PRIORITIZING CRISIS MANAGEMENT APPROACHES IN THE AIRLINE INDUSTRY. EVIDENCE FROM GREECE

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ABSTRACT

The global airline industry has faced a considerable downturn, because of the recent COVID-19 pandemic crisis. Numerous measures had to be taken from governments and the airline industry itself in order to survive the pandemic crisis. The Greek airline industry is the main case of this study. The main goal of this study is to prioritize the appropriateness of crisis management approaches in the domestic airline market. To achieve that, Fuzzy MCDM (Multi-Criteria Decision Making) is employed (consequently a set of criteria and their weighting). The criteria are extracted using the thematic analysis and synthesis method gathering data from the international literature and news. The MCDM analysis is implemented in a fuzzy setting due to the inherent uncertainty in the airline market. The results of this study demonstrate that the actions better characterizing the crisis operations of the domestic airline companies fall under the knowledge-based management approach.

Keywords: crisis management; airline industry; uncertain environments; operations management; tourism industry; COVID-19

1. INTRODUCTION

In order to provide a good and sufficient definition of the concept "crisis", three basic perspectives have been identified in worldwide literature so far. These are the corporate-business management perspective, the organizational perspective, and the public administration perspective.

In the first perspective, corporate-business management, the definition of "crisis" is directly related to the two basic concepts that characterize a company, growth and survival. Two of the perspective's founders (Krystek, 1987; Schulten, 1995) describe a crisis as a process that results in a threat to the business's survival during or after the occurrence of an unanticipated phenomena or event, as well as one or more negative consequences on the business's growth rate. In addition to these approaches, Burtscher (1996) defines the crisis as a condition that endangers the company's strategic plan's implementation. Fink (2002) quotes a dual (and more optimistic) approach to this perspective, claiming that the crisis shapes new data that may bring the organization to a worse or better position in respect to the one before its emergence.

The organization-level perspective defines a crisis as an emergency situation that has a negative impact on the two main dimensions that characterize an organization, namely reputation and performance (Ziek, 2015). Furthermore, the same author mentions that significant conflicts between stakeholders emerge during the crisis. Using the same reasoning, Coombs (2019) defines a crisis as a series of unanticipated events that raise the insecurity of stakeholders' expectations. Furthermore, according to Combs (2019), the crisis might be economic, environmental, health-related, or even security-related, and it can cause considerable problems in the two distinctive characteristics of an organization, namely reputation and performance.

The third perspective is that of public administration, where the crisis is described as a circumstance in which public administration institutions and processes struggle to manage the crisis's consequences (Walby, 2015). According to the same author, the main types of crises in public administration are the following: a. the financial crisis, which is associated with the emergence of difficulties in financial governance, b. the economic crisis, which has an impact on macroeconomic figures, c. the fiscal crisis, which has a negative impact on public benefits, and d. the political crisis, which is associated with the malfunction of governance models.

In the international literature on crisis management, many elements are assigned in connection to the crisis stage (Rotting, 1976; Muller, 1986; Schulten, 1995; Smith, 2004). Coombs (2015) recently defined crisis management as a series of steps aimed at managing

the crisis and smoothing its effects at various levels. The same author attributes four major characteristics to the concept of "crisis management": prevention and preparation (in the pre-crisis phase), reaction (during the crisis), and revision (in the phase after the crisis). The following question emerges as a result of this definition. Is risk management a component of crisis management or an independent process? Dorfman and Cather (2013) define risk management as the process of identifying and managing risk in relation to company's strategic planning. This process includes setting goals, identifying risks, developing management techniques, establishing performance indicators, and monitoring growth. Wut et al. (2021), underline that risk management should be a critical step within the crisis management process. This results from the fact that one or more unaddressed risks may trigger a crisis.

In this research paper the aim is to analyze the crisis management approaches in the airline industry and to perform their prioritization using multi-criteria analysis. For the implementation of the prioritization, a set of criteria will be formulated as well as their weighting, which will be extracted from an analytical study of the international literature and news. The multi-criteria analysis will be implemented in a fuzzy environment due to the inherent uncertainty in the airline market. The result of the research will be a set of criteria for prioritizing crisis management approaches and the prioritization of these approaches in the Greek aviation industry. This method can also be applied to the international aviation industry.

The paper is organized as follows: In section 2, the international literature on crisis management approaches in general and in the aviation industry is analyzed. In section 3, the type of data used in the research (primary) as well as the steps of the applied methodology is described. In section 4 the findings of the study are listed in detail and in section 5 the discussion of these results in relation to previous studies on this topic. Finally, the last section concludes.

2. LITERATURE REVIEW

2.1. Crisis Management Approaches

As far as crisis management is concerned, it is considered that there are three phases. These are prevention, response and recovery (Hale et al., 2005). Managers must decide the tactics they will follow to manage the crisis, which will greatly influence the perception of interest groups about the company itself, with the main consideration being its reaction time (Alpaslan et al., 2009). The COVID-19 pandemic concerns the global tourism market as an

event that needs to be addressed with specific crisis management methods that include disaster and risk management (Wutet al., 2021). Albers and Rundshagen (2020) examined the COVID-19 responses from European airline companies and concluded that even though crises create new opportunities, takeovers are not expected as long as COVID-19 evolves.

Three dominant approaches to crisis management are found in international literature.

Knowledge management is a group of techniques for gathering, processing and managing information for a company or an organization (Grand and Girard, 2015). It is a set of steps aimed at achieving business goals such as increasing performance, better positioning in the market, adopting innovations and lessons learned for their future utilization (Gupta and Sharma, 2004). Many researchers have studied knowledge management as a reliable approach to crisis management (Alavi and Leinder, 2001; Wang, 2005; Evans and Elphic, 2005; Mistilis and Sheldon, 2006; Scott et al., 2008; Wang, 2009; Jia et al. al., 2011; Blackman et al., 2011; Jia et al., 2012; Paraskevas et al., 2013). The main function of this approach has to do with the identification of knowledge groups, the main knowledge management activities and processes and how this knowledge can be used to manage a crisis situation. This approach includes three stages. 1. Crisis prevention and planning (pre-crisis, pre-event/pre-dromal), 2. Strategic Implementation (during crisis, emergency-intermediate), 3. Resolution Evaluation and Feedback (post-crisis, long-term resolution and feedback). In the first stage, knowledge acquisition, creation and storage take place. The second stage includes knowledge retrieval, dissemination and application. In the third stage, knowledge internalization and feedback take place.

Another approach to crisis management is the lifecycle-based one. Coombs (2011) states that the lifecycle of a crisis should be separated into stages. Lauge et al. (2009), consider three main phases in the lifecycle of a crisis. The first is the pre-crisis phase where actions should be implemented in order to limit the risk that could lead to a crisis. These actions include signal detection where those in charge detect the signs and analyze them, crisis prevention where the looming crisis should be prevented to the maximum extent possible, crisis preparation where a plan should be drawn up to manage the crisis, continuous update of the plan, training of the crisis management team, identification of vulnerabilities and the development of communication structures. The second is the crisis-event phase where actions should be implemented to resolve the crisis. This phase includes crisis acknowledgment where crisis identification is done and crisis response where, depending on the type of crisis, an attempt is made to normalize the consequences and side effects of the crisis. The last phase is the post crisis phase where actions are implemented for crisis recovery, crisis evaluation and preparation for the next one. A set of significant applications

of this approach is indicated (Faunkler, 2001; Henderson, 2007; Sawalha et al., 2013; Tokakis et al., 2019; Paraskevas and Quek, 2019; Berbekova et al., 2021; Leta and Chan, 2021)

The last of the three approaches examined in this paper is the strategy-based management approach. Ritchie (2004) presenting such a crisis management approach emphasizes that for achieving effective crisis management, integrated strategic approaches should be employed. Despite the fact that the management of a sustained crisis presents differences in relation to the management of an immediate crisis, many similarities are observed regarding the stages of the crisis in its strategic management: 1. The pre-event stage, 2. the stage just after or before the crisis emergence aiming to the strategic reduction of crisis effects, 3. the stage related to resolving the crisis, 4. the stage related to the long term recovery and lessons learned for possible future crises. Despite the similarity in the stages of the crisis, the main characteristics and particularities of each crisis should be taken into account in the development of a strategy for crisis management and the satisfaction of all stakeholders. Many researchers have studied crisis management from a strategic perspective (Comfort, 2007; Davies and Walters, 1998; Huang et al., 2008; Johnston et al., 2007; Jones, 2016; Khan et al., 2008; Li et al., 2022; Momani and Alzaghal, 2009; Paraskevas et al., 2007; Sun et al., 2022; Wang and Ritchie, 2010; Wilks and Moore, 2003). The pillars of crisis management in this approach are: 1. Crisis prevention and planning which includes the preventive plan and the strategy plan, 2. Strategic implementation which includes strategic assessment, crisis communication, resource allocation, and stakeholders' satisfaction and 3. The resolution, assessment and experience gained which lead to normality.

The strategies followed in order to manage the COVID-19 crisis in the airline industry include the cutbacks, the persistence, the innovation and the exit. Cut referσ to the management of expenses and reductions of assets and its short-term survival organization, persistence refers to the way of maintaining the status quo of the company, innovation refers to renewing the company strategically and the exit refers to the cessation of a company's activities either in whole or in part (Albers, &Rundshagen, 2020).The importance of communication with customers and stakeholders during and following a crisis is emphasized by previous studies (Helm and Tolsdorf, 2013; Ham and Kim, 2019; Wei and Kim, 2021)

2.2. The Airline Industry

The main form of international tourism and travel is air transport (Papatheodorou, 2002). Due to the pandemic, which grounded airplanes for a long time, in recent years the heads

of airline companies have had to solve a particularly difficult exercise. They should manage to maintain the companies' competitive advantage, so that when the heavy cloud of the health crisis passes, they will be able to increase their market share or even not lose the existing one (Delevegos, 2022).International Air Transport Association (IATA) has shown that in 2020 the airline industry lost more than 118.5 billion dollars, with direct government interventions of 35 billion in Europe for the backing of the airline industry, and 70 billion in the USA and an average of 3-4 years is required for the full recovery (Reporters United, 2021).

According to IATA airlines will return to profit in 2023 for the first time since 2019, despite slowing global growth and as they recover from the crisis caused by Covid-19, the International Air Transport Association announced. After narrowing losses in 2022, airlines are expected to make a net profit of $4.7 billion in 2023. IATA General Director indicated that the main characteristic of the airlines during the Covid-19 crisis was resilience. Governments in many countries have had to bail out airlines as travel has ground to a halt to slow the spread of the coronavirus and the industry suffered losses of $137.7 billion in 2020 at the height of travel restrictions. IATA expects passenger traffic to return in 2023 to 85.5% of pre-crisis levels (Euronews, 2022).

More than 3,000 planes remained grounded, while travel was down more than 90%. This caused American Delta to lose almost 60% of its market value, while United Airlines lost 70%. In Greece, Aegean Airline’s market value fell by 45%. The losses of the major European airlines were similar (Ligerou, 2020).

Most airlines suffered huge losses from fuel price hikes in 2020 as demand soared during the Covid-19 pandemic and were left holding contracts for delivery at much higher prices (AirNews, 2021).

The tourist segment is expected to bring in $522 billion in revenue. The demand of the passengers is expected to reach 85.5% of 2019 levels during 2023. Much of this expectation considers the uncertainties of China's Zero COVID-19 policies. COVID-19 that constrain both domestic and international markets. However, passenger numbers are expected to exceed 4 billion since 2019, with 4.2 billion travelers expected to fly. Passenger return, however, is expected to decline (-1.7%) as lower energy costs are transferred to the consumer, although passenger demand growing faster (+21.1%) than passenger capacity (+18.0 %) (Rokou, 2022). The economic and geopolitical environment faces sundry potential and future risks to the outlook for 2023. The risk of some economies slipping into recession remains, although there are signs that there could be an easing of aggressive rate hikes to fight inflation from early 2023. Such a downturn could affect passenger and cargo services’

demand. Airlines have built pliability into their business models to handle economic accelerations and slowdowns that affect demand. The profitability of each airline is zero. Every passenger is expected to contribute an average of $1.11 to the industry's net profits. Global economic return continues to improve. The only region which has returned to profitability in 2022 is North America. Europe and the Middle East are the next two regions which joined North America in 2023, while Africa, Asia Pacific and Latin America will remain in the red (Rokou, 2022).

Nearly 70% of the passengers are traveling as much or more than before the COVID-19 pandemic, as per a recent poll revealed by IATA in eleven global markets. And, while the financial situation concerns 85% of travelers, 57% have no intention of curtailing their travel habits. 91% of the travelers said air connectivity is crucial to the economy, 90% indicated that air travel is necessary for modern life, while 87% believed that air travel has a positive effect on societies (Rokou, 2022).

Air ticket prices show a 22% increase in 2023 compared to 2022. It was preceded by a 21.7% increase in 2021-2022. One reason is inflation in Europe; another is high demand, the imbalance between supply and demand. As airlines run short of staff, which, as they seek to absorb losses from the pandemic, they do not intend to cover, the number of flights has decreased. At the same time, despite the economic difficulties caused by the energy crisis and punctuality, the demand for air travel is constantly increasing. The airlines face three serious problems: accumulated debts; very high salaries of their executives; doubling of the price of fuel. Indeed, in 2022 the price of fuel has increased by 50% from 2021. 1/3 of the price of an airline ticket represents the expense of kerosene. So, for example, Lufthansa will make 34,000 fewer flights this summer than in 2019 (Athens Voice, 2023).

2.3. Aegean Airlines Group

Greece closed its borders to international passengers on the 13th of March 2020. This caused a 98% reduction in flights to Greece, while billions of euros were owed to passengers for canceled flights (Aegean Group, 2021).

The COVID-19 pandemic, which spread to Europe and Greece on early 2020, is the most powerful shock the airline industry has ever faced. The main effect of the pandemic, the Aegean Airlines Group experience, was a rapid drop in flights' demand, because of its impact on demand for planning business or leisure travel and as a cause of unprecedented restrictive measures imposed by the governments for the restriction of the pandemic, during 2020 and 2021. The vaccination program and its growth rate and the implementation of the green certificate in Europe in 2021, smoothed out the business environment and consumer

behavior. From June 2021 and onwards, this had as a consequence the relaxation of the restrictive measures.

From the beginning of 2020, and throughout 2021, the Group immediately take the following actions:

- *Implementation of the necessary procedures for the best passengers and staff's protection and, under the new conditions of the pandemic.* This action is part of the lifecycle-based management approach and more specifically with the crisis-event phase where actions should be implemented to resolve the crisis.
- *Dynamic and flexible network management so that it adapts directly to the changing market conditions.*This action describes the strategy-based management approach, where integrated strategic approaches should be employed.
- *Consecutive negotiations with the main suppliers of products and services to manage cost reduction, but also to create adaptability and flexibility to changing conditions.*This action is taken through the knowledge-based management approach, where the business is trying to achieve business goals such as increasing performance and better positioning in the market.
- *Utilization of the state's horizontal measures for workers and businesses.*This is based on the lifecycle-based management approach and more specifically on the crisis-event phase where actions are implemented to resolve the crisis.
- *Capital and cash shielding.*This action refers to the strategy-based crisis management and the knowledge based crisis management approach.

Aegean Airlines since the beginning of 2021 supported the "National Operational Immunization Plan – Operation Freedom", transporting throughout the domestic network vaccines, the necessary accompanying personnel and equipment for the implementation of the vaccination program in the region. 717 flights were implemented with 786 free tickets.

In 2021, aiming to make it easier for young people to travel, Aegean undertook to "double" the value of prepaid Freedom Pass cards, while at the same time triple the Miles+Bonus miles of every flight that carried out using the Freedom Pass, contributing to the national effort to return to regularity through the vaccination program (Aegean Group, 2021).

The Group of the Aegean made all necessary adaptations to operational level to fully comply with all new health protocols. At the same time, they implement new enhanced health and safety measures but also aircraft decontamination process. Aegean Airlines introduced Hygiene Attendants, who took care of all the necessary safety and prevention measures. Hygienists assisted passengers to observe all safety measures during boarding, flight and

during disembarking and thereby ensuring that air travel remains the safest mode of travel not only for themselves but also for their fellow passengers and cabin crew.

Risk factors that may affect business and financial condition of the Group are the following:

- COVID-19 outbreaks or possible new mutations with consequent new travel restrictions.
- The European economy and Greece may negatively affect the tourism market and lead to a decline in air traffic.
- Geopolitical developments and turmoil in neighboring countries may negatively impact demand.
- Future oversupply of airline seats and intense competition could lead to a decline in average revenue per passenger as well as reduced flight occupancy.
- There may be significant increases in fuel costs.
- Possible imposition of environmental taxes or other charges and inability to pass on costs to end consumers (Aegean Group, 2021).

Aegean seeks to proceed with recruitment for specialties that do not only concern the cabin crew, but also support the wider operation of the airline. Namely, it is looking for data analysts for the commercial department, IT controllers, aircraft painters and people to staff the call centers. Airbus A320 pilots and co-pilots could not be missing from the list, with the airline's fleet consisting, until 2026 of 46 new Airbus 320 and 321neo. The airline seeks to create the new generation of pilots, with its new scholarship program in progress, with the aim that within the next three years 120 young men and women will become the future captains of Aegean and Olympic Air aircraft. According to aviation industry players, the broader goal is for the industry to boost its GDP footprint, which can only happen if airlines become a pillar of expertise. Sky Express is also recruiting, looking for captains for Airbus A320s and ATR turboprops. The airline is also looking for workers for cabin crew, IT and marketing departments, accounting and call center, among others (Delevegos, 2022).

3. DATA AND METHODOLOGY

Fuzzy approach was used to evaluate the collected data for the goals of this paper. To familiarize the reader with the methodology's principles, Fuzzy TOPSIS method is introduced.

3.1. Fuzzy Topsis Method

Chai et al. (2013) emphasized the usefulness of the fuzzy set theory in conjunction with Multicriteria Decision Making Analysis in modeling alternatives selection process in uncertain

conditions. Furthermore, as Chai et al. (2013) assert, the prevalent tendency in latest studies is to blend decision-making processes with the formulation of appropriate decision models to tackle complicated alternatives selection issues, particularly when there is uncertainty. This argument leads to the use of fuzzy TOPSIS (Chen, 2000) rather than the classic TOPSIS technique.

For the alternatives selection process, the Fuzzy TOPSIS approach is applicable. The use of this strategy results in the best approach selection, in accordance with the company's policy. The Fuzzy TOPSIS method's criteria are consistent with all of the financial and management restrictions imposed by the company's internal and external environments. Lima et al. (2014) emphasize the primary advantages of the Fuzzy TOPSIS approach over alternative MCDM method. To begin, they say that the insertion of alternatives has no effect on the final ranking in Fuzzy TOPSIS. This exhibits objectivity in the comparative evaluation of the alternatives. According to Lima et al. (2014), the additional criteria have no effect on the relevance of the criterion or their ranking order, and because the criteria matrix is constructed using the arithmetic mean of fuzzy numbers, any weight will never be zero. Furthermore, when it comes to the correlation of data supplied by decision makers, Fuzzy TOPSIS outperforms Fuzzy AHP. Additionally, an increase of decision makers leads to increased complexity when compared to Fuzzy AHP approach calculations. Lastly, Fuzzy TOPSIS has no limit on the number of options and criteria that may be applied.

Linguistic variables, which are produced as positive triangular fuzzy numbers, are employed for the weights of criteria and the evaluations of alternatives. The weight of each criterion in this technique can be specified either directly or by utilizing pairwise comparisons (Hsu and Chen, 1994). The decision makers consider the weights of the criteria and the ratings of alternatives in relation to the linguistic factors. Regarding the decision group, it consists of $\mathbf{k}$ decision makers $\mathbf{D_r(r = 1,..,k)}$. $\mathbf{W}$ describes the weights of $\mathbf{jth}$ criterion $\mathbf{Cj}$. $\mathbf{X_{ij}}$ describes the ratings of the $\mathbf{ith}$ alternative $\mathbf{Ai}$ with respect to criterion $\mathbf{j}$ by the $\mathbf{rth}$ decision maker. Lima et al. (2014), present the following steps for the Fuzzy TOPSIS method:

i. The first step consists in the aggregation of the criteria weights and ratings of the alternatives. Calculate the importance of the criteria and the rating of alternatives by using equations (1) and (2) :

$$w_j = \frac{1}{k}[w_j^1 + w_j^2 + \cdots + w_j^k] \quad (1)$$

$$x_j = \frac{1}{k}[x_j^1 + x_j^2 + \cdots + x_j^k] \quad (2)$$

ii. Create the fuzzy decision matrix using the criteria weights and alternative ratings from equations (3) and (4):

$$D = \begin{array}{c} \\ A_1 \\ A_2 \\ \vdots \\ A_n \end{array} \begin{array}{c} \begin{array}{ccc} C_1 & \dots & C_m \end{array} \\ \begin{bmatrix} x_{11} & \cdots & x_{1m} \\ \vdots & \ddots & \vdots \\ x_{n1} & \cdots & x_{nm} \end{bmatrix} \end{array} \quad (3)$$

$$W = \frac{1}{k}[w_1 + w_2 + \cdots + w_m] \quad (4)$$

The fuzzy choice matrix of possibilities is then normalized using a linear scale transformation. The fuzzy decision matrix is generated in its normalized version as follows:

$$R = [r_{ij}]_{m*n} \quad (5)$$

$$\widetilde{r_{ij}} = \left(\frac{l_{ij}}{u_j^+}, \frac{m_{ij}}{u_j^+}, \frac{u_{ij}}{u_j^+}\right) \text{ and } u_j^+ = max\ (x_i u_{ij}) \text{ - benefit criteria} \quad (6)$$

$$\widetilde{r_{ij}} = \left(\frac{l_j^-}{u_{ij}^+}, \frac{l_j^-}{m_{ij}^+}, \frac{l_j^-}{l_{ij}^+}\right) \text{ and } l_j^- = max\ (x_i l_{ij}) \text{ - cost criteria} \quad (7)$$

The weighted normalized decision matrix may be constructed by multiplying the criterion weights, w, by the elements, r, of the normalized form (from the fuzzy decision matrix).

$$\check{V} = [\check{v}_{ij}]_{m*n} \quad (8)$$

$$\check{v}_{ij} = x_{ij} * \check{w}_j \quad (9)$$

Using the following equations, define the Fuzzy Positive and Fuzzy Negative Ideal Solutions (FPIS,A+) and (FNIS,A-).

$$A^+ = \{\check{v}_1^+, \check{v}_2^+, \dots, \check{v}_m^+) \quad (10)$$

$$A^- = \{\check{v}_1^-, \check{v}_2^-, \dots, \check{v}_m^-) \quad (11)$$

Where $\check{v}_1^+ = (1,1,1)$ and $\check{v}_1^- = (0,0,0)$

The distances of options d j+ and d j- from v _j+ and v _j- must then be computed using the following equations:

$$d_j^+ = \sum_{j=1}^n d_v(\check{v}_{ij}, \tilde{v}_j^+) \quad (12)$$

$$d_j^- = \sum_{j=1}^n d_v(\check{v}_{ij}, \tilde{v}_j^-) \quad (13)$$

$$D(x,z) = \sqrt{\frac{1}{3}[(l_x - l_z)^2 + (m_x - m_z)^2 + (u_x - u_z)^2} \quad (14)$$

The closeness coefficient, CCi, is calculated next.

$$CCi = \frac{d_i^+}{d_i^+ + d_i^-} \quad (15)$$

Lastly, the ranking of alternatives based on the proximity coefficient calculation must be done in decreasing order, with the ideal option being closest to the FPIS and farthest from the FNIS. Chen's linguistic variables for weights (up) and alternative evaluations (down) are based on Chen's (2000):

Very Low – VL : (0, 0, 0.1)
Low – L : (0, 0.1, 0.3)
Medium Low – ML : (0.1, 0.3, 0.5)
Medium – M : (0.3, 0.5, 0.7)
Medium High – MH : (0.5, 0.7, 0.9)
High – H : (0.7, 0.9, 1)
Very high – VH : (0.9, 1, 1)

Table 1. Chen's linguistic variables for the criteria weights

Very Poor – VP: (0, 0, 1)
Poor – P : (0, 1, 3)
Medium Poor – MP : (1, 3, 5)
Medium – M : (3, 5, 7)
Medium Good – MG : (5, 7, 9)
Good – G : (7, 9, 10)
Very Good – VG : (9, 10, 10)

Table 2. Chen's linguistic variables for the alternatives evaluation

3.2. Criteria and Alternatives

The following criteria resulting from the thematic synthesis of the international literature and international news were used to analyze the above methods:

a. speed of implementation
b. ease of method
c. speed of results
d. implied cost
e. staff training time
f. best fitting the Greek airline industry
g. best fitting the hygienic crises (COVID-19)

The above criteria are also consistent with on the three, presented above, crisis management approaches

4. RESULTS

The linguistic variables are quantified via triangular fuzzy numbers as seen above. Following the Fuzzy TOPSIS method's steps (Tables 3-11) the final ranking of the alternatives can be computed. Five experts in the Greek airline industry were asked to give their opinions. Using the experts' criteria weights evaluations and the alternatives' ratings, the alternative 1 (knowledge-based management approach) results to be the optimal one (as shown in Table 11).

	Expert 1	*Expert 2*	*Expert 3*	*Expert 4*	*Expert 5*
Criterion 1	VH	VH	VH	H	VH
Criterion 2	VH	H	VH	VH	VH
Criterion 3	MH	MH	M	M	M
Criterion 4	ML	M	M	M	ML
Criterion 5	VH	VH	VH	H	VH
Criterion 6	VH	VH	VH	H	VH
Criterion 7	VH	VH	VH	VH	VH

Table 3. Expert ratings for the weights of criteria

W1			W2			W3			W5			W5			W6			W7		
0,86	0,98	1	0,86	0,98	1	0,38	0,58	0,78	0,22	0,42	0,62	0,86	0,98	1	0,86	0,98	1	0,9	1	1

Table 4. Weights of criteria for short-term level

Criteria	Scenarios	Experts				
		E1	E2	E3	E4	E5
	A1	G	VG	G	MG	G
C1	A2	M	MP	M	MP	MG
	A3	M	M	MP	MP	MP
	A1	MG	G	M	MG	VG
C2	A2	MP	M	MP	MP	M
	A3	M	M	MP	MP	M
	A1	M	M	M	MG	MG
C3	A2	M	MP	MG	M	M
	A3	G	G	MG	MG	MG
	A1	G	VG	G	VG	VG
C4	A2	P	P	P	VP	VP
	A3	VP	VP	VP	VP	MP
	A1	P	VP	VP	VP	VP
C5	A2	VG	VG	G	VG	VG
	A3	M	MG	M	M	M
	A1	G	VG	G	G	VG
C6	A2	P	P	P	VP	VP
	A3	VP	VP	P	VP	VP
	A1	MG	MG	MG	G	MG

C7	A2	MP	MP	P	VP	MP
	A3	P	P	P	P	VP

Table 5. Experts' Scenarios ratings for the seven criteria

	C1			***C2***			***C3***			***C4***			***C5***			***C6***			***C7***		
A1	7,0	8,8	9,8	5,8	7,6	9,0	3,8	5,8	7,8	8,2	9,6	10,0	0	0,2	1,4	9,0	10,0	10,0	5,4	7,4	9,2
A2	2,6	4,6	6,6	1,8	3,8	5,8	3,8	5,8	7,8	0	0,6	2,2	8,6	9,8	10,0	8,6	9,8	10,0	0,6	2,0	3,8
A3	1,8	3,8	5,8	2,2	4,2	6,2	5,8	7,8	9,4	0	0,2	1,4	3,4	5,4	7,4	8,2	9,6	10,0	0	0,8	2,6

Table 6. The fuzzymatrix

	C1			***C2***			***C3***			***C4***			***C5***			***C6***			***C7***		
A1	0,7143	0,8980	1,0000	0,6444	0,8444	1,0000	0,4043	0,6170	0,8298	0,8200	0,9600	1,0000	0	0,0200	0,1400	0,9000	1,0000	1,0000	0,5870	0,8043	1,0000
A2	0,2653	0,4694	0,6735	0,2000	0,4222	0,6444	0,4043	0,6170	0,8298	0	0,0600	0,2200	0,8600	0,9800	1,0000	0,8600	0,9800	1,0000	0,0652	0,2174	0,4130
A3	0,1837	0,3878	0,5918	0,2444	0,4667	0,6889	0,6170	0,8298	1,0000	0	0,0200	0,1400	0,3400	0,5400	0,7400	0,8200	0,9600	1,0000	0	0,0870	0,2826

Table 7. The fuzzy normalized matrix

	C1			***C2***			***C3***			***C4***			***C5***			***C6***			***C7***		
A1	0,6143	0,8800	1,0000	0,5542	0,8276	1,0000	0,1536	0,3579	0,6472	0,1804	0,4032	0,6200	0	0,0196	0,1400	0,7740	0,9800	1,0000	0,5283	0,8043	1,0000
A2	0,2282	0,4600	0,6735	0,1720	0,4138	0,6444	0,1536	0,3579	0,6472	0	0,0252	0,1364	0,7396	0,9604	1,0000	0,7396	0,9604	1,0000	0,0587	0,2174	0,4130
A3	0,1580	0,3800	0,5918	0,2102	0,4573	0,6889	0,2345	0,4813	0,7800	0	0,0084	0,0868	0,2924	0,5292	0,7400	0,7052	0,9408	1,0000	0	0,0870	0,2826

Table 8. The fuzzy weighted normalized matrix

	C1	*C2*	*C3*	*C4*	*C5*	*C6*	*C7*
A1	0,233	0,276	0,646	0,625	0,949	0,131	0,295
A2	0,576	0,621	0,646	0,948	0,152	0,152	0,784
A3	0,648	0,582	0,549	0,969	0,513	0,174	0,885

Table 9. Distances of Scenarios from S+

	C1	*C2*	*C3*	*C4*	*C5*	*C6*	*C7*
A1	0,847	0,815	0,436	0,440	0,082	0,924	0,801
A2	0,489	0,453	0,436	0,080	0,907	0,907	0,272
A3	0,416	0,493	0,546	0,050	0,552	0,891	0,171

Table 10. Distances of Scenarios from S-

A1	0,5943
A2	0,4249
A3	0,4457

Table 11. Clos0eness coefficient for each Scenario

5. CONCLUSIONS

This study focuses on the crisis management approaches in the airline industry and to perform their prioritization using multi-criteria analysis. For the implementation of the prioritization, a set of criteria formulated, which extracted from an analytical study of the international literature and news. The multi-criteria analysis implemented in a fuzzy environment due to the inherent uncertainty in the airline market. The result of this study was a set of criteria for prioritizing crisis management approaches and the prioritization of these approaches in the Greek aviation industry. This study and its results will be useful for policy makers and managers who are focusing on adapting new approaches to face a crisis in their business in an effective way.

Following are the findings that can be drawn for the Greek airline market from both the thematic synthesis used to examine how the Aegean Group handled the crisis, and the analysis of expert opinions through the Fuzzy TOPSIS method: The most effective approach for managing crises concern actions to sustain business operations, improve business performance, maintain and grow market share, adopt novel and best practices, and utilize the experience that was gained for a potential future crisis. The fact that the methodology has only been applied to the Greek market is a drawback of the current study. The usage of a specific MCDM approach, Fuzzy TOPSIS, is another restriction. As a direction for future research could be set a. the implementation of the proposed methodology in the global airline industry and b. the usage of an alternative MCDM method.

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