Transport Policy 46 (2016) 20–31

Contents lists available at ScienceDirect

Transport Policy

journal homepage: www.elsevier.com/locate/tranpol

Passenger satisfaction evaluation model for Urban rail transit: A structural equation modeling based on partial least squares

Weiwei Shen [a], Weizhou Xiao [a,*], Xin Wang [b]

[a] School of Urban Rail Transportation, Soochow University, Suzhou 215137, Jiangsu Province, China
[b] University of Tennessee, Knoxville, TN 37996, USA

ARTICLE INFO

Article history:
Received 19 March 2015
Received in revised form
10 September 2015
Accepted 28 October 2015
Available online 21 November 2015

Keywords:
Rail transit
Passenger satisfaction
Evaluation indicator system
Partial least square method
Structural equation modeling

ABSTRACT

The rail transit has played an important role in economic vitality of the urban area. Providing services with high levels of quality is essential in order to promote public transportation by customizing the users of the services, and to reduce traffic congestion by shifting people away from private car use. For this reason, it is essential to understand passenger satisfaction with urban rail transit from a quantitative and systematic perspective. This paper borrows the fundamental concept of the American Customer Satisfaction Index (ACSI) model to establish a passenger satisfaction evaluation model for urban rail transit in China. A structural equation modeling (SEM) method and its parameter estimation method: Partial Least Squares (PLS), are applied to estimate the proposed model. An evaluation indicator system including three levels of indicators is established to measure passengers' satisfaction on the services offered by the rail transit operation companies. The satisfaction index is obtained to quantize the degree of passenger satisfaction. The IPA matrix is used as an assist tool to show the advantages and disadvantages of the services of rail transit. Suzhou rail transit line 1 was used as a case study, four models with different latent constructs or estimation methods were built and compared, to demonstrate the proposed PSI model based on PLS estimation method was reliable and the sign and magnitude of parameters were reasonable. The causality between passenger satisfaction and its influence factors were confirmed by path coefficients of the model.

1. Introduction

The expanding economy has transformed and reshaped the urban landscapes of many Chinese cities, while it also challenges the urban transport systems. As an emerging tier-2 city, Suzhou (50 miles west of Shanghai), has its population increased from 3.37 million in 2004 to roughly 5.1 million in 2014 (this is 50% increase within ten years). Meanwhile the deterioration of urban transportation and air quality are following the expanding economy. The share of private automobile in transportation mode has increased from 6% to 23% in past decade, which contributes to severe confliction between motorized and non-motorized transportation, transportation social equity issues as well as heavy air pollution. To deal with these problems, the rail transit has been adopted by Suzhou to provide reliable, efficient, spatial-economic, and environmental friendly service to urban passengers. The first rail transit line in city of Suzhou began operation in 2012 and the second line began operation in Dec 2013, with other five lines planned to be completed before 2020. The ridership of rail transit line 1 has doubled within two years with near 1.5 million passengers per week.

As suggested by many literatures, the success of a public transport system depends on the number of passengers which the system is able to attract and retain (de Oña et al., 2013). Therefore, it is critical for transit management agencies and rail transit operation companies to assess how they are meeting the needs of their customers by investigating whether rail transit passengers are satisfied with the products and services the rail transit industry offered. To that end, a strategic tool is needed for assessing the current passenger satisfaction level and identifying the management strategies which can be potentially used to improve passenger satisfaction, match passenger desires and promote the use of rail transit system. Also, a standard passenger satisfaction evaluation model can be a handy tool for assessing and comparing the rail transit system performance against peer or nationwide.

The paper is structured in six sections. After a literature review in Section 2, Section 3 introduces the methodology of PSI model. Section 4 takes Suzhou rail transit as a case study, introduces the

* Corresponding author.
E-mail addresses: 20134246017@stu.suda.edu.cn (W. Shen), xiaoweizhou@suda.edu.cn (W. Xiao), wxin_chn@hotmail.com (X. Wang).

http://dx.doi.org/10.1016/j.tranpol.2015.10.006
0967-070X/

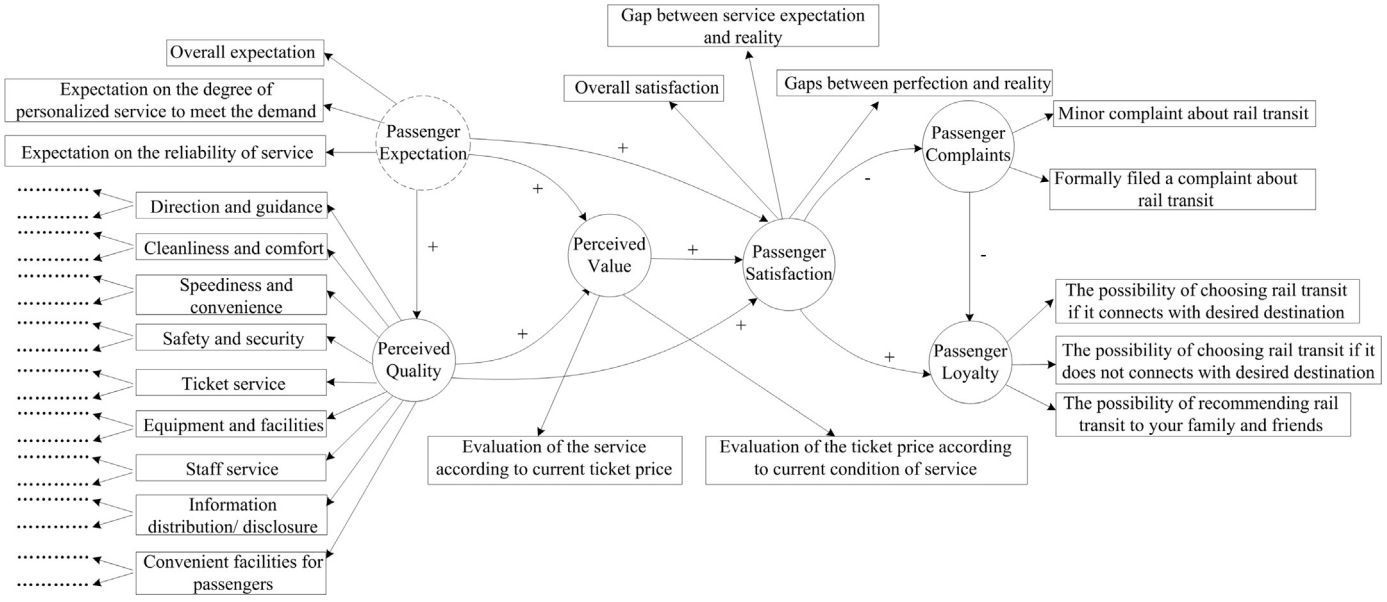

Fig. 1. The Conceptual framework of the PSI model for Urban rail transit.

questionnaire design and passenger survey, and then demonstrates the feasibility of proposed PSI model. Section 5 gives several limitations in this study, and finally Section 6 presents some conclusions about the study.

2. Literature review

The customer satisfaction theories and methodologies have been utilized in private industry. The Swedes proposed the theory of satisfaction called customer satisfaction at the earliest, later Fornell summarized Customer Satisfaction Index (CSI) and came up with the American customer satisfaction index (ACSI) model (Fornell et al., 1996). The ACSI model measured the causality between the antecedents of customer satisfaction (customer expectation, perceived service quality, and perceived value) and its consequences (customer complaints and customer loyalty). Moreover, studies have point out that CSI can be used to predict profitability and market value of a company (Anderson et al., 1994, 1997; Eklof et al., 1999). Currently based on the ACSI model, lots of countries in the world (e.g. Germany, South Korea, China and other countries in Europe) have established CSI models customized for their contextual situation.

In the field of transportation, researchers are increasingly recognizing the importance of passenger satisfaction. Hensher (1990) considered the key of measuring bus service quality was to identify the important dimensions of service quality that passenger perceived. By studying the preferences of bus passengers, they put forward a bus preference model. Later in 2003, Hensher et al. (2003) established an in-depth methodology to quantify each service quality measurement and identify their relative importance in the overall satisfaction calculation using stated preference approach. Friman and Gärling (2001) proposed an evaluation model by studying public transportation passenger satisfaction and found that overall satisfaction was positively correlated with accumulative satisfaction. Stradling et al. (2007) presented a six-step method for measuring satisfaction to combine measures of performance and importance. Friman et al. (2013) used confirmatory factor analyses to examine the psychometric properties of the satisfaction with travel scale. Celik et al. (2014) proposed a novel framework which includes SERVQUAL, statistical analysis, interval type-2 fuzzy sets and Vlsekriterijumska Optimizacija I Kompromisno Resenje (VIKOR) methods to evaluate the customer satisfaction for the rail transit network of Istanbul.

Various theories and methodologies have been applied in satisfaction research, including hierarchical process, fuzzy mathematics and factor analysis etc. These methods (e.g. Delphi, analytic hierarchy process and fuzzy clustering method) focus on using subjective methods for determining the weights of variables for assessment. At the same time, studies focusing on analyzing the relationship between satisfaction, or service quality, and different attributes are more and more popular by using SEM models or path analysis. Some studies (Stuart et al., 2000; Karlaftis et al., 2001; Eboli and Mazzulla, 2007; Chen, 2008; Ngatia et al., 2010; Irfan et al., 2011; de Oña et al., 2013) have estimated SEM models which can represent the causality between variables. However, they mainly focused on the service attributes impacting overall passenger satisfaction but neglected the degree of satisfaction. Moreover for the parameter estimation in SEM model, traditional method is linear structural relationships (LISREL), which assumes that all observations are independent and the manifest variables obey the multivariate normal distribution, but this is not usually the case in passenger satisfaction survey (Chin and Newsted, 1999; Lin et al., 2005). Alternative method is Partial Least Squares (PLS), which relaxes the assumption of normal distribution and can obtain explicitly estimated latent variable scores directly in the process of parameter estimation, therefore PLS is more suitable for satisfaction research. In this study, SEM method based on PLS estimation is used to build the passenger satisfaction index (PSI) model for urban rail transit, and the causality between passenger satisfaction and its influence factors (e.g. passenger expectation, service quality and service value) is addressed.

Prior studies also explored the relationships between customers' expectation, perceived quality, perceived value, satisfaction, complaints and loyalty (Fornell et al., 1996; Zeithaml et al., 1996; Cronin et al., 2000; Kuo et al., 2009). Expectation, perceived quality, and perceived value are assumed to be three antecedents of satisfaction, and complaints and loyalty are two behavioral intentions or consequences of satisfaction.

Expectation represents both prior consumption experience with the company's offering and a forecast of the company's ability to provide quality in the future, and it is assumed to have a direct and positive association with the perceived performance, such as service quality, perceived value, and customer satisfaction