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Evaluation of key performance indicators of Indian airlines using fuzzy AHP method

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Abstract: Due to intense competition, decreasing profit margins and demanding customers in the air transport business, airlines have to measure their performance in order to remain competitive as well as sustainable in the airline market. The performance of an airline depends on many factors these are known as key performance indicators (KPIs). This study makes an attempt to evaluate the KPIs of airlines. Evaluation of KPIs is done using a combined approach based on fuzzy theory and analytic hierarchy process (AHP) method. A case example of Indian airlines is conducted to illustrate the proposed model applicability. The results of the study indicates that the priority order of the KPIs is SSR > OMR > CR > FBR, which show that safety and security related indicators are found most important in this priority list and financial and business related parameters ranked last. This study makes an important contribution to various airline companies by solving significant problems in order to enhance their performances in the competitive market with proposed methodology. This proposed method considered fuzzy framework that can handle impreciseness and uncertainty. Sensitivity analysis is also performed to test the robustness of the proposed model.

Keywords: key performance indicators; KPIs; airlines; fuzzy theory; analytic hierarchy process; AHP; India.

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1 Introduction

The air transportation industry has become essential for international trade due to the impact of globalisation on the international airline sector. As we know that, with an increase in international trade and business, the demand for air sector is also raising gradually as well. Also, tourism market has also a great impact on aviation business (Evler et al., 2021; Debbage, 1994).

Indian aviation industry is on a high-growth trajectory. India aims to become the third largest aviation market by 2026. As per ARG (2016), the air passenger market is estimated to increase from 3.8 billion to 7.2 billion from 2016 to 2035. In India, it has predicted air cargo market will grow approximately at 9% over the next few years (Mahtani and Garg, 2020). In FY15–16, the growth in international passengers and domestic passengers market is 8.33% and 22% respectively. India has become the world's fastest-growing domestic travel market and replaced Japan to become the third largest domestic aviation market globally. It is expected in the FY 2017–18, domestic air traffic will grow approximately 25% and cross 130 million (Mahtani and Garg, 2018).

Due to a major contribution to the economy is given by airline sector, measuring the performance of the airline sector is essential for the current competitive market. Thus, various KPIs need to identify which can be used analyse and understand the performance of any airline company. But the data taken from the financial reports will not be enough to understand the performance of the airline as it will provide a limited range of information about the components. Therefore, we also need to consider up to non-financial performance indicators also while analysing the performances of airline companies (Simon, 2021; Perera et al, 1997). Many authors have utilised different models to measure the performance of the airlines; these authors have applied DEA to measure the performance of number of airlines (Zhang et al., 2021; Merkert and Hensher; 2011; Mallikarjun, 2015; Cui and Li, 2015). In today's competitive environment all around the globe including India in airlines industry, airline operators need to focus on efficiency and effectiveness in order to improve airlines performance.

1.1 Research motives

There are dearth of such studies which can evaluate the KPIs of airline industry including financial as well as non-financial indicators simultaneously. Moreover, there are few studies which have assessed airlines KPIs in Indian context. This inspired us to analyse the KPIs including financial and non-financial indicators of airlines companies of India.

This exploration has a few targets, as hereunder:

- To identify and finalise the KPIs specific to Indian airlines.
- To prioritise and analyse the identified KPIs.

To support the above, we propose to identify and investigate the KPIs of Indian airlines. This study makes an attempt to recognise relevant KPIs of airline industry. After identification of those KPIs; this work classify and finalise the most significant KPIs of Indian airlines. After that the analysis of KPIs is being done by prioritising them using Fuzzy analytical hierarchal process (AHP) model. Data analysis may be difficult under vagueness so we propose a fuzzy set theory with AHP method. The AHP is a commonly used method under multi-criteria decision making (MCDM) but it is unable to provide a better understanding of a linguistic variable rated through Likert scale pertaining to confusion in opinion under exploratory studies. Therefore it is recommended to use the integrated fuzzy AHP concept to meet desired objectives (Mahalik, 2014; Garg, 2016).

The rest of the paper is planned as follows. Part 2 concisely reviews the literature on the identification, classification and finalisation of KPIs of Indian airlines. The research methodology of fuzzy AHP approach is discussed in Part 3. Part 4 represent the analysis of result and discussion with managerial implications. Sensitivity analysis is reported in part 5. Finally, part 6 provides the conclusions, limitations and future scope of the study.

2 Literature review

2.1 Performance measurement in airline industry

Performance measurement analysis of the companies is very important and critical for their survival and growth in today's competitive and dynamic business environment. Performance measurement of the firms provides future courses of actions and how well the firms are doing as compared to their rivals (Gunasekaran et al., 2004). But many firms are poor in details and insight about performance measurement framework. Firms are not fully aware about tools, metrics and key parameters which are very crucial and significant for effective performance measurement. Due to high taxation and fuel charges, extremely price sensitive and overcapacity; aviation market of India is treated as toughest aviation markets in the world (Saranga and Nagpal, 2016). Therefore, it is imperative to measure the performance of the airline sector in today's time. Additionally, Owing to hyper competition, global nature and demanding customers in airline business; airlines of India are trying to concentrate on key indicators which can improve their performance. There are many authors who have applied different models such as regression, DEA, multivariate analysis, MCDMs and SEM to analyses the performance of the airlines in different countries as highlighted in Table 1.

Table 1 Recent studies on airlines performance

S. no.	*Authors*	*Key performance indicator*	*Modelling technique*	*Country*
1	Wang et al. (2011)	Operation performance of airlines, efficiency of US airlines	Truncated-regression model, data envelopment analysis, multivariate analysis	Taiwan
2	Martin and Esteban (2007)	Potential influences of market orientation on airline performances	MARKOR scale	Spain
3	Tavassoli et al. (2014)	Operational performance of airline with production and consumption technologies	SBM-NDEA Model	Iran
4	Saranga and Nagpal (2016)	Impact of technical efficiency for market performance of airline companies	Data envelopment analysis	India
5	Chow(2015)	Actual on-time performance	Regression	China
6	Mellat-Parast et al. (2015)	Customer delays and arrival delays impact on revenue of airlines	Regression	US
7	Pate and Beaumount (2006)	Effective human resource management for airline performance	Descriptive statistics	Europe
8	Lee et al. (2013)	Corporate social responsivities activity	Regression	US
9	Greenfeild (2014)	Effect of competition on airline on-time performance	Regression	US
10	Dinçer et al. (2017)	Balanced scorecard based performance analysis of European airlines	Fuzzy DEMATEL, Fuzzy ANP, MOORA	Turkey
11	Liou et al. (2007)	Airline safety measurement	Hybrid model	Taiwan
12	Fernández-Muñiz et al. (2009)	Occupational safety management	Structural equation model	Spain
13	Dursun et al. (2014)	Economic stability for airline performance	Descriptive statistics	Turkey

Source: Compiled by authors

2.2 Identification of key performance indicators (KPIs)of Indian airline industry

This study has reviewed the papers which have considered both the key parameters, i.e., financial and non-financial in order to understand the performance of Indian airline companies.

2.2.1 Customer related KPIs

Airline performance depends on the customer relations. The relationship with customers depends on the change in profit amount of the company in comparison with the number of customers (Wu and Liao, 2014; Barros and Peypoch, 2009; Dinçer et al., 2017). Lin and Hong (2006) suggested that available seats and number of passengers reflects the success of an airline company in attracting customers. Customer loyalty and their retention indicator reflect customer relations with airlines which ultimately affect the performance of the airlines (Liou et al, 2007; Dinçer et al., 2017). Additionally, destinations covered by the airlines would attract more number of customers (Garg, 2016). Airlines performance also depends on how the airlines are performing economically and financially which would reflect a return on equity is a very important aspect in this regards (Wang, 2008; Dinçer et al., 2017).

2.2.2 Finance and business related KPIs

Airline economic performance depends on the return on assets, net profit, increased profit over a period of time and current asset ratio (Dinçer et al., 2017). These measures and ratio show the liquidity power of a company to pay its short-term obligation (Wang, 2008). Furthermore, the debt ratio would reflect the sound financial position of the firm. Higher debt ratio refers to the situation of higher financial risk (Feng and Wang, 2000; Dinçer et al., 2017). Operational performance refers to the ability of an airline company to generate profit as a percentage of its total employees (Liou et al., 2007). On time flying performance reflects the efficiency of the airline companies (Dinçer et al., 2017).

2.2.3 Operations and marketing related KPIs

The marketing performance of the airlines depends on net sales revenue of that airline and increase in net sales as compared to the previous years (Wu et al., 2009). On another operational performance, the parameter has identified the size of the fleets and total flights operated by the particular airline (Lin, 2008; Dinçer et al., 2017). Safety and Security aspect is the prime importance in the airline business. This aspect includes occupational accidents that interrupt the operational process which leads to both types of risks including financial and opportunity costs (O'Connell and Williams, 2005; Fernández-Muñiz et al., 2009).

2.2.4 Safety and security related KPIs

Retention ration of the airline shows unsafe working environment of the firm which would affect the performance of the firm. Furthermore, number of flight accidents examines distort the firm's image and reputation provoking a severe deterioration in its public relations (Gunningham and Sinclair, 2009; Fernández-Muñiz et al., 2009). The service quality of the airline affects the operational and marketing performance of the airline as a consequent decline in the firm's performance (Fernández-Muñiz et al., 2009). There are quite a number of studies regarding airline industry performance. The identified various KPIs are highlighted in Table 2.

Table 2 Identified KPIs of the airlines

S. no.	*KPIs*	*Code*	*Sub-dimensions*	*References*
1	Customer related	CR1	Profit per customer	Wu and Liao (2014)
		CR2	Number of seats/ Number of passengers	Dinçer et al. (2017)
		CR3	Customer loyalty and retention	Dinçer et al. (2017)
		CR4	Number of destinations	Garg (2016)
		CR5	Customer feedback	Prakash et al. (2015)
2	Operations and marketing related	OMR1	Profit per employee	Feng and Wang (2000), Dinçer et al. (2017)
		OMR2	On-time performance	Cho and Lee (2011)
		OMR3	Sales Performance	Wu et al. (2009); Shaverdi et al. (2013)
		OMR4	Number of flights/ Number of fleets	Lin (2008); Dinçer et al. (2017)
3	Finance and business related	FBR1	Return on equity	Liou et al. (2007), Wang (2008)
		FBR2	Return on asset	Lin (2008)
		FBR3	Growth in profit	Wang (2008)
		FBR4	Current ratio	Dinçer et al. (2017)
		FBR5	Debt ratio	Dinçer et al. (2017)
4	Safety and security related	SSR1	Occupational accidents	Fernández-Muñiz et al. (2009), Liou et al. (2007)
		SSR2	Attrition rate	Fernández-Muñiz et al. (2009)
		SSR3	Number of flight accidents	Garg (2016)
		SSR4	Service quality	Prakash and Barua (2016b)

Source: Compiled by authors

2.3 Fuzzy AHP in the diverse area

In this study, Fuzzy AHP approach has been used to analyse KPIs of Indian airlines. This fuzzy based integrated AHP method would enable us to deal with problems of vagueness, and the biasness associated with human judgment in analysing KPIs, which is difficult in classical AHP (Khatri and Metri, 2016; Garg et al., 2017; Prakash and Barua, 2016b). Moreover, modelling the real life situations precisely using crisp data is critical. Hence, this fuzzy assessment and multiple experts' inputs are employed to cope up with uncertain information and impreciseness in evaluation of KPIs (Gupta et al., 2017). There is enough evidence available in literature to show that many authors and researchers have used fuzzy AHP methodology in diverse areas (for example, the studies of Sengar et al., 2018; Prakash and Barua, 2015, 2016a; Vishwakarma et al., 2015, 2016; Prakash et al., 2015a, 2015b).

Since AHP has been used in many management decision making areas (Luthra et al., 2017) which can be seen in Table 3, and there are number of the studies available which justifies the integration of Fuzzy theory with AHP in order to improve decision

framework and research outcomes. Hence, considering the highlighted significance this study used fuzzy AHP methodology for evaluating KPIs in airline industry.

Table 3 Recent studies used Fuzzy AHP approach in diverse area

S. no.	*Author (Year)*	*Use of fuzzy AHP*	*Application area*
1.	Wang et al. (2012)	Fuzzy AHP	Risk analysis for adoption green practices in the fashion supply chain
2.	Shaverdi et al. (2013)	Fuzzy AHP	Evaluation and development of sustainable supply chain model
3.	Rezaei et al. (2014)	Fuzzy AHP	Supplier selection for the airline industry
4.	Gold and Awasthi (2015)	Fuzzy AHP	Sustainable supplier selection considering risk
5.	Vishwakarma et al. (2015)	Fuzzy AHP	Prioritised the quality dimensions under technological integration of pharmaceutical supply chain, India
6.	Prakash et al. (2015)	Fuzzy AHP	Prioritised the TQM enablers to improve Indian airlines performance
7.	Vishwakarma et al. (2016)	Fuzzy AHP	Risk analysis of pharmaceutical supply chain, India
8.	Prakash and Barua. (2017)	Fuzzy AHP	Barrier analysis of reverse supply chain, electronics industry, India
10.	Vishwakarma et al. (2017)	Fuzzy AHP	Barrier analysis of pharmaceutical supply chain, India
11.	Prakash and Barua (2016c)	Fuzzy AHP	Supplier selection in reverse supply chain
12.	Kumar and Garg (2017)	Fuzzy AHP	Evaluation of critical success factors for implementing sustainable supply chain
13	Amrita et al. (2018)	Fuzzy AHP	Evaluation of critical success factors of women entrepreneurship in Indian MSMEs
14	Raghuvanshi and Garg (2018)	Fuzzy AHP	Evaluation of innovation capability factors of Indian MSMEs
15	Garg and Kashav (2019)	Fuzzy AHP	Assessment of the factors of greening the global maritime supply chain
16	Vishwakarma et al. (2019)	Fuzzy AHP	Assessment of the barriers of pharmaceutical supply chain of India
17	Garg (2020a)	Fuzzy AHP	Evaluation of the airport service quality indicators

Source: Compiled by authors

2.4 Research gap

There are numerous studies available on KPIs of airlines in developed countries. Many studies have tried to identify and suggest critical dimensions of KPIs in different business. But these dimensions may vary from country to country and industry to industry. Even the same dimension requires different handling and primacy for same type of organisations due to varied nature of resources, capabilities and strategies. Review of

literature found that many authors and researchers are showing interest to analyse the KPIS in different fields. Based on previous studies, this paper finds, there is a lack of qualitative studies/articles from developing countries, especially from India. Moreover, Indian aviation industry has emerged as a fast growing sector. This sector is contributing highly in overall travel and tourism industry. Moreover, Govt. initiatives such as UDAAN scheme, promoting to increase regional connectivity as well as overall network expansion. Hence, airlines sector wants to increase its contribution into tourism as well as service industry and provide more opportunities to provide safe, secure, economical and effective air transport service in India. Further, previous work has diversified into the sub categorisation of the issue laying partly in considerations of its financial KPIs, losing the essence of the holistic concept of the KPIs including financial and non-financial in Indian airlines. It is also confirmed that fuzzy AHP has extensive application in diverse areas. There is various application of fuzzy AHP as highlighted in Table 3 but there is no such study found till date which has evaluated KPIs in Indian airlines and presented sensitivity analysis in Indian context.

3 Research methodology

In this work Fuzzy AHP method is applied to prioritise and assess the recognised specific KPIs of Indian airlines as shown in Figure 1.

Figure 1 Flowchart for fuzzy AHP analysis (see online version for colours)

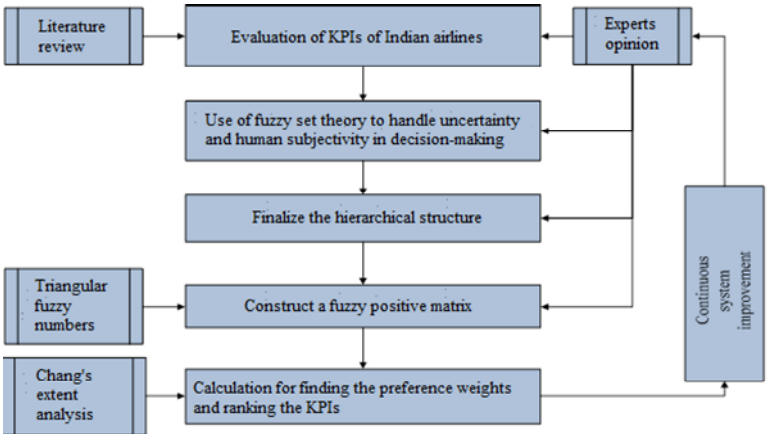


Figure 1 highlights the process to evaluate the KPIs of airlines. Initially, identification of KPIs has been done through in-depth literature analysis and followed by discussions with industrial experts. After that KPIs are assessed by using FAHP and ranking of specific KPIs are obtained. All computations are discussed below. The further process has been given in the subsequent sections.

3.1 Identification and finalisation of KPIs

The extensive literature search has been done to identify the KPIs. After literature review on KPIs of airline industry and brainstorming sessions 4 main KPIs evaluation criteria

along with 18 sub-criteria were presented to group of the experts for validation. This decision group has finalised them. All in all, they seem to be satisfied with the list and were not agreed for including any other. Hence, a total of 18 KPIs sub-criteria under 4 main criteria relevant to the performance of airline industry were selected. In the process of data collection, an expert panel of 8 professionals was formed. It consists of airline top management personnel; middle and senior level managers, airport personnel, distributor and consultants. The selection of professionals was decided on the basis of certain criteria such as their individual industrial and consultancy experiences, qualification level (helpful in decision making skills), expertise in area, (their background), etc. Identified professionals are highly skilled personnel in their field and having good airline operations and management knowledge.

3.2 Fuzzy AHP

AHP approach is a numerical approach to multi-criteria decision making. The application of AHP has few drawbacks due to its uses in a crisp environment, measurement scale is not stable, and impreciseness exists along with its subjective nature. This necessitates a fuzzy environment to answer such problems (Prakash and Barua, 2015; 2016a; 2016c; Ocampo, 2017). In the fuzzy AHP approach, there is always an error and lack of clarity in judging linguistic variables. By the application of fuzzy approach, this uncertainty can be reduced (1965). In reality, triangular fuzzy numbers (TFNs) are frequently used as given in Table 4.

Table 4 TFN matrix

Linguistic variables	*Allotted TFN*
Equally	(1, 1, 1)
Very lower	(1, 2, 3)
Lower	(2, 3, 4)
Medium	(3, 4, 5)
Higher	(4, 5, 6)
Very higher	(5, 6, 7)
Excellent	(7, 8, 9)

Chang's extent analysis (1992) is the FAHP process, according to this approach, the values of extent method for each criterion gi are obtained by using following notation.

$M_{g_i}^1, M_{g_i}^2, M_{g_i}^3, \ldots, M_{g_i}^m$ (i = 1, 2, 3, 4, 5 ,…, n and j = 1, 2, 3, 4, 5 ,…, m) in TFNs and followings are the steps of Chang's analysis:

Step 1 The fuzzy synthetic extent value (S_i) with respect to the i^{th} criterion is defined as,

$$S_i = \sum_{j=1}^{m} M_{g_i}^j \times \left[\sum_{i=1}^{n} \sum_{j=1}^{m} M_{g_i}^j \right]^{-1} \tag{3.1}$$

where l is the lower limit value, m is the most promising value and u is the upper limit value.

Step 2 The degree of possibility of

$S_2 = (l_2, m_2, u_2) \geq S_1 = (l_1, m_1, u_1)$ is defined as below

$$V(S_2 \geq S_1) = \sup_{y \geq x} \left[\min \left(\mu_{s_2}(x), \mu_{s_2}(y) \right) \right]$$

and x and y are the values on the axis of the membership function of each criterion.

Step 3 The degree of possibility for a convex fuzzy number S to be greater than k convex fuzzy numbers S_i ($i = 1,2,\ldots, k$) can be defined by

$$V(S \geq S_1, S_2, \ldots, S_k)$$

$$V\left[(S \geq S_1) \text{ and } (S \geq S_2) \text{ and } (S \geq S_k) \right]$$

$$\min V(S \geq S_i), i = 1, 2, \ldots, k$$

$$\text{Assume that } d'(Ai) = \min V(S_i \geq S_k) \tag{3.2}$$

For $k = 1, 2, \ldots, n$, $k \neq i$, Than the weight vectors are given in equation 3.3 as,

$$W' = (d'(A_1), d'(A_2), ..., d'(A_m))T \tag{3.3}$$

Step 4 Via normalisation, the normalised weight vectors are given in equation 3.4 as,

$$W = \left(d(A_1), d(A_2), ..., d(A_m) \right) T \tag{3.4}$$

4 Analysis of results

4.1 Calculation of the value of fuzzy synthetic extent

Experts have assigned ratings for 4 KPIs and 18 sub-KPIs, as given in Table 4 through the questionnaire (please refer to Appendix). The TFN pair-wise matrix of the KPIs is specified in Table 5. The fuzzy comparison matrices by computing arithmetic mean of these values of KPIs and final weights of the KPIs (please see Table 5).

Table 5 Pair-wise matrix for specific KPIs category

KPIs	*CR*	*OMR*	*FBR*	*SSR*	*Preference weights*	*Ranking*
CR	(1, 1, 1)	(1, 2, 3)	(1, 2, 3)	(0.2, 0.25,0.33)	0.2595	3
OMR	(0.33, 0.5, 1)	(1, 1, 1)	(1, 2, 3)	(1, 2, 3)	0.2666	2
FBR	(0.33, 0.5, 1)	(0.33, 0.5, 1)	(1, 1, 1)	(1, 2, 3)	0.1876	4
SSR	(3, 4, 5)	(0.33, 0.5, 1)	(0.33, 0.5, 1)	(1, 1, 1)	0.2862	1

Source: Fuzzy AHP Analysis

Fuzzy value of 4 KPIs is obtained by using equation (3.1).

$$S(CR) = (3.2, 5.25, 7.33) \otimes [13.87, 20.75, 26.33]^{-1}$$
$$= (0.121, 0.253, 0.529)$$

$$S(OMR) = (3.33, 5.55, 7) \otimes [13.87, 20.75, 26.33]^{-1}$$
$$= (0.126, 0.265, 0.504)$$

$$S(FBR) = (2.66, 4, 5) \otimes [13.87, 20.75, 26.33]^{-1}$$
$$= (0.101, 0.192, 0.36)$$

$$S(SSR) = (4.66, 6, 7) \otimes [13.87, 20.75, 26.33]^{-1}$$
$$= (0.177, 0.289, 0.504)$$

Minimum possibility degrees (V values) are obtained by using the equation 3.2, 3.3 respectively.

m(CR) = min $V(S_1 \geq S_k)$ = 0.9068 and other values are

m(OMR) = 0.9315,

m(FBR) = 0.6555,

m(SSR) = 1

Weightage values of KPIs are given by:

$$W_v = (0.9068,\ 0.9315,\ 0.6555,\ 1)^T$$

Final weightage values are calculated after normalisation –

$$W = (0.2595,\ 0.2666,\ 0.1876,\ 0.2862)$$

Table 6 Ranking of KPIs of CR

KPIs	*Preference weights*	*Ranking*
CR1	0.3637	1
CR2	0.0558	5
CR3	0.2572	2
CR4	0.1295	4
CR5	0.1938	3

Table 7 Ranking of KPIs of OMR

KPIs	*Preference weights*	*Ranking*
OMR1	0.2424	3
OMR2	0.2616	2
OMR3	0.1995	4
OMR4	0.2965	1

Table 8 Ranking of KPIs of FBR

KPIs	*Preference weights*	*Ranking*
FBR1	0.2510	2
FBR2	0.1241	4
FBR3	0.2222	3
FBR4	0.3137	1
FBR5	0.0890	5

Table 9 Ranking of KPIs of SSR

KPIs	*Preference weights*	*Ranking*
SSR1	0.4527	1
SSR2	0.1087	3
SSR3	0.3937	2
SSR4	0.0450	4

Table 10 Final ranking for specific KPIs

KPIs category	*Relative preference weights*	*Relative rank*	*Specific KPIs*	*Relative preference weights*	*Relative ranking*	*Global preference weights*	*Global ranking*
CR	0.25954	3	CR1	0.36370	1	0.09440	3
			CR2	0.05584	5	0.01449	17
			CR3	0.25720	2	0.06676	6
			CR4	0.12947	4	0.03360	13
			CR5	0.19379	3	0.05030	10
OMR	0.26661	2	OMR1	0.24240	3	0.06463	7
			OMR2	0.26159	2	0.06974	5
			OMR3	0.19953	4	0.05320	9
			OMR4	0.29648	1	0.07905	4
FBR	0.18763	4	FBR1	0.25098	2	0.04709	11
			FBR2	0.12414	4	0.02329	15
			FBR3	0.22216	3	0.04168	12
			FBR4	0.31368	1	0.05886	8
			FBR5	0.08904	5	0.01671	16
SSR	0.28622	1	SSR1	0.45267	1	0.12956	1
			SSR2	0.10870	3	0.03111	14
			SSR3	0.39366	2	0.11267	2
			SSR4	0.04497	4	0.01287	18

4.2 Discussions and practical implications

The diligent efforts have been made in order to find and evaluate there KPI's using AHP technique under fuzzy conditions as shown in the results (See Table 5). The diagraph of

this fuzzy based AHP framework is shown through Figure 2. The ranks of identifying KPIs quite stand on realistic grounds, as illustrated throughout the studies as supported by the literature. The priority order came out as SSR > OMR > CR > FBR. The results of FAHP analysis show that safety and security related indicators are found most important in this priority list and finanacial and business related parameters ranked last. In the global ranking of the specific KPIs are furthermore identified, calculated and ranked on the respective global weights (See Table 10). The global ranking was determined by the multiplication of preference weights of specific KPIs and respective category respectively. Later, the research finding was analysed again by our team of experts aiming to interpret and furthermore develop some insights to analyse the KPIs which could help the robustness of airline industry which helps them to enhance their overall performance.

If we analyse global ranking we could see that top five globally weighted specific KPIs are SSR1>SSR3>CR1>OMR4>OMR2. This indicates that occupational accidents (SSR1) indicator ranked first which required higher concentration from airlines. Airline management need to focus on safety and security asect of aircrafts in order to get good performance. It also shows that safety and security related, customer related and operations and marketing related indicators are having largest impact as compared to others. SSR4 occupies the last rank which can be interpreted as least impacting KPI.

The safety and security related indicators (SSR) are ranked first which shows these indicators are most important as compared to other KPIs. The purpose of this study is to identify various KPIs which can help airline industry to improve their performances with respect to customer relations, operations and marketing, financial and business relations and safety and security relations of any airline company. The ranking under this categories is SSR1 > SSR3 > SSR2 > SSR4. Among the safety and security related KPIs (SSR), occupational accidents (SSR1) is identified as an utmost indicator which can improve the airline performance. This indicator depends on how airlines are managing their operational process and curbing incidents and accidents through efficient safety and security measures. The number of flight accidents (SSR3) occupies second priority under safety and security related category because the effect of a number of flight accidents can lead to the distortion of firm's image and reputation provoking a severe deterioration in its public relations (Gunningham and Sinclair, 2009; Fernández-Muñiz et al., 2009). With a due understanding of current scenario of the airline industry, other subfactors of specific KPIs (SSR2, SSR4) are yet to gain importance as shown by our analysis.

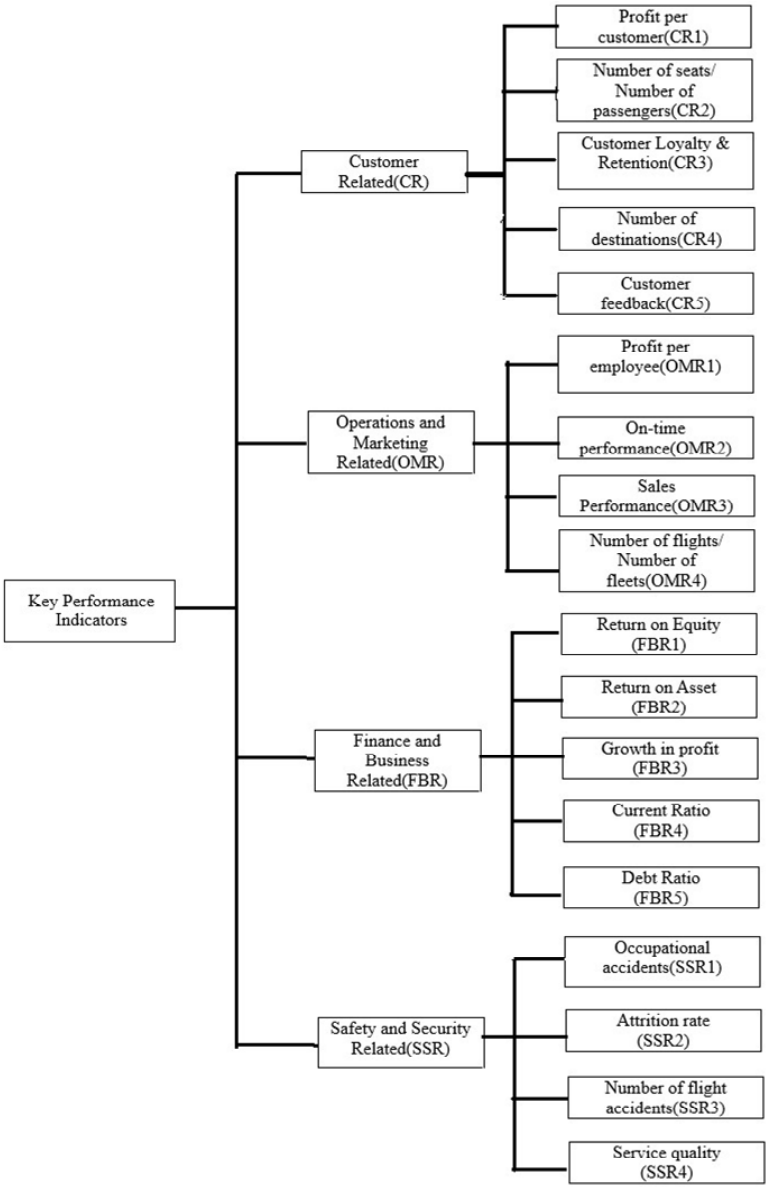
Operations and market related (OMR) KPIs are the third most impactful indicators which are related to sales revenue of that airline and the size of the fleets and total flights operated by the particular airline. It occupies a higher rank in both criteria ranking as well as global ranking. Within this category, sub-indicators ranked as OMR4>OMR2>OMR1>OMR3. In this category OMR4, i.e., numbers of total flights and number of fleets shows the connectivity and destinations covered by airline which determine the performance of the airlines (Dinçer et al., 2017). Similarly importance of the other indicators in this category can be understood as per priority rating obtained in this category.

The customer relations KPIs occupies third in performance analysis of airline industry which is shown by our expert's response. The ratio of 'profit per customer' is the global concern as it gives information about the increase or decrease in the profit amount of the company in comparison with the number of customers (Wu and Liao, 2014; Barros

and Peypoch, 2009). Other sub-indicators priority ratings are as follows CR1>CR3>CR5>CR4>CR2.

Financial and business related occupies last place on the rating on KPIs for Indian airline industry which specifically focuses on the overall business perspectives. Within this criteria listed ranks are as follows FBR4>FBR1>FBR3>FBR2>FBR5. The current ratio is the highest priority here followed by return on equity, growth in profit, and return on asset and debt ratio. Similarly importance of the other indicators in this category can be understood as per priority rating obtained in this category.

Figure 2 Fuzzy AHP – based hierarchal structure



5 Sensitivity analysis

Sensitivity analysis is needed to validate the outcome of the study. It verifies the robustness of the proposed model. Sensitivity analysis is executed to assess the ranks of specific KPIs by changing their weights (Garg, 2021; Garg, 2020b; Garg and Sharma, 2020). This indicates that amongst all KPIs, the SSR KPIs receives the first rank with high priority weights (please see Table 5). So this factor has the potential to influence other factors. Hence, it is advised to examine the final ranking by altering the weights of all KPIs (Prakash and Barua, 2016a, 2016d; Luthra et al., 2017, 2018). To demonstrate the sensitivity analysis of influence of an increment in the value from 0.1 to 0.9, to the SSR KPIs, was determined as given in Table 11. The sensitivity analysis conclusions indicate that the highest relative change showed up in the FBR KPIs (for details please see Table 11). Further, as SSR KPIs category weights vary, the specific KPIs category weights and their final ranking were also affected. In sensitivity analysis, when the value of SSR KPIs category is 0.1, CR1 acquires the first rank, while, the final rank is held by SSR4. At normalised level when individual factor value is 0.2862, SSR1 occupies the first rank, while, SSR4 acquired the last rank. Again the factor SSR1 holds the first rank when individual factor value is 0.3 and 0.4, while SSR4 holds the last rank. Now onwards individual factor value varies from 0.5 to 0.9, SSR1 acquires first rank and last rank is held by FBR5. The placing of other KPIs in the ranking also varies (for details please see Table 12 and Figure 3). At this circumstance, it may be conclusive to say that SSR KPIs category is most crucial in the airlines business in the case of India, and so, greater concentration is needed. If the airlines need to focus more on safety and security related indicators in order to improve their business performance.

Figure 3 Rankins of specific KPIS (see online version for colours)

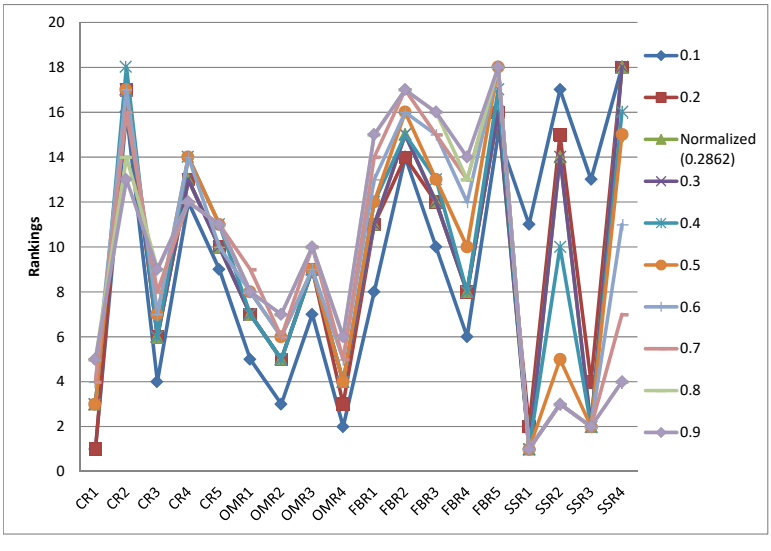


Table 11 Factors category values when increasing SSR category

Listed factors category	*Values of preference weights for listed KPIs category*								
CR	0.3216	0.2883	0.2549	0.2216	0.1883	0.1549	0.1216	0.0883	0.0449
OMR	0.3287	0.2954	0.2620	0.2287	0.1954	0.1620	0.1287	0.0954	0.0520
FBR	0.2497	0.2164	0.1830	0.1497	0.1164	0.0830	0.0497	0.0164	0.0030
SSR	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
Total	1	1	1	1	1	1	1	1	1

Table 12 Ranking for specific factors by sensitivity analysis when individual factor varies

Identified Factors	*SSR category values in performing the sensitivity analysis test*									
	0.1	*0.2*	*Normalised (0.2862)*	*0.3*	*0.4*	*0.5*	*0.6*	*0.7*	*0.8*	*0.9*
CR1	1	1	3	3	3	3	4	4	5	5
CR2	16	17	17	17	18	17	17	16	14	13
CR3	4	6	6	6	6	7	7	8	9	9
CR4	12	13	13	13	14	14	14	12	12	12
CR5	9	10	10	10	11	11	10	11	11	11
OMR1	5	7	7	7	7	8	8	9	8	8
OMR2	3	5	5	5	5	6	6	6	7	7
OMR3	7	9	9	9	9	9	9	10	10	10
OMR4	2	3	4	4	4	4	5	5	6	6
FBR1	8	11	11	11	12	12	13	14	15	15
FBR2	14	14	15	15	15	16	16	17	17	17
FBR3	10	12	12	12	13	13	15	15	16	16
FBR4	6	8	8	8	8	10	12	13	13	14
FBR5	15	16	16	16	17	18	18	18	18	18
SSR1	11	2	1	1	1	1	1	1	1	1
SSR2	17	15	14	14	10	5	3	3	3	3
SSR3	13	4	2	2	2	2	2	2	2	2
SSR4	18	18	18	18	16	15	11	7	4	4

6 Conclusions and further scope of the study

Airlines performance measurement has been gaining attention in global to local arena. Indian airlines are facing stiff competition from both international and domestic air carriers; they are also sensing the necessity to evaluate KPIs. While considering all these aspects, it can be said that the present study tries to add in the literature, through identifying the KPIs for airline industries in India. The findings of this study are useful for industry and management to become more capable in terms of improving their performances in this competitive world. The identified parameters are prioritised using

fuzzy AHP approach. The analysis of data by FAHP will assist managers to overcome performance-related problems and enhances the value as well as increases the efficiency in the competitive world of business. The priority wise, we identified four categories of KPI as, SSR>OMR>CR>FBR. According to this study, it is recommended that Indian airline industries should firstly focus on the safety and security related factors followed by the operational and marketing, customer relations and financial business related factors respectively. In other words, with the help of this model companies can assess KPIs and balance with good efficiency and profitability.

With respect to airline industry the present study attempts to evaluate significant KPIs of Indian airlines. The major limitation of the current study is the expert panel considered for the study has a limited count of participants and future researches may increase the number for more extensive results.

The present study considers evaluation of 18 KPIs of Indian airlines so this study provides the scope for future researches to consider more factors and further strengthen the framework. Different MCDM approaches may be applied using several approaches such as ANP, ISM, MAUT and TOPSIS for the similar problem and outcomes/results can be matched in the further studies.

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Appendix

Questionnaire form to facilitate the comparison of KPIs with respect to goal (Similar types of questionnaire are used for sub-criteria w.r.t. each criterion) due to space constraint only 1 sub criteria are presented and other sub-criteria questionnaire is not given:

KPIs	*CR* *Equal (1, 1, 1)* *Very Low (1, 2, 3)* *Low (2, 3, 4)* *Medium (3, 4, 5)* *High (4, 5, 6)* *Very high (5, 6, 7)* *Excellent (6, 7, 8)*	*OMR* *Equal (1, 1, 1)* *Very Low (1, 2, 3)* *Low (2, 3, 4)* *Medium (3, 4, 5)* *High (4, 5, 6)* *Very high (5, 6, 7)* *Excellent (6, 7, 8)*	*FBR* *Equal (1, 1, 1)* *Very Low (1, 2, 3)* *Low (2, 3, 4)* *Medium (3, 4, 5)* *High (4, 5, 6)* *Very high (5, 6, 7)* *Excellent (6, 7, 8)*	*SSR* *Equal (1, 1, 1)* *Very Low (1, 2, 3)* *Low (2, 3, 4)* *Medium (3, 4, 5)* *High (4, 5, 6)* *Very high (5, 6, 7)* *Excellent (6, 7, 8)*
CR	--			
OMR		--		
FBR			--	
SSR				--

KPIs of CR criteria

Criteria code	*CR1* *Equal (1, 1, 1)* *Very low (1, 2, 3)* *Low (2, 3, 4)* *Medium (3, 4, 5)* *High (4, 5, 6)* *Very high (5, 6, 7)* *Excellent (6, 7, 8)*	*Cr2* *Equal (1, 1, 1)* *Very low (1, 2, 3)* *Low (2, 3, 4)* *Medium (3, 4, 5)* *High (4, 5, 6)* *Very high (5, 6, 7)* *Excellent (6, 7, 8)*	*Cr3* *Equal (1, 1, 1)* *Very low (1, 2, 3)* *Low (2, 3, 4)* *Medium (3, 4, 5)* *High (4, 5, 6)* *Very high (5, 6, 7)* *Excellent (6, 7, 8)*	*CR4* *Equal (1, 1, 1)* *Very low (1, 2, 3)* *Low (2, 3, 4)* *Medium (3, 4, 5)* *High (4, 5, 6)* *Very high (5, 6, 7)* *Excellent (6, 7, 8)*	*CR5* *Equal (1, 1, 1)* *Very low (1, 2, 3)* *Low (2, 3, 4)* *Medium (3, 4, 5)* *High (4, 5, 6)* *Very high (5, 6, 7)* *Excellent (6, 7, 8)*
CR1	--				
CR2		--			
CR3			--		
CR4				--	
CR5					--