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Exploring service quality of low-cost airlines in Europe: An integrated MCDM approach[1]

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Abstract: This study aims to evaluate service quality performance of major LCCs (Low Cost Carriers) in Europe by the MCDM (Multi-Criteria Decision Making) methodology. In addition it focuses on managerial business models and includes the international airline service providers that have applied the cost leadership strategy. In the study passenger reviews based on customer-rating systems are adopted as an alternative data source. For this purpose 24,971 passenger reviews, including 7 evaluation criteria, are analyzed. In this integrated methodology the Entropy method is used to weight the service quality criteria and the WASPAS method is used to rank the airlines. A sensitivity analysis is also applied and the robustness and stability of the application are confirmed. Consequently Jet2.com demonstrates the best service performance overall and legroom is the most important evaluation criterion.

Keywords: airline, service quality measurement, MCDM methods.

JEL codes: C02, F1, L93, M31.

Introduction

Intensifying competition and liberalization tendencies have driven companies in the service industry to seek ways of differentiation (Parasuraman, Zeithaml & Berry, 1988, p. 12). Deregulation and liberalization, which began in the 1970s in the US and then spread to Europe, dramatically changed the structure of the airline industry (Lim and Tkaczynski, 2017, p. 245). As a result of this process the airline industry has evolved into a dynamic free market structure that once used to be tightly regulated (Cento, 2009, p. 13). With the tendency of liberalization; tight legal regulations have been abolished, OpenSky policies have

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taken root, various changes have taken place in tourism models, income management policies have begun to be implemented and the airline industry has gained a more competitive character with the emergence of LCCs (Lim and Tkaczynski, 2017, p. 245). One of the most important consequences of liberalization is that LCCs have made important contributions to the development of the airline industry (Han, 2013, p. 125).

The essence of the LCC business model is to minimize operational costs (Baker, 2013, p. 74). In this context some policies implemented by LCCs differ from those applied by Full-Service Carriers (FSCs). Some policies applied by the nature of this business model are the implementation of a simple pricing strategy, use of secondary airports, point-to-point operations, service with a single flight class, a single type of aircraft and fast turnaround operations (O'Connell & Williams, 2005, p. 260). Therefore LCCs, following the cost leadership strategy have a significant advantage over FSCs regarding operational costs such that when Southwest Airlines entered the US airline market the cost per available seat-mile (CASM) of its competitors was around 0.12 cents while its cost per available seat-mile was around 0.08 cents. The lower operating costs of LCCs have also led to a decrease in ticket prices. The low prices and the innovations they have brought to the industry have increased the options for passengers and further increased the competition between airlines (O'Connell & Williams, 2005, p. 259).

When LCCs spread across the industry price was used as the primary competition tool not only among LCCs but also between LCCs and FSCs. Airlines understood that a sustainable competitive advantage could only be achieved by service quality, which is the precursor of customer satisfaction and loyalty (Chen, Tseng, & Lin, 2011, p. 2854). Therefore service quality has become a strategic tool that LCCs use and it has led them to evaluate their service performance in order to increase their competitive advantage and become sustainable (Vuthisopon & Srinuan, 2017, p. 252). Also service quality has now become one of the most critical factors affecting the long-term success of all airlines (Perçin, 2017, p. 1).

Service quality is defined as the perceptions of consumers about the relative superiority or inferiority of an organization which arises from comparing customer expectations and services performed (Ghorabaee, Amiri, Zavadskas, Turskis, & Antucheviciene, 2017, p. 45). Service quality specifies an organization's ability to meet and exceed customer expectations. As can be seen from the definition service quality is determined by the customers and it is critical how the quality is perceived by them (Gümüş & Göker, 2012, p. 28). Therefore service offerings that target customer-focused service quality increase the market share and profitability by influencing the competitive advantage of LCCs positively (Park, Robertson, & Wu, 2004, p. 435). In order to measure service quality in a customer-focused approach it is important to understand what service means for the customers. For this reason companies evaluate their service

quality by using the data obtained from various channels (Eroğlu, 2005, p. 8). Especially in recent years developments in information and communication technologies have provided various platforms to enable customers to evaluate the services they received. This development has brought a renewed approach as the communication is not only between companies and customers but also among customers themselves. Along with this it is thought that the increasing interaction between stakeholders would positively affect service quality.

Passengers can write a review for the service they received on many web portals. TripAdvisor is one of these portals and it is frequently used by travellers (Miguéns, Baggio, & Costa, 2008, p. 2). Users can share their own travel experiences on TripAdvisor as well as accessing qualitative or quantitative feedback on any airline, hotel or restaurant reviewed by other travellers (O'Connor, 2010, p. 761). Having recently become one of the most active travel content sharing websites TripAdvisor has become an important indicator of the quality of many services such as tourism and air transportation (Gal-Tzur, Rechavi, Beimel, & Freund, 2018, p. 2). Thus TripAdvisor has been included in the study as it influences buying behaviours. There are different reasons why TripAdvisor is used in this research. First, consumers seek information about their purchasing decisions and rely more on such resources than on official resources (Cox, Burgess, Sellitto, & Buultjens, 2009, p. 747). Secondly, nowadays user-generated content is highly effective and a large quantity of this content is produced in some industries such as tourism and transportation, which often involve high-risk purchasing decisions (Huang, Chou, & Lin, 2010, p. 515). Finally, the importance of the role of reviews in searching for travel information and decision-making is understood (Yoo & Gretzel, 2008, p. 284).

The main objective of the study is to propose an integrated methodology to evaluate service quality in the context of LCCs. The objective is thought to be noteworthy because the studies evaluating service quality with a focus on the business model are so scarce in literature. Therefore this study aims to evaluate the service quality of the largest 13 LCCs operating in Europe by using the integrated methodology of Entropy and WASPAS. In this study MCDM methods were adopted because the multidimensional nature of service quality is considered as an MCDM problem. Moreover the MCDM methods are the most popular in literature evaluating service quality (Perçin, 2017, p. 2). The data used in the study consisted of reviews made on the TripAdvisor website. This approach is thought to be more generic and insightful since it allows this research to reach a wider geographical area and a larger number of data than could be obtained with any physical surveys. Furthermore this study is expected to contribute and fill the gap in literature due to the lack of studies that address the evaluation of service quality in airlines through customer-rating websites.

The rest of the study continues as follows: firstly the previous studies in literature are summarized and then the Entropy and WASPAS methods and ap-

plication steps are explained. In section 3 the empirical case study is presented and the airlines are ranked. In section 4 the findings are discussed. Finally, in section 5, implications and limitations are explained and suggestions are made for further studies.

1. Literature review

In today's business, where global competition is increasingly intensified and customer expectations are rising, service quality has been seen as a key to success and is considered to be one of the most powerful tools in competitive strategies (Zeithaml, Berry, & Parasuraman, 1996, p. 31). Customer satisfaction and repurchasing intention, which is the result of service quality, are among the main issues for the survival and growth of airlines (Cunningham, Young, & Lee, 2004, p. 10). Since the relationship between passenger satisfaction and profitability has been observed (Heskett, Jones, Loveman, Sasser, & Schlesinger, 1994; Sultan & Simpson, 2000) studies on the service quality of airlines have increased steadily.

In many studies researchers have investigated many aspects of service quality with different methodologies (Ghorabaee et al., 2017, p. 46). It has been observed that different research approaches have been applied to evaluate airlines service quality and passenger satisfaction. It seems that whereas some researchers used statistical methods, such as regression analysis to test hypotheses, another group of researchers has used models such as SERVQUAL. In another trend multi-criteria decision making (MCDM) methods have been used in the evaluation and improvement of airline service quality (Tsafarakis, Kokotas, & Pantouvakis, 2018, p. 62).

It is possible to define airline service quality as a component of the interactions among passengers, airlines and employees who aim to influence the passengers' perception of the airline. Sultan and Simpson (2000) aimed to find out whether passenger nationality had an effect on customer expectation and perceived service quality. As a result of the study it was found that European passengers of airlines operating in the Transatlantic Corridor have a higher level of expectation and are more critical than American passengers. Tsaur, Chang and Yen (2002) used the fuzzy set theory to evaluate airline service quality in Taiwan and the Analytical Hierarchy Process (AHP) and TOPSIS were used. In the study SERVQUAL criteria were used as evaluation criteria and physical factors were found to be the most important criterion. Atilgan, Akinci and Aksoy (2003) aimed to investigate whether there is a difference in consumer perceptions in the services provided by Turkish and foreign airlines. The study revealed that whereas perceived differences between passengers in terms of punctuality and speed are low, perceptual differences are found in all other criteria. Park, Robertson and Wu (2004) proposed a conceptual model of the

behavioural orientation of passengers and considered variables such as service perception, service expectation, image, passenger satisfaction, service value and behavioural orientation. They found that passenger satisfaction, service value and image affected the behavioural orientation of the passengers directly. In another study on the behavioural orientation of passengers, Saha and Theingi (2009) tried to explain the relationships between service quality, customer satisfaction and behavioural orientation and found that the most influential variable was customer satisfaction. The study also found that whereas unsatisfied passengers prefer to change the airline instead of giving feedback, satisfied passengers, as it has been pointed out in previous studies (Koklic, Kinney, & Vegelj, 2017, p. 188), prefer re-purchasing and positive word-of-mouth communication. O'Connell and Williams (2005) investigated the influence of the airline business model on the perception of passengers in Europe and Asia and found that there was no significant difference between FSCs passengers and LCCs passengers. Tsantoulis and Palmer (2008) stated that airline service quality includes parameters such as airline tariff and price as primary measures and safety, comfort, in-cabin services, the attitude of cabin crew, on-time performance and baggage delivery as secondary measures.

In another study on airline service quality Rhoades and Waguespack Jr. (2008) evaluated airline service quality performance for a 20 year (1987-2006) period and found that airline service quality in the US improved during the 1987-1993 period and decreased to the 1987 level in 2006. Chen and others (2011) measured the effect of cabin service quality on customer perception by investigating eight airlines in Taiwan and observed that cabin service quality had a direct influence on customer purchasing decisions as opposed to previous studies. Curtis, Rhoades and Waguespack (2012) aimed to reveal the relationship between passenger flight frequency and satisfaction levels in their study.

The study concluded that more frequent passengers were becoming less satisfied by airline service quality but the importance attributed to the facilities offered by the airline increased. Baker (2013) in studying service quality and customer satisfaction of the top 14 airlines operating in the USA between 2007 and 2011 found that the service quality of LCCs is higher than traditional legacy airlines. Sandada and Matibiri (2016) investigated the effect of service quality and safety perception on passenger satisfaction. The study revealed that while service quality contributes to passenger satisfaction positively, frequent flyer programmes and safety perception contribute to customer loyalty. Tsafarakis and others (2018) measured the satisfaction level of Aegean Airlines passengers by using the Multi-criteria Satisfaction Analysis (MUSA) method. It was explained how multi-criteria analyzes in the study could be applied to measuring and improving the quality of airline service. Gupta (2018) used multi-criteria decision making methods in his study related to airline service quality in India. In this study the Best-Worst Method (BWM) was used for determining criteria weights and VIKOR was used for

ranking. The SERVQUAL measure was used as evaluation criteria and it was found that physical elements were the most important criterion as they were in previous studies (Tsaur et al., 2002).

When the literature is examined it is seen that several studies have been evaluating the service quality performance of the airlines with different scopes and approaches. On the basis of the business model it has been observed that studies focus on the service quality performance between LCCs and FSCs or among the LCCs. In addition no studies have been conducted in which the service quality performance of airlines in Europe as evaluated by MCDM methods. In this study both the number of observations and the number of LCCs widen its scope .

2. Research methodology

2.1. Selection of evaluation criteria and sample

In this study the performances of LCCs that carried the highest number of passengers in Europe are investigated according to various criteria, focusing on the service quality of LCCs (IATA, 2017). The details of the airlines covered in the study are given in Table 1.

Table 1. LCCs' sample in the study

ICAO code	Airline	Passenger carried (thousands)
RYR	Ryanair	112,015
EZY	easyJet	70,747
VLG	Vueling	27,937
PGT	Pegasus Airlines	23,876
WZZ	Wizzair	22,787
EWG	Eurowings	18,430
AEA	Air Europa	10,375
BEE	FlyBe	8,957
TRA	Transavia Airlines	7,957
CFG	Condor	7,642
EXS	Jet2.com	6,572
HLX	TUI Fly	4,591
VOE	Volotea	3,259

Source: Based on (IATA, 2017).

The evaluation criteria are taken from the TripAdvisor website (TripAdvisor, 2018). TripAdvisor allows passengers to write a review on the website and provide a rating based on eight criteria, using the 5-point Likert scale method. While evaluations on the website are made based on the same criteria without delineating the airline business model, LCCs seem to have limited or no in-flight entertainment. Therefore only 7 evaluation criteria are taken into consideration ignoring the *in-flight entertainment* criterion on the website (Table 2).

Table 2. Evaluation criteria for airline service quality

Codes	Criteria	Max./Min.
C1	Seat comfort	Max.
C2	Customer service	Max.
C3	Cleanliness	Max.
C4	Food and beverages	Max.
C5	Legroom	Max.
C6	Value for Money	Max.
C7	Check-in and Boarding	Max.

Source: Based on (TripAdvisor, 2018).

As given in Table 1 the study covers a large number of airlines of different size . The criteria given in Table 2 include some tangible and intangible attributes related to airline services. In addition these criteria are all beneficial (max.) criteria.

2.2. Entropy method

Rudolph Clausius (1865) first used Entropy, known as the second law of thermodynamics, in literature. Entropy, initially agreed as a measure of physical irregularity, was then reshaped by Shannon (1948) as a measure of information irregularity in the ''Information Entropy'' concept (Stamps, 2003, p. 450).

The concept of Entropy is considered as a measure of uncertainty about random variables (Zhang et al., 2011, p. 444). According to the Information Entropy Theory the quality or quantity of the information in the decision-making process is determinant in order to solve the problem correctly and reliably. Therefore in the decision-making process the Entropy method is used to measure the amount of useful information provided by the data (Wu et al., 2011, p. 5163).

The weighting process, which is essential for obtaining the importance levels of criteria in multi-criteria decision-making methods, is usually done in two different ways: subjective weighting and objective weighting. While the prefer-

ences and judgments of the decision makers are used in the subjective weighting method, objective weighting takes into account the quantitative properties of the alternatives (Zhang et al., 2011, p. 444). Entropy, one of the subjective weighting methods, can be used to weight only by using the decision matrix without the need for decision-makers' judgments.

Shannon's Entropy method is very suitable for finding the appropriate weight representing useful information provided by the evaluation criteria. In the Entropy method, as the dispersion in the criterion grows, the criterion weight becomes higher (Karami & Johansson, 2014, p. 523). Thus as the weight of the criteria increases, the useful information that the criteria contain increases (Li et al., 2011, p. 2087).

The steps of the Entropy method are as follows (Karami & Johansson, 2014, p. 523-524):

Step 1. P_{ij} values are calculated in a normalization process to eliminate anomalies in different measurement units and scales:

$$P_{ij} = \frac{a_{ij}}{\sum_{i=1}^{m} a_{ij}}, \tag{1}$$

where P_{ij} denotes the normalized attribute value of the ith alternative. In addition a_{ij} denotes the initial performance value of the ith alternative and m denotes the last alternative.

Step 2. The Entropy value (E_j) of each criterion is calculated:

$$E_j = -k \sum_{i=1}^{m} [P_{ij} ln P_{ij}], \tag{2}$$

where $k = (\ln(m))^{-1}$ and E_j denotes the entropy value of the jth criteria.

Step 3. The uncertainty (d_j) is calculated as the degree of diversification:

$$div_j = d_j = 1 - E_j. \tag{3}$$

As the value of d_j increases, the criteria becomes more important.

Step 4. The weights (w_j) representing the importance levels of each criterion are calculated.

$$w_j = \frac{d_j}{\sum_{j=1}^{m} d_j}.$$

The weight values above denote how important each criterion is and, $\sum_{j=1}^{m} w_j = 1$ should be provided.

2.3. WASPAS method

The WASPAS (Weighted Aggregated Sum Product Assessment) method was developed by Zavadskas, Turskis, and Antucheviciene (2012) as a combination of WSM (Weighted Sum Model) and WPM (Weighted Product Model) methods to provide robust computation by increasing ordering accuracy (Zavadskas et al., 2012, p. 3). It is known that aggregated methods give more accurate results than a single method. In past studies it was determined that the use of WASPAS is 1.3 times more accurate than using WPM and 1.6 times more accurate than using the WSM method (Zavadskas et al., 2012, p. 6).

Hence it can be seen that the WASPAS method is very suitable for application to the MCDM problems in order to achieve a high ranking accuracy and that the method has a very high predictability (Chakraborty, Bhattacharyya, Zavadskas, & Antucheviciene, 2015, p. 78). While the WASPAS method solves the problems of decision making by integrating additive and multiplicative approaches, both methods are easily applicable to many selection problems in terms of simple calculations (Adalı & Işık, 2017, p. 72).

The WASPAS method uses λ as a parameter in the application and this value is $0 < \lambda < 1$ (Adalı & Işık, 2017, p. 67). The WASPAS method becomes WPM method in case of $\lambda = 0$ and becomes WSM method in case of $\lambda = 1$ (Chakraborty & Zavadskas, 2014, p. 4). Zavadskas and others (2012, p. 4) proposed the calculation of the optimal λ value, but there are disagreements as to what this value is in practice (Chakraborty & Zavadskas, 2014, p. 17). On the other hand many studies use the $\lambda = 0.5$ known as simplified WASPAS (Lashgari, Antuchevičienė, Delavari, & Kheirkhah, 2014, p. 740).

The steps of the WASPAS method are as follows (Chakraborty & Zavadskas, 2014, p. 3):

Step 1. The initial decision matrix is established:

$$X = \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1n} \\ x_{21} & x_{22} & \cdots & x_{2n} \\ \vdots & \vdots & \cdots & \vdots \\ x_{m1} & x_{m2} & \cdots & x_{mn} \end{bmatrix}. \tag{5}$$

Step 2. The initial decision matrix is normalized by linear normalization according to beneficial and unbeneficial criteria types respectively:

$$\bar{x}_{ij} = \frac{x_{ij}}{max_i x_{ij}} \ \ \text{if } j = N_b \ \ \text{or} \ \ \bar{x}_{ij} = \frac{min_i x_{ij}}{x_{ij}} \ \ \text{if} = N_u, \tag{6}$$

where N_b represents benefit criteria, and N_u represents unbeneficial criteria.

Step 3. The total relative evaluation of the ith alternative is calculated based on the Weighted Sum Model (WSM) method. In the weighting processes within WSM or WPM, weights are determined by methods such as AHP or Entropy (Rao, 2007, p. 78):

$$Q_i^{(1)} = \sum_{j=1}^{n} \overline{x}_{ij} w_j. \tag{7}$$

Step 4. The total relative evaluation of the ith alternative is calculated based on the Weighted Product Method (WPM) as follows:

$$Q_i^{(2)} = \prod_{j=1}^{n} (\overline{x}_{ij})^{w_j}. \tag{8}$$

Step 5. By integrating the additive and multiplicative methods in Step 3 and Step 4, the total relative evaluation value of the ith alternative is calculated:

$$Q_i = 0.5 Q_i^{(1)} + 0.5 Q_i^{(2)} = 0.5 \sum_{j=1}^{n} \overline{x}_{ij} w_j + 0.5 \prod_{j=1}^{n} (\overline{x}_{ij})^{w_j}. \tag{9}$$

Step 6. In order to determine the relative evaluation of the ith alternative to increase ranking accuracy and the effectiveness of the decision making process, the following generalized equation can be used:

$$Q_i = \lambda \sum_{j=1}^{n} \overline{x}_{ij} w_j + (1-\lambda) \prod_{j=1}^{n} (\overline{x}_{ij})^{w_j}, \quad \lambda = 0, \dots, 1. \tag{10}$$

The optimal λ value is also calculated using Eq. (11) as follows:

$$\lambda = \frac{\sigma^2 \left(Q_i^{(2)} \right)}{\sigma^2 \left(Q_i^{(1)} \right) + \sigma^2 \left(Q_i^{(2)} \right)}. \tag{11}$$

After the calculation the alternatives are ranked based on the integrated value of Q. For example, the alternative having the highest Q_i value is chosen as the best alternative.

3. Empirical case study

In this section the evaluation of the service quality of LCCs is considered as an empirical case study. In the sampling process it is focused on the European

region, which has the second largest passenger market (26.3%) after Asia Pacific (IATA, 2018). For this case study 13 major low-cost airlines meeting the ICAO definition of LCCs (ICAO, 2017), operating in Europe and leading in terms of the number of passengers carried, are evaluated (IATA, 2017). Although 92 airlines meet the criteria in the ICAO's list the focus is on the 18 LCCs in the IATA's "TOP 200 Airlines" list in 2017. However 13 airlines are included in the study as a result of the bankruptcy of Monarch and the elimination of airlines that do not have enough observations. The data analyzed in the study is obtained from the TripAdvisor website. Data is collected manually into a Microsoft Excel spreadsheet and analyzes are performed using the same application. During the data collection period only quantitative reviews of the airlines between January 1, 2017 and December 31, 2017 are taken into consideration and 24,971 passenger reviews are analyzed. The data is filtered by selecting English as the language and Europe as the route. Excluding the filters used screening questions such as destination or gender are not used since they are not in the scope of research. The methodology framework proposed for the study is given in Figure 1.
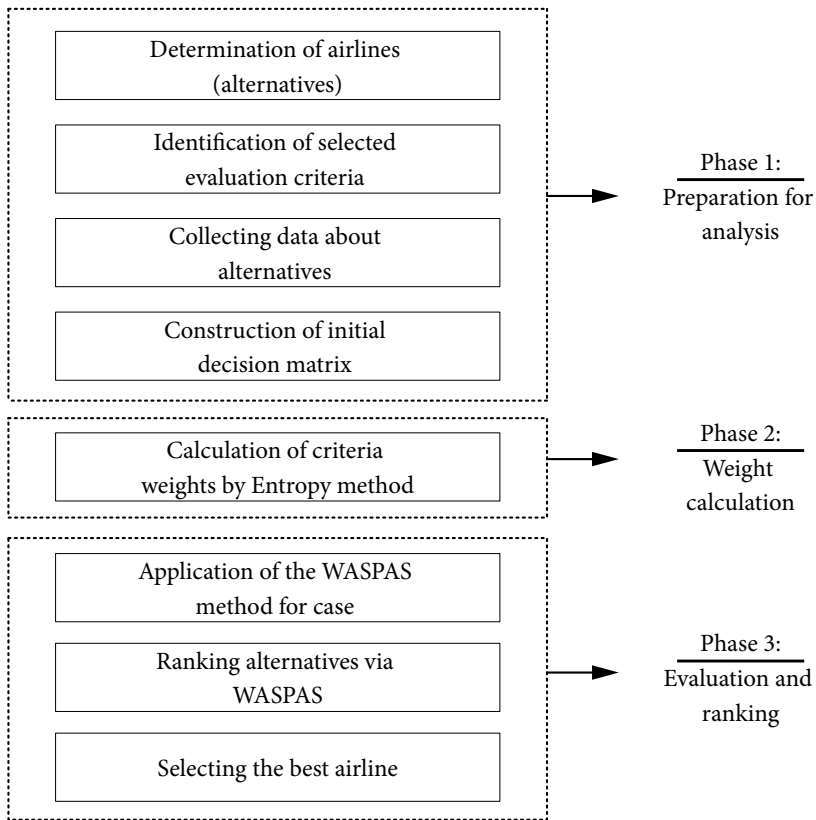

Figure 1. The framework of the proposed methodology for evaluation process

As given in Figure 1 the arithmetic means of the scores according to 7 criteria in 24,971 reviews are taken and the initial matrix is established (Table 3). In the next step the Entropy method is applied to obtain the weights of criteria and finally, the service quality performance of the LCCs according to different λ parameters is evaluated through the WASPAS method.

3.1. Application of the Entropy method

In this step of the case study criteria weights are calculated by using the Entropy method. Criteria weights are essential for the solution of the decision problem. The equations (1-4) are used and the initial matrix is given in Table 3.

Firstly, based on the beneficial and unbeneficial criteria in the decision matrix, the normalization process is performed by using Eq. (1) (Table 4). In the next step, based on the normalized matrix, the E_j value of each criterion is calculated by using Eq. (2). After the calculation of E_j values the diversification degree of the criterion is calculated by using equation (3), and finally, the criteria weights are calculated by using equation (4). The results of the calculations by using equation (2-4) are given in Table 5.

Table 3. Initial decision matrix

	C1	C2	C3	C4	C5	C6	C7
RYR	2.8965	3.1848	3.4459	2.5865	2.9614	3.6302	3.3322
EZY	3.3073	3.6510	3.8205	2.9998	3.3299	3.8525	3.6460
VLG	2.8822	2.8630	3.5024	2.5235	2.7484	3.1811	3.1981
PGT	2.8851	3.0955	3.5000	2.4552	2.9086	3.4000	3.3333
WZZ	2.8093	2.9697	3.5321	2.5596	2.7347	3.2713	3.0073
EWG	3.3128	3.1080	3.7883	2.6480	3.3443	3.3035	3.3867
AEA	2.8917	3.0214	3.4208	2.6056	2.8741	3.0982	3.2374
BEE	3.6041	3.7816	3.9940	3.1332	3.5956	3.6789	3.8807
TRA	3.3329	3.6683	3.9047	2.8684	3.1874	3.7364	3.6068
CFG	3.0163	3.2737	3.8071	3.0675	3.0740	3.3169	3.2707
EXS	3.9540	4.4127	4.3864	3.7444	4.1822	4.3115	4.5365
HLX	3.1039	3.5256	3.7391	3.0303	3.2468	3.2692	3.5072
VOE	3.6429	3.3636	3.9320	2.5765	3.8478	3.6357	3.5421

Table 4. Normalized decision matrix

	C1	C2	C3	C4	C5	C6	C7
RYR	0.0696	0.0725	0.0707	0.0703	0.0705	0.0795	0.0733
EZY	0.0794	0.0831	0.0783	0.0815	0.0792	0.0843	0.0802
VLG	0.0692	0.0652	0.0718	0.0686	0.0654	0.0696	0.0703
PGT	0.0693	0.0705	0.0718	0.0667	0.0692	0.0744	0.0733
WZZ	0.0675	0.0676	0.0724	0.0696	0.0651	0.0716	0.0661
EWG	0.0796	0.0708	0.0777	0.0720	0.0796	0.0723	0.0745
AEA	0.0694	0.0688	0.0701	0.0708	0.0684	0.0678	0.0712
BEE	0.0866	0.0861	0.0819	0.0851	0.0855	0.0805	0.0853
TRA	0.0800	0.0835	0.0801	0.0779	0.0758	0.0818	0.0793
CFG	0.0724	0.0745	0.0781	0.0834	0.0731	0.0726	0.0719
EXS	0.0950	0.1005	0.0899	0.1018	0.0995	0.0944	0.0997
HLX	0.0745	0.0803	0.0767	0.0823	0.0772	0.0716	0.0771
VOE	0.0875	0.0766	0.0806	0.0700	0.0915	0.0796	0.0779

Table 5. Different indicators of the decision matrix

	C1	C2	C3	C4	C5	C6	C7
$\sum_{i=1}^{m}[P_{ij}lnP_{ij}]$	−2.55925	−2.55787	−2.56252	−2.55773	−2.55691	−2.56083	−2.55961
Entropy (E)	0.99778	0.99724	0.99905	0.99718	0.99687	0.99840	0.99792
Degree of diversification (div_j)	0.00222	0.00276	0.00095	0.00282	0.00313	0.00160	0.00208
Weight (w_j)	0.14269	0.17732	0.06095	0.18091	0.20136	0.10309	0.13368

Table 5 shows the criteria weights. According to this the most important criterion is *legroom* (C5). On the other hand the least important criterion is *cleanliness* (C3). Finally, the criteria weights are transferred to the WASPAS application.

3.2. Application of the WASPAS method

After the weights are obtained the airlines are ranked according to service quality (SQ) performance using the WASPAS method and based on the reviews made on the 5 point Likert scale (5: Excellent, 4: Very good, 3: Average, 2: Poor, 1: Terrible).

The decision matrix used in the application is the same as that used in Table 3. Then beneficial and unbeneficial criteria are normalized by using equation (6) and the normalized values are given in Table 6. The relative evaluation of the alternatives is calculated in the next step by using equations (7-8) using WSM and WPM methods, respectively. Total relative evaluation levels based on the WSM ($Q_i^{(1)}$) and WPM ($Q_i^{(2)}$) procedures are shown in Table 7. After calculating $Q_i^{(1)}$ and $Q_i^{(2)}$ values, Q_i value of alternatives are obtained by using equation (9). The Q_i values indicate the performance value of alternatives assuming that $\lambda = 0.5$. On the other hand, to improve the accuracy of the calculation, performance scores for each λ parameters in the range of $0 < \lambda < 1$ are calculated by using equation (10).

As Chakraborty and others (2015, p. 79) pointed out, the optimal λ value can also calculated by using equation (11). The relative evaluation of the alternatives depends on the λ parameter change and the resulting ranking is given in Table 8. In order to better understand Table 9, the ranking based on the λ parameter change is shown in Figure 2.

Table 6. Normalized decision matrix for the WASPAS method

W_i	0.1427	0.1773	0.0610	0.1809	0.2014	0.1031	0.1337
RYR	0.7325	0.7217	0.7856	0.6908	0.7081	0.8420	0.7345
EZY	0.8364	0.8274	0.8710	0.8011	0.7962	0.8935	0.8037
VLG	0.7289	0.6488	0.7985	0.6739	0.6572	0.7378	0.7050
PGT	0.7297	0.7015	0.7979	0.6557	0.6955	0.7886	0.7348
WZZ	0.7105	0.6730	0.8052	0.6836	0.6539	0.7587	0.6629
EWG	0.8378	0.7043	0.8636	0.7072	0.7997	0.7662	0.7465
AEA	0.7313	0.6847	0.7799	0.6959	0.6872	0.7186	0.7136
BEE	0.9115	0.8570	0.9105	0.8368	0.8597	0.8533	0.8554
TRA	0.8429	0.8313	0.8902	0.7661	0.7621	0.8666	0.7951
CFG	0.7628	0.7419	0.8679	0.8192	0.7350	0.7693	0.7210
EXS	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
HLX	0.7850	0.7990	0.8524	0.8093	0.7763	0.7583	0.7731
VOE	0.9213	0.7623	0.8964	0.6881	0.9200	0.8433	0.7808

Table 7. Total relative evaluation levels

	$Q_i^{(1)}$	$Q_i^{(2)}$
RYR	0.7329	0.7317
EZY	0.8240	0.8234
VLG	0.6923	0.6910
PGT	0.7153	0.7141
WZZ	0.6920	0.6907
EWG	0.7648	0.7630
AEA	0.7070	0.7066
BEE	0.8643	0.8640
TRA	0.8096	0.8085
CFG	0.7652	0.7641
EXS	1.0000	1.0000
HLX	0.7899	0.7896
VOE	0.8223	0.8175

Table 8. Performance ranking of alternatives (Q_i) depending on different λ values

|	$\lambda = 0$	$\lambda = 0.1$	$\lambda = 0.2$	$\lambda = 0.3$	$\lambda = 0.4$	$\lambda = 0.5$	$\lambda = 0.6$	$\lambda = 0.7$	$\lambda = 0.8$	$\lambda = 0.9$	$\lambda = 1$	Ranking
RYR	0.732	0.732	0.732	0.732	0.732	0.732	0.732	0.733	0.733	0.733	0.733	9
EZY	0.823	0.823	0.824	0.824	0.824	0.824	0.824	0.824	0.824	0.824	0.824	3
VLG	0.691	0.691	0.691	0.691	0.692	0.692	0.692	0.692	0.692	0.692	0.692	12
PGT	0.714	0.714	0.714	0.714	0.715	0.715	0.715	0.715	0.715	0.715	0.715	10
WZZ	0.691	0.691	0.691	0.691	0.691	0.691	0.691	0.692	0.692	0.692	0.692	13
EWG	0.763	0.763	0.763	0.764	0.764	0.764	0.764	0.764	0.764	0.765	0.765	8
AEA	0.707	0.707	0.707	0.707	0.707	0.707	0.707	0.707	0.707	0.707	0.707	11
BEE	0.864	0.864	0.864	0.864	0.864	0.864	0.864	0.864	0.864	0.864	0.864	2
TRA	0.809	0.809	0.809	0.809	0.809	0.809	0.809	0.809	0.809	0.810	0.810	5
CFG	0.764	0.764	0.764	0.764	0.765	0.765	0.765	0.765	0.765	0.765	0.765	7
EXS	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1
HLX	0.790	0.790	0.790	0.790	0.790	0.790	0.790	0.790	0.790	0.790	0.790	6
VOE	0.817	0.818	0.818	0.819	0.819	0.820	0.820	0.821	0.821	0.822	0.822	4
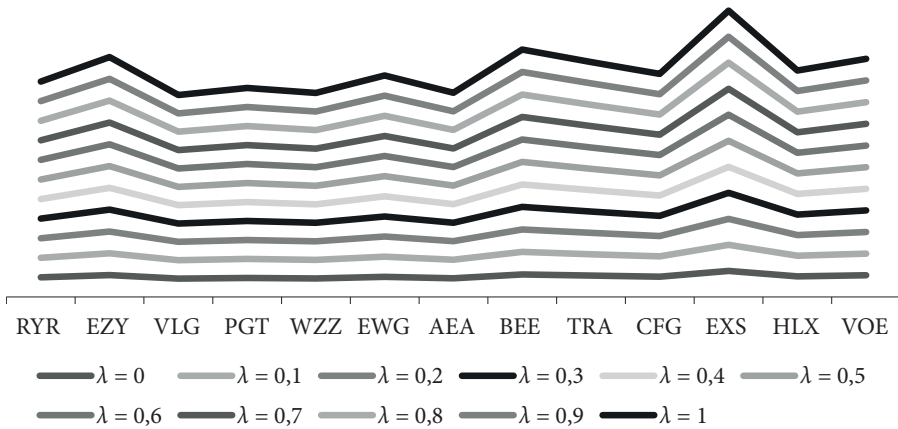
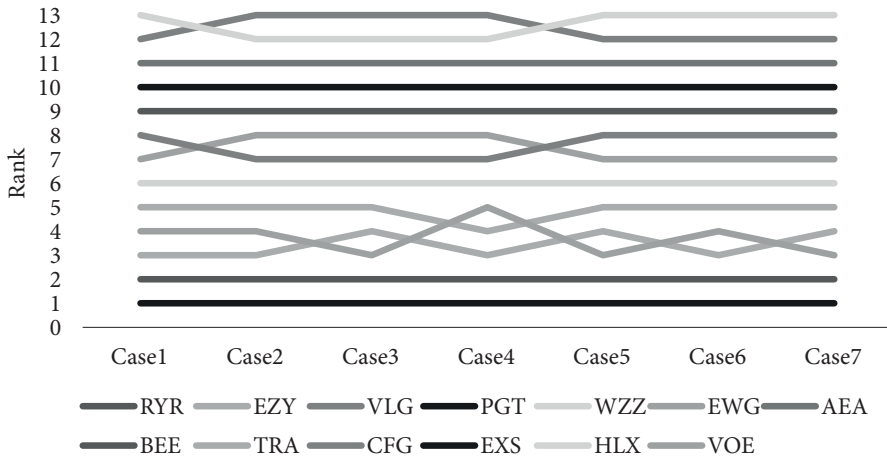**Figure 2. Effect of λ on the ranking of LCCs' SQ performance**

Figure 3. Stability of ranking in different cases

As seen in Figure 2 the change of the λ parameter does not change the overall ranking. Finally, in this section a sensitivity analysis based on the criteria weight is applied to verify the robustness of the application. In this context the weight coefficients assigned to each criterion are changed and the stability of the rankings is tested. The analysis procedure is based on the sensitivity model proposed by Ghorabaee, Amiri, Zavadskas and Antucheviciene (2018). Accordingly 7 cases (Case1-Case7) are simulated for 7 criteria. Sensitivity analysis is then applied to the weighted coefficients and the analysis output is presented in Figure 3.

Figure 3 shows that the ranking is sensitive to the change in weight coefficients. However it can be concluded that the change in the rankings is not dramatic. For example EXS is the best alternative in all cases. Similarly BEE ranks

second in all cases. On the other hand, it is seen that EZY and VOE share the third and fourth ranks in different cases. Similarly there are minor changes in some case transitions. Overall, sensitivity analysis supports the stability and validity of the calculation.

4. Discussion

One of the most important factors in the success of firms is how customers perceive the quality of goods or services. Therefore being aware of these perceptions will contribute to the longevity of businesses. However it is evident that businesses cannot read customer expectations sufficiently well (Kurtulmuşoğlu, Can & Tolon, 2016, p. 134). In this regard misreading or misinterpretation of anticipation leads to inappropriate use of available resources as well as diminishing the effectiveness of airlines. Of course it is practically impossible to meet all expectations. However prioritizing the most important service elements for the customers will be an important strategy in this respect. When this study is considered from the methodological point of view the coefficients obtained by the Entropy method denote the most important expectation factors and the data used in the WASPAS application denote how the customers perceive the service performance offered by the airlines.

In this study *legroom* is found to be the most important criterion for passengers. The second most important criterion for passengers is that of *food and beverages* followed by *customer service* and then *seat comfort*. The least important criteria are *value for money* and *cleanliness*. Consequently these results support the findings obtained in literature. In fact it is known that the most important criterion, *legroom*, is a physical element and that physical elements have come to the fore in various studies (Tsaur et al., 2002; Gupta, 2018). On the other hand the second most important criterion, *food and beverages*, reveals the importance of in-cabin services. Moreover in past studies it has been determined that the in-cabin service is a very effective area in which airlines can gain a competitive advantage (Tsantoulis & Palmer, 2008; Chen et al., 2011).

In 2000 the two largest airlines in the US introduced a new "coach class" cabin to increase legroom. This resulted in an increase in in-flight service quality yet airlines suffered an increase in CASM (Cost Per Available Seat Mile) value as in-flight seat capacity decreased (Lee & Luengo-Prado, 2004, p. 377). Therefore it can be said that legroom creates a unique dilemma between the financial situation and the service quality in the airline industry. The expansion of legroom intrinsically reduces seating capacity and increases the unit costs resulting in passengers having to pay extra. However it is clear that passengers are not willing to pay more due to high-price elasticity.

Despite the fact that the information sources for consumers are increasing nowadays, consumers believe in *f*-factors (friends, families, fans, follow-

ers) more instead of marketing communication tools. As a result of the growing *f*-factor belief customer-rating systems such as TripAdvisor and Yelp have achieved significant growth. While these systems allow consumers to evaluate the brands with which they interact, customers are also able to determine future purchasing decisions by using Francis Galton's "The Wisdom of Crowds" through these websites (Kotler, Kartajaya & Setiawan, 2017, p. 12,22). Hence it is thought that the use of TripAdvisor as an alternative data source in the study is quite reasonable in this respect. Consumers intrinsically benefit from the advice of other people because the airline industry is a service industry and it is impossible to test services. Today, while people benefit from TripAdvisor to ease purchasing and reduce potential risks, airline operators can use the customer voting system more effectively to influence consumer decisions to improve customer satisfaction.

Conclusions

Since airlines' success depends on the "voice of customers", meeting customers' expectations is vital in the service design process. This study presents an alternative approach to managers in that it demonstrates passengers' attitudes towards their service quality and their relative strengths and weaknesses against their competitors. From a managerial perspective with criteria weights denoting expected service quality, airlines may identify strategies to gain satisfactory service quality.

Some features of TripAdvisor which might be useful for airline managers are noteworthy. First, the website is a platform where passengers evaluate their airlines intensively. Passenger reviews on Tripadvisor include such information as destination, date, language, comments and rating. Owing to the passengers' reviews airlines can monitor the destination where they offer high or low service level and identify which expectations could not be met. Therefore airlines can benefit from these opportunities to promote their advertising and promotional activities. Furthermore TripAdvisor offers official accounts which would enable airlines to respond to passenger reviews. Airlines should use this function as an effective marketing communication channel.

Theoretically the key contributions of this study are: a) the use of Entropy-WASPAS methodology for the first time in the measurement of airline service quality, b) contributing to LCC literature by considering airline service quality as part of a strategic business model, c) the use of a very large sample in the evaluation of service quality.

This paper also presents some recommendations for future studies. TripAdvisor contains both quantitative and qualitative data that can be used in future studies. In addition to quantitative data researchers can use qualitative data to evaluate airline service quality through some methods such as text-

mining. Some information found in TripAdvisor, such as destination, flight, language and date can be used to compare the airline service quality of different regions and on different business models. Due to the lack of comparative studies in literature it is considered that such studies would contribute greatly. In addition, different MCDM methods may be adopted as a solution to counter the difficult nature of the evaluation of service quality.

This study also has some limitations. First, the evaluation criteria are based on TripAdvisor's passenger review system. However airlines provide a large number of services such as pre-flight, on board and post-flight services. Therefore this should not be forgotten when the findings are reviewed. Second, passengers of different ages, educational backgrounds and nationalities have different perceptions about the service criteria. In the study these differences are ignored since they are out of scope. Third, the results cannot be generalized to other airlines because they represent only the 13 LCCs. Therefore different results can be obtained in service quality evaluation of FSCs and even other LCCs. Finally, the findings only represent the period in which the data were obtained.

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