Original Article
ISSN (Online): 2456-8651

International Journal of Engineering Science Technologies
May-June 2025 9(3), 98–109

PEAK HOUR AT SMALL AIRPORTS – A CASE STUDY FOR REGIONAL AIRPORTS UNDER CONCESSION IN BRAZIL

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Received 15 April 2025
Accepted 17 May 2025
Published 16 June 2025

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DOI 10.29121/IJOEST.v9.i3.2025.702

Funding: This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

ABSTRACT

This paper compares the different peak hour values (a reference for infrastructure planning) at regional airports under concession in Brazil. This assessment is based on the different criteria proposed by international entities, regulatory agencies and the concession contract itself. These criteria are applied to two regional airports under concession in the State of São Paulo. The main results indicate that the use of the criteria of the current regional airport concession contracts to calculate peak hour leads to an underestimation of airport facilities, which becomes worse as the airport's regular traffic decreases, leading to a service level much lower than expected at a concessioned airport.

Keywords: Regional Airport, Peak Hour, Concession

1. INTRODUCTION

Peak times are the result of temporal concentration of customer movements in any mode of transport. In the case of air transport, most consumers traveling to the northern hemisphere want to travel by night (to "save the day" at their destination), which generates a peak in international departures at night and a peak in international arrivals early in the morning. Another visible peak time is the "hub-and-spoke" type of operation, in which the airline concentrates all its arrivals in a short space of time at the "hub" airport in order to multiply the possibilities of serving different locations. Regardless of the behavioral pattern (of the customer or the operator), the peak period perception depends on the level of service expected by airport customers Lopes and Filho (2021)

Thus, peak passenger´s (or aircraft´s) hours are a fundamental parameter for planning and designing the entire airport infrastructure – runway and apron systems, terminals, access roads, utilities, etc. – to result in a compatible offer with expected traffic volumes.

The literature review on peak hours at airports shows that there is no single reference for estimating passenger and aircraft demand during this greatest movement period, both in terms of definition and estimation procedures. But there is a consensus: peak hour demand means estimating a level of demand that is not the maximum, but that is exceeded only for a small part of the time, in order to guarantee an acceptable level of service for most of the time.

In the case of airports under concession, the discussion on peak hours has some additional conditions. Peak hour movement equal or very close to maximum hourly demand implies a private investment that will be underutilized most of the time. The apportionment of operating costs tends to put pressure on higher fares paid by passengers and airlines, given the large gap between the infrastructure offered and the demand. At the end of the day, the customer will pay more than they should.

On the other hand, peak hour demand estimates that are very far from the maximum hour cause a serious contractual management problem. Building according to a contractual reference when it is lower than the real demand, the investment will be lower, with less pressure on airport fares. However, even though the concessionaire complies with the contract terms, there will be a degradation of the service provided to the customer, who will experience a very low level of service, which can compromise the private operator image and, ultimately, the granting authority image itself.

When it comes to the concession of regional airports, the problem becomes even greater, since demand is sparser, the variation between maximum and minimum movements occurs in a much shorter time interval than observed in medium and large airports, thus complexifying the task of selecting a passenger movement level compatible with the general concept of peak hour.

2. AIRPORT PEAK HOUR DEFINITIONS

As explained, there are many peak hours definitions for planning purposes in use by airport authorities. They attempt to define an acceptable portion of time (usually one year) in which users will receive no less than an adequate level of service. Several references, such as Ashford et al. (2011) present various peak hour definitions. Literature on the subject also includes works with specific applications in Brazilian airports, such as the works from Wang and Pitfield (1999) and Paulo et al. (2016).

The most traditional definition is the Standard Busy Rate (SBR), used in the past by BAA in the United Kingdom, defined as the 30th highest hour in annual passenger flow. Derived from road engineering, SBR means a level of demand exceeded by only 29 hours of operations at higher flows. A SBR modification is the Busy Hour Rate (BHR), a metric used to determine the passenger flow in which 5% of passengers experience a certain traffic volume or higher Waltert et al. (2021). Both methods use the same principle – they rank all year hours in descending order of passenger flow and then they select a fraction (hours or percentage).

Literature review shows that North American Aviation Authority (Federal Aviation Administration – FAA) works with more than one peak hour concept. The oldest, from the 1970s, is the concept of Typical Peak Hour Passengers (TPHP) which the value relates to annual flow United States (1976). The following table relates peak and year values, by annual demand range.

Table 1

Table 1 TPHP and Annual Passengers Ashford et al. (2013)

Annual passengers	TPHP / Annual passengers (%)
≥ 30 millions	0,035
20 – 29,999 millions	0,040
10 – 19,999 millions	0,045
01 – 09,999 millions	0,050
500.000 – 999.999	0,080
100.000 – 499.999	0,130
< 100.000	0,200

Concerning small airports, there is little historical data available, so FAA uses the Busiest Traffic Hour (BTH) as a metric for peak traffic. The BTH is based on scheduled flight times and the utilization factors of aircraft operating these flights.

Also used by the FAA, the Peak Profile Hour (PPH) is defined as the hour of greatest passenger flow on average day of the peak month.

The Brazilian Civil Aviation Authority – ANAC also developed a model that relates peak-hour passengers to annual volumes. The model is based on 194 observations from 64 airports in INFRAERO system from 1997 to 2005. The difference between the approaches is that ANAC proposes two limits for this relationship (lower and upper), and the use of one or the other limit (or the average between) depends on the reliability of annual traffic projections and the desired safety margin in the dimensioning ANAC (2007). The following table shows the limits by demand range.

Table 2

Table 2 Ratio Between Passengers at Peak Hour and During the Year ANAC (2007)

Annual passengers	Peak hour passengers / annual (%)	
	Upper bound (%)	Lower bound (%)
≥ 8 millions	0,027	0,024
03 – 07,999 millions	0,038	0,036
01 – 02,999 millions	0,051	0,046
400.000 – 999.999	0,070	0,064
100.000 – 399.999	0,118	0,084
< 100.000	0,399	0,169

Like the FAA, ANAC also considers peak hour concept as "the busiest 60 (sixty) minute interval on an average day of the calendar year peak month" ANAC (2012).

In the ICAO manual that guides the preparation of demand projections ICAO (2006), ICAO points out that "There is no universally accepted definition of typical peak periods. Typical peak hour is sometimes defined as the thirtieth or fortieth peak hour in a year, or traffic in a typical peak hour or peak day may be defined as an average over a specified period, such as the peak month."

IATA (2022) defines peak hour as the busiest hour of the second busiest day in an average week in the busiest month of the year.

However, there are other approaches. While ICAO states a common practice to use the 30th or 40th busiest hour of the year, Dutch airports use 6th busiest hour and Paris Airport uses a 3% overload standard.

Completing the survey, the peak hour definition adopted by the concession contract between the State of São Paulo and two (private) companies for 22 airports operation in the interior of São Paulo, which includes two airports covered by this text. In Annex 02 of the contract – Airport Operation Plan (PEA), there can be found in the Definitions item: "Peak hour – The 30th (thirtieth) busiest hour of a calendar year" ARTESP (2022).

3. CASE STUDY – THE AIRPORTS

In order to evaluate the various criteria used for determining peak hour, two airports were selected: São José do Rio Preto (SBSR) and Presidente Prudente (SBDN), both operated by the same private company (ASP Aeroportos Paulistas SPE), under a concession contract signed in 2022 with the Government of State of São Paulo, thirty years long.

Professor Eribelto Manoel Reino State Airport (SBSR - ICAO and SJP - IATA) is located in the city of São José do Rio Preto, in the interior of São Paulo, 420 km from the capital and approximately 4 km from the city center. Its infrastructure includes a 1,630 x 35 m runway, approved for non-precision IFR operations; taxiways (five); two aircraft aprons totaling 38,200 m^2; all the equipment necessary for non-precision IFR operations; a 6,000 m^2 passenger terminal; aircraft refueling services; ground support services (ramp), thirteen hangars specifically for general aviation and a flight school. The airlines operating in the airport are: LATAM, GOL, AZUL and VOEPASS, which connect the city to 12 domestic destinations. It is the largest regional airport in the state, with approximately 800,000 passengers in 2024.

Presidente Prudente Airport (SBDN, ICAO acronym and PPB, IATA acronym) is located in the city of Presidente Prudente, in the interior of São Paulo, approximately 7 km from the urban center and 570 km from the state capital. It has a runway measuring 2,100 x 35 m, approved for non-precision IFR operations; taxiways (three); two aircraft aprons totaling 31,000 m^2; all equipment required for non-precision IFR operations; 1,400 m^2 passenger terminal building; aircraft refueling services; ground support services and hangars for general aviation activities. The airlines LATAM, GOL and AZUL operate there, with connections to São Paulo / Congonhas, Guarulhos and Campinas airports, in addition to chartered flights to Bahia (Porto Seguro) and Maceio (Alagoas), which resulted in the movement of 310,000 passengers in 2024.

For a better understanding of the airports under study, below follow location maps of the airports and their ADC charts. We also present Graph 1 which shows the passenger movement evolution since the concessionaire took over those airports (April 2022).

Figure 1

Figure 1 Location of São José Do Rio Preto (SP)

Figure 2

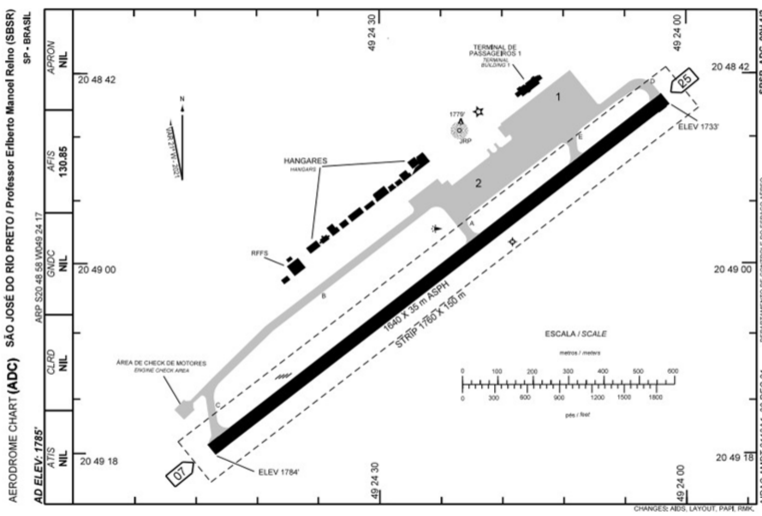


Figure 2 São José Do Rio Preto Airport (SBSR): ADC Chart

Figure 3

Figure 3 Location of Presidente Prudente (SP)

Figure 4

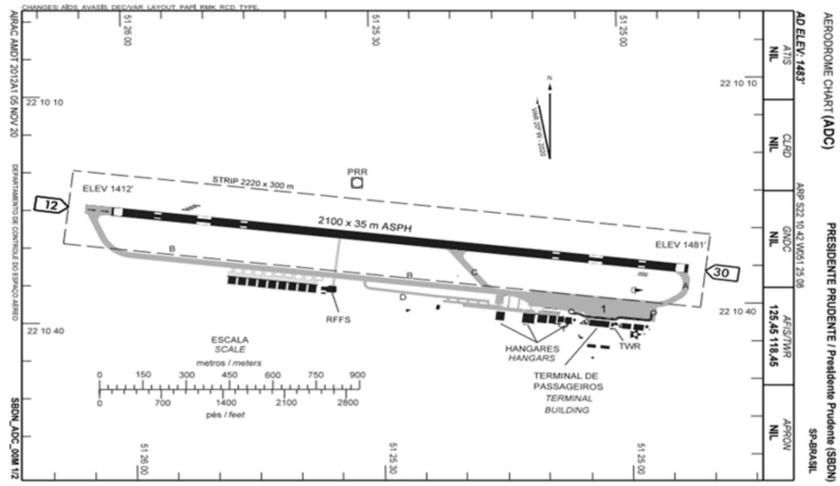
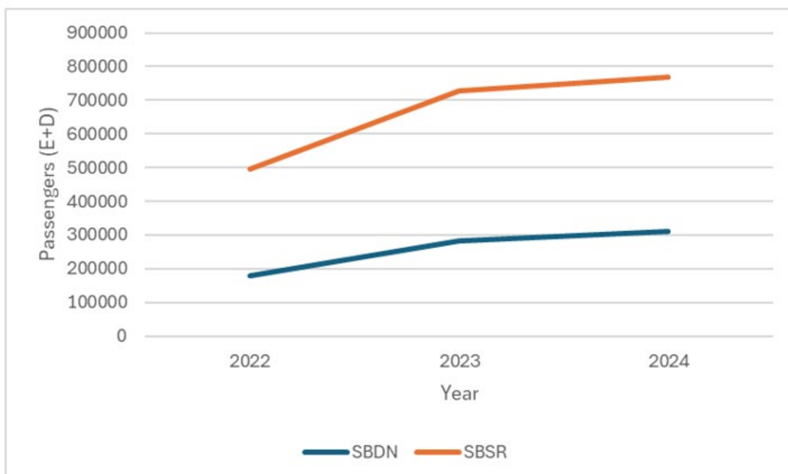


Figure 4 Presidente Prudente Airport (SBDN): ADC Chart

Graph 1



Graph 1 Passenger Movement in Rio Preto (SBSR) and Prudente (SNDN)

4. PEAK HOUR: CALCULATION AND RESULT ANALYSIS

In order to calculate and perform a comparative analysis of the number of passengers during peak hours at the airports of São José do Rio Preto and Presidente Prudente, we selected proposals from all the major air transport organizations in the world (ICAO, IATA, FAA). We also considered Brazilian criteria and, of course, those established in the concession contracts of the airports under study. Thus, the following criteria were used:

1) Thirtieth hour.
2) FAA peak/year ratio TPHP, Table 1.
3) ANAC peak/year ratio Table 2.
4) Peak hour of an average day of the peak month (DMMP).

5) The second busiest day peak hour of an average week in the peak month (IATA).
6) Busy hour rate (BHR).

The database for the analyses was the monthly movement reports produced by the concessionaire's Operational Control Center, with all the information on flights scheduled for each month: airline; flight number; aircraft; origin/destination; scheduled and actual landing/takeoff day and time; passengers and baggage boarded and disembarked. The calculations and analyses were performed using the actual landing and takeoff dates and times and the recorded number of passengers boarded or disembarked. The database contained 4,501 observations from São José do Rio Preto airport and 3,533 observations from Presidente Prudente airport, both covering the entire year of 2024. Each observation consisted of date/time/passengers.

The first step of the analysis was to construct the airport time curves. This task was accomplished in two stages: the first was to calculate the hourly movement for the entire period, and the second was to arrange data in decreasing order of the hourly movement. The results are shown in the figures below.

Figure 5

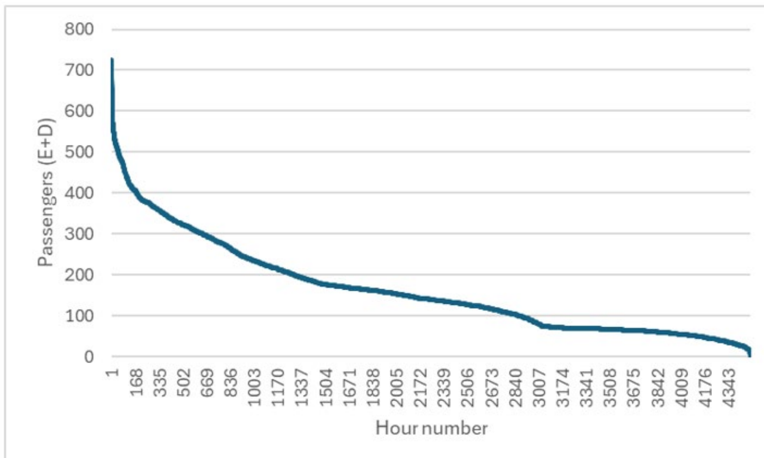


Figure 5 São José Do Rio Preto (SBSR) Airport: Time Curve 2024

Figure 6

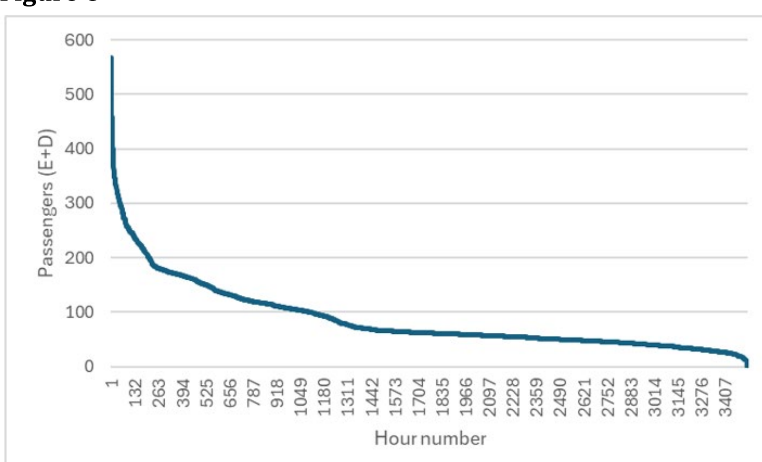
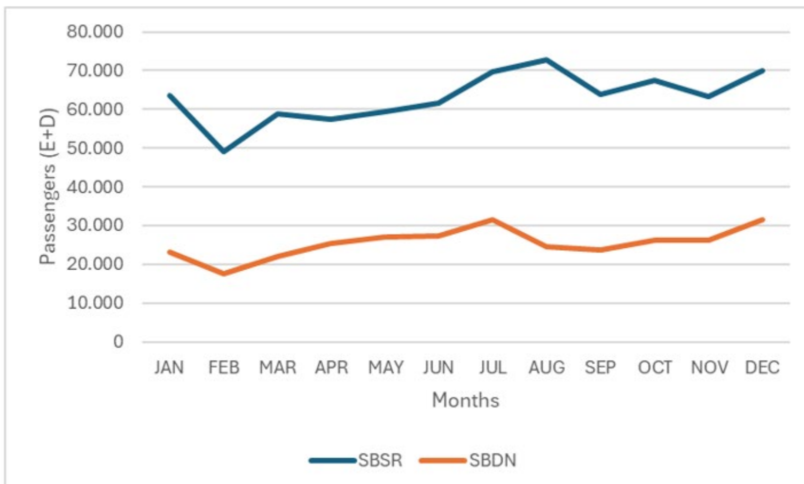


Figure 6 Presidente Prudente (SBDN) Airport: Time Curve 2024

Based on curves, the number of passengers at peak hour was calculated using the six criteria listed above. The thirtieth hour was easily identified given the decreasing order of the hourly movement used to construct the hourly curves. The typical peak hour passengers (TPHP) were calculated using the percentages in Table 1. The peak hour according to the ANAC criteria was calculated using a value average in Table 2 (upper and lower limits) for the traffic band of these airports. Calculating the peak hour of an average day of the peak month (indicated by DMMP) was more laborious. Initially, monthly movement in 2024 was calculated (see Graph 2) by selecting the peak month – August for SBSR and December for SBDN. Daily totals of the peak month were then calculated and then we identify the day with the movement closest to the average. By separating the movements of this average day, already aggregated in hours, it was then possible to obtain the peak hour. The case of the peak hour of the second busiest day in an average week in the peak month was equally laborious, with a similar script to the previous one but with the segregation of movements by closed week (Monday to Sunday). Finally, the peak hour rate (SBH) was identified when the sum of the hourly movements arranged in decreasing order exceeded 5% of the annual movement.

Graph 2



Graph 2 Monthly Passenger Movement at SBSR and SBDN Airports in 2024

The results obtained are summarized in the following tables, which contain, for each of the two airports studied, the maximum value of the hourly passenger movement, and for each criterion used: peak date and time (when applicable), peak hour passenger movement and the ratio between the calculated peak hour movement and the maximum hourly movement in the year. The ratio between the calculated value for the peak hour and the annual maximum hourly movement is a proxy for the maximum degradation in the level of service provided to customers.

Table 3

Table 3 SBSR: Peak Hour Values by Different Criteria (2024)

	Day	Hour	Peak PAX	Peak PAX / MAX (%)
Annual MAX	08.JUN	14:00 – 14:59	724	100
30th Hour	19.FEB	19:00 – 19:59	520	72
FAA – TPHP	-	-	615	85
ANAC	-	-	514	71

DMMP	19.AUG	19:00 – 19:59	495	68
IATA	04.AUG	19:00 – 19:59	556	77
BHR	26.DEC	21:00 – 21:59	479	66

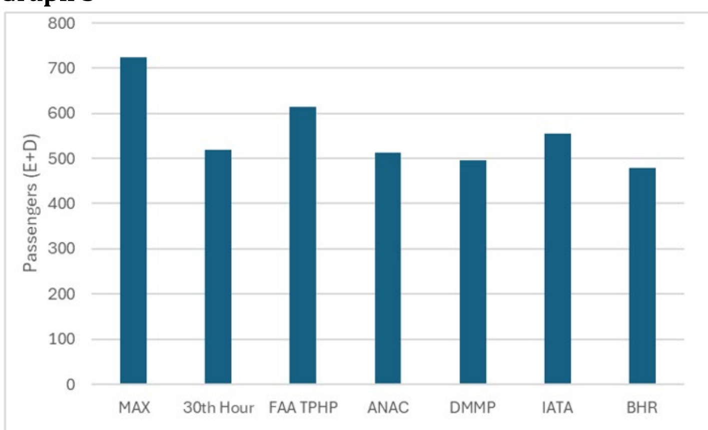
Table 4

Table 4 SBDN: Peak Hour Values by Different Criteria (2024)

	Day	Hour	Peak PAX	Peak PAX / MAX (%)
Annual MAX	24.NOV	14:00 – 14:59	567	100
30th Hour	19.FEB	14:00 – 14:59	330	58
FAA – TPHP	-	-	403	71
ANAC	-	-	312	55
DMMP	19.AUG	14:00 – 14:59	460	81
IATA	04.AUG	14:00 – 14:59	348	61
BHR	26.DEC	13:00 – 13:59	311	55

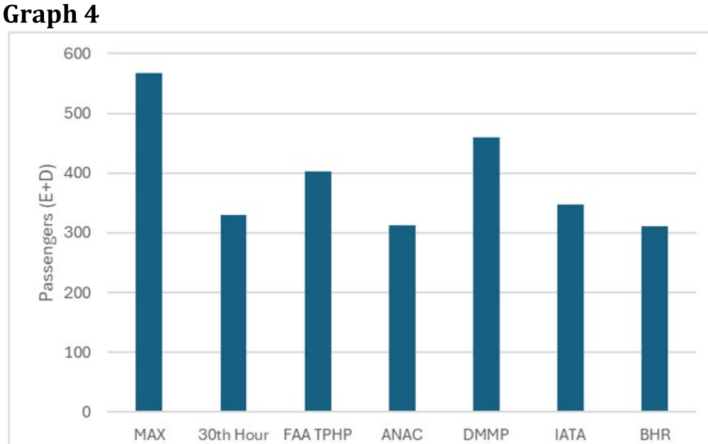
For better visualization and comparative analysis, Graph 3 and Graph 4 show peak hour values and the maximum hour for the airports of São José do Rio Preto and Presidente Prudente, respectively.

Graph 3



Graph 3 São José Do Rio Preto (SBSR) Airport: Peak Hours 2024

Graph 4



Graph 4 Presidente Prudente (SBDN) Airport: Peak Hours 2024

Some observations from these results:

1) Regarding peak times in various estimates, there is a certain pattern at both airports. At both airports, three of the four criteria that identify peak times pointed the same time range – from 7:00 p.m. to 7:59 p.m. in the case of São José do Rio Preto, and from 2:00 p.m. to 2:59 p.m. in the case of Presidente Prudente.
2) There is a greater estimates dispersion for Presidente Prudente (SBDN) in relation to those for São José do Rio Preto (SBSR).
3) The six criteria applied to São José do Rio Preto (SBSR) airport generated an average of 530 passengers at peak times. The highest estimate was 28% higher than the lowest calculated value. For Presidente Prudente (SBDN) airport, the average of calculations was 361 passengers at peak times, and the highest estimate was 48% higher than the lowest.
4) Maximum time at SBSR was 37% higher than average. The SBDN was 57% higher than average, indicating that degradation of service level will be greater in Prudente when traffic volume exceeds the reference demand at peak hours.
5) This finding is corroborated by data in the “Peak PAX / MAX” columns. In the case of SBSR, the average ratio is 73%, and in SBDN the average is 63%, that is the peak hour estimates are further away from the maximum hourly rate at Prudente airport.
6) Comparing the peak hour estimates for the two airports, Presidente Prudente has a greater dispersion, a greater distance between the estimates average and the maximum hour, and a greater portion of customers who will experience a degradation in the level of service. A possible explanation for these facts is that demand is thinner in Presidente Prudente and this volatility contributes to a greater dispersion of the data.
7) Regarding the estimates using the 30th hour criteria: in the case of SBSR, the estimate was practically the average (520 of the estimate for 530 passengers on average), representing 72% of the maximum hourly movement. In the case of SBDN, the use of the 30th hour criteria led to a low estimate (almost 10% below the average), far from the hourly maximum (the calculated value is 58% of the maximum).
8) Still regarding the 30th hour criterion – the lower the volume of demand, the greater the probability of repeating the total hourly number of passengers boarding and disembarking. This means that the "thirtieth busiest hour of a calendar year" can be preceded by much more than 29 hours. Thus, the lower the volume of demand, the greater the degradation of the level of service and the longer this degradation will take.

5. CONCLUDING REMARKS

This study aimed to evaluate different criteria for estimating peak hours at airports, focusing on the criteria used in regional airport concessions in Brazil. The results indicate that at airports with low traffic volume (in this case, around 300,000 annual passengers) there is a wide dispersion of estimates, making it difficult to select a criterion. In regional airports with higher traffic volume (in this case, over 700,000 annual passengers) there is stability between the criteria and greater proximity of estimates to maximum time.

As a corollary of these observations, the 30th hour criterion (the peak hour definition adopted by the concession contract for the airports in this case study) has shown that it may be more suitable for the busiest scenario. In the case of an airport similar Presidente Prudente (300,000 annual passengers), the results do not recommend using this criterion. The significant difference between the peak hour estimated and the maximum time and the number of hours with service level degradation will certainly be the subject of serious criticism by customers.

This finding indicates that local airport concession processes should not automatically reproduce the parameters adopted in the Brazilian federal airport privatization program. The difference in size, volume and temporal distribution of demand requires a prior assessment of current and future characteristics of airport traffic in order to have a robust concession process with real quality gains for customers.

CONFLICT OF INTERESTS

None.

ACKNOWLEDGMENTS

The author thanks the ASP team for their support in collecting operational data – Alvaro Cardoso, Angelica Andrade, Bruno Conceição, João Paulo Neves, Letícia Amado and Ricardo Saturnino.

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