



A methodology for evaluating satisfaction with high-speed train services: A case study in Turkey



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ABSTRACT

Customer satisfaction is a prominent aspect of customer-oriented transportation services. To increase the quality of service and customer satisfaction, it is important to measure how the service provided is perceived and to determine customers' expectations and demands. In 2009, the Turkish Republic State Railways (known as TCDD in Turkey), which provide railway transportation services in Turkey, started High Speed Train (HST) transportation services. HSTs are comfortable and technologically modern transportation vehicles that attract both current and potential customers. Since 2009, efforts have been made to expand HST services to other cities. The current HST service between the cities of Istanbul and Ankara in Turkey can be used as a model to evaluate customer satisfaction and quality of service during the development of additional HST services between other cities. Therefore, the purpose of the present study was to create a mathematical model to determine which areas of service influenced customers' views and satisfaction regarding HST services in Turkey and the magnitude of contribution of these factors to overall satisfaction. Thus, factor analysis was conducted to determine the relevant factors affecting satisfaction with HST services. A mathematical model was then created with the help of factor scores. As residual outliers were found during the creation of the model in both the x and y directions, certain bounded influence estimators resistant to outliers in both directions were proposed for the estimation of model parameters. The mathematical models established in this study enabled the analysis of the influence of advertisements and information services, food service, physical conditions, the attitudes and behavior of personnel on customers' overall satisfaction with HST services.

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1. Introduction

An examination of transportation policies implemented globally over the last thirty years demonstrates that fundamental changes have occurred. Railways have become prominent again, and the rapid momentum in railway development globally has also influenced Turkish railways specifically since 2003, necessitating the development and expansion of the railway network to respond to increases in cargo and customer traffic that parallel the increasing population of Turkey. To meet increasing customer demand, HST transportation services began between the cities of Eskisehir and Ankara in Turkey in 2009. Two years later, the HST railway network was expanded to provide HST services between the cities of Ankara and Konya. Efforts have also been made to establish an HST railway network between the cities of Ankara and

Istanbul, beginning in 2014. HST services, currently operating between Ankara and Istanbul, are expanding to the Pendik station, and studies of transit networks between Asia and Europe are examining the Marmaray connection.

The HST project between Ankara and Istanbul is independent from the existing older line, which is 533 km in length, suitable for speeds up to 250 km/h, and operates using electric double-line railway signaling. HST service aims to reduce the duration of travel between Ankara and Istanbul to 3 h upon completion of the planned project. Trips along this route currently last approximately 4 h. When HST service begins, the former (older) public transportation line between Istanbul and Ankara, a trip on which lasts 6.5 h, will cease to operate.

High-speed trains obtained from CAF, a Spanish company, consist of 6 carriages. These trains provide passengers with maximum levels of comfort, and include air conditioning, video, TV, music systems, equipment for people with disabilities, closed-circuit video recording systems, and vacuumed toilets. Each train includes separately designed business class and economy class carriages and carries a total of 419 passengers.

Abbreviations: LS, Least Squares; RSE, Residual Standard Error; KMO, Kaiser-Meyer-Olkin; HST, High Speed Train; TCDD, Turkish Republic State Railways

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TCDD is a member of the International Union of Railways (UIC) and conforms to the specifications and standards of this association. The latest technological systems currently being used in Europe are also used in Turkey.

TCDD has put effort recently into providing comfortable railway transportation services in Turkey that utilize the latest technological developments to attract both current and potential customers. The TCDD has also undergone renovations to provide customer-oriented railway transportation services.

In the transportation industry, customer satisfaction is important for the provision of customer-oriented services. Measuring perceptions of the services provided and determining expectations and demands for these services will help customer transportation firms increase the quality of their services.

Several studies have investigated customer satisfaction in the transportation industry (Tyrinopoulos and Antoniou, 2008; Vanniarajan and Stephen, 2008; Agarwal, 2008; Geetika, 2010). Other studies have measured customer satisfaction, quality of service, and degree of loyalty to HST (Nathanail, 2008; Chou and Kim, 2009; Cao and Chen, 2011; Cheng, 2011; Kuo and Tang, 2013).

Tyrinopoulos and Antoniou (2008) focused on the customer's perception of transit performance with an emphasis on the variability between operators and the policy implications of such differences. In their studies, two statistical methods (factor analysis and ordered logit modeling) were used to assess the quality implications of the variability in users' perceived satisfaction across operators. Vanniarajan and Stephen (2008) identified the attributes that customers use to evaluate the quality of service of Indian railways and developed a comprehensive instrument named Railqual. The relationship between Railqual and customer satisfaction was also evaluated using data collected from the customers of Southern Railways. The factors identified by Railqual as important to customers are reliability, assurance and empathy. Agarwal (2008) examined factors related to Indian Railway services that affect customer satisfaction using a survey, and collected data through a structured questionnaire given to a sample of 500 customers. Agarwal used factor and regression analysis to analyze the gathered data and identify the effects of customers' perceptions of various factors on customer satisfaction. His study showed that, of the various factors considered, employee behavior has the largest effect on customer satisfaction with Indian Railways as a whole. Geetika (2010) identified components of the quality of service of Indian Railways at railway platforms. This exploratory study used factor analysis to identify the most important factors for customer satisfaction with the quality of service. Nathanail (2008) presented a framework developed to assist railway operators in monitoring and controlling the quality of service provided to their customers. The author developed a multicriteria evaluation to estimate an overall performance index for the quality of service provided. Chou and Kim (2009) empirically assessed the quality of service perceived by customers who ride the HSR and examined related effects on customer satisfaction and loyalty with the aid of structural equation modeling (SEM). Cao and Chen (2011) analyzed the relationships between service quality, customer satisfaction and degree of loyalty to high-speed railways using a structural equation model and the high-speed railway from Shanghai to Nanjing as a case study. Cheng (2011) investigated customers' perceptions of the electronic service quality (e-SQ) of the Taiwan High Speed Rail (THSR) website using the Rasch measurement model to measure a subjective latent construct: perceived e-SQ. Kuo and Tang (2013) investigated elderly customers' demands and examined the relationships between service quality, corporate image, customer satisfaction, and behavioral intention. Their empirical analytical results are based on structural equation modeling. In their study, satisfaction directly affected travel behaviors, while service quality and corporate image played

indirect roles. The authors determined that service quality had a significant effect on satisfaction.

In Turkey, prominent studies were conducted by Citil (2003) and Celik (2004) to measure customer satisfaction and quality of service in railway transportation, but no research has been conducted on customer satisfaction with HST transportation. Thus, the primary purpose of this study is to determine customers' views on HST transportation services provided between the metropolitan cities of Istanbul and Ankara in Turkey, to measure customers' satisfaction with these services and to estimate parameters for the relative importance of key factors that predict overall customer satisfaction with HST services.

Customer satisfaction is an important measure of the quality of service in public transportation. According to De Ona et al. (2012), "service quality is related to a series of attributes that describe the transportation service. To estimate the relative importance of each attribute in terms of the service quality perceived by each customer have been used several approaches. The methods can be classified as stated importance methods or derived importance methods". Stated importance is assessed by asking customers to rate each attribute on an importance scale; this is the more intuitive and direct of the two methods to assess importance, but as it requires a lengthy questionnaire, it is used less frequently than derived importance. In recent years, many derived importance methods based on customer satisfaction surveys have been developed (Weinstein, 2000; Cavana et al., 2007; Eboli and Mazzulla, 2007; Joewono and Kubota, 2007; Dell'Olivo et al., 2010; Jen et al., 2011; Nurul-Habib et al., 2011; Lai and Chen, 2011; De Ona et al., 2012). Factor analysis is also a traditional method used to derive attribute importance.

Within the scope of this study, a survey including a number of quality attributes associated with services was provided. Considering the bilateral relationships between these attributes, it is quite difficult to evaluate and interpret service quality. Therefore, factor analysis, which facilitates the interpretation of a number of interrelated attributes and gathers these attributes under a few sub-dimensions, was used in this study.

Factor analysis, which is used to derive attribute importance, was conducted to determine which factors influence customer satisfaction with HST services provided by TCDD, to gather highly correlated attributes, and to determine a smaller set of factors that are uncorrelated among themselves.

Considering customer expectations of HST provided by TCDD, regression analysis was conducted on factor scores to reveal which service areas (factors) influenced overall satisfaction with services and the degree of overall influence of each of these factors.

Regression analysis is traditionally used to derive attribute importance. This approach allows the inclusion of additional independent variables (attributes) when testing the relationship with the dependent variable (overall satisfaction). However, important consideration is that it is common in customer satisfaction research for attributes to be correlated – sometimes highly – with each other. This multicollinearity makes it difficult to measure the separate effects of the individual attributes on overall satisfaction using the multiple regression approach. When multicollinearity is encountered in multiple regression modeling, factor analysis can be used to first transform the independent variables to a smaller set of dimensions that are uncorrelated among themselves. Then multiple regression modeling is performed to predict the relative impact of the newly constructed dimensions on the dependent variable (overall satisfaction). To date, factor analysis combined with multiple regression analysis has been the most prevalent analytical technique applied in customer satisfaction research within the transportation industry (Transit Cooperative Research Program (TCRP) Report 47, 1999). Many techniques have been developed to perform regression analysis. Methods such as linear

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