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## Evaluating airline service quality using a combined fuzzy decision-making approach

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## ABSTRACT

Developments in the airline industry in the last decade have been forcing airlines to evaluate the quality of their service performance with the goal of improving their competitive advantage. It has also become one of the most challenging tasks potentially influencing airlines' long-term success. This challenge calls for a systematic decision-aid tool that can not only handle the vagueness and conflicting nature of service quality evaluation criteria but also integrates the strengths of various multi-criteria decision-making (MCDM) methods in a fuzzy environment.

This paper aims to evaluate airline service quality in Turkey, using a combined fuzzy decision-making approach, for the first time in the literature. For this purpose, it identifies sixteen airline service quality criteria under five dimensions. The paper then describes the fuzzy DEMATEL method to deal with the interactions among the evaluation criteria. In addition, it proposes a fuzzy ANP method to consider the interdependence and calculate the relative importance of each criterion. Finally, it introduces a fuzzy VIKOR method for evaluating and ranking the service quality performance of airlines in Turkey. The paper also implements a sensitivity analysis to validate the proposed solution methodology's usefulness and practicality by testing different parameters of index values.

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### 1. Introduction

In today's business environment, evaluating the service quality performance of airlines is of crucial importance not only for countries' economic development but also for the airlines taking place in the same industry. The airline industry has played a vital role in Turkey's development and competitiveness and has gained much more attention than other modes of transport. Turkey's airline industry has experienced substantial growth in its number of airlines and operating fleets, as well as its market share. In the last decade, air traffic in Turkey has increased significantly. In 2015, the total number of the commercial flights to and from Turkey increased by 126% compared to 2006, reaching 1,254,615 flights. Passenger numbers also increased 194% compared to 2006, reaching 181,074,531 passengers. In fact, air traffic in Turkey is increasing at an amazing speed, achieving new records in both passenger numbers and cargo traffic. In 2015, the number of destinations reached 258 nodes, and the total cargo amount was 3,072,831 tons ([General Directorate of State Airports Authority of](#)

[Turkey \(DHMI\) Sector Report, 2015](#)). When the new Istanbul airport begins operation in 2018, it is expected to become one of the largest airports in the world, with six runways, flights to nearly 350 destinations, and an ultimate annual capacity of over 200 million passengers. In addition, Turkey will become a new mega-hub and transit center from north to south and from the Far East to Europe and Africa ([DHMI Annual Report, 2015](#)). Therefore, measuring and evaluating service quality performance of Turkey's airlines is necessary to maintain their level of performance and strive to improve the quality of their services continuously.

Generally, service quality can be defined as a comparison of consumer expectations to the actual services delivered. The service quality functions performed by the airlines can encompass various activities, such as, ticket reservation, purchasing, check-in, comfortable and safe travelling and value-added services, such as on-board services, seat comfort, and cleanliness, luggage transportation, promotional incentives, including frequent membership programs and miles rewards, lost baggage handling and services for delayed passengers. Therefore, service quality dimensions can be seen as a combination of various subjective and objective factors, which are difficult to evaluate appropriately. Airlines aim to develop operational performance and market share to enhance

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profitability by focusing more on service quality than cost reduction. Improving airlines' service quality can reduce operating costs and increase market share, return on investment (ROI), flexibility, and transportation efficiency (Chen and Chen, 2010). In other words, providing high-quality service to passengers can lead to customer satisfaction, which is key to airlines' long-term success and competitiveness.

In the recent past, a subject of service quality has been heavily researched in related literature. Briefly, airline industry and services (Tsaour et al., 2002; Aksoy et al., 2003; Pakdil and Aydın, 2007; Liou et al., 2007, 2011b; Chen and Chen, 2010; Kuo, 2011; Wu and Cheng, 2013), airports (Kuo and Liang, 2011; Pandey, 2016), on-line shopping websites (Cebi, 2013), banks (Karatepe et al., 2005), healthcare services (Taskin et al., 2015), public agency (Gowan et al., 2001), supermarkets (Vazquez et al., 2001) and hotels (Wilkins et al., 2007). The common feature of these studies is that they focus merely on either evaluating service quality or on defining service quality criteria in different industries for all customers. However, many evaluation criteria used to assess customer requirements often conflict because they combine qualitative and quantitative factors. Moreover, the decision-makers often assume that evaluation criteria are independent of one another. In other words, few studies have examined interactions by considering causal relationships among the evaluation criteria. In addition, service quality performance of airlines in Turkey has yet to be fully analyzed. To overcome these shortcomings, we propose a systematic decision-aid tool that deals with the interdependencies among evaluation criteria.

Evaluation of the service quality performance of Turkey's airlines is a type of MCDM problem and requires MCDM approaches to strengthen the decision-making process. However, the service quality evaluation issue usually involves imprecise and uncertain judgment. Fuzzy set theory is useful (Zadeh, 1965) in evaluating the uncertainty, ambiguity, and vagueness inherent in decision-makers' subjective judgments. Therefore, the proposed method is capable of handling vagueness and conflicting nature of service quality evaluation criteria which was often neglected by the prior literature focusing on a stand-alone, single analytical method. This study aims to propose a combined fuzzy based DEMATEL, ANP, and VIKOR methodology to evaluate the service quality performance of Turkey's airlines. It uses the Fuzzy Decision Making Trial and Evaluation Laboratory (DEMATEL) method to define interrelationships among subjective criteria and the ANP approach to determine how to weight each measurement criterion. It then uses fuzzy VIKOR to measure and rank the airlines' service quality performance. The proposed method allows experts' judgments regarding service quality dimensions and performance ratings to be incorporated into the evaluation process. In other words, the main reason why the fuzzy-based DEMATEL and ANP methods are employed is to consider inter-dependent relationships among service quality attributes. Furthermore, fuzzy VIKOR is an appropriate method, which can utilize the importance of individual criteria derived from the DEMATEL and ANP methods to obtain the final ranking results of Turkey's airlines. The rest of the paper is organized as follows: The second section explains the literature review and presents the combined approach's method details, service quality dimensions and evaluation criteria. Third section presents the research methodology. The fourth section describes the empirical case's proposed framework, and the fifth section describes conclusions and makes future research suggestions.

## 2. Literature review

Reflecting the growing popularity of service quality and a sustained development of airline industry, there has been an extensive

literature that describes methods used in the combined approach, and airline service quality dimensions.

### 2.1. Methods used in the combined approach

In this study, analytical methods regarding service quality are classified as survey methods and MCDM methods. A summary of selected analytical studies on airline service quality is presented in Table 1.

Survey methods are generally applied to identify evaluation criteria or develop an evaluation scale by collecting data from participants who responded to the survey questionnaires. MCDM methods require determining alternative ratings and criteria weights by eliciting decision-makers' preferences (Cui et al., 2011). Besides, as seen in Table 1, MCDM methods are the most popular approaches used in service quality evaluation literature.

Many traditional MCDM methods are considered useful but depend largely on independence assumption in selecting evaluation criteria. In addition, many decision criteria that describe decision-makers' judgments about service quality perceptions are often imperfect and probably uncertain. In other words, crisp values are inadequate to develop causal relationships between complex factors due to the inherent vagueness of the concepts of service quality. This calls for fuzzy DEMATEL, which can capture and solve complex relationships in a fuzzy decision environment. Fuzzy DEMATEL also handles independency by considering that any decision criteria may influence or be affected by other criteria.

In the recent past, a combination of DEMATEL and ANP has been researched in the literature. Tseng and Lin (2009) developed DEMATEL and ANP methods to find an appropriate solution regarding municipal solid waste management in metropolitan Manila. More recently, Büyükoçkan and Güleriyüz (2016) applied a combined DEMATEL and ANP method for renewable energy resources selection in Turkey. However, few studies include a combination of fuzzy set theory, DEMATEL and ANP methods. Uygun et al. (2015) developed a combined DEMATEL and fuzzy ANP model to select the most outsourcing provider. Yeh and Huang (2014) examined the key factors in determining wind farm location selection by using an integrated fuzzy DEMATEL and ANP approach. Tseng (2011) also, adopted a combined fuzzy DEMATEL and fuzzy ANP to evaluate knowledge management capability of a firm, while Kahraman (2015) used the same methodology for selecting health-care organizations.

Going a step further beyond these earlier attempts, combined DEMATEL, ANP, and VIKOR techniques have also been researched in literature. Some of examples have been conducted in various fields which include portfolio selection (Ho et al., 2011), outsourcing provider selection (Liou and Chuang, 2010), e-store business evaluation (Chiu et al., 2013), stock selection (Shen et al., 2014), education centers selection (Wu et al., 2011), and airport and transportation evaluation (Liu et al., 2013). Recently, integration of these three models in an uncertain environment has also been discussed. These include logistics concept selection (Tadic et al., 2014) and hospital service selection (Taskin et al., 2015). However, a combined fuzzy based DEMATEL, ANP, and VIKOR methodology have not been employed to measure airline service quality performance. To fill this gap, we would combine both fuzzy DEMATEL and fuzzy ANP, and then integrate them with fuzzy VIKOR to develop a more effective decision-aid tool for evaluating airline service quality in Turkey.

### 2.2. Airline service quality dimensions

The analytical techniques used in the service quality evaluation can handle both qualitative and quantitative criteria. The airline's

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