

Research Article

Modeling the Satisfaction of Bus Traffic Transfer Service Quality at a High-Speed Railway Station

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Bus transit is one of the main transfer modes at high-speed railway (HSR) stations. Performing a scientific and reasonable evaluation of the present bus traffic transfer service is highly significant for improving the efficiency of the HSR and increasing the use of the system. This paper focuses on the passengers' transfer experience and proposes a methodology to evaluate current bus traffic transfer service. Factors that affect passenger satisfaction during the bus transfer process at HSR stations based on the passengers' perceptions are analyzed by convenience, comfort, safety, service, and economy. A structural equation model (SEM) is developed as an evaluation approach to explore the correlations of bus transfer service, passenger perceived value, and passenger satisfaction. To calibrate the model, a questionnaire survey of passengers transferring to a bus was conducted at Xi'anbei Railway Station. This paper analyzes the relationships between observed variables and latent variables in the measured model, the influences of exogenous variables on endogenous variables in the structural model, and the impact of the passengers' socioeconomic attributes on passenger satisfaction. Analysis results of the SEM show that economy and convenience are the critical influential indicators of passenger satisfaction, among which bus fare preferential policy and transfer distance are the most significant factors. The findings can provide helpful information for planners and managers to improve the services of existing HSR stations and to guide the planning of new ones.

1. Introduction

The high-speed train, known as China Railway High-speed (CRH) and also called the bullet train, has a transformative influence on Chinese society and economy and on the people's travel mode. A World Bank study found that extensive travelers at different income levels chose CRH rather than existing alternatives for its comfort, convenience, safety, affordability, and punctuality [1]. In particular, the high-speed rail (HSR) has become one of the major alternatives of long-distance passenger transport [2]. Less than a decade ago, China had yet to connect any of its cities by bullet train. Now several commuter corridors have been built up among some megacities. The CRH has attracted a large number of passengers in the intercity transportation market because it shortens their traveling time [3]. For example, the bullet train connecting Xi'an and its satellite city, Xianyang, only costs 18 minutes and 9 yuan (\$1.36), but it takes 45 minutes (Google maps navigation) to travel the same route

by car. In 2016, a new "Mid-to-Long Term Railway Network" plan was drafted, envisioning a larger 8+8 high-speed rail grid serving the nation and expanded intercity lines for regional and commuter services for large metropolitan areas in China (Figure 1) [4]. With this increasing speed, the HSR has been an important part of the modern and integrated transportation system in China.

Meanwhile, the HSR station needs bus transit to concentrate and diffuse a large number of travelers. It is one of the main transfer modes at the HSR station and is the only public alternative except for private modes (private car and taxi) in cities without an urban rail transport system. Due to the synthetic complexity of the traffic organization of HSR stations, the bus transfer service characteristics are totally different from the general transfer hub. The quality of the bus transfer service in this article depends not only on the construction of infrastructure and the environment of the high-speed railway station but also on its management and the public-perceived value of the bus traffic. In other



FIGURE 1: High-speed rail network in China (from <https://www.economist.com/>).

words, the scope of this study involves two public transport systems, inner- and intercity traffic, and two dimensions of service, tangible (facilities and environment) and intangible services. An improvement in the level of service quality leads to a more efficient public traffic transfer system and to an increase in the users of the system. Research in this field is critical for operators and managers in the context of the rapid construction of an HSR network. As noted by Leonard et al. (1990) [5], the only judge of the service quality is the customer. Therefore, passengers' perceptions of satisfaction with each characteristic of the service can effectively reflect the quality of service [6].

This study explored the cause-and-effect relationship between service quality, passenger satisfaction, and the perceived value of the bus transport system from the passenger perspective by a quantitative analysis technique, namely, the structural equation model (SEM). It is worth noting that, for the part of the transfer services provided by the bus transit system, passengers only estimate the tangible facilities, not including the operation service. Consequently, the perceived value of bus transit is introduced into this research from the perspective of social and individual benefits. That is in part because it is more feasible for the survey to target the passengers who are waiting for a bus and partly because adopting these generalized perceptions of the bus transit system can eliminate the influences on the survey data, which are caused by the differences in the knowledge of the Xi'an bus transit system among different passengers.

Using the Xi'anbei Railway Station as an example, the SEM methodology is developed as a measurement model to explore the correlations among the bus transfer service, perceived value, and passenger satisfaction. The main motivation of this research is to determine the following 3 problems,

which are helpful for bus transit agencies and planners to identify the weakness of the bus transfer system and set priorities for bus transfer service improvement in HSR stations.

- (1) How would a public satisfaction model be constructed to examine the public bus transfer service in the HSR station?
- (2) Which service attributes have the greatest impact on public satisfaction and are high priorities for improvement?
- (3) According to the travelers' demographic characteristics, what are the targeted policies that should be considered by the manager and operator to maximize their effects?

The overall framework of the paper is as follows: Section 2 presents a brief state-of-the-art review regarding the subject; Section 3 describes the methodological approach; Section 4 depicts the data collection procedure and descriptive statistics; Section 5 provides the modeling process and the discussion of the results; and Section 6 summarizes the main findings and conclusions drawn from this work.

2. Literature Review

2.1. Review of the Literature on the High-Speed Rail. In recent years, many countries have constructed HSR systems to advance their transportation system [7]. As the high-speed rail system continues to spread around the world, many kinds of unexpected and undesirable events have occurred since operations began, including facilities and service and organizational management issues [8]. To solve these problems and improve the competitiveness of the HSR, numerous studies in different countries assess the service quality from the passenger's perspective.

Chou et al. [8–11] use multiyear data (2007, 2010, and 2013) and transnational surveys to study the passengers'

perceptions of service quality for both the Taiwan High-Speed Rail (THSR) and Korea Train Express (KTX) systems. In their series of studies, some useful conclusions were proposed to improve their service quality in an efficient and targeted way. For example, they used an SEM to investigate the relationships among service quality, corporate image, passenger satisfaction, complaints, and passenger loyalty for both high-speed rail (HSR) systems [9]. Further, a novel passenger satisfaction index (PSI) model integrated with a modified importance–performance analysis (IPA) technique was proposed to identify top-priority performance evaluation indicators for high-speed rail corporations [8]. They also compared the passenger perceptions of the high-speed rail systems between these two districts [11]. The results suggested that THSR passengers are very concerned about the facility of the infrastructure services, while KTX passengers are mainly concerned about the frontline staff interaction. After further longitudinal comparison and exploration (from 2007 to 2013), causal relationship analyses for both Taiwan and Korea revealed that operating performance is mainly affected by corporate image, followed by passenger loyalty.

Some researchers also assessed the service quality of the HSR system from various angles. Lee et al. [12] focused on the ride comfort in the Korean Train Express (KTX) and developed an SEM to present the relationships among the environment, seat belt, tunnel effect, motion sickness, and passenger fatigue. This study revealed that overall ride comfort was significantly affected by seat fatigue and customer satisfaction variables. Chou and Yeh [10] focused on the construct relationships between customers and employees of the Taiwan High-Speed Rail (THSR). The related construct included leadership, employee satisfaction, employee loyalty, service quality, corporate image, customer satisfaction, and customer loyalty. Chou et al. [3] also investigated the relationships between service quality, customer satisfaction, and customer loyalty for the THSR. Their analysis concluded that customer satisfaction had a positive effect on customer loyalty, and service quality had a positive effect on customer satisfaction and customer loyalty. Kuo and Tang [13] paid attention to elderly passengers using THSR's services. They examined the relationships between service quality, corporate image, customer satisfaction, and customer loyalty adopting an SEM. The study found that, for elderly passengers, service quality also had a significant effect on satisfaction. For the Nanjing-Shanghai HSR, the busiest route in China, Cao and Chen [2] developed an SEM to understand the causal relationships between service quality, customer satisfaction, and customer loyalty. They found that high-quality service is essential for customer satisfaction and customer loyalty. Veysel and Erkan [14] proposed an SEM to analyze the factors affecting the loyalty of passengers traveling by HSR between Eskişehir and Ankara. In the proposed structural model, functional service quality and technical service quality are defined as the exogenous latent variables, and corporate image, customer satisfaction, customer complaint, and customer loyalty are defined as the endogenous latent variables. This study found that Turkish State Railways can increase customer satisfaction and loyalty by improving their service quality and corporate image.

2.2. Review of the Literature on Service Quality, Perceived Value, and Satisfaction of Public Transport. Customer satisfaction, closely related to perceived service quality and value [15–17], is widely regarded as the main driver of consumer loyalty to PT and behavior [18]. Numerous studies [9, 12, 19–22] state that the service quality of PT has a direct and positive correlation with passenger satisfaction. Improving the service quality could lead to higher passenger satisfaction, which could increase the ridership of public transport.

To measure customer satisfaction, indices of the ACSI (American Customer Satisfaction Index) are analyzed, such as perceived value, customer expectation, customer loyalty, and customer complaint. An extensive body of literature on customer satisfaction and service quality of public transport (PT) has been published. Zhu and Wang [23] analyzed how these factors influence bus transport satisfaction in Shanghai, China. de Oña et al. [24] investigated the direct and indirect effects of passengers' judgments about light rail transit service quality and their satisfaction on passengers' behavioral intentions to continue to use public transit. Lierop and El-Geneidy [25] examined the relationships of service quality, user satisfaction, and loyalty in public transit. According to the existing studies, from the passengers' perspective, comfort, facilities, reliability, waiting time, journey time, convenience, travel cost, punctuality, and accessibility have been considered as the main factors that affect the quality of service [26–30].

Some approaches were derived from customer satisfaction surveys to measure passenger satisfaction and determine the correlation between service quality and satisfaction. Factor analysis and regression analysis are widely used [19, 28, 29]. Discrete choice model is also proposed to explore the significant variables which affect the service quality of PT [30–33]. With higher accuracy, SEM combines factor analysis and path analysis to more precisely estimate and validate the causal models. Moreover, SEM permits modeling the relations between observed variables and unobserved variables [34], which remedies the deficiency of traditional multivariate statistical methods. The studies that used the SEM method mainly analyzed service quality and passenger satisfaction in bus transit. Ebolli and Mazzulla [35] explored the impact of bus service quality on global customer satisfaction. Oña JD et al. [6] revealed the factors describing the main characteristics of the service quality of bus transit and found a better fitting model. Githui et al. [26] evaluated how bus service attributes influenced total passenger satisfaction in developing countries.

Compared with traditional research on the customer satisfaction and service quality of PT, the bus transit transfer service of the HSR has its own peculiarity. From the view of service supply, the choice of transfer mode for a passenger at a high-speed railway station is influenced by the service quality of both the transfer process and the target traffic mode. The relationships between customer satisfaction and service quality in both the HSR and PT systems have been researched in past studies [36, 37]. However, few studies have focused on the transfer service between these two modes. To address the gap between HSR and PT in the current literature, the aim of this study is to determine how to perform a scientific

TABLE 1: The latent variables and observed attributes of the structure equation model.

	Latent Variables	Observed Attributes
Exogenous variables	Convenience	V1: Transfer Distance
		V2: Walking Time
	Comfort	V3: Waiting Time
		V4: Cleanliness of the Square
		V5: Queues at the Bus Stop
Safety	V6: Facilities of the Bus Stop	
	V7: Crowding on Board	
	V8: Conflict with Motor Vehicles	
	V9: Conflict with Nonmotorized Vehicles	
Service	V10: Safety Facilities	
	V11: Enquiry Service	
Economy	V12: Reliability of Guidance Marks	
	V13: Clarity of the Bus Stop Board	
	V14: Ticket Price	
	V15: Preferential Policy	
Endogenous variables	Perceived value	V16: Lower price and better economy
		V17: Bus stop close to destination
	Satisfaction	V18: High safety
		V19: Low-carbon emission and alleviating congestion
		V20: Overall satisfaction of the transfer service quality

and reasonable evaluation of the present bus transfer service in a HSR station. In addition, some researchers determine and define the service quality of PT considering the different influence of socioeconomic characteristics and idiosyncrasies of the users and different bus lines [30–33]. Rojo et al. [31] analyzed the most relevant variables affecting interurban bus service quality from the users' viewpoint and measured different groups of users' value. Shaaban and Khalil [27] stated that individual socioeconomic attributes could affect passenger satisfaction, such as gender, age, occupation, income, and marital status. This explicitly shows the necessity to view the traveler population as being composed of heterogeneous groups, which should be individually analyzed.

3. Methodology

3.1. Theoretical Model Framework. To evaluate the performance of the PT transfer system at HSR stations, three main constructs were defined: service quality, customer satisfaction, and perceived value. Five attributes of HSR service quality, namely, convenience, comfort, safety, service, and economy, were selected based on the transfer conditions of the Xi'anbei Railway Station. These 5 latent variables were expressed by 15 specific service attributes perceived by passengers during the transfer process, as shown in Table 1. Convenience is associated with the walking distance and transfer time during the transfer process. Comfort is related to the degree of passenger's comfort of walking square, bus stop, and interior configuration of a bus. Safety includes the integrity of the facilities and the conflict with motor and nonmotorized vehicles. Service is associated with the reliability of the staff, guidance marks, and bus stop boarding.

Economy is represented by ticket price and preferential policy. The latent variable, perceived value, was expressed by 4 observed attributes. As shown in Figure 2, the elliptical boxes and rectangular boxes represent latent variables and observed variables, respectively.

3.2. Causal Path Hypothesis. The meaning of each path is explained in the SEM path diagram assumed by Figure 2, and assumptions are made. Taking the choice of travel mode as an example, people who have a better understanding of the services provided by public transit are more likely to have higher overall satisfaction and continue to use this mode. Customers who are satisfied with the service quality, experience, and perception could recommend this service to others and increase their willingness to revisit [38]. Service quality is defined as the customer acceptance and overall assessment of the provided services, and the customers' perceptions of the quality of service are heterogeneous [39]. Customer satisfaction is a key service quality indicator [40]. Lai and Chen [41] also reported that high-quality service and positive passenger perceptions are essential for high passenger satisfaction. Perceived value is defined as the overall evaluation of the effectiveness of a product or service after balancing the benefits perceived by the customer with the cost of acquiring the product or service. Passengers assessed the PT value by perceiving economic cost, environmental influence, traffic impact, and service environment. Based on these relevant studies, the following hypotheses for the bus transfer service at HSR stations are proposed:

H_1 : service quality has a positive effect on passenger satisfaction.

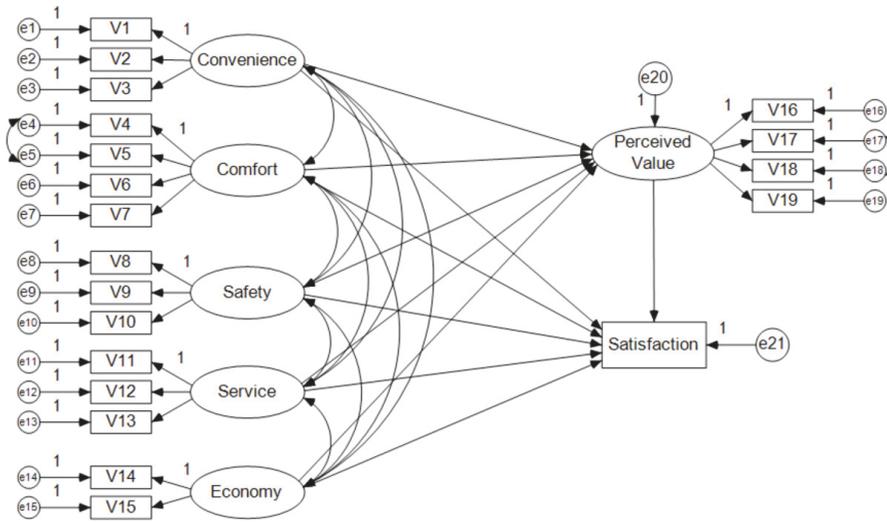


FIGURE 2: Theoretical model framework.

H₂: service quality has a positive effect on passenger perceived value.

H₃: perceived value has a positive effect on passenger satisfaction with the service.

4. Experimental Context

4.1. Data Collection. To verify the theoretical model mentioned in Figure 2, a questionnaire survey was conducted in the Xi'anbei Railway Station to collect empirical data for this study. Xi'anbei Railway Station is the largest railway passenger hub in northwest China. The public traffic hubs locate near the south square of the station as shown in Figure 3. There are 3 bus routes to the east side of the city, 2 routes to the west, 1 route to the north, and 3 bus routes to the south. In addition to walking underground from arrival floor of the station to the ground exits, passengers who are going to transfer to a bus should walk 270 meters through the square and across Yuan Shuo Road. The total time elapsed for a passenger from arrival at the station to the completion of the bus traffic transfer approximately costs 15 minutes or longer for those who have never been to this location before. For passenger, whether or not one chooses the bus transfer depends not only on its low price but also on its safety (mainly referring to crossing the road), convenience (transfer distance or time), comfort (the feeling of the bus stop environment), and information service (the guide service and the bus stop board).

The questionnaire was designed based on an extensive review of related literature to verify the three hypotheses in the theoretical model and was structured into two main sections. The first section gathered detailed information about the passengers, including socioeconomic characteristics (e.g., gender, age, occupation, and monthly income), travel purpose, and the ownership of the bus card. The second section measured the passengers' attitudes and perceptions about the bus transfer services. This section is also divided

into three main subsections (service quality, perceived value, and satisfaction) consistent with the factors defined in Figure 2. All these indicators are measured on a 5-point Likert scale that ranges from 1 (strongly dissatisfied) to 5 (strongly satisfied).

(1) Service quality refers to the passengers' perceptions of approximately 15 service attributes during the transfer process concerning convenience, comfort, safety, service, and economy. This part is a measurement used to quantify the passengers' perception of the transfer service.

(2) Perceived value pertains to the evaluation of the PT value by perceiving the benefits of economic cost, accessibility, safety, and social and environmental protection. This part reflects the passengers' different views on PT development.

(3) Satisfaction collects a global evaluation of the service quality and is an important mediator in the process defined by the theory of planned behavior [42]. The overall satisfaction is defined as a holistic evaluation after a service delivery experience [17, 41].

An on-site survey was conducted at Xi'anbei Railway Station during the 1st to 15th of April in 2017. The daily survey lasted for 14 hours, from 8:00 am to 10:00 pm. Investigators were arranged at each of the bus transfer stations to randomly interview passengers who were planning to transfer by bus during the waiting time. The respondents could basically represent the Xi'anbei Railway Station users. Four hundred questionnaires were distributed, and 291 usable questionnaires were obtained. After deleting incomplete and irrational questionnaire, there was an effective response rate of 72.8%. The sample size is greater than the recommended value of approximately 150-400 [43-48].

4.2. Statistical Analysis. Table 2 shows that the sample is equally spread between females and males. Almost half of the passengers are aged between 21 and 30 years (48.5%), followed by those aged between 31 and 40 (21%). Students (28.9%) and employees (28.2%) constitute more than half of the sample, while employed workers (5.5%), civil servants

TABLE 2: Socioeconomic attributes.

Characteristics	Statistics
(1) Gender	Male (51.5%), female (48.5%)
(2) Age	<=20 (4.1%), 21-30 (48.5%), 31-40 (21.0%), 41-50 (12.7%), 51-60 (8.9%), ≥60 (4.8%)
(3) Occupation	Student (28.9%), employee (28.2%), employed worker (5.5%), civil servant (3.8%), manager (5.2%), educator and researcher (5.8%), service worker (1.4%), self-employed worker (10.3%), pensioner (8.6%), other (2.4%)
(4) Income	<=1000 (25.8%), 1001-2000 (8.6%), 2001-5000 (42.6%), >5000 (23.0%) yuan (RMB)
(5) Purpose of the trip	Return home (23.4%), business (15.8%), studying (15.5%), work (14.8%), tourism (13.4%), shopping (9.3%), visiting friends and relatives (7.9%)
(6) Bus IC card ownership	Does not own a bus card (26.8%), owns a bus card (73.2%)



FIGURE 3: The schematic diagram of Xi'anbei Railway Station.

(3.8%), managers (5.2%), educators and researchers (5.8%), service workers (1.4%), self-employed workers (10.3%), pensioners (8.6%), and others (2.4%) represent the remaining sample (42.9%). Almost half of the passengers have incomes in a class between 2,001 and 5,000 yuan, 23.0% belong to a class of income more than 5,000, and the remaining 34.4% belong to classes characterized by income levels less than 2001 yuan. Concerning the purpose of the trip, 23.4% of the passengers were traveling to return home from other cities, 15.8% for business, 15.5% for studying, and 14.8% for work. Another important group (13.4%) was traveling for tourism. The rest of the sample (17.2%) stated that they were traveling for shopping and visiting friends and relatives. In particular, among all the surveyed passengers, only 26.8% did not have a bus IC (integrated circuit) card and bought a one-way ticket. Most of the sample (73.2%) had a bus card, which is valid throughout the whole city.

Table 3 shows the contents of the second part of the survey, the specific attributes assessed, and the mean and standard deviation for the satisfaction rates. The low values of the standard deviation among the attributes (<1.8) show the similarities of the judgments of the passengers. Concerning the mean of the satisfaction rates, we can see that the most

satisfied service characteristics are linked to all the aspects of information services and economy. It is worth noting that the mean rates of the perceived value nearly reach the “agree” (4) level, which shows the passengers’ positive subjective attitudes toward the bus transfer mode. By observing the mean and standard deviation of the satisfaction attribute, we can easily observe that all passengers considered the transfer experience to be not as satisfying as they expected.

5. Results and Discussion

5.1. Reliability and Validity Analysis. The evaluation of a model usually includes three aspects: parameter test, degree-of-fit test, and interpretation ability evaluation. Using explorative theory, the surveys of customer experience were summarized into some subconstructs (latent variables) such as convenience, comfort, safety, service, and economy, as shown in Table 4.

Before moving to the examination of the theoretical framework in Figure 2, the construct reliability and validity are confirmed first in this section. Cronbach’s alpha was calculated to examine the internal consistency of the items in the survey. An alpha score above 0.5 is considered acceptable,

TABLE 3: The assessed attributes and the mean and standard deviation of the satisfaction rates.

Variables	Service Attributes	Mean	Std. deviation
Service quality	V1: Transfer Distance	3.00	1.462
	V2: Walking Time	2.95	1.246
	V3: Waiting Time	2.92	1.270
	V4: Cleanliness of the Square	3.32	1.771
	V5: Queues at the Bus Stop	3.31	1.601
	V6: Facilities of the Bus Stop	3.32	1.584
	V7: Crowding on Board	3.35	1.539
	V8: Conflict with Motor Vehicles	3.19	1.002
	V9: Conflict with Nonmotorized Vehicles	3.36	0.957
	V10 Safety Facilities	3.25	0.859
	V11: Enquiry Service	3.49	1.389
	V12: Reliability of Guidance Marks	3.57	1.419
	V13: Clarity of the Bus Stop Board	3.52	1.568
	V14: Ticket Price	3.42	1.664
	V15: Preferential Policy	3.38	1.644
Perceived value	V16: Lower price and better economy	3.70	1.708
	V17: Bus stop close to destination	3.82	1.618
	V18: High safety	3.76	1.571
Satisfaction	V19: Low-carbon emission and alleviating congestion	3.80	1.696
	V20: Overall satisfaction of the transfer service quality	3.25	0.839

TABLE 4: Cronbach's alpha scores of the questionnaire.

Latent variables	Observed variables	Cronbach's alpha	Total coefficient
convenience	V1~V3	0.894	0.922
comfort	V4~V7	0.898	
safety	V8~V10	0.883	
service	V11~V13	0.887	
economy	V14~V15	0.851	
perceived value	V16~V19	0.883	
All	19	0.922	

indicating a good construct reliability [47]. Table 4 shows that all Cronbach's alpha scores are above 0.8, which means the questionnaire has high reliability. The reliability of the questionnaire was tested using factor analysis by SPSS19.0.

For the data obtained from the questionnaire survey, it is necessary to analyze its structural validity to test whether the data are suitable for factor analysis. SPSS software was used to perform the exploratory factor analysis of scales, which are KMO and Bartlett's spherical inspection. When the value of KMO is greater than 0.7 and the value of Bartlett's spherical inspection is significant (sig. <0.001), the survey data satisfy the prerequisites for factor analysis [48]. Meanwhile, the factor loading values of the latent variables are all greater than 0.5, indicating that each latent variable can be better explained by the selected observation variable. The results of the KMO test in this paper are shown in Table 5. The value of KMO is greater than 0.8, and Bartlett's spherical inspection shows significance. Besides, the factor loading values in the model shown in Figure 4 are greater than 0.7. Therefore, the survey data has a higher structural validity.

TABLE 5: KMO and Bartlett's spherical inspection.

Statistics	Value
Kaiser-Meyer-Olkin (KMO)	0.885
Bartlett's spherical inspection (sig.)	0.000

5.2. Structural Equation Modeling. The SEM methodology is applied in this research to identify which aspects of the service most influence the users when they decide to use the service. In the proposed model, five latent exogenous variables, namely, convenience, comfort, safety, services, and economy, were introduced, together with two latent endogenous variables, namely, perceived value and satisfaction; the latent variables are linked to 19 observed variables, as represented in Table 2. The relationships of convenience, comfort, safety, services, economy, perceived value, and satisfaction were empirically tested using AMOS 17.0. All analyses were based on the correlation matrix of the indicators of interest. AMOS estimates the path coefficient based on the variance and covariance of the indicator.

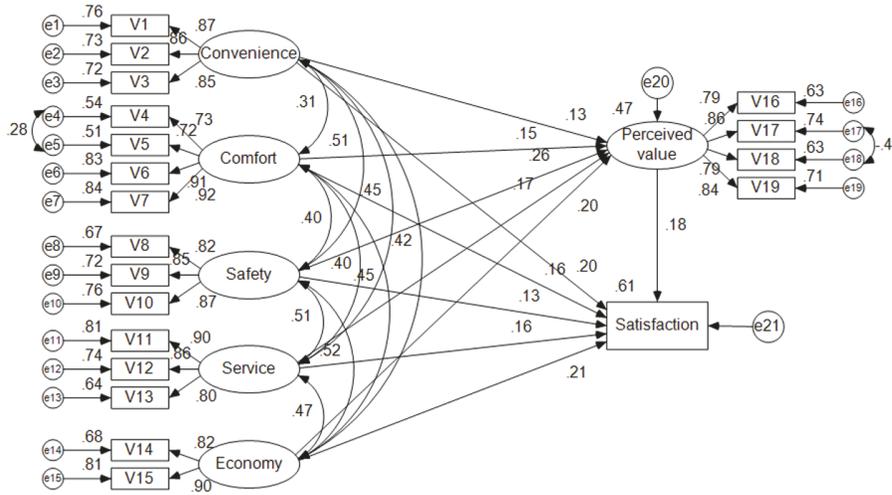


FIGURE 4: Results of the transit transfer satisfaction model.

TABLE 6: Goodness-of-fit test of the modified model.

Goodness-of-fit index	Index value	Goodness-of-fit standard
DF	148	/
GFI	0.931	>0.90
RMSEA	0.040	<0.080
NFI	0.947	>0.90
CFI	0.982	>0.90

The model fit was determined according to the guidelines and acceptable threshold levels suggested by Hooper et al. [46]. The descriptive fit statistics and their recommended values for this model are displayed in Table 6. Five indices are used to estimate the model fit, namely, the ratio of the chi-square value to degrees of freedom (DF), goodness-of-fit index (GFI), root mean square error of approximation (RMSEA), normed fit index (NFI), and the comparative fit index (CFI). A GFI, an NFI, an RFI, and a CFI above 0.90 (acceptance levels) indicate a close fit of the model to the data collected. Moreover, an RMSEA less than 0.08 also indicates a good fit [49].

5.2.1. Measured Model. Concerning the measured model, all the regression coefficients are reasonably high and have a high statistical significance. Some interesting results can be drawn from these coefficients. The latent variable of convenience is better explained by “Transfer distance” (0.87), “Walking time” (0.86), and “Waiting time” (0.85). The variable of comfort is best understood by the “Crowding on Board” (0.92). For economy, the strongest relationship is found with “Preferential policy” (0.90). The endogenous latent variable of perceived value is well described by the four observed variables, which obtained high values for the factor loadings.

5.2.2. Structural Model. The proposed hypothesized relationships between service quality, perceived value, and overall satisfaction are examined by maximum-likelihood-estimation

procedures. Figure 4 depicts the results of the estimated structural model.

There are some clear results according to the relationships between the seven latent variables in Table 7. Five exogenous latent variables, which indicate the passengers’ perception of the bus transfer service, have significant positive effects on both perceived value and satisfaction ($\beta > 0, P < 0.05$) [16]. This means that a high-quality public bus transfer service in Xi’anbei Railway Station will stimulate high satisfaction and promote a better understanding of public traffic value. Therefore, it is important to promote the passengers’ final use behavior by improving the service quality of PT to improve the evaluated attitude toward PT. For example, the provision of more information on bus routes and bus schedules could improve passengers’ perception of the PT service and further promote their choice behavior [50]. In addition, the added information helps planners provide more interactive services [51].

Perceived value has a significant positive effect on satisfaction. As expected, this implies that when passengers highly approve of the advantages of PT, they tend to feel more satisfied with the transfer service. Among the observed variables of perceived value, the most important variable is “Bus stop close to destination” (0.74) and the second most important is “Low-carbon emission and alleviating congestion” (0.71). The most interesting finding is that passengers care for not only their own travel benefits but also the social benefits. From the perspective of policy and management, it is quite necessary to increase the density of bus stops, improve the guidance information, and recognize the significant contribution of public traffic to sustainable development.

In this case, the strength of the relationship between the latent exogenous variables and satisfaction is very different. The exogenous latent variable that has the highest positive effect on perceived value is safety, with a standard regression weight value of 0.255. This means that when other factors remain constant, a one-unit increase in safety results in a

TABLE 7: Calculation results of the structural model.

Path	Non-standardized regression coefficient (B)	Standardized regression coefficient (β)	Standard Error (S.E.)	C.R. (t-value)	P value	Squared Multiple Correlation (SMC)
Perceived value <- - Convenience	0.131	0.134	0.062	2.128	0.033*	0.469
Perceived value <- - Comfort	0.156	0.148	0.062	2.502	0.012*	
Perceived value <- - Safety	0.321	0.255	0.090	3.563	* * *	
Perceived value <- - Service	0.168	0.172	0.064	2.630	0.009**	
Perceived value <- - Economy	0.192	0.197	0.067	2.874	0.004**	
Satisfaction <- - Perceived value	0.163	0.184	0.051	3.210	0.001**	0.606
Satisfaction <- - Convenience	0.173	0.199	0.045	3.866	* * *	
Satisfaction <- - Comfort	0.147	0.157	0.045	3.230	0.001**	
Satisfaction <- - Safety	0.143	0.128	0.066	2.175	0.030*	
Satisfaction <- - Service	0.141	0.163	0.046	3.047	0.002**	
Satisfaction <- - Economy	0.185	0.214	0.049	3.780	* * *	

Note: * * * is significant at $P < 0.001$ level, $|t| > 3.29$; ** is significant at $P < 0.01$ level, $2.57 < |t| < 3.29$; * is significant at $P < 0.05$ level, $1.96 < |t| < 2.57$.

TABLE 8: Effects of the passengers' socioeconomic attributes on their rating.

	Convenience	Comfort	Safety	Service	Economy	Perceived value	Satisfaction
Gender	—	—	—	—	—	—	0.042*
Age	0.014*	* * *	0.048*	0.008**	—	0.012*	* * *
Occupation	0.026*	0.001**	* * *	0.002**	0.001**	* * *	* * *
Income	0.034*	—	* * *	0.011*	—	* * *	0.010*
Transfer purpose	—	0.002**	0.001**	0.001**	0.005**	* * *	* * *
Bus IC card Ownership	—	—	0.048*	0.026*	0.029*	0.001**	0.013*

Note: * * * is significant at $P < 0.001$; ** is significant at $P < 0.01$; * is significant at $P < 0.05$.

0.255-unit increase in perceived value. Considering satisfaction, the two highest standard regression weight values of the exogenous latent variables are economy and convenience, with the values of 0.214 and 0.199, respectively.

5.3. *The Influence of Socioeconomic Attributes on the Constructs.* Passenger satisfaction is affected by various service attributes, and different groups of passengers have different needs and expectations. Another important point of this work is to understand how passengers' socioeconomic attributes influence the rating of each aspect of the transfer service, which is represented by the average score of the observed variables. One-way analysis of variance was calibrated by using SPSS19.0, in which the socioeconomic attributes are considered as impact factors, while the convenience, comfort, safety, service, economy, perceived value, and satisfaction are considered dependent variables. As reported in Table 8, the results show that gender has an effect only on overall satisfaction and that female passengers are more sensitive to the bus transfer experience. Different age groups have homogeneous opinions on the economic attributes but have significant heterogeneous opinions on other service attributes. Older passengers feel more dissatisfied with convenience and service. This may be because, for the older passengers, long

transfer distances and long waiting times are the most intolerable aspects, and they cannot clearly recognize the guidance signs. Passengers with high income are more critical to the service quality. Considering the transfer purpose, passengers who travel for tourism, shopping, and visiting friends and relatives have good impressions of the transfer experience. These intragroup variations provide valuable implications for planners and managers, which signifies that the importance of "customization" should be a primary focus [42].

6. Conclusion

As mentioned above, the rapid development of the HSR has been ongoing in China and numerous HSR stations are under or planned for construction. Measuring the quality of the bus transfer service is currently one of the most important aspects for both the companies that provide these services and for the supervisory public administration.

The bus transfer at the HSR station works as a bridge that connects inner- and intercity traffic. The level of service quality of the bus transfer can greatly affect both the efficiency of the HSR and the PT competitiveness. However, there are few practical applications in measuring the services of the transfer experience from the high-speed railway station to

a nearby bus stop. A structural equation model (SEM) was chosen to describe the complex phenomenon of passenger perception of the bus transfer service at high-speed railway stations. A refined model was proposed to identify public satisfaction factors. Based on the data of 291 valid questionnaires at Xi'anbei Railway Station, the results provide valuable information for understanding which aspects of the service are influencing passengers the most when they are using the service. This information can help transport managers to prepare new strategies and investment plans in order to continually improve the quality perceived by passengers and, consequently, the use of the system. Some conclusions can be drawn from this research.

- (1) The managers should improve the service by focusing on the convenience and economy aspects because these were considered as the most important to the users and considerably increased the overall satisfaction of the users, for example, for promoting convenience, adopting multidimensional traffic organization to realize station transfer to shorten the passengers' transfer distance, and coordinating the schedules of bus dispatching and high railway arriving to reduce waiting time. For economy aspect, flexible and diverse ticketing system can stimulate more users to choose public transit.
- (2) It is noteworthy that increasing public awareness of the benefits of PT on environmental protection and congestion mitigation can improve the perceived value. As Bamberg and Möser [52] and Spears et al. [53] stated, passengers could be encouraged by some "soft" measures, such as advertising and celebrity endorsements.
- (3) Another important point of this work is to understand the perception discrepancy among different questionnaire categories, such as gender, age, and occupation. This is useful for managers to understand the more specific requirements of different passengers. For instance, as the bus stations are some distance from the exit gate of the high-speed railway station, offering clearer transfer information and improving the guidance signs for the elderly who are unable to use smartphones for navigation will improve their transfer efficiency.

Therefore, the main findings that emerged from this research highlight the appropriateness of this methodology to evaluate the performance of the PT transfer system in high-speed railway stations. The results of the relationships between service quality, perceived value, and satisfaction suggest important implications for the Xi'anbei Railway Station in its efforts to prioritize the important service attributes and ensure its service quality meets or exceeds passenger expectations. On the subject of railway network expansion, the proposed framework can be used as an improvement program for other similar railway services.

In spite of these contributions, this study has some limitations that call for further investigation. Although the differences in the satisfaction and service quality attributes

among subgroups under different categories have been discussed, due to the limited data volume (the amount of data in each group after dividing the groups was less than the threshold value), it is not possible to have a detailed and in-depth discussion of the differences in the specific influence methods and degrees within each group, such as in those studies by X. Fu and Z. Juan Transportation Research Part A 103 (2017) 70-82 and Chou 2017. Moreover, Bordagaray et al. (2014) [34] stated that heterogeneity is clearly present in the perception of service quality, due to the socioeconomic and journey characteristics. Therefore, the quality perceived in different bus lines should be analyzed separately.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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