred, because the market share of the densely populated city center in shared bicycles is much higher than that of the suburbs, and the market demand is growing more. The demand pressure of sharing bicycle service sites in the central area will increase with time and economic environment. The core area is prioritized for network optimization in line with market development logic. Network segmentation selects high priority areas in the same area.

IV. TEACHING CASE IMPLEMENTATION ORGANIZATION

A. Teaching Content

The top view of the simulation model is shown in Figure 1:

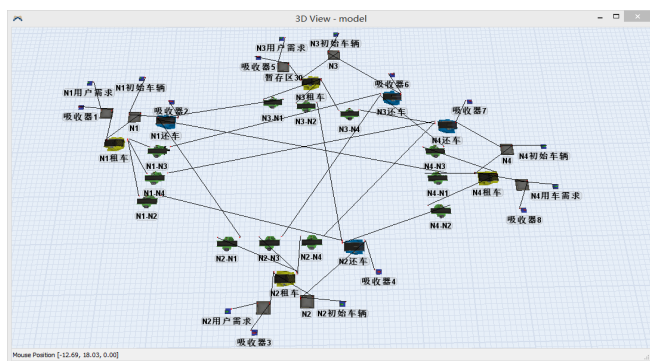


Fig. 1. Simulation model

After the model is run, the output data can be processed and calculated to obtain corresponding model indicators. These output indicators can help us visually analyze the advantages and disadvantages and overall stability of the shared bicycle network system.

1) Vehicle utilization rate

The vehicle utilization index can be used to evaluate the quality of the site, and u is used to simplify the representation. The vehicle utilization rate for a particular site is expressed as u_1 , which is used to measure the pros and cons of the site, and $u_1 = \text{average daily loan times} / (\text{site initial number of vehicles} + \text{site average daily return number of vehicles})$. For the vehicle utilization rate of all stations in a certain area, it is expressed as

u_2 , which can reflect the quality of the shared bicycle network system in the whole area, and $u_2 = \text{the total number of vehicles borrowed from all stations in the area} / (\text{the sum of the initial number of vehicles in the area} + \text{the area The site returns the total number of trips})$.

2) Demand pressure

The demand stress indicator is an evaluation of the user's demand behavior, and the meaning is the ratio of the number of users arriving at the site to the number of rentable vehicles at the site within a certain time. Similar to the vehicle utilization rate, the required pressure index is divided into the demand pressure of a single site, which is simplified by p_1 ; the overall demand pressure in the entire research area is simplified by p_2 . $P_1 = \text{number of people arriving at the site} / \text{number of vehicles available at the site}$. $P_2 = \text{number of vehicles arriving at each site in the area and/or number of vehicles available at each site in the area}$.

3) Network system quality

The network system quality indicators reflect the advantages and disadvantages of different network solutions, and can directly and directly judge the quality of each network solution. This indicator is not directly represented by the data from the model simulation, but includes the two indicators mentioned above. In order to fully consider the two sub-indicators, this paper adopts the quintile principle of statistics and divides the five levels of 1, 3, 5, 7, and 9, so it is necessary to determine the level corresponding to the value of each sub-indicator. The weights corresponding to the two sub-indicators are set [7-8], the weight of the vehicle utilization is 5, and the weight of the demand pressure is -3. If the weight is positive, it means positive impact on the system, and if the weight is negative, it means to generate system. Negative impact, the magnitude of the weight indicates the degree of impact on the network system. The quantification of network system indicators as a quantitative indicator can be intuitively used to evaluate the stability and advantages and disadvantages of network systems under various network schemes.

B. Teaching Analysis

How to choose the best solution in various optimization schemes to improve the quality and stability of the network system? The paper analyzes the calculated vehicle utilization and demand pressure of each site to determine the optimization strategy suitable for the site. Three common scenarios are mentioned above: site expansion, new site, site consolidation.

Henglong Gui and site n1, the vehicle utilization level is relatively high, and the demand pressure level is large, which is suitable for site expansion or nearby new site strategy;

Si Li Street Community Site n2, the vehicle utilization level is relatively high, the demand pressure level is medium, and no optimization strategy can be adopted;

Huaneng Building site n3, the vehicle utilization level is low, the demand pressure level is small, suitable for adopting partial consolidation strategy;

Provincial Water Resources Department site n4, medium vehicle utilization level is medium, the demand pressure level is large, suitable for site expansion strategy.

Assume that the correction of the shared bicycle network system is now improved, but at the same time, the cost factor should be considered, and 10 new parking frames can be provided. Through the analysis of the current situation of each site, the following three optimization schemes are proposed: scheme one, only for the province The water conservancy hall site n4 expansion, other sites remain the same; scheme 2, only Henglong Gui and site n1 expansion, other sites remain intact; scheme 3, Huaneng Building site n3 part merged to Henglong Gui and site n1, that is, ten of n3 sites The parking frame is transferred to the n1 site, and the water conservancy hall site n4 is expanded.

The number of parking frames at the corresponding site after using the optimization scheme is shown in Table II:

TABLE II. OPTIMIZATION PLAN

	N1	N2	N3	N4
Scheme 1	55	45	60	52
Scheme 2	65	45	60	42
Scheme 3	65	45	60	52

Sharing traffic is like a double-edged sword, sharing the way to improve the utilization of vehicles to provide services to the society, but also gradually eroding the limited public space resources in the city. Therefore, the rational and appropriate use of shared bicycles can improve the status quo of urban traffic. Once excessive, it will have a negative impact on urban transportation systems and even public security. How to operate an existing network system is a top priority and a long-term concern. The network system is regularly monitored, and the problems that arise are promptly fed back, and the optimization plan is produced in a targeted manner.

V. CONCLUSION

Starting from the planning and design of logistics system, based on the idea of virtual simulation, virtual and real, create a

visual virtual simulation experiment environment, so that students are placed in a virtual 3D learning environment. Applying virtual simulation and optimization theory, we strive to enable students to simulate the teaching cases of the entire shared bicycle system design in a virtual and real environment. With the goal of opening and sharing high-quality experimental teaching resources, virtual is practical, virtual complements, student-oriented, and students are trained to analyze and solve complex logistics projects on the basis of self-learning, self-education and self-improvement. The complexity and innovation of the problem.

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