

Assessment of Airports: An Expert View Using Analytic Hierarchy Process (AHP) Analysis.

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ABSTRACT

The airport assessment gains its importance in recent time due to the competitive terrain along with the shift in airport ownership patterns. An effective airport assessment process helps identify which airports are most suited to provide continuous air travel services, instructing authorities to monitor investment utilization, reduce operating costs, increase market share. It also gives airport administrators a wealth of information about their relative strength and weakness in comparison to other rivalry airports. Given that most research focused on evaluating airport performance from the perspective of passengers, the present study made an attempt to gain insight from the expert point of view by applying Analytic Hierarchy Process (AHP) method. By surveying the experts who possess the required knowledge and expertise from the field of aviation, and by performing the pairwise comparison, the weight of importance of each criterion for airport assessment is calculated. And based on the criteria the two airports in Kerala (Cochin International Airport and Calicut International Airports) under consideration are evaluated and ranked. It is found that the passenger service is the most important criteria of airport assessment and the Cochin International Airport is ranked first compared to Calicut International Airport.

Keywords: Airport, Performance Assessment, Analytic Hierarchy Process (AHP)

JEL Classification: L93, L25, C44

INTRODUCTION

Airport efficiency evaluation has been a rapidly expanding field of research in recent years. Considering the intricate nature of airport operations, developing a suitable system to gauge performance is challenging (Eshtaiwi et al., 2018; Humphreys & Francis, 2002).

The necessity of airport performance assessment was further highlighted by the transfer of ownership to the PPP model. By privatizing several of its airports and emphasizing the provision of high-quality services at its airports, India has taken on this trend (Prakash & Barua, 2016). Additionally, there are multiple reasons for evaluating airport performance, including assessing the operational and financial effectiveness of different airport components, verifying the safety and to evaluate potential environmental effects of airport operations and to implement security measures (Humphreys & Francis, 2002).

The ability to provide services that not only match but also exceed the quality that customers demand is one of the largest problems facing airport operators today, on a global scale (da Rocha et al., 2022). In the end, an effective airport assessment process helps identify which airports are most suited to provide continuous air travel services, instructing authorities to monitor investment utilization, reduce operating costs, increase market share. It also gives airport administrators a wealth of information about their relative advantages and disadvantages in comparison to other participating airports (Barros & Dieke, 2008).

The aviation industry in Kerala is now witnessing an up growth with its four airports where majority of the airports are either privatized or in the verge of privatization. Therefore, it demands a neutral ground of assessment of the airports to compare the status internally and externally. Although a large body of research has been done on airport evaluation, most of it has been from the viewpoint of the passengers. It is also evident that many of the research pertaining to airport

evaluation making use of various Multi Criteria Decision Making Models instead of the conventional methodologies. To evade the aforementioned status of studies, the current study is attempting to gather information from experts in order to prioritize the criteria for evaluating airports and select the best airport out of the two from Kerala by applying Analytic Hierarchy Process. After surveying the experts in the field and performing the pairwise comparison using AHP method, the two alternatives (Calicut and Cochin International Airports) are assessed and ranked along with ranking of selected airport assessment criteria.

LITERATURE REVIEW

A growing amount of concern is being expressed regarding the assessment of airports worldwide which in turn demanding the attention of the researchers to address the same. Prior literatures have centered on various key aspects relating to an airport ranging from its service quality, service performance, safety and security, to economic and environmental aspects etc. (Bezerra & Gomes, 2016b). Increased interest in ASQ has triggered the empirical literature to refocus on the different measurement technique (Correia & Wirasinghe, 2004).

The airport industry was first exposed to efficacy rating literature in the middle nineties, having previously been applied to many other industries (Gillen & Lall, 1997). Numerous articles with various themes and approaches have been published then. The multi criteria decision making model is associated with an emerging class of approaches that ascertain preference between alternatives concerning a given set of objectives and the literature on airport efficiency is hardly ever using these methods (Lai et al., 2015). The aviation industry began to employ these techniques more frequently after 2020s. Wang et al. (2004) made use of one of the MCDM technique called TOPSIS to assess the performance of Taiwan's airports. Frontier analysis techniques have proven to be by far the most widely used method for evaluating efficiency. These techniques determine a frontier of efficiency and measure inefficiency in relation to it. The most widely used of the related techniques is DEA (Lai et al., 2015). Major other frontier methods are also used by many authors like stochastic frontier method (Oum et al., 2008), total factor productivity index method (Hooper & Hensher, 1997), Bayesian dynamic frontier model (Yoo & Choi, 2006) etc.,

Numerous studies ranked and prioritized the options using various multi-criteria decision-making techniques in various settings (Prakash & Barua, 2016). Yoo & Choi (2006) used the Analytic Hierarchy Process (AHP) technique to analyze and rank the security aspects of passenger travel at airports, he discovered that personnel elements took precedence over infrastructure and procedural dimensions. Yeh & Kuo (2003) by employing a fuzzy MCDM framework, 14 significant international airports in the Asia-Pacific area were assessed for traveler service quality aspects, and recommended evaluation tactics for those airports were provided.

METHODOLOGY

Step 1: Criteria Selection

As a first phase of applying AHP analysis, the necessary criteria, based on which the pairwise comparison of expert is being made, is selected. A thorough review of literature served as the foundation for this action. It would have been challenging to employ a very large number of indicators in the validation survey. Five criteria were thus chosen for the pairwise comparison. Following the meticulous scrutiny of the literature review, four crucial criteria are found as follows

Table 1

Details of Selected Criteria

Criterion	Reference	Details
Financial perspective	Humphreys & Francis, (2002); Eshtaiwi et al. (2018)	An airport's financial performance that takes revenue and expenses into account
Passenger services	Bezerra & Gomes. (2016a); Humphreys & Francis. (2002);	Various elements of passenger satisfaction in connection to the

	Lozano et al. (2013); Eshtaiwi et al. (2018)	quality of services rendered.
Safety and Security	Enoma & Allen. (2007); Andersson Granberg and Munoz (2013); Eshtaiwi et al. (2018)	Indicators in this field are employed to monitor incidents as well as human-generated threats like crimes and acts of terrorism.
Airside area	Yu et al. (2008); Lozano et al. (2013); Fan et al. (2014); Eshtaiwi et al. (2018)	Refers to an airport's movement area, which includes its taxiways, runways, and aprons, for example, aircraft movements and logistical operations.

Step 2: Conducting questionnaire survey with experts

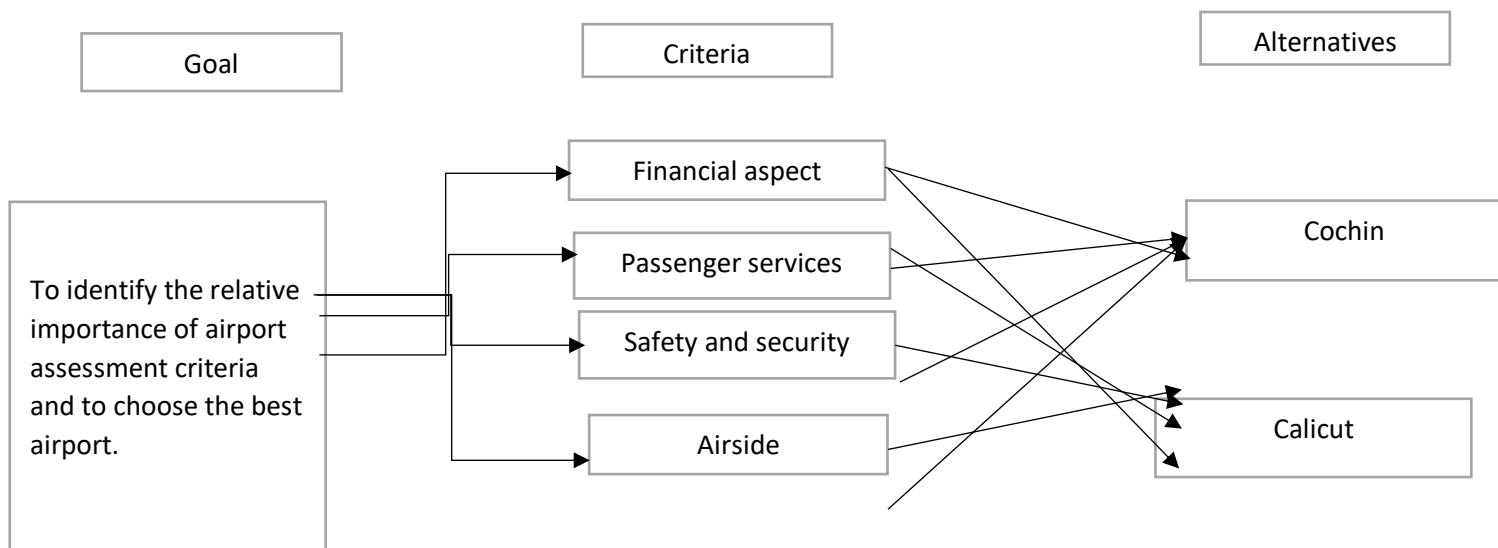
A questionnaire is prepared and distributed to the experts in the area of aviation who is having more than 10 years of experience in the respective field like airline, ground handling companies and various departments (safety and security, ATC, Operational, Planning etc.) at airports in Kerala. Since it is a decision technique, the number of respondents is not mandatorily very large. So, the researcher purposively chosen five experts from the field who possess the required knowledge and experience.

Step 3: Develop an AHP Hierarchy

Analytic Hierarchy Process (AHP) is one of the most prevalent Multi Criteria Decision Making Technique which was initially developed by Thomas L Saaty (Saaty, 1990). AHP has received a lot of attention as a useful tool for illustrating and resolving difficult decision-making scenarios across many industries (Eshtaiwi et al., 2018). In the present study the researcher made use of an AHP methodology to calculate the respective weights for the major criteria of an assessment of airport and to chose the best alternative from the two airports in Kerala. So as an initial action to apply AHP, the researcher developed an AHP Framework to organize the problem in a hierarchy which is shown in Figure 1.

Figure.1

AHP Hierarchy



Step 4: Pairwise Comparison

The experts are asked to perform a pairwise comparison among all the criteria using Saaty scale (developed by Thomas L Saaty in 1990) ranging from 1 (equal importance) to 9 (extreme importance) as shown in Table No.2. There are also some intermediate values to compromise between the extreme values.

Table 2

Scale of relative importance (Saaty, 1990)

Intensity of Importance	Definition
1	Equal Importance
3	Moderate Importance
5	Strong Importance
7	Very Strong Importance
9	Extreme Strong Importance
2,4,6,8	Intermediate values (For compromise between the above values)

For the pairwise comparison two criterion took up at a time. That is, financial aspect to passenger services, financial aspects to the airside area, financial aspects to safety and security, and financial aspects to the environmental aspects like that. Then carryout a pairwise comparison to the alternatives (Calicut and Cochin Airport) also. Both the alternatives compared with each other pair only based on each criterion.

Each element in the matrix A is divided by the total of its corresponding columns to ascertain the weights of the each criteria and the specific weight of each criterion is then determined by taking the average of each rows of the matrix (Al-Hubhi, 2001; Eshtaiwi et al., 2018).

$$A = \begin{bmatrix} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2n} \\ \dots & \dots & \dots & \dots \\ a_{n1} & a_{n2} & \dots & a_{nn} \end{bmatrix} \quad (1)$$

Step 5: Consistency Check

In the next phase the consistency check should be performed where the Consistency Index (CI), lambda max value and the Consistency Ratio (CR) is calculated. The Consistency Ratio is calculated by using the following formula

$$CI = \frac{(\lambda_{max} - n)}{(n-1)} \quad (2)$$

Where n is the number of criteria and the lambda max value is calculated by dividing the aggregate weight by the corresponding elements in weight column or it is said to be the principal eigen value of the matrix.

After the determination of CI, then the Consistency Ratio (CR) is to be calculated. The consistency ratio is calculated by dividing the CI (Consistency Index) with RI (Random Index) as shown in equation (3).

$$CR = \frac{CI}{RI} \quad (3)$$

RI is a value selected from the standard table depending upon the n (number of criteria being compared)

Table 3**Random Index Table** (Saaty and Vargas, 2012)

n	1	2	3	4	5	6	7	8	9	10
RI	0	0	0.52	0.89	1.11	1.25	1.35	1.40	1.45	1.49

If the consistency ratio is less than or equal to 0.10 (up to 10%), it is acceptable. That is the matrix is consistent and the calculated weight can be accepted. If the determined CR value is more than 10%, the researcher wants to move back, revise the data and go back to the respondent and get questionnaire filled again until the required consistency meet.

RESULTS

The results of Analytic Hierarchy Process show that all pairwise comparison matrices and are consistent since the $CR < 0.10$. It indicates that the weight is acceptable. The Table 4 represent the weights of each criterion of airport assessment. From the results obtained, it is understood that the passenger service has relatively more important weight with the value of 0.4907. It is followed by airside facilities with a weight of 0.2867. Then safety and security and financial aspects ranked third and fourth with weight of 0.2025 and 0.0498 respectively.

Table 4**Result of AHP for Criteria of Airport Assessment**

Criteria of Airport Assessment	Weights
Financial Aspect	0.0498
Passenger Services	0.4607
Safety and Security	0.2025
Airside	0.2867

With respect to the AHP analysis about selecting the best international airports from the two available alternatives, Cochin ranked first. The weights obtained is shown in Table 5. Cochin International Airport got the highest weight of importance with the value of 0.6056 followed by Calicut airport with 0.4943 as weight of importance. The AHP analysis carried out here is actually based on the judgement of five experts in the field. The final ranking may be improved by accommodating a large number of experts during the survey. The results allow the individual airports to compare their performance internally to the airport assessment criteria and externally to the competitors in order to improve their performance.

Table 5**AHP Result for Airport Assessment**

Airport	IATA Code	Weights	Rank
Cochin	CCJ	0.6056	1
Calicut	COK	0.4943	2

CONCLUSION

The competitive environment and accompanying change in airport ownership have led to a global surge in interest in airport evaluations. Given that most research focused on evaluating airport performance from the perspective of passengers, the present study made an attempt to gain insight from the expert point of view by applying Analytic Hierarchy Process (AHP) method. By surveying the experts who possess the required knowledge and expertise from the field of aviation, and by performing the pairwise comparison, the weight of importance of each criterion for airport assessment is calculated. And based on the criteria the two airports under consideration are evaluated and ranked. Among the four criteria under

consideration the passenger services are found to be relatively important, followed by airside facilities. The criterion safety and security and financial aspect ranked third and fourth respectively. While comparing the alternative weights the Cochin International Airport is ranked first compared to Calicut International Airport. It is noted that the Cochin airports falls under the category of airport which is having private participation. The Analytic Hierarchy Process (AHP) is performed purely based on the judgement of five experts. The increased number of experts in the survey process may bring much more consistency in result. In short, the research will undoubtedly assist to perform an internal assessment of relevant criteria of the respective airports as well as an external evaluation with rivalry airports and to stack up against the comparable standards.

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