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An Empirical Analysis of the Relationship Among the Service Quality, Customer Satisfaction and Loyalty of High Speed Railway Based on Strctural Equation Model

UNE ANALYSE EMPIRIQUE DE LA RELATION ENTRE LA QUALITE DES SERVICES, LA SACTIFACTION DU CLIENT ET LA FIDELISATION DE LA LIGNE A GRANDE VITESSE

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Abstract

China has longest mileage of high speed railway in the world, and high speed railway has been one of the main traffic travel choices of Chinese people. This paper analyzes the relationship among the service quality, customer satisfaction and loyalty degree of high speed railway by adopting the structural equation model as analytical method with the high speed railway from Shanghai to Nanjing as case study. This paper firstly establishes the model of customer satisfaction on the high speed railway, and develops the measurement table of the customer satisfaction. The research results manifest: the reliability and validity of the survey data about the model of the customer satisfaction on the high speed railway have been tested and verified. As to the hypothesis, except the hypothesis "from customer satisfaction to loyalty degree" and "from customer complaints to loyalty degree", others have been well tested and verified. The results show that the service quality of the high speed railway has the greatest influence on the company image, and it has direct and positive influence on the customer satisfaction. The image of the high speed railway company has direct and positive influence on the customer satisfaction, and it has indirect influence on the customer complaints and loyalty degree. The customer satisfaction on the high speed railway has indirect influence on the customer loyalty degree, and it has direct influence on the customer complaints. The customer complaints will not greatly influence the customer loyalty degree.

Key words: Structural equation model; Intercity high speed railway; Service quality; Customer satisfaction; Customer loyalty

Résumé

La Chine a la plus longue de kilométrage de voies ferrées à grande vitesse dans le monde, et la voie ferrée à grande vitesse a été l'un des principaux choix de voyage de la circulation du peuple chinois. Cet article analyse la relation entre la satisfaction des clients un service de qualité, et le degré de fidélisation de la grande vitesse ferroviaire en adoptant le modèle d'équation structurelle que méthode d'analyse avec la voie ferrée à grande vitesse entre Shanghai et Nanjing comme étude de cas. Ce document établit tout d'abord le modèle de la satisfaction du client sur la voie ferrée à grande vitesse, et développe la table de mesure de la satisfaction client. Le manifeste de résultats de recherche: la fiabilité et la validité des données d'une enquête sur le modèle de la satisfaction client sur le chemin de fer à grande vitesse ont été testées et vérifiées. Quant à l'hypothèse, à l'exception de l'hypothèse «de la satisfaction du client au degré de loyauté" et "de plaintes de clients au degré de loyauté», d'autres ont été bien testés et vérifiés. Les résultats montrent que la qualité de service de la voie ferrée à grande vitesse a le plus d'influence sur l'image de l'entreprise, et elle a une influence directe et positive sur la satisfaction du client. L'image de la compagnie ferroviaire à grande vitesse a une influence directe et positive sur la satisfaction du client, et il a une influence indirecte sur les plaintes des clients et le degré de loyauté. La satisfaction du client sur la voie ferrée à grande vitesse a une influence indirecte sur le degré de fidélisation des clients, et elle a une influence directe sur les plaintes des clients. Les plaintes des clients ne sera pas une grande influence sur le degré de fidélisation.

Mots clés: Modèle du structurelle d'équation; L'Interville ferroviaire à grande vitesse; La qualité de service; La satisfaction des clients; La fidélisation de la clientèle

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INTRODUCTION

According to the definition made by UIC (Union Internationale des chemins der fer), the high speed railway refers to the railway system including the lines with the speed of over 200km per hour changed from the original ones by linearization and gauge standardization, as well as the new high speed lines specially built with the speed of over 250km per hour. The first high speed railway is the Shinkansen in Japan which formally started to operate in 1964. After that, France, Italy and Germany built the high speed railway one after another. France built the south-east TGV (Train à Grande Vitesse) and the Atlantic TGV. Italy built the high speed railway from Roman to Florence.

In 2008, China built the first high speed railway with the speed over 300 kilometers—the intercity high speed railway from Beijing to Tianjin. In 2009, China built the longest railway with the highest speed in the world—the special line for passenger transport from Wuhan to Guangzhou.To November 2010, China has built the high speed railways from Beijing to Tianjin, from Shijiazhuang to Taiyuan, from Wenzhou to Fuzhou, from Wuhan to Guangzhou, from Zhenzhou to Xi'an, from Fuzhou to Xiamen, from Chengdu to Dujiang Dam, from Shanghai to Nanjing, from Nanchang to Jiujiang, and from Shanghai to Hangzhou. China has the high speed railway system which is fastest with the overall techniques, strong integration capabilities, longest distance, and biggest construction scale.

The high speed railway is fast with the advantage of good security, strong transport capacity, low energy consumption, and few influences on the environment. It has become the one of the main transport ways for long distance passenger transport. The railways in China develop quickly, and China has the longest operation line in the world. However, there are some problems about the high speed railway: the ticket is too expensive, the contact line is not ideal. The service quality of the high speed railway influences the customer satisfaction and loyalty degree. This paper analyzes the relationship among the service quality, customer satisfaction and loyalty based on the structural equation model.

1. LITERATURE REVIEW AND HYPOTHESIS

For a long time, the scholars at home and abroad have deeply researched the relationship among the service quality, customer satisfaction and loyalty. The service quality is a kind of general experience that the customers' feeling for the service provided by the enterprises. Parasuraman, Zeithaml and Berry measure the customers' feeling for service quality from five aspects: reliability, responsiveness, assurance, empathic, tangibility.

Gronroos proposes the model of perceived service quality which includes function quality and technique quality. The former can be reflected in the worker's attitude to the customers and the environmental equipment, and the latter includes management quality and service procedure.

Oliver regards the customer satisfaction as a kind of emotional reflection for special trade. It depends on the fulfillment degree of the expected product or service benefits, as well as the consistency degree of the expectation and the actual result.

The customer satisfaction is a kind of feeling that whether the product or service has met or surpassed the expectation. It is the gap functions between the customer conception for the service level and the expected service level. Generally speaking, the customer satisfaction is related to the quality of products and service, and the customer loyalty is related to the satisfaction, but satisfaction does not result in loyalty. The literature indicates that there is close relationship among the service quality, customer satisfaction and customer loyalty degree. However, in the service industry, especially in the service industry of traffic transportation, the relationship needs to be confirmed. Olsen analyzes the relationship among the service quality, customer satisfaction and the purchase loyalty. Liu and Zhao take Chinese insurance industry for instance, and analyzes the relationship among the customer perception for quality, values, satisfaction , and loyalty degree. They state that the customer perception for quality and value has direct and positive impact on the satisfaction. And then customer satisfaction influences the customer trust degree and loyalty degree. Jui-Sheng Chou and Changwan Kim analyze the service quality, customer satisfaction and loyalty degree with the high speed railway in Taiwan and South Korea as example. They proclaim that the corporate image of Taiwan High Speed Railway Company has stronger influence on the customers than South Korea High Speed Railway Company. The complaints from the customers of Taiwan High Speed Railway have positive influence on the customer loyalty degree, but in South Korea, it was just the opposite. The service qualities of the high speed railway in Taiwan and South Korea have positive and direct influence on the customer satisfaction. In order to scientifically analyze the relationship among the service quality, the customer satisfaction and the customer loyalty degree, this paper

learns from the research results mentioned above and proposes the hypothesis as follows:

Hypothesis 1: the service quality of the high speed railway has direct and positive influence on the company's image.

Hypothesis 2: the service quality of the high speed railway has direct and positive influence on the customer satisfaction degree.

Many scholars have researched the influence on the customer satisfaction and loyalty degree made by the company image of the high speed railway. Hsu and S.-H state that the company image has positive influence on the customer satisfaction and loyalty degree. For the sake of obtaining good image, the high speed railway company has to try the best to improve its product and service quality, which will enhance the customer satisfaction and loyalty degree. Therefore, the better image will be formed in the customer heart. The hypothesis can be made as follows:

Hypothesis 3: the company image of the high speed railway has direct and positive influence on the customer satisfaction.

With the deep research of the loyalty theory, many scholars start to research the relationship between the customer satisfaction and some kind of the customer loyalty degree. The Dutch scholar Ko de Ruyter and the Belgian Scholar Josee Bloemer announce that the customer satisfaction is highly related to the customer loyalty degree. Chinese scholar Wang Chunxiao and Han Xiaoyun research five kinds of service industry and the results indicate: the customer satisfaction is an important factor that influences the customer loyalty degree. The customer satisfaction in different industries have different influences on the customer loyalty degree. The customer complaint is the external expression of the customer dissatisfaction for the product and service. According to the ACSI model, the complaints is the result of the customer dissatisfaction and the customer satisfaction can decrease the complaints to a large extent. Based on the above reasons, in the operation of the high speed railway company, the customer complaints should be focused on. The hypothesis can be proposed as follows:

Hypothesis 4: the higher satisfaction has direct and positive influence on the customer complaints.

Hypothesis 5: the customer satisfaction rate has direct and positive influence on the customer loyalty degree.

Hypothesis 6: the customer complaint is closely related to the customer loyalty degree.

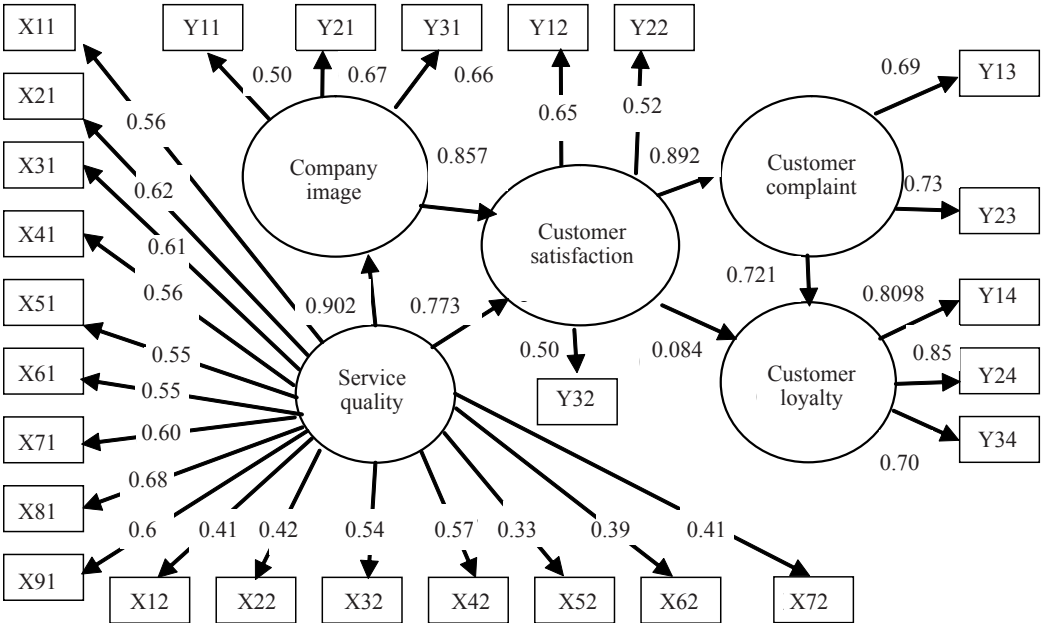

Figure 1
Structural Equation Model of Customer Satisfaction of High Speed Railway

2. METHODOLOGY AND DESIGN

2.1 Methodology

The structural equation Model is proposed by the Sweden statisticians Karl Joreskog and Dag Sorbom in the late 1960s, and it is reformed and improved step by step. It includes ANOVA (analysis of variance) and analysis of regression, path analysis and factor analysis. It compensates the weakness of the traditional analysis of regression and factor analysis, which can analyze the relationship between the many reasons and results, as well as the relationship among the variables that cannot be directly measured. In the structural equation model, as to the questions researched, the variables that cannot be

directly measured are marked as latent variables or hidden variables. The variables that can be directly measured are marked as observed variables or manifest variables. As a linear statistical model, the structural equation model usually adopts matrix form to signify the relationship among the variables. At the same time, in order to make the conception and correcting of the model as well as expressing of the model's meaning convenient, the method of path model in path analysis is adopted to signify.

The structural equation model includes measurement model and structural model. According to the measurement model, the relationship between the observed index and the latent variable can be known. According to the structural model, the relationship among the latent variables can be known.

The AMOS software constructs the fitting function of Model Estimation covariance and sample covariance by estimating the model parameter with the method of maximum likelihood. Then, it gets the parameter estimation which can make the fitting function best by iteration.

2.2 The Establishment of the Structural Equation Model on the Customer Satisfaction of the High Speed Railway

According to the above analysis, this paper proposes the evaluation models of the customer satisfaction of the high speed railway combining with the features of Chinese high speed railway passengers and the practice of the high speed railway company after learning the research results and experiences at home and abroad. This model includes five structure variables: the service quality of high speed railway, company image, customer satisfaction, customer complaint, customer loyalty. Every structure variable is measured by the variables of different amounts. The structural relationship model is shown in the figure 1.

Table 1
Parameter Estimation Results for Factor Loader of Measurement Model

latent variable	factor	measured variables	nonstandard factor loader	Standard factor loader
ξservice quality	riding safety	X11 safety	1.29	0.56
		X21 driving behavior	1.36	0.60
	access convenience	X31 station site	1.68	0.65
		X41 from the departure place to the station	1.73	0.63
		X51 from station to destination	1.59	0.61
		X61 information and communication technologies	1.59	0.57
		X71 information availability	1.45	0.60
	service responses	X81 response time of complaint channel	1.91	0.67
		X91 the steward's ability to handle problems	1.39	0.57
	tangible facilities	X12 facilities are neat and clean	0.98	0.55
		X22 the passenger's space in the train	1	0.52
		X32 the design of the waiting space	1.38	0.53
		X42 arrangement of moving route	1.33	0.56
	riding comfort	X52 air-conditioning interior	0.97	0.48
		X62stability of operation	1.01	0.52
		X72 comfortableness of operation	1	0.54
η1 company image		Y11 punctuality of the train	1	0.52
		Y21 the public praise for the high speed railway company	1.23	0.67
		Y31 the satisfaction for the passengers' requirements	1.39	0.69
η2 customer satisfaction		Y12 the customer general feeling	1	0.65
		Y22 whether the ticket price is reasonable	1.26	0.56
		Y32 the stability of the ticket distributor	1.08	0.64
η3 customer complaint		Y13 the frequency of the customer complaints	1	0.70
		Y23 whether the complaints can be handled in time	1.11	0.73
η4 customer loyalty		Y14 Re-riding willingness	1	0.79
		Y24 recommend to other people	1.09	0.86
		Y3 will take again if the service quality is improved	0.83	0.70

2.3 The Research Design

In order to verify the research model and hypothesis, this paper designs the concrete question items for researching the variables, combining with the exposition of the concepts and the operational definition of the measured variables. It adopts the five scores scale made by Likert to record the respondents' assessment attitudes from "absolutely agree" to "totally disagree". The research takes the passengers on the high speed railway from Shanghai to Nanjing as the research objects. In order to make the samples close to the actual situations, the investigation is made twice. The first one is made in the middle of August. 200 questionnaires were sent in Nanjing, Suzhou, Kunshan and Shanghai. 161 questionnaires of the ones that received back were effective. The second investigation was made in the middle of September. 300 questionnaires were sent in Shanghai, Nanjing and Suzhou. 225 questionnaires of the ones that received back were effective. The general effectiveness rate is 77.2%.

According to the first table, the number of the observed

variables can be obtained by adapting the observed variables into the questions on the questionnaire and using the passengers' answers.

3. DATA ANALYSIS

3.1 Reliability Analysis

In order to ensure the effectiveness of the assessment and hypothesis inspection for the fitting degree of the model, it is necessary to make the reliability analysis on the potential variables. The paper adopts the SPSS18.0 software and the Gronbach's Alpha to make the internal consistency inspection. In most cases, if the Alpha coefficient is above 0.8, it can be regarded that the questionnaire has high internal consistency. After calculating, the Alpha coefficient of the 27 observed variables of the total scale is 0.917 which is above 0.8, so the result of the scale is reliable.

3.2 Validity Analysis

In order to verify and evaluate the overall validity of the questionnaire, firstly we need to assess what contents can be the theoretical basis of the questionnaire. This research takes the literature at home and abroad as reference and uses the method of interview to ensure the validity of the questionnaire. The scale is pretested for many times, and the choices which don't meet the requirements are adjusted, so the validity of the contents is good. After preliminarily handling the structural model, we can handle the nonstandard factor loader and the standard factor loader. Most of the factor loader is above 0.5, and the lowest one is 0.48, while the highest one is 0.86. It can be concluded that the structural validity is good.

3.3 The Analysis of the Index Assessment and the Fitness Degree

After preliminarily estimating the structural model of the customer satisfaction of the high speed railway, the goodness-of-fit indices can be obtained (shown in the second table).

X^2 = 981.533(p = 0.000), DF = 318; CMIN/DF = 3.087; RMSEA = 0.074; GFI = 0.821; AGFI = 0.788; CFI = 0.825.

According to the preliminary calculation, the benign fit indices of the structural equation model of the customer satisfaction , as well as the benign fit indices after adjustment and the comparative fit indices are all smaller than 0.9. CMIN/DF is bigger than 3, which does not reach the appropriate standard and needs to be adjusted. Owning to the value for different thickness among some of the errors is too big, we need to correct it and establish their relationship of co-variation. Then the CMIN/DF can be decreased and the fitness index can be increased.

3.4 Model Modification

3.4.1 The Modification of the Goodness-of-fit Indices of the Model

Among the error terms, the covariant relationship is established by using arrows going back and forth respectively. The new fitness value can be obtained as follows: X^2 = 420.71(p = 0.000), DF = 291; CMIN/DF = 1.446;RMSEA = 0.034; GFI = 0.925; AGFI = 0.902; CFI= 0.966, After modification, the index parameters have reached the standard of model goodness-of-fit.

3.4.2 The Testing and Analyzing of the Hypothesis

After further analysis, the regression coefficient among the five potential variables (the service quality, company image, customer satisfaction, customer complaints and loyalty degree) and the measured variables is shown in the first figure. The path coefficient among the five structural variables is shown in the third table.

In the path coefficient, service quality has direct positive influence on the company image. It is the same to the influence from the service quality to the customer satisfaction degree, the company image to the customer satisfaction, which confirms to the hypothesis. The customer satisfaction has direct and negative influence on the customer complaints, that is to say, the customer satisfaction will decrease the customer complaints. The customer satisfaction has positive influence on the customer loyalty degree, but the influence index is small. In other words, the customer satisfaction will not result in the customer loyalty, which is not consistent with the hypothesis. The customer complaints have positive influence on the customer loyalty, which is not consistent with the hypothesis. That is to say, the customer complaints may not result in the customer disloyalty.

Table 2
Estimated Result of Goodness-of-fit Indices

	standards of goodness-of-fit	testing results	goodness-of-fit of the model
X^2	the smaller the better,but to the bigger sample, the value will be bigger	981.533	no
CMIN/DF	1-3	3.087	no
RMSEA	0.05-0.08	0.074	yes
GFI	>0.9	0.821	no
AGFI	>0.9	0.788	no
CFI	>0.9	0.825	no

Table 3
Path Coefficient Estimates for Customer Satisfaction Structural Model of High Speed Railway

path relationship(hypothesis)	path name	direction	standard coefficient	path result
service quality- company image	ξ - η1	positive	0.902	support
service quality - customer satisfaction	ξ - η2	positive	0.773	support
company image - customer satisfaction	η1 - η2	positive	0.857	support
customer satisfaction – customer complaint	η2 - η3	negative	0.892	support
customer satisfaction - loyalty degree	η2 - η4	positive	0.084	nonsupport
customer complaints - loyalty degree	η3 - η4	negative	0.721	nonsupport

Table 4
Direct, Indirect, and Total Effects Between the Latent Variables for Customer Satisfaction Model of High Speed Railway

	service quality	company image	customer satisfaction	customer complaints	customer loyalty
service quality					
company image					
direct effect	0.902				
indirect effect	0.000				
general effect	0.902				
customer satisfaction					
direct effect	0.773	0.857			
indirect effect	0.023	0.000			
general effect	0.796	0.857			
customer complaints					
direct effect	0.000	0.000	0.892		
indirect effect	0.710	0.765	0.000		
general effect	0.710	0.765	0.892		
customer loyalty					
direct effect	0.000	0.000	0.084	0.721	
indirect effect	0.579	0.624	0.644	0.000	
general effect	0.579	0.624	0.728	0.721	

4.4.3 The General Effect Analysis of the Relationship Among the Potential Variables

There is direct or indirect effect among the five potential variables of the structural model of the customer satisfaction on the high speed railway. Comprehensively, it is general effect influence. The related coefficient matrix among the five potential variables is shown in table 4. The service quality of the high speed railway has direct and positive effects on the company's image. It is the same from the company's image to the customer satisfaction, and the service quality to the customer satisfaction. The customer satisfaction has direct and negative influence on the customer complaints. There is indirect effect from the service quality to the customer loyalty, the service quality to the customer complaints, the company image to the customer complaints, and the customer satisfaction to the customer loyalty degree. The satisfaction of the customers on the high speed railway may not directly result in the loyalty, but it will have indirect effect. Unexpectedly, the direct effect of the customer complaints can directly result in the customer loyalty, which is totally inconsistent with the theories. Chinese High Speed Railway Company is a state monopoly company, so even though the customers have complaints, they have no better choices. Then it results in the loyalty to a certain extent. Although the loyalty is inconsistent with the common sense, it reflects the limitation of the customers' choices.

CONCLUSION

This paper adopts the method of structural equation model to establish the assessment model about the service quality, the customer satisfaction and loyalty degree of high speed railway. We can get the conclusions as follows:

(1) According to the analysis of SEM, the validity of the model of the customer satisfaction on the high speed railway is approved. The measurement tables in this research, as well as the validity and reliability of the main factors that influence the service quality, customer satisfaction and loyalty have been empirical tested, which are reliable. From the aspect of hypothesis testing, except the influence from the customer satisfaction to loyalty degree and from the customer complaints to loyalty degree, the others have been well tested.

(2) The structural equation model of the customer satisfaction on the high speed railway manifests: the service quality is closely related to the customer satisfaction and loyalty degree. The service quality has the greatest influence on the company image. At the same time, it has the direct and positive influence on customer satisfaction. The service quality has indirect influence on the customer complaints and loyalty. The high service quality can increase the customer loyalty degree. On the contrary, it will increase the customer complaints. The high speed railway company can improve its service

quality by strengthening the management and standard service procedure, as well as improving the attitude to the customers. Finally, it can promote the company image, the customer satisfaction degree and loyalty of the high speed railway, and then the customer complaints are decreased.

(3) The company image of the high speed railway company has direct and positive influence on the customer satisfaction. With the development of the hardware condition on the high speed railway and the enhancement of the service, the company image has been promoted to a large extent. Therefore, the customer satisfaction increases. The company image of the high speed railway has direct influence on the customer complaints and loyalty. The traditional railway company is a monopolized state-owned enterprise, so it is needed for the high speed railway company to focus on the functions of company image and form positive and honest company image.

(4) The customer satisfaction on high speed railway will not directly result in the customer loyalty, but it has indirect influence. Meanwhile, the customer satisfaction has direct influence on the customer complaints. The improvement of the customer satisfaction will directly lead in the decreasing of the customer complaints. If the high speed railway company can handle the customer complaints quickly and effectively and make the service procedure standard, the customer complaints can be decreased while the customer satisfaction will be increased.

(5) The customer complaints of the high speed railway have direct and positive influence on the customer loyalty, which is inconsistent with the theories. The Chinese high speed railway company is a state-owned enterprise, so the customers have few choices. Even though they have complaints on the price of high speed railway tickets, they have to choose high speed railway as the main vehicle.

This paper takes the relationship among the service quality, customer satisfaction and loyalty degree of the high speed railway from Shanghai to Nanjing as case study. There is some limitation on the regions of research and the objects of investigation. It is needed to further demonstrate the relationship among the service quality, customer satisfaction and loyalty degree of the high speed railway in other regions. With the line linking of the high speed railway from Beijing to Shanghai, Beijing to Guangzhou, the high speed railway will have profound influence on the long distance transportation pattern and the travelling space structure. It is also the following research of this paper.

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