

Application of a Fuzzy Multiple Criteria Decision Making method to Selection of Low Cost Carriers

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Abstract: In the past few years, global airline industry has grown dramatically, and low cost carrier obviously become prosperous and gains enormous market shares of the airline travelling. Furthermore, low cost carrier has increased their competitiveness rapidly and earned significant market share from full service airline. The purpose of this study is to find the key criteria (both quantitative and qualitative) and to use a fuzzy multiple criteria decision making (MCDM) method to select low cost airlines in Asia as well as South East Asia by the ranking approach of centroid which was applied to complete the method. In addition, we hope that the results of this study could serve as a guideline for the managers of low cost airlines to effectively develop their marketing strategies in order to gain the competitive advantage and meet passenger's satisfaction.

Keywords: Fuzzy multiple criteria decision making, MCDM, Low-cost Carrier, LCC, Ranking, Centroid

1. Introduction

Air transport is a vital part of the total travel and tourism industry, and air services have played a major role in the growth of tourism in many parts of the world (Nadiri et al., 2008). Particularly, with the increasing competition and advancing technology air transportation became more affordable to wider ray of tourists (Sultan & Simpson, 2000).

Due to rapid industrialization and economic growth, spending power of people has increased manifold in past few decades. Also the working class prefers to travel through airlines to save their time (Jou et al., 2008).

Airline industry is considered as an important branch of air transportation. It is a typical service industry, being a part of aviation industry and focusing on moving people and cargo from one location to another. In former times, airline industry has gone through a significant remodeling in its structure. The competition in the airline industry is very intense. Currently, this strong competition forces the whole industry to rethink their marketing strategy to meet the demand of customers. Therefore, all airlines need to try hard to increase profit.

In recent years, the concept of low-cost carriers (LCCs), which originated in the United States, has spread to Europe, Australia, and New Zealand in the 1990s and to Southeast and South Asia in the early 2000s (O'Connell & Williams, 2005). This new wave of LCCs offers scheduled services that

directly compete with the traditional airlines. A survey conducted by Mason (2000) on UK travelers revealed that 40% of domestic passengers preferred to travel by low-cost airlines, substantiating the great demand for this particular mode of air travel.

2. Literature review

2.1. Low-cost Carrier

A low-cost carrier or low-cost airline (LCC or LCA) also known as budget airlines or "no-frills" airlines, are airlines that offer relatively low fares in exchange for eliminating many traditional services. One common feature is ticketless travel for cost-saving purposes (Yeung et al. 2013).

This helps to significantly reduce the cost of issuing, distributing, processing, and reconciling millions of tickets each year. There are different pricing strategies for LCCs, such as the simple fare scheme in which fares typically increase as the plane fills up, thus encouraging people to book their tickets earlier by enjoying the "come on" early-bird fares. Late-booking travelers are therefore usually charged higher fares (Collis, 2003)

The original low cost business model, as established by Southwest Airlines, is set out in Table 2.1

Table 2.1. The Original Low Cost Business Model in the Airline Industry, as Initiated by Southwest Airlines

Product Features	
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1. Fares/network	Low, simple and unrestricted fares, high frequencies, point to point, no interlining
2. Distribution	Travel agents and call centres (today internet sales), ticketless
3. In-flight	Single class, high density seating, no meals or free alcoholic drinks, snacks and light beverages can be purchased, no seat assignment
Operating Features	
1. Fleet	Single type, Boeing 737 types, high utilisation, 11–12 hour/day
2. Airport	Secondary or uncongested, 20–30 minute turnarounds
3. Sector length	Short, average 400 nautical miles
4. Staff	Competitive wages, profit sharing, high productivity

(Source: Alamdari and Fagan (2005, 378))

It is widely recognized that there have been many departures from this initial business model within the low cost airline sector in the US, Europe and Asia (Pate & Beaumont, 2007).

The LCC business model is typified by several cost reduction strategies (Vidovic et al., 2013). One cost reduction strategy is using a new, homogeneous fleet of medium range, medium-size aircraft (like Airbus A320 or Boeing 737), which enables the airline to reduce its operational and maintenance costs as well as realizing economies of scale. Other cost reduction and increased revenues include increased seat density, single-class service, elimination of on-board amenities such as free food and drink, and charging

for ground amenities like check-in or checked baggage. Furthermore, the LCC typically operates short-haul or medium-haul routes directly between destinations and often uses secondary destinations, such as smaller airports within a city or smaller cities located near major cities (Vidovic et al., 2013). These differences can result in 50% reduction in per passenger costs, which are then passed on in the form of lower fares.

Asia is one of the fastest-growing regions for LCCs with fierce competition between national and regional competitors such as Lion Air (Indonesia) and Air Asia (Bland, 2014). Part of this growth can be attributed to current under-service of large parts of Asia, despite its large population. However, the price of LCCs is also attractive in the region, with full-service carriers rapidly losing ground to their lower-priced competitors (Bland, 2014). This has resulted in rapid growth of LCCs in many countries, including Asian countries as well as South East Asia region.

2.2. Selected Criteria for Low Cost Carrier Evaluation

From all the factors that started in the previous study, there are 7 factors that are relevant and may consider for using in this study. The following table is the selected qualitative and quantitative criteria which will be used in this research.

Table 2.2. The selected qualitative and quantitative criteria which will be used in this research

	Evaluation Criteria	Description	Nature
Qualitative	Safety (C ₁) Gilbert & Wong (2003), Jiang (2013), Jou et al.(2008), Zhang (2011)	Perceived safety refers to the passenger’s impression of the airline and its general safety record. An airline’s safety record, especially a record of recent accidents, will influence passenger choice	Benefit
	Airline’s Image (C ₂) Atalık & Ozel (2007), Yeung (2012), Zhang (2011)	Image of the airline refers to the passenger’s general perception of the airline based on public knowledge and information (for example safety record). An airline’s public reputation will influence passenger choice.	Benefit
	On-time performance (C ₃) Atalı & Ozel (2007), Jiang (2013), Yeung (2012), Zhang (2011)	is on time without delay flights	Benefit
	In-flight Service (C ₄) Jiang (2013), Yeung (2012)	In-flight services (such as food and drink service, provide air condition, well arranged comfort seat, and easy-to-use shelf space for baggage during the whole journey)	Benefit
	Ground Service (C ₅) Chen & Chang (2005), Yeung (2012),	These services consist of all the activities such as the stage of gathering information about airports, airlines, flights; reservations and ticket purchases; airport check-in process	Benefit
Quantitative	Airfare (C ₆) Chang & Hung (2013), Chiou & Chen (2010), Jiang (2013), Yeung (2012),	Airfare is the passenger’s perception of the price of the ticket based on their available information. Price is often the main factor for LCC selection. However, sometimes it is a perception of low price, rather than a confirmed low price, that drives selection. LCC passengers are more price-sensitive than FSC passengers in general	Cost

	Flight Available and Frequencies (C _i) Atalik & Ozel (2007), Jiang (2013), Yeung (2012), Zhang (2011)	Route availability and convenience refers to the extent to which the passenger views the airline’s schedule and route offerings as appropriate for their needs. This factor includes passenger preferences for direct route and, if necessary, ease of transfer between airlines or routes.	Benefit
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2.3. Fuzzy Multiple Criteria Decision-Making (MCDM)

Fuzzy set theory was first introduced by Zadeh (1965) to deal with problems involving fuzzy phenomena. Fuzzy decision making is the decision making of approximating rather than exact reasoning. The importance of the fuzzy decision making obtains from the fact that most human decision makings, especially common-sense decisions, are approximate in nature.

Fuzzy multiple criteria decision-making is one of the important fields in decision analysis. It was introduced as a promising and important field of study in the early 1970’s. Criteria in fuzzy MCDM can usually be classified into subjective (qualitative) and objective (quantitative) ones. The ratings of various alternatives versus different subjective criteria and the important weights of different criteria are usually assessed in linguistic values represented by fuzzy numbers. Fuzzy MCDM (multiple criteria decision making) (Chen and Hwang, 1992) has been widely applied to resolve many problems under uncertain and multiple criteria environment. Some recent applications can be found in (Hu, 2009; Çifçi and Büyüközkan, 2011; Afkham, et al., 2012; Ghorbani, et al., 2013; Govindan, et al., 2013; Akdaget et al., 2014; Pak et al., 2015; Chiappa et al. 2016; Deveci et al., 2017). The final values of alternatives in most of the above fuzzy MCDM problems are usually still fuzzy numbers and these fuzzy numbers need a proper ranking approach to defuzzify them into crisp values for decision making. Thus, a ranking method is needed.

3. Results and discussion

The global airline industry has grown rapidly in recent years. Moreover, much of this growth could be attributed to the growth in low cost airline business model. The data from The International Air Transport Association shows that low cost airline business gained almost 25% of the worldwide market in 2014. Low cost airline will unceasingly continue to grow around the world so as to satisfy the strong demand on diverse air transportation (Ko, 2016).

Therefore, this intense competition exists not only within the full service airline business sector, which

they have to establish their own subsidiary low cost airlines, but also within the low cost airline business sector. Price is regarded as the most important strategy that it is able to neutralize the dominance of competitors, so as to maintain the market share against the rivals. However, low cost airlines may not make profits if the market is saturated with too many low cost airlines competing on the basis of price (Kim and Lee, 2010). Thus, it is necessary for the airlines to find the other effective strategies to gain the competitive advantages beyond the price war.

This research has proposed a fuzzy MCDM method to help LCCs to evaluate service quality and select the most suitable one, where ratings of alternatives as well as the importance of all criteria are assessed in linguistic values represented by fuzzy numbers.

In this research, a ranking approach based on Yager’s method is also proposed to defuzzify all the final fuzzy values for decision making. Ranking procedure of the proposed method has been developed, so airline industry could easily compute ranking values of the alternatives.

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