



RESEARCH ARTICLE

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AIRLINE SELECTION - USING THE AHP FOR CUSTOMER CRITERIA EVALUATION

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ABSTRACT

Considering the growth of demand in the air sector it is important to verify factors that can be determinant from the point of view of the customer in the choice of the air operator. The method adopted in this research was bibliographic research and literature review on the themes and criteria established with the application of the AHP method. The research consisted of a study of 5 (five) criteria that can influence the customer when choosing an air operator. The focus of the work was based on the application of the AHP method for the decision-making process of the most indicated air operator facing the alternatives presented. The method used demonstrated effectiveness by answering the proposed initial question. The AHP method allowed structuring the problem, comparing criteria and calculating data consistency. The use of the method consisted in the integration of information facilitating decision-making. Additionally, the method indicated which would be the best alternative, from the viewpoint of the customer, for the choice of the air operator.

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INTRODUCTION

According to data from the National Civil Aviation Agency (ANAC) in 2018 Brazilian airlines carried 103 million passengers on domestic and international flights, an increase of 4.1% over the number of passengers transported in 2017 (98.9 million). In domestic flights 93.6 million passengers were transported in 2018, an increase of 3.3% before the year 2017. In international flights, the high number of passengers carried was 11,9%, reaching 9,4 million passengers transported, in December 2018 were 875 thousand passengers on international flights, being the highest level ever recorded in the historical series of ANAC, since its beginning in the year 2000. The offer of flights within Brazil also grew and obtained a high of 4,6% compared to 2017, still according to ANAC in the year 2018. In the international market, air demand grew 16.6% in 2018, compared to December 2017 and the offer of flights out of Brazil grew 19.8% in 2018. Considering this growth of demand in the air sector it is important to verify factors that can be determinant from the point of view of the customer in the choice of the air operator. The work includes the analysis of these scenarios considered by the regulatory agencies used

as a basis in the data collected as a reference in the work and that affect the client's choice. The AHP method will perform the analysis by proposing guidance on a possible choice by the customer according to the criteria presented.

MATERIAL AND METHOD

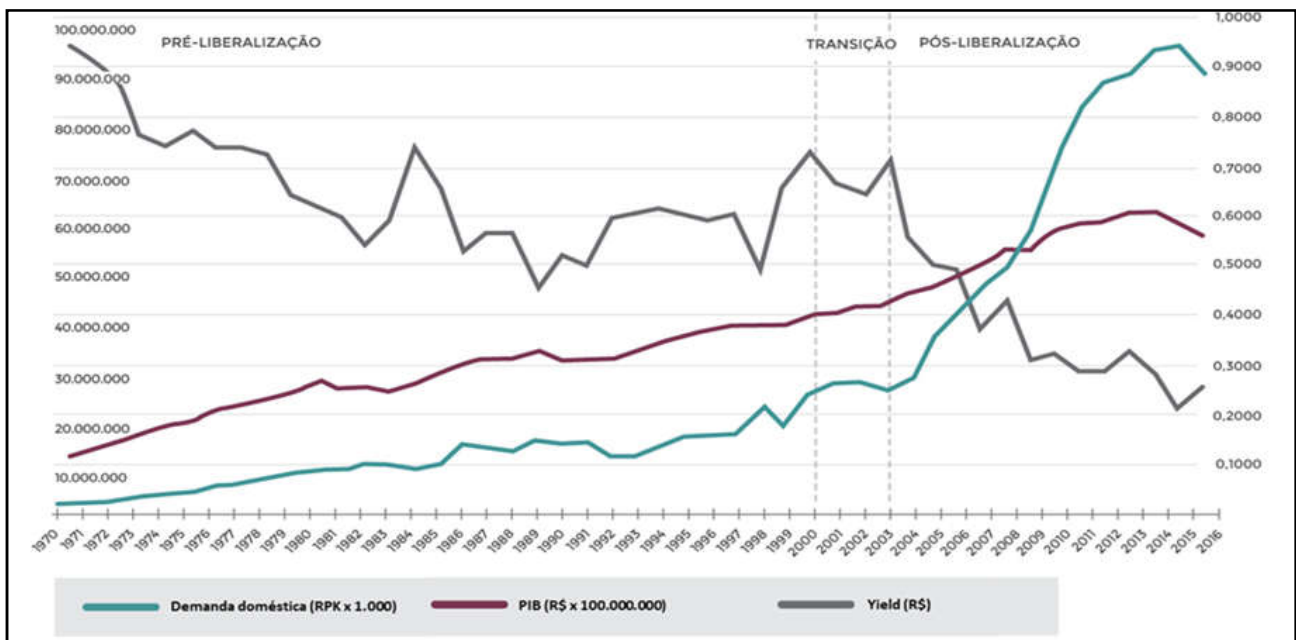
The customer is effectively and should be considered important in determining or guiding strategic decision-making as well as the strategic management processes of air operators. The client's influence is manifested in this case not so much by the existence of an effective direct influence power, but because it is the differentiation factor in the activity, considering the relevance within the competitiveness factor in the companies. In fact, the product can (or should) be seen as a set of values, in which the analysis of the buyer's needs evidences the existence of a multidimensional structure of needs. For the consumer, an asset brings a functional value – the base service –, but also other values, additional services or secondary utilities of various natures (LAMBIN, 2006; PETER, OLSON, 1996).

Air fare: According to the Brazilian Association of Air Companies (ABEAR, 2019), the dynamic pricing systems use parameters such as the advance of purchase, the day and time

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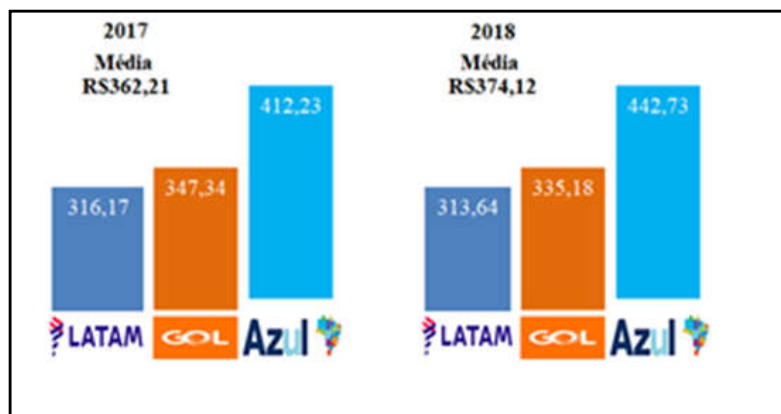
of the trip and the time of stay at the destination to segment the sales according to the profile of the public, cheapening the average values of the domestic tickets over time. The financial and cost-benefit assessment, and what the product aggregates in terms of differential vis-à-vis others, is usually one of the criteria used by customers to choose the best operator. The price will always remain a determining factor of the option of the customer (ASSEL, 1993), however, we must understand the price as the cost that the customer is willing to bear to obtain the value proposition (DOLAN, SIMON, (1996). That is, the customer makes the cost-benefit ratio and optimizes it. We must act on this aspect, finding solutions that increase the value and decrease the cost (MAZUR, HOGG, 1993). In the past, in the 1970s, air travel was expensive and for few, but thanks to the liberalization of the domestic market between 2000 and 2003 the number of passengers transported each year tripled, making the airplane a means of mass transport, especially for domestic travel. It was in this context of economic growth and free competition, that the productivity gains obtained were passed on to passengers in the form of lower tariffs, attracting more customers to the air modal. Graphic 1 shows the parallelism between demand and the Brazilian GDP until the period in which tariff liberalization occurs. From then on, the growth of domestic demand becomes significantly higher than that of the GDP.

These monetary values (GDP and Yield) are updated by the average IPCA 2016. The left vertical axis shows the reference scale of the GDP data (in R\$) and demand (in RPK, Revenue Passengers-Kilometers, or paid-passenger-kilometers transported). To reconcile in the same axis variables of different magnitudes, the GDP values must be multiplied by 1.000.000.000 (to reach the quadrillion's house) and the values of demand must be multiplied by 1.000 (to reach the billions). The vertical axis of the right gives the real values of Yield (price paid per flown kilometer, on which you can read below, which has magnitude of a few tens of cents of R\$). The forecasts of Yield values at constant prices were made from the geometric average of the annual variations verified in the data history, of approximately -2.8% per year. This value is very close to the historical average variations observed in the sector worldwide, estimated at around -3% per year, and corresponds to the global average rate of productivity gains in the sector, signaling that in the long term, airlines do not retain these gains as profit margins but transfer them to passengers in the form of lower fares due to intense competition. Through a report released by the National Civil Aviation Agency (ANAC,2019) on Domestic Air Tariffs in the 4th quarter of 2018 It was found that the real average domestic air fare rose 1% in 2018 compared to the previous year, reaching the amount of R \$ 374,12.



Sources: ANAC (2019), Yearbook of Air Transport (IPEA, 2019); ABEAR(2019)

Graphic 1. Parallelism between demand and the Brazilian GDP



Source: ANAC (2019) – Adapted by Authors

Graphic 2. Evolution of the Air Tariff between 2017 and 2018

While Azul increased its average rate by more than 7%, Gol and Latam registered drop 3,5% e 0,8%, respectively, during the year 2018. In the fourth quarter alone, the tariffs of Azul and Latam showed an increase of 3.5% and 4.3%, respectively, in relation to the same period of the previous year and that of Gol showed a decrease of 2.1%. When viewing Graphic 2, it is noticed that there was an increase in the average value of the air fare, but it remained an average standard value with variations between increases and decrease in the values expressed in real (R\$) in the cited airlines. It can be seen in this context that the airlines with the largest fleet and the largest number of flights can practice better prices, since they have more availability of routes and destinations, which represents a convenience for the customer.

Flights cancelled

In Brazil, Resolution n° 141/2010, of the National Civil Aviation Agency (ANAC, 2019), is the set of rules that protects the passenger in the face of delays and Cancellations of flights can be caused by multiple factors that escape the control of airline flight cancellations. Although the problems causing cancellations are multifactorial, most of them are based on ensuring passenger safety. And the laws in force as mentioned help to help resolve the problem in the best possible way and the passenger is relocated on the next flight, is by rescheduling the ticket to another day or more convenient time. Considering the many factors that cause delays and cancellations of flights and how they interfere with customers' travel routine, the study pointed out three that occur with greater frequency based on an empirical study of the real scenario of flight cancellations at airports which are:

- Climatic conditions such as rainfall, storms, fogs, strong winds and adverse weather conditions such as blizzards and hurricanes can even prevent the operation of airports.
- Due to technical problems in aircraft, it is often the cancellation of flights by setbacks in routine checks. The protocol stipulates that the flight is cancelled if the need for a more specific repair is detected or if there is a minimum risk of the problem compromising the safety of the trip.
- When control and communication systems and handling at airports are out of the air. Air traffic and communication with pilots shall take place in a fully interconnected manner. As safety is the priority item in air transport, any problem in these systems requires the stoppage of operations that may lead to the cancellation of several flights, because it is enough that the system of only one airport presents problems so that several other terminals ¹ and consequently the scheduled flights for them are also affected.

Table 1. Delays and Cancellations in Brazil in 2017




Airline Company	Flighth Time	Delay +30min.	Delay +60min.	Flights Cancelled	% of Cancellations
Azul	59.734	123.823	7.726	39.863	17.25%
Gol	166.313	21.046	7.593	14.392	6.87%
Latam	148.810	25.465	10.091	12.263	6.25%
Total	374.857	170.334	25.410	66.518	30,37%

* For the total number of passengers only carried by the three airlines mentioned above
Source: Quickbrasil.org and ANAC – Adapted by Authors

Table 1 presents data on the number of flights of Azul, Gol and Latam airlines in 2017, which took off during the scheduled flight, with takeoff of more than thirty-sixty minutes, and the total number of cancelled flights of 66,518 representing 30.37% of the total flights of the studied period.

Number of Claims: Data from the National Civil Aviation Agency of June 2016 show a drop of 7% in transported passengers, 6,4% retraction of supply and 5,9% drop in demand, this was due to the political and economic crisis that worsened in Brazil in 2014. A number of problems are identified in the services provided by air operators, such as delays and cancellations of flights, failures in the information provided to passengers and compromises in safety. By means of a bulletin ANAC presented the data calculated in the third quarter of 2018 (July to September), where were recorded 7.191 complaints about the services of the 20 airlines registered with the agency. Together, the companies carried 28 million of the passengers paid in the quarter, or about 92% of the total. Table 2 mentions the companies with the highest complaint rates, according to data from consumer.gov.br website and ANAC in the third quarter of 2018.

Table 2. Delays and Cancellations in Brazil in 2017

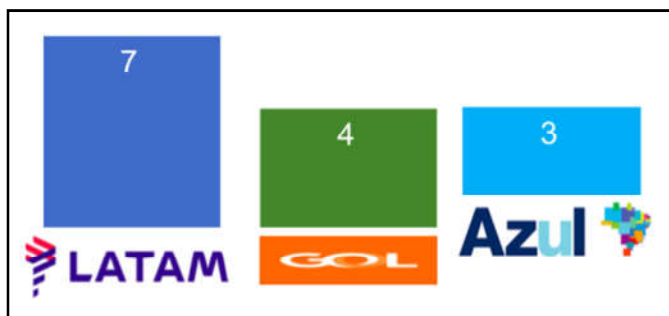
	Complaints	Carried passengers	Number of Claims per 100,000 Passengers Carried
 LATAM	3.512	8.787.963	40
 Azul	1.050	5.934.915	18
 GOL	1.359	8.658.769	16
TOTAL*	5.921	23.381.647	74

*For the total number of passengers only carried by the three airlines mentioned above
Source: Consumer.gov.br and ANAC - Adapted by Authors

Considering the airlines with more than 10% market share, Latam received the highest number of complaints on the platform in relation to the number of paid passengers transported. Each group of 100 thousand passengers, the company had 40 records of complaints, with 3.512 manifestations (48,8% of the total manifestations in the period). Then, Azul filed 18 complaints to every 100 thousand passengers, with 1.050 complaints (14,6%). Finally, of the national companies with more than 10% market, Gol was the company that received the lowest number of complaints, with 16 complaints to each 100 thousand passengers, totaling 1.359 manifestations (18,9%). In addition to the figures highlighted, the report brings the themes and subitems most demanded in the period, the average response time of the demonstrations and the number of complaints per company. The theme most demanded by passengers, related to the service provided by Brazilian and foreign companies, was about the flight execution services. The item had 15,49% of the total complaints on the platform, which is equivalent to 1.114 manifestations. The second of the list is offer and purchase, with 14,25%, or 1.025 complaints, followed by contract rules, with 14,14%, equivalent to 1.017 the total. The Subtheme with the highest complaint rate in the quarter was fines provided in the contract, with 779 manifestations.

Average Response Term: The Consumer.gov.br tool allows the user to communicate directly with the airlines, who are committed to receive, analyze and respond to complaints within 10 days. Of the Brazilian airlines with more than 10%

market, Azul was the one who took the least time to respond to consumer demands. In the third quarter, the average term of the air was three days. The Goal was the second company that took less time to respond to users' demands with, and Latam took more time to respond to consumers on the platform, the average was seven days, as demonstrated: four days.



Graphic 3. Average period of return in days by the airlines mentioned

Index of Satisfaction: The satisfaction index of users was disclosed in the annual report of ANAC 2017 and presented a ranking with manifestations pertinent to the degree of satisfaction of air transport users, more than 12 thousand users were interviewed in the period according to the agency. On a scale of 1 to 5, where 5 is considered excellent by the user, Gol was the company best evaluated in this index, with 2.65 points. The Latam occupied the second position, with 2,54 points and the Azul was in last with 2,08. As Graphic 4.



Source: Adapted by Authors

Graphic 4. Average customer satisfaction index of the airlines mentioned

In this study we applied the AHP - Analytic Hierarchy Process method in order to evaluate five criteria that can influence the choice of an air operator from the viewpoint of the customer in Brazil. The five criteria considered by means of which due weights will be assigned and classified according to the impact on the choice of the customer will be: the tariffs applied by the airlines, the number of complaints, the average response time for complaints against companies, the number of flights cancelled and the customer satisfaction index. According to data from the National Civil Aviation Agency (ANAC) in 2018 Brazilian airlines carried 103 million passengers on domestic and international flights, an increase of 4.1% over the

number of passengers transported in 2017 (98.9 million). In domestic flights 93.6 million passengers were transported in 2018, an increase of 3.3% before the year 2017. In international flights, the high number of passengers carried was 11,9%, reaching 9,4 million passengers transported, in December 2018 were 875 thousand passengers on international flights, being the highest level ever recorded in the historical series of ANAC, since its beginning in the year 2000.

METHODOLOGY

The method adopted in this research was bibliographic research and literature review on the themes and criteria established with the application of the AHP method, including articles, dissertations and theses, in addition to data collection in secondary sources such as: National Civil Aviation Agency (ANAC) and the Institute of Applied Economic Research (IPEA) for evaluation and selection of the best air operator from the viewpoint of the client. Applications of the AHP method for the best decision-making by the client were identified using the established criteria, which presented results that point to the most viable alternative for the client. The choice of airlines was determined according to the number of flights operated by each airline and information provided by reliable sources directly related to the air sector. According to the creator of the Thomaz L. Saaty AHP method (SAATY, 2013), the decision factors are organized in hierarchy or network structures and judgments are then made by the decision maker, or by an expert, on the dominant element for each pair with respect to a common property. From simple judgments on two elements at a time in relation to a common property, are obtained priority vectors that are combined across the structure to give the best result for a decision. Judgments can be inconsistent, and there is a mathematical way of measuring inconsistency so that judgments can be reviewed by the decision maker in an acceptable manner or a decision can be postponed until more consistent information is obtained. In practical applications using hierarchical or network structures, decisions are often analyzed in part for their benefits, opportunities, costs and risks, and the results are then appropriately combined in a general summary of those priorities.

ANALYSIS AND RESULTS

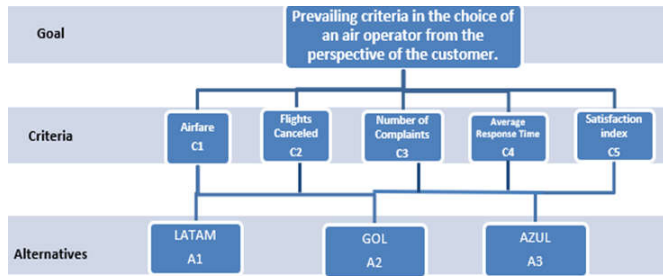
The hierarchical structure: The AHP method, submitted by Saaty (1980), selects one among several alternatives in a decision-making process using multiple criteria. The application of the method depends on a hierarchical structure of the problem that demonstrates the relationship between criteria and alternatives. Initially, three stages were followed: definition of the problem; identification of significant criteria and identification of alternatives. In the first stage of the work the following question was proposed: "What are the predominant criteria in the choice of an air operator from the viewpoint of the client"? The next stage consisted of the following criteria:

- a) C1: Air Tariff;
- b) C2: Flights cancelled;
- c) C3: Number of Claims;
- d) C4: Average Response Time;
- e) C5: Satisfaction Index.

The last step involved identifying possible alternatives:

- A1: Latam;
- A2: Gol;
- A3: Azul.

Figure 1 demonstrates the structuring of the criteria and alternatives in the formulation of the AHP Method. The main objective is to determine which air operator is most advantageous to the customer.



Source: Adapted by the Author

Figure 1. Hierarchical structure

Pair to Pair Comparison: After the hierarchical construction, the comparison of n elements of a given hierarchical level should be started. The fundamental scale proposed by Saaty (2013) in accordance with Table 03 is used to make judgments on criteria paritarilyly.

Table 3. Saaty Core Scale

Degree of Importance	Scale	Definition
1	Equal importance	The two activities contribute equally to the goal
3	Moderate importance	Experience and judgment slightly favor one activity over another
5	Strong importance	Experience and judgment strongly favor one activity over another
7	Very strong importance	One activity is strongly favored over another; element is very dominant as shown in practice
9	Extremely important	The evidence is in favor of one activity over another, to the greatest extent possible
2, 4, 6, 8	Intermediate values between two judgments	They are used to express preferences that are between the values of the above scale
Reciprocal values	If activity i has one of the above numbers, by comparing i to j, the inverse of i with respect to j is obtained.	

Source: Saaty (2013)

The decision maker’s preferences should be arranged in a square matrix (reciprocal and positive) n x n, according to Figure 02.

$$A = \begin{bmatrix} 1 & a_{12} & \dots & a_{1n} \\ 1/a_{21} & 1 & \dots & a_{2n} \\ \vdots & \vdots & \dots & \vdots \\ 1/a_{n1} & 1/a_{n2} & \dots & 1 \end{bmatrix}$$

Source: Adapted by the Author

Figure 2. Main

Pair comparisons are used to express the degree of preference of the decision maker. Thus, the judgments are correlated according to the fundamental numerical scale from which the self-vector of the priorities derives. In addition, the auto vector demonstrates the dominance of each element with respect to the others for a given criterion. Table 04 shows the comparative matrix of criteria presented in the study.

Table 4. Partial Comparison between Criteria

	Criteria					Auto Vector	Normalized Vector Auto
Criteria	C1	C2	C3	C4	C5		
C1	1	5	5	5	8	3,98	56,98%
C2	1/5	1	2	1/3	1	0,67	9,57%
C3	1/5	1/2	1	2	4	0,96	13,69%
C4	1/5	3	1/2	1	3	0,98	14,02%
C5	1/8	1	1/4	1/3	1	0,40	5,75%
Σ	1,73	10,50	8,75	8,67	17	6,99	100,00%

Source: Adapted by the Author

Consistency of Data: The next step is to verify the consistency of the data by means of the consistency ratio (CR). The final result should be less than 10% (ten percent) in order to be consistent. The calculation of the consistency index can be observed by the following formula, proposed by Saaty (1991):

$$IC = \frac{\lambda_{max} - N}{N - 1}$$

The Consistency Reason can be verified by the ratio between CI by the Saaty Factor.

$$RC = \frac{IC}{IR}$$

IR is a random value calculated for square matrices of order n and has standardized values according to Table 05.

Table 5. IR values

1	2	3	4	5	6	7	8	9	10
0,00	0,00	0,58	0,9	1,12	1,24	1,32	1,41	1,45	1,49

Source: Saaty (2013) Adapted by Authors

For the purpose of assessing the data it was necessary to verify the Reason for Consistency in order to proceed to the next step. Table 06 states the degree of consistency for previously compared

Table 6. Consistency Ratio

λ - Max	5,3766
IC = λ - Max - N/N - 1	0,0941
RC = IC/IR to N	8,48%

Source: Adapted by the Author

Therefore, the AHP method can be continued since the CR was less than 10% (ten percent).

Analysis of Alternatives: The next point represents the analysis of alternatives for each attribute. The study contemplated three alternatives: LATAM, GOL and AZUL.

The statistical data of criteria were obtained by means of ANAC. Table 06 shows the comparison of the Air Tariff criterion (C1) with the three alternatives. It is observed that the data should be normalized. So it is possible to realize that lower air fares carry more weight.

Table 7. Comparison of Air Tariff and Alternative Criteria

Alternatives	C1	Harmonization	Normalize
LATAM	R\$ 314,72	3,37	36,90%
GOL	R\$ 328,95	3,23	35,30%
AZUL	R\$ 417,64	2,54	27,80%
Σ	1061,31	9,14	100%

Source: Adapted by the Author

Table 08 shows the comparison of the Cancelled Flights (C2) criterion with the three alternatives analyzed. It is clear that the lowest number of cancelled flights (12263) carries the greatest weight in comparison.

Table 8. Comparison of Criteria Cancelled and Alternative Flights

Alternatives	C2	Harmonization	Normalize
LATAM	12263	5,42	46,30%
GOL	14392	4,62	39,45%
AZUL	39863	1,67	14,24%
Σ	66518	11,71	100,00%

Source: Adapted by the Author

Table 09 indicates the Criterion Number of Complaints (C3) comparing the alternatives studied in this study. It is observed that the operator with the lowest number of complaints (1050) presents greater weight in the comparison.

Table 9. Criterion Comparison Number of Complaints and Alternatives

Alternatives	C3	Harmonization	Normalize
LATAM	3512	1,69	14,43%
GOL	1359	4,36	37,30%
AZUL	1050	5,64	48,27%
Σ	5921	11,68	100%

Source: Adapted by the Author

Table 10 expresses the criterion Average Response Term (C4) and its proposed alternatives. It is observed that the longest response time (7 days) has the lowest weight (19.67%) in the comparison. The shorter term (3 days) has a higher weight (45.90%).

Table 10. Comparison of the Criteria Average Response and Alternatives

Alternatives	C4	Harmonization	Alternatives
LATAM	7	2,00	19,67%
GOL	4	3,50	34,43%
AZUL	3	4,67	45,90%
Σ	14	10,17	100,00%

Source: Adapted by the Author

Table 11 indicates the criterion Satisfaction Index (C5) compared to the alternatives. Finally, we can identify that the highest grade (3.3) represents a greater weight (36.67%)

Table 11. Comparison of the Criteria Satisfaction Index and Alternatives

Alternatives	C5	Alternatives
LATAM	2,70	30,00%
GOL	3,00	33,33%
AZUL	3,30	36,67%
Σ	9	100,00%

Source: Adapted by the Author

RESULTS

After initial analysis it is possible to obtain the Vector Decision by the AHP method as explained in the table:

Table 12. Vector Decision

Alternatives	C5	Alternatives
LATAM	2,70	30,00%
GOL	3,00	33,33%
AZUL	3,30	36,67%
Σ	9	100,00%

Source: Adapted by the Author

For the calculation, the data of the initial matrix and the data of the previous tables are transposed. The sum and product resulting in the final decision vector is then carried out. Table 11 shows that the predominant alternative for choosing an air operator in the survey presented 35.74%.

Final Considerations

The research consisted of a study of 5 (five) criteria that can influence the customer when choosing an air operator. The focus of the work was based on the application of the AHP method for the decision-making process of the most indicated air operator facing the alternatives presented. The method used demonstrated effectiveness by answering the proposed initial question. The AHP method allowed structuring the problem, comparing criteria and calculating data consistency. The use of the method consisted in the integration of information facilitating decision-making. Additionally, the method indicated which would be the best alternative, from the viewpoint of the customer, for the choice of the air operator.

It was identified in the work that the air fare criterion was very relevant for customers when choosing the airline of their preference. However, other criteria may also influence decision-making as demonstrated in mathematical calculations. In this way, airlines can offer better services to customers, as it is more obvious to the air operator what consumer preferences are. These, in turn, will benefit from better service in the service received. It is also noteworthy that the study did not aim to exhaust the topic. It is therefore suggested a more in-depth study with the aim of analyzing and expanding knowledge through the use of other criteria and other alternatives. It is recommended to use computational tools for the use of the AHP method in order to allow faster and more accurate decisions.

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