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Analysis of the operational performance of brazilian airport terminals: A multicriteria approach with De Borda-AHP integration

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ABSTRACT

Objective: This study proposes a multicriteria approach for the comparative analysis of the operational performance of Brazilian airport terminals.
Methodology: Two multicriteria decision aid (MCDA) methods – De Borda and Analytic Hierarchy Process (AHP) - were applied in an integrated manner to the database of the performance report from the Brazilian Department of Civil Aviation (Secretaria de Aviação Civil – SAC/PR), composed of evaluations issued by 18,062 respondents regarding 15 airport terminals, 12 of which are analyzed in this study considering 8 evaluation criteria. On the first level, the AHP method was used to assign weights to the criteria. On the second level, the De Borda method was applied to rank the alternatives.
Results: The proposed method resulted in a final ranking of alternatives that was significantly different from the one presented in the SAC/PR report.
Contribution to knowledge: The employment of the integrated De Borda-AHP method is not common and ensured a greater approximation with the overall user satisfaction indicator, showing that it is the more appropriate methodological option when compared with the arithmetic mean commonly used in public reports.
Contribution to society: Based on the obtained ranking, air transport users will be able to have a more realistic comparative picture of the main airport terminals analyzed.
Contribution to the management of the airport system: This work contributes to the strategic planning and allocation of investments seeking to adapt and expand the sector, and also to the continuous improvement of the service levels provided at airports.

1. Introduction

Civil aviation plays a strategic role in development, either by the transport of people and goods it provides, or by the generation of jobs and financial transactions, particularly in a country of continental size such as Brazil. In alignment with its development plans, Brazil needs to devote efforts to make an airport infrastructure available that is consistent with the circulation of people by air forecast for the next few years, because in addition to the growing domestic circulation, the country will host large-scale international events. For the 2016 Olympic Games in Rio de Janeiro, for example, more than 10,500 athletes from around 205 nations, in addition to thousands of press and support professionals and tourists from all over the world are expected.

As a result of these activities, various factors associated with the Brazilian airport infrastructure and issues related to the operational performance of the airports, in addition to the way these are assessed from a passenger's perspective, began to be the subject of debate. The uncertainty regarding the existing infrastructure's capacity to meet the demand in a timely manner and according to passenger expectation was put on the agenda. As such, it has become important to identify methodologies that are able to assess the operational performance of Brazilian airports in order to enable the planning of future availability in a way that is consistent with the quality standards in force.

Thus, in order to measure the operational performance of

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Brazilian airport terminals, the Department of Civil Aviation (*Secretaria de Aviação Civil* - SAC/PR) has been conducting a survey *in loco* at the main airports to capture general data on passenger perception regarding the established operational performance metrics. This measure represents a support to Brazilian airport management and seeks to guide actions for improvements in the provision of airport services to passengers (SAC/PR, 2014). The research conducted by SAC/PR is consolidated in quarterly reports and presents the operational performance of airports for each indicator through arithmetic means of the passengers' general assessments. The final result is also only presented using the arithmetic mean of the indicators, i.e. in a compensatory way, without taking into account the allocation of importance (weights) to criteria.

In this context, faced with the existence of this data source and its currently non-existent treatment in the public report, the following research question arises: can the comparative analysis of the operational performance of Brazilian airport terminals be enhanced by employing a method that comes closer to the reality perceived by passengers?

Customer satisfaction is an important issue concerning organizations of all types (Grigoroudis and Siskos, 2002). Customer satisfaction measurement may be considered as the most reliable feedback system, considering that it provides in an effective, direct, meaningful and objective way the clients' preferences and expectations.

In this way, customer satisfaction is a baseline standard of performance and a possible standard of excellence to the air transport industry. Considering judgments on the importance of criteria, based on the Analytic Hierarchy Process (AHP) and the De Borda methods a new methodology is proposed to evaluate airport terminals.

The objective of this study, therefore, is to perform a comparative analysis of the operational performance of the main Brazilian airport terminals through a non-compensatory multicriteria approach, which aggregates two methods: the Analytic Hierarchy Process (AHP) and the De Borda.

The work is organized in four more sections, in addition to this introduction. The second section presents a review of the literature on the evaluation of service quality in airport terminals. The third section lays out the methodology used in the study. The results of the research are presented and evaluated in the fourth section. And in the fifth and final section, the concluding remarks are summarized.

2. Airport service quality evaluation

The growth in air transport across the world has caused a considerable increase in studies on the service quality at airport terminals, especially in the last two decades. Today, and keeping up with this trend, there is an increased urgency among airport managers to differentiate their airports based on the needs of customers. These managers also clearly understand the importance of the quality of service perceived by passengers (Fodness and Murray, 2007). The quality of service at airports is often expressed in terms of the perception of the service levels offered to the users of airport terminals (Francis et al., 2003).

Models that assess service levels are being addressed in studies applied to airport terminals located in different regions of the world. Chien-Chang (2012) presented a fuzzy decision making method applied at airports in Taiwan. Kuo and Liang (2011) also used a fuzzy multicriteria approach to evaluate seven international airports in North-East Asia. Lubbe et al. (2011), on the other hand, investigated the perceptions of passengers on the quality of service at the international airport of Johannessburg, in South Africa. In the same sense, Atalik (2009) addressed the expectations of passengers at the international airport in Istanbul, Turkey. Gkritza et al. (2006), in turn, investigated the satisfaction of users regarding the applied security procedures by access control point in American airports.

The issue of passenger perception regarding the quality of service offered in airport terminals in Brazil has also been addressed by several scientific papers. Some of these employ a generalist vision, adopting procedures that include both comments from passengers and the collection of socioeconomic and physical variables that could influence the evaluation of the user of the airport infrastructure as a whole (Correia et al., 2008a, 2008b; Fernandes and Pacheco, 2010; Gregui et al., 2013). Other studies, however, use a more specific vision, assessing components of airport infrastructure individually, such as boarding, unboarding and check-in (Correia and Wirasingue, 2007, 2008; Borille and Correia, 2013).

Correia and Wirasingue (2004) conducted an extensive review of the research on service level assessments in airport terminals. The main purpose of the study was to categorize the works with respect to the objective and the employed technique, pointing to the following groups of studies: investigations of factors that influence the level of service; assessments of service levels using statistical analysis; uses of the perception-response (P-R) curve concept; applications of fuzzy theory; applications of Data Envelopment Analysis (DEA); and assessments focused on the passenger guidance factor at terminals.

The study by Correia and Wirasingue (2004) also presents some interesting conclusions about the service level evaluation surveys in airport terminals:

- There is no globally accepted standard procedure for the assessment of service levels at airports;
- Several researchers have concluded that their approaches required more data to validate the methodology, particularly with regard to the overall assessment of the service level of the terminal.
- There has been little research designed to evaluate terminals in developing countries; and
- Most studies consider only boarding passengers. There has been little research effort on passengers who are disembarking or transferring.

Assessing the quality of service at airport terminals is therefore a very complex task, since it involves conflicting factors that need to be taken into account. The employed methodology should be able to properly handle the collected data and make use of techniques that come as close as possible to the reality perceived by passengers in the analyzed airport terminals.

On the other hand, as reported in Costa et al. (2013), the assessment of the quality of a service involves its evaluation in light of multiple criteria, some of which are subjective. This observation, coupled with the fact that the principles and methods of Multicriteria Decision Aid (MCDA) have been developed for the modeling of problems with these characteristics (multiple criteria and presence of subjectivity), has led Freitas and Costa (1998) to propose the adaptation of the ELECTRE III method (Roy, 1978) to assess the quality of services.

Variations of this proposal have been developed, such as in Costa et al. (2007) and Nepomuceno and Costa (2015), who developed models based on ELECTRE TRI (Mousseau and Slowinski, 1998) for the evaluation of services; and in Sant'anna et al. (2015a; 2015b), who adopted the CPP-TRI for the assessment of quality of services. CPP-TRI merges the Probabilistic Composition of Preferences (CPP) with the principles of trichotomic segmentation presented in ELECTRE TRI.

In spite of the progress achieved by the use of the ELECTRE and its variations, the modeling cited above did not adopt a multi-criteria systematization to obtain the weights and to include some treatment of the subjectivity present in the process of acquiring the weights of the criteria.

Costa (1994) demonstrated that although AHP has been proposed by Saaty (1977) initially as a method of choice, this method could be applied successfully to the process of obtaining weights for criteria. The use of AHP to generate weights can be observed in Costa and Corrêa (2010), Tsai et al. (2011) and in Méxas et al. (2012), and it is interesting to note that Costa and Corrêa (2010) applied AHP for the evaluation of weights of criteria in a specific model for the evaluation of the perceived quality of buildings by users who lived in them.

Zietsman and Vanderschuren (2014), in their turn, discuss the application of an AHP analysis for the assessment of a potential multi-airport development, addressing the relative weighting of criteria in the AHP. Finally, Castelli and Pellegrini (2011) use AHP to assess the opportunity of implementing the target windows concept by considering the views of experts.

3. Methodology

This study uses an integrated approach, proposed by Costa (2014), and adopts the AHP method (Saaty, 1977) as a structuring method for the allocation of weights to the criteria to be used in the ranking of alternatives by the De Borda method (De Borda, 1781). This proposition is precisely a result of the fact that, despite the possibility of allocating weights by using a variation of the De Borda method, the method itself does not address how the weights should be assigned. As such, the issue can be addressed at two levels: the first level is the allocation of weights to the criteria through the AHP method; and the second level is the ranking of alternatives through the De Borda method. In other words: the choice to integrate De Borda-AHP is a result of the adaptation of the AHP method to the weight definition process in multicriteria modeling, and of the simplicity of the De Borda method when compared to the classification methods of the ELECTRE family. Fig. 1 illustrates the structure of the methodology proposed by Costa (2014) at two levels.

In a more detailed description, the methodology goes through the following steps, according to Costa (2014):

a) Definition of the object of study and characterization of the general constraints that define the validity domain of the encountered solution;
b) Specification of the main focus or general objective that one expects to reach;
c) Definition of the elements or alternatives (*set A*) to be ranked or sorted;
d) Identification of the set of k relevant criteria (g) and their organization in a hierarchy or tree of criteria (Fig. 3);
e) Acquisition of the evaluations or judgments established in each g_i criterion, for each alternative (A_j) (Table 1);
f) Association of the scores, order numbers or ranking scores of each alternative (A_j), considering the judgments in each g_i criterion (Table 2);
   If ***n*** is the number of alternatives,
   The best performance in *gi* criterion gets ***n*** score,
   2nd best performance in *gi* criterion gets (***n-1)*** score,
   :::
   Nth best performance in *gi* criterion gets ***1*** score
g) Allocation of weights to each criterion:
   g.1) Collection of value judgments regarding the relative importance, evaluated pair by pair, of the criteria (Table 3);
   g.2) Summary of the data obtained from judgments and consistency analysis, calculating the distribution of importance of the criteria; and,
   g.3) Calculation of the consistency ratio (CR);
h) Realization, for each alternative, of a sum (compounded by weights of criteria) of the order numbers, getting a global order number;

$$A_j = \sum_{i=1}^{k} w_i * g_i$$

i) Obtainment of the final ranking of alternatives based on the global order numbers.

To adjust this proposal to the problem under study, the specific methodology of this study was structured in the steps illustrated in Fig. 2.

4. Results and discussion

The information of this study is based on the general report on operational performance indicators in airports, regarding the first quarter of 2014 and released by SAC/PR. The report is the result of an *in loco* survey performed by a consulting firm hired by SAC/PR, which collected data through the application of standardized questionnaires in face-to-face interviews with passengers traveling through the analyzed airports. Each interviewed passenger assigned grades from 1, the lowest possible, to 5, the highest possible, to 40 indicators that make up the 8 elements of research, and then a general satisfaction grade for the service provided by the airport. Over the months of January to March 2014, 18,062 interviews were carried out, obtaining a statistical sample of the population (SAC/PR, 2014).

Because of the realization of large events in Brazil, SAC/PR saw the need to obtain airport indicators that reflected the views of passengers, and that would enable actions to improve the level of services. To this end, the data collection was conducted in the 15 airports involved in these events, specifically all airports of the hosting cities of the 2014 World Cup, including those that are directly linked to these cities, even if not located directly in them. Of

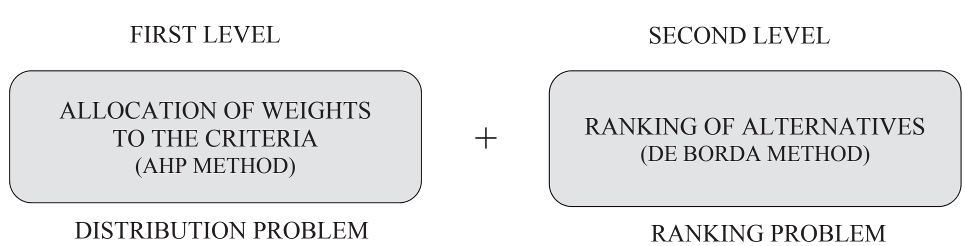

Fig. 1. Structure of the methodology proposed by Costa (2014) at two levels.

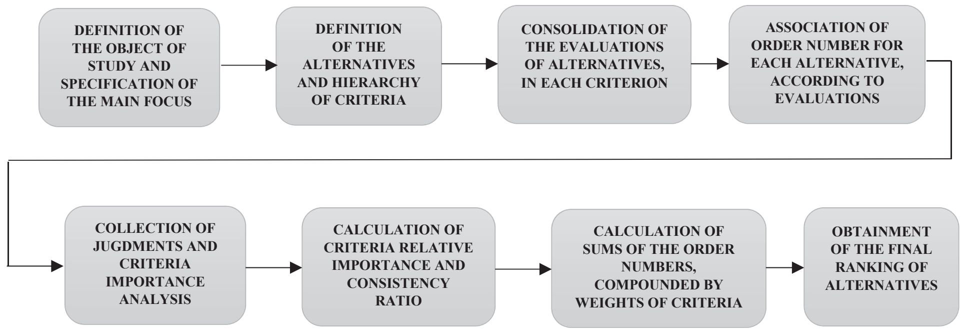

Fig. 2. Steps for the execution of the study.

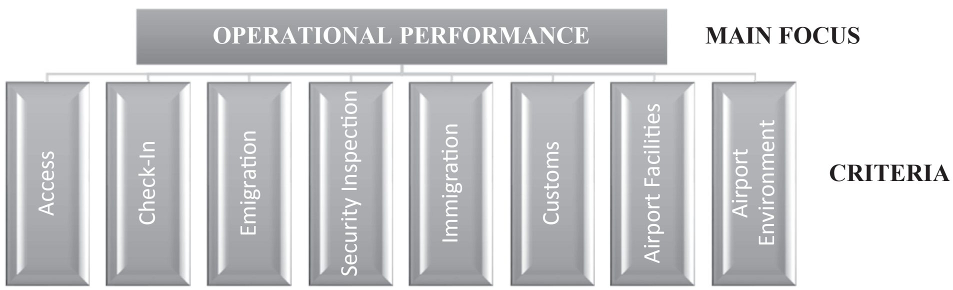

Fig. 3. Hierarchy of criteria constructed according to the main focus.

Table 1
Consolidation of the evaluations of the alternatives in each criterion (means per quarter).

	Access	Check-in	Emigration	Security inspection	Immigration	Customs	Airport facilities	Airport environment
SBBR	3.17	4.48	4.54	4.32	3.54	3.57	3.33	3.68
SBCF	3.86	4.63	4.91	4.45	4.54	4.75	3.42	3.87
SBCT	4.01	4.44	4.59	4.48	3.94	3.98	3.80	4.17
SBEG	3.41	3.71	3.78	3.70	3.23	3.50	3.42	3.64
SBFZ	3.75	4.06	4.24	3.94	4.07	4.21	3.75	3.96
SBGL	3.92	4.06	3.45	4.15	3.54	3.91	3.71	3.66
SBGR	2.60	3.43	3.27	3.76	3.93	3.84	3.42	3.74
SBKP	3.72	4.58	4.72	4.33	3.74	4.08	3.57	4.16
SBNT	4.28	4.61	4.32	4.51	2.89	2.89	3.63	4.30
SBPA	3.85	4.55	4.57	4.48	3.82	3.96	3.78	4.31
SBRF	3.74	4.33	4.60	4.30	3.67	3.46	3.62	4.15
SBSV	3.38	4.17	4.62	4.24	3.80	4.26	3.51	3.71

Table 2
Consolidation of scores associated with the alternatives in each criterion.

	Access	Check-in	Emigration	Security inspection	Immigration	Customs	Airport facilities	Airport environment
SBBR	2	8	6	7	4	4	1	3
SBCF	9	12	12	9	12	12	4	6
SBCT	11	7	8	11	10	8	12	10
SBEG	4	2	3	1	2	3	4	1
SBFZ	7	4	4	3	11	10	10	7
SBGL	10	4	2	4	4	6	9	2
SBGR	1	1	1	2	9	5	4	5
SBKP	5	10	11	8	6	9	6	9
SBNT	12	11	5	12	1	1	8	11
SBPA	8	9	7	11	8	7	11	12
SBRF	6	6	9	6	5	2	7	8
SBSV	3	5	10	5	7	11	5	4

the 15 airports analyzed, three operated only domestically. As such, their passengers did not evaluate the elements of emigration, immigration and customs. The lack of indicators for these elements does not allow for a fair comparison with the other airports. As a result, these three airports — Santos Dumont (SBRJ), Cuiabá (SBCY), and Congonhas (SBSP) - are not addressed in this study.

The main focus of this study is therefore the operational performance of the airports terminals involved in the 2014 World Cup

Table 3
Matrix of judgments of the importance of criteria in light of the main focus.

	Access	Check-in	Emigration	Security inspection	Immigration	Customs	Airport facilities	Airport environment
Access	**1**	1/2	1	1/5	1	1	1/5	3
Check-In	2	**1**	3	1/5	2	2	1/3	5
Emigration	1	1/3	**1**	1/5	1	1	1/5	2
Security Inspection	5	5	5	**1**	5	5	1/3	7
Immigration	1	1/2	1	1/5	**1**	1	1/5	3
Customs	1	1/2	1	1/5	1	**1**	1/5	3
Airport Facilities	5	3	5	3	5	5	**1**	9
Airport Environment	1/3	1/5	½	1/7	1/3	1/3	1/9	**1**

that have international passenger flights. The alternatives to be sorted are the passenger terminals at the airports of: Brasília – Federal District (SBBR); Confins - Minas Gerais (SBCF); Curitiba – Paraná (SBCT); Fortaleza – Ceará (SBFZ); Galeão - Rio de Janeiro (SBGL); Guarulhos – São Paulo (SBGR); Viracopos – São Paulo (SBKP); Manaus – Amazonas (SBEG); Natal – Rio Grande do Norte (SBNT); Porto Alegre – Rio Grande do Sul (SBPA); Recife – Pernambuco (SBRF); and Salvador - Bahia (SBSV).

The indicators collected by the SAC/PR report are grouped into 8 elements of evaluation, namely:

I. Access: concerning the availability of public transport and taxis, the conditions and costs of parking facilities for vehicles, and the availability of luggage carts and curbs for the arrival and departure of passengers;
II. Check-In: concerning the queue times in the self-service and the counters, and the efficiency and service/friendliness of check-in staff;
III. Emigration: concerning the queue times and service or friendliness of emigration staff;
IV. Security Inspection: concerning the rigor of security inspections, the queue times and service or friendliness of the security personnel, and the feeling of safety and security at the airport;
V. Immigration: concerning the queue times and service or friendliness of immigration staff;
VI. Customs: concerning the queue times and service or friendliness of Customs agents;
VII. Airport Facilities: regarding the availability of flight information panels, the ease of finding your way around the airport, of making connections and walking distances, the availability and conditions, including the amount paid, of the food and business facilities, including banks, ATMs, currency exchange agencies and VIP lounges, the availability and hygiene conditions of toilets, the speed of luggage returns and the availability of internet and wi-fi networks; and
VIII. Airport Environment: concerning the general cleaning, thermal comfort and acoustic comfort of the airport.

These 8 evaluation elements are, therefore, the criteria of the problem under analysis in this study. Fig. 3 illustrates the hierarchy of criteria constructed according to the main focus.

As shown by the SAC/PR report (2014), the arithmetic means of the performance of the alternatives in each of the criteria, in the first quarter of 2014, are consolidated in Table 1 below.

Based on the performance of the alternatives (Table 1), order numbers are assigned to them in each of the criteria, as recommended by the De Borda method. As there are 12 alternatives in this case, 12 points were assigned for the best performance in a given criterion, 11 points for the second best performance, and so on, up to 1 point for the worst performance. Table 2 presents the consolidation of scores associated with the alternatives in each one of the criteria.

In the criterion Access, for example, the alternative SBNT (Natal) received 12 points because it had the best performance on this criterion, with an average of 4.28. The alternative SBGR (Guarulhos), on the other hand, received only 1 point in this criterion because it represents the worst performance, with an average of 2.60.

Next, the step of assigning weights to each of the criteria is discussed. The collection of value judgments as to the relative importance of the criteria was performed with a group formed by six experts in civil aviation regulation. The verbal scale developed by Saaty (1980) in the AHP method was used for the pair-to-pair comparison of each criterion, such as: 1 – equal importance; 3 – moderate importance of one over other; 5 – essential or strong importance; 7 – very strong importance; 9 – extreme importance; 2,4,6 and 8 – intermediate values between the two adjacent judgments. For more details on the scale for the realization of pair judgments, see Saaty (1980).

The judgments on the importance of criteria are not presents in SAC/PR standardized questionnaires. Then, as a solution to enable the research, this gap was filled with a group formed by experts in civil aviation regulation. The discussion time for the group to perform the judgments was approximately 45 min Table 3 shows the matrix of judgments on the importance of criteria in light of the main focus, after conversion of the verbal scale into a numeric one.

For example, the allocation of the value 5 in the 5th line of the 2nd column, at the cross-section between the criteria Security Inspection and Access, means that the criterion Safety Inspection has a strong preference, or more importance, in relation to the criterion Access in the opinion of the specialists. For more details on the scale for the realization of pair judgments, the authors suggest consulting Saaty (1980).

In order to calculate the distribution of importance of the criteria and the consistency ratio (CR), the operating system IPÊ was used, version 1.0 (Costa, 2004). IPÊ is a support decision software, which runs AHP's prioritization algorithm. The weights of the criteria obtained are shown in Table 4 below.

The CR was calculated at 0.028, a value considered within acceptable limits by Saaty (1980), i.e., less than or equal to 0.1. It is worth noting that this CR was obtained in the first and only round

Table 4
Distribution of weights of the criteria.

Criterion	Weight
Airport facilities	0.340
Security inspection	0.274
Check-in	0.119
Access	0.062
Immigration	0.062
Customs	0.062
Emigration	0.056
Airport environment	0.026

of judgments performed with experts. Since its value was within the recommended limits, it was not necessary to revise the judgments.

Once the weights of the criteria were obtained, it was possible to calculate the weighted sum of the order numbers for each alternative, thus obtaining the global order numbers. The final ranking of alternatives through the integrated De Borda-AHP method is shown in Table 5.

With the employment of the integrated De Borda-AHP method, therefore, the alternative SBCT (Curitiba) is ranked in 1st place with 10.43 points, the alternative SBPA (Porto Alegre) comes in 2nd place, with 9.96 points, and the alternative SBNT (Natal), in 3rd place, with 8.75 points. The last place is occupied by SBEG (Manaus), with only 2.62 points.

For purposes of comparison, Table 6 below shows the ranking of alternatives by a simple arithmetic mean, as shown in the SAC/PR report (2014).

As can be observed in the comparison between the rankings presented in Tables 5 and 6, there are significant differences in the orders of the alternatives. The alternative SBCF (Confins), for example, which occupies 4th place according to the integrated De Borda-AHP method applied in this study, comes in 1st place according to the simple arithmetic mean. Another relevant change regards SBNT (Natal), which came in 3rd place according to the first ranking and in 8th according to the second. These facts show that the forms in which results are presented, and the respective methodologies, may considerably change the positioning of alternatives in ranking problems. This study concludes, therefore, that it is essential to use grounded methodologies that are realistically focused on achieving their purposes.

Finally, as a way to check the proximity with the general satisfaction reality of passengers using the analyzed airport terminals, a comparative analysis was performed of the previously obtained rankings, through the integrated De Borda-AHP and the arithmetic mean methods, with the overall satisfaction indicator of passengers. The overall satisfaction indicator is also obtained through *in loco* survey conducted by SAC/PR, where passengers assess their overall satisfaction with the airport terminal, assigning grades from 1, the lowest possible, to 5, the highest possible.

Table 7 shows the variation in positioning of the alternatives through the integrated De Borda-AHP method in comparison to the overall satisfaction indicator.

In contrast, Table 8 shows the variation in positioning of the alternatives through the arithmetic mean method in comparison to the overall satisfaction indicator.

When the ordering of alternatives obtained by the arithmetic mean is compared with the ranking according to the overall satisfaction indicator, one sees that there is a total variation of 42 positions. In other words, the sum of all the positioning variations suffered by alternatives is equal to 42. However, when the ordering obtained with the integrated De Borda-AHP method is compared, this variation is only 32 positions. This decrease in the variation of positions can be an indication that the integrated De Borda-AHP method applied in this study is better able to capture the inherent subjectivity in the assessment of overall satisfaction of passengers, by considering relative importance, both regarding the position of the alternative in the criterion and regarding the weights of the criteria.

The use of simple arithmetic means may therefore ignore important issues and remove the result obtained even further from reality. Although the small positions variation of the alternatives between De Borda-AHP and arithmetic mean, the assessment of the alternatives is more evident in the first one. For instance, the distance between the first and last alternative is enlarged.

The huge variation for SBCF shows in Table 8 just enhances how bad the use of arithmetic mean is, because great performances in some indicators are offset by bad performances in other indicators. Furthermore, there is the question of relative weights assigned to the human subjectivity. In the SBCF case, is evident that its great positioning by the arithmetic mean reflects the compensatory effect of this method that hide bad performances in specific indicators, which might have higher relative weight. In other words, by the arithmetic mean, SBCF has a very good performance, however, when judged in terms of overall satisfaction it has an awful performance, because it is bad in indicators that the respondents assign higher value. This situation endorses the necessity to use non-compensatory methods, as proposed in this study that take in account the criteria weights.

It should be highlighted that this study contributes to the management of airport systems to the extent that it assists in the consolidation of a service quality evaluation model in airport passenger terminals. It also can help strategic planning and allocation of investments seeking to adapt and expand air transport.

Table 5
Final ranking of alternatives through the integrated De Borda-AHP method.

Order	Alternative	Final score
1°	SBCT	10.43
2°	SBPA	9.96
3°	SBNT	8.75
4°	SBCF	8.13
5°	SBKP	7.51
6°	SBFZ	6.84
7°	SBRF	6.26
8°	SBGL	6.04
9°	SBSV	5.63
10°	SBBR	4.24
11°	SBGR	3.14
12°	SBEG	2.62

Table 6
Ranking of alternatives by the arithmetic mean.

Order	Alternative	Final mean
1°	SBCF	4.30
2°	SBCT	4.18
3°	SBPA	4.17
4°	SBKP	4.11
5°	SBFZ	4.00
6°	SBRF	3.99
7°	SBSV	3.96
8°	SBNT	3.93
9°	SBBR	3.83
10°	SBGL	3.80
11°	SBEG	3.55
12°	SBGR	3.50

5. Conclusions

This study has reached its goal of proposing a multicriteria model for the evaluation of the quality of services provided in civil aviation airport terminals. The application of the proposed model to the specific case of Brazilian airport terminals has enabled their ranking with respect to the quality of services provided from the point of view of the users of these services.

The use of the AHP method for the mapping of weights differentiates this work from others realized previously, since it allows for the assessment of the consistency of judgments issued by experts. In general, customer and expert have discordant interests. However, the judgments by experts were an alternative to a limitation present in the SAC/PR survey. It is suggested the inclusion of

Table 7
Comparison between the De Borda-AHP method and the overall satisfaction indicator.

Alternative	Overall satisfaction order	De Borda-AHP method order	Variation
SBCT	3°	1°	↑ 2 positions
SBPA	5°	2°	↑ 3 positions
SBNT	1°	3°	↓ 2 positions
SBCF	12°	4°	↑ 8 positions
SBKP	6°	5°	↑ 1 position
SBFZ	2°	6°	↓ 4 positions
SBRF	4°	7°	↓ 3 positions
SBGL	7°	8°	↓ 1 position
SBSV	10°	9°	↑ 1 position
SBBR	11°	10°	↑ 1 position
SBGR	8°	11°	↓ 3 positions
SBEG	9°	12°	↓ 3 positions

Table 8
Comparison between the arithmetic mean and the overall satisfaction indicator.

Alternative	Overall satisfaction order	Arithmetic mean order	Variation
SBCT	3°	2°	↑ 1 position
SBPA	5°	3°	↑ 2 positions
SBNT	1°	8°	↓ 7 positions
SBCF	12°	1°	↑ 11 positions
SBKP	6°	4°	↑ 2 positions
SBFZ	2°	5°	↓ 3 positions
SBRF	4°	6°	↓ 2 positions
SBGL	7°	10°	↓ 3 positions
SBSV	10°	7°	↑ 3 positions
SBBR	11°	9°	↑ 2 positions
SBGR	8°	12°	↓ 4 positions
SBEG	9°	11°	↓ 2 positions

the judgments on the importance of criteria in the standardized questionnaires.

Another unique aspect of this work is the employment of the De Borda method integrated with AHP method for the establishment of the ranking between alternatives. This fact is relevant because the De Borda method, by its very nature, has a more democratic characteristic than the simple vote method, and it reduces the compensatory effects in relation to the weighted average.

The central contribution of this work is therefore the unprecedented proposal to apply the De Borda-AHP integration to the context of the assessment of quality of services, with as main contribution the ability to mitigate inconsistencies in the judgments of weights in the process of constructing rankings between alternatives. The employment of the integrated De Borda-AHP method is not common and ensured a greater approximation with the overall user satisfaction indicator, showing that it is the more appropriate methodological option when compared with the arithmetic mean commonly used in public reports.

The conclusion above is general and does not depend on the case under study. When looking at the specific results obtained when using the Brazilian airport system as background, on the other hand, one can conclude that the obtained results could enable managers to identify the terminals that could be used as benchmarks for the others and, especially, to identify those that require closer monitoring from the perspective of improving their quality of services.

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