# LEVEL OF SERVICE STANDARDS FOR BAGGAGE CLAIM FACILITIES AT AIRPORT PASSENGER TERMINALS

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## ABSTRACT

Our aim is to provide a methodology to develop level of service standards for baggage claim areas at airports. Regression analysis was used to define a causal relationship between waiting time at baggage claim and passengers' opinions in terms of score ratings. Subsequently, the level of service standards proposed for these airports were compared between each other and with an airport located in North America, in order to compare passengers´ opinions about different airports and countries. The research results are useful for airport planners to evaluate the level of service and to propose alternatives for improving customer service.

**Keywords**: Level of service, airport, passenger terminal, baggage claim, regression

## 1. INTRODUCTION

Besides the major sports events to occur in Brazil (2014 FIFA Soccer World CUP and 2016 Summer Olympic Games), the air transport sector has been facing high growth rates over the last ten years. The trend in Brazil is that the intensity of the use of air modal comes close to the air travel intensity in developed countries; it is expected to go from 0.3 to 0.7 travels per person per year in the medium term (McKinsey & Company, 2010). In this context of growing demand for air travel, it is critical for airports to be developed accordingly. Investments in expansion, modernization and even the construction of new airports, aiming to increase its operational capacity, may be essential. Consequently, the level of service standards, according to Brazilian customers' perception, would be very useful.

In the last decades, the development of level of service measures for airport passenger terminals has been a major issue for airport operators worldwide. Today, quality has become an essential measure to assess the level of service in any industry and in any market. Studies on the quality of terminal services are being performed in order to reduce costs, redirect investment and increase the customer satisfaction level. The level of service of an airport as a whole must be analyzed. However, the baggage claim area becomes even more important in the airport system because it is the "gateway" to the city. The passenger has a first contact with the terminal when landing and heading into the baggage claim area. The initial perception of the quality of service offered at the destination airport happens in activities related to landing (Borille and Correia, 2011).

Our main objective is to provide a methodology to develop level of service standards for baggage claim areas of airports according to users' perception.

## 2. LITERATURE REVIEW

### 2.1 Passenger Terminal

The main function of an airport passenger terminal is to provide a convenient mechanism for the transfer mode from ground to air transport, and vice versa, besides promoting the flow of transit passengers. It is also the national borderline for international passengers, in order to offer all the necessary facilities to the passenger, and the landing procedure required in the destination places. The passenger terminal is usually the first place of contact of the passenger with the foreign country.

Passengers, airlines and other customers of the terminal have their own ideas about comfort, convenience, cost and environment, which must follow the movement of passengers and their baggage between the aircraft and ground transport. There are inevitable compromises to be made between capital and operating costs, including cost and level of service and between form and function, which influence the ability of a terminal to meet all all the users' needs (Kazda and Caves, 2007).

The baggage claim areas are typically located near the route of deplaning passenger traffic. The area can be operated by one or more airlines, or can be operated by the airport. The baggage claim areas are usually equipped with carousels. In addition to the baggage handling equipment, operations related to baggage claim are usually managed by the airlines. Airlines try to avoid crowds and especially delays driving from this phase (TRB, 1987).

### 2.2 Level of service Evaluation for Airport Passenger Terminals

A joint research effort between the FAA – Federal Aviation Administration and the TRB – Transportation Research Board (TRB, 1987) enumerated some key indicators that influence the level of service and capacity of baggage claim areas, including: the configuration of the equipment and the area available for restitution (layout and type of equipment), staff behavior (inspection of luggage at customs), the amount of luggage per flight (number of bags per passenger, the percentage of passengers with luggage, time of arrival of luggage from the plane), and the

passengers' characteristics, among others. According to the study, a research effort should be developed to obtain level of service standards according to users' perceptions.

According to Pagani *et al.* (2002), some airport organizations known worldwide, such as BAA (British Airport Authority), IATA (the International Air Transport Association), and ADP (Aeroports de Paris) suggest some design and layout patterns for the space and time for the baggage claim area. These organizations set limits on the percentage of passengers experiencing service indicators such as waiting time and degree of crowding.

According to Andreatta *et al.* (2007), the level of service represents quality and conditions of service of one or more facilities from the passengers' point of view. Inter-relationships between measurements of typical level of service are common, such as waiting time, processing time, walking time, overcrowding and facilities for passengers (comfort and convenience).

Bandeira and Correia (2008) developed a research effort to evaluate the degree of importance of the level of service attributes at São Paulo International Airport, according to users' perception. The general idea of the study was to obtain a composite measure of the airport level of service, as a function of the level of service of individual components. One drawback of the paper is that it does not evaluate or survey deplaning passengers. In this case, baggage claim components were not considered in the study.

Correia and Wirasinghe (2010) proposed level of service standards for baggage claim facilities, using the Calgary International Airport as a case study. In particular, domestic passengers from West Jet Airlines (a low-cost carrier) were observed and surveyed. According to the study, the main indicators of level of service for these facilities are waiting time and the carousel perimeter. The results of that study will be further used in this paper to make a comparison between Latin American and North American passengers.

## 3. SELECTED CASE STUDY AIRPORTS

Passenger surveys were conducted at three major Brazilian airports: Campinas/Viracopos International Airport, São Paulo/Congonhas Domestic Airport, and Fortaleza/Pinto Martins International Airport. Altogether, 425 passengers were observed and surveyed at these airports. Table 1 presents the annual volume of passengers at major Latin American airports. São Paulo/Congonhas is the 3rd airport in Latin America in terms of volume of passengers. Campinas/Viracopos International Airport, was the fastest growing airport in Latin America from 2000 to 2010 (annual average growth rate of 22.5%). Leigh Fisher (2011) expects 35.6 million annual passengers in this airport by 2021.

**Table 1: Annual Volume of Passengers at Major Latin American Airports. Source: Leigh Fisher (2011)**

| Position | City (airoport), Country | Annual Passengers (millions) | | Average annual increase |
|---|---|---|---|---|
| | | 2000 | 2010 | 2000-2010 |
| 1 | São Paulo (Guarulhos), Brasil | 13,743 | 26,849 | 6.9% |
| 2 | Cidade do México, México | 21,043 | 24,131 | 1.4 |
| **3** | **São Paulo (Congonhas), Brasil** | **10,537** | **15,499** | **3.9** |
| 4 | Bogotá, Colômbia | n,d, | 14,968 | -- |
| 5 | Brasília, Brasil | 5,235 | 14,347 | 10.6 |
| 6 | Cancun, México | 7,745 | 12,439 | 4.9 |
| 7 | Rio de Janeiro (Galeão), Brasil | 5,043 | 12,338 | 9.4 |
| 8 | San Juan, Porto Rico | 8,567 | 10,444 | 2.0 |
| 9 | Santiago, Chile | 5,778 | 10,315 | 6.0 |
| 10 | Lima, Peru | 4,506 | 10,233 | 8.5 |
| 11 | Guadalajara, México | 6,507 | 9,291 | 3.6 |
| 12 | Caracas, Venezuela | 6,660 | 8,970 (b) | 3.4 |
| 13 | Buenos Aires (Ezeiza), Argentina | 5,690 | 7,910 (b) | 3.7 |
| 14 | Rio de Janeiro (S. Dumont), Brasil | 4,883 | 7,823 | 4.8 |
| 15 | Salvador, Brasil | 3,285 | 7,696 | 8.9 |
| 16 | Belo Horizonte, Brasil | n,d, | 7,261 | -- |
| 17 | Porto Alegre, Brasil | 2,519 | 6,676 | 10.2 |
| 18 | Havana, Cuba | 2,497 | 6,633 (b) | 11.5 |
| 19 | Buenos Aires (J. Newberry), Arg. | 7,038 | 6,449 (b) | (1.0) |
| 20 | Recife, Brasil | 2,472 | 5,959 | 9.2 |
| 21 | Curitiba, Brasil | 2,167 | 5,775 | 10.3 |
| **22** | **São Paulo (Viracopos), Brasil** | **713** | **5,430** | **22.5** |

Even though Fortaleza/Pinto Martins International Airport is not among the major airports portrayed in Table 1, it was included in the analysis, since it is a major airport in terms of tourism in Brazil. Additionally, it has processed more than 5 million passengers in 2010, according to Infraero, the federal company that manages the major 67 airports in Brazil, including Fortaleza. It is the second largest airport in the Northeast of Brazil, the most important touristic area in the country.

### 3.1. Sample Size Estimation

This item is just to briefly explain the inferential statistics because we will use sample data to make inferences about populations. Specifically, we will use sample data to make estimates of population parameters. The two major applications of inferential statistics involve the use of sample data to (1) estimate the value of a population parameter, and (2) test some claim (or hypothesis) about a population. In this paper, the important is determining the sample sizes necessary to estimate those parameters (Triola, 2004). Figure 1 can clearly demonstrate the concept of the sample.

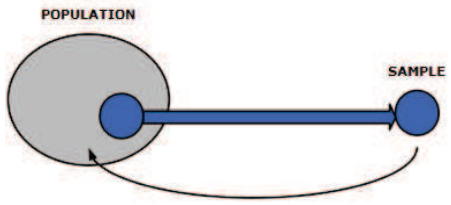



**Figure 1: Inferential Statistics. Source: PORTAL (2012)**

So as to obtain a representative sample of airport population, a minimum sample size is necessary. For determining the samples of the three airports studied, the confidence intervals most frequently used in the literature were considered, 90%, 95% and 99%.

**Table 2: Confidence Intervals and corresponding Critical Value (Z)**

| Z | (1-α) |
|---|---|
| 1.65 | 0.90 |
| 1.96 | 0.95 |
| 2.58 | 0.99 |

The sample size is considered an intriguing aspect of conducting a research. Costa Neto (2002) states that the sample does not perfectly represent the population, i.e. the use of a sample implies acceptance of a margin of error called sampling error, which is the difference between a sample result and the true population result. As you cannot avoid the occurrence of this error margin, the technique that should be employed is to limit the amount of sampling error by choosing an appropriate sample size (TRIOLA, 2004). In order to ensure that the required sample size is at least as large as it should be, if the computed sample size is not a whole number, round it up to the next higher whole number.

For sizing the sample of the present study, equation (1) is used, which is based on an estimate of the population proportion:

$$n = \frac{[Z_{\alpha/2}]^2 \times p \times q}{E^2} \quad \text{(Equation 1)}$$

Where $n$ is the sample size, $Z_{\alpha/2}$ is the critical value corresponding confidence interval (1-α), $E$ is the margin of error, $p$ is an estimate of the population proportion but if no such estimate is known (as is usually the case), it replaces $p$ by 0.5, $q$ is complementary to $p$ and $N$ is the population size.

**Table 3: Airport Sample Size Estimation**

| Z | (1-α) | Airport (sample size) |
|---|---|---|
| 1.65 | 0.90 | 69 |
| 1.96 | 0.95 | 97 |
| 2.58 | 0.99 | 167 |
| | E | 0.1 |

### 3.2 Passenger Survey

Data were collected through the observation of passengers, measurement of the waiting time, and passenger survey. The observation of passengers aimed to analyze their positioning next to the baggage carousel. The measured time represents the time that passengers wait to receive their luggage.

Initial questions (travel purpose, gender, amount of luggage, and origination city) were asked passengers at the carousel while they waited for luggage. After receiving their luggage, the passengers interviewed were asked about the perception of time and space for baggage claim. At this stage, passengers rated the service with scores from 1 to 5 (5 being the highest score) for these two criteria.

#### 3.2.1Campinas/Viracopos International Airport

Two field researches were conducted at Viracopos Airport. The first on June 1st, 2011 (Wednesday) and the second on November, 17th, 2011 (Tuesday) during daytime at domestic baggage claim areas. The domestic baggage claim area has three carousels. The perimeter of each carousel is

around 27 meters (Figure 2). On the second survey day (17), carousel 4 (about 88m perimeter), which is normally used for international arrivals, was used for domestic arrivals. The total number of passengers surveyed was 156 passengers.

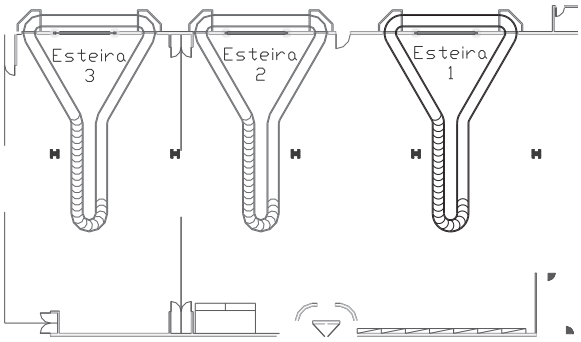



**Figure 2: Layout baggage claim area at Viracopos Airport. Source: Infraero**

3.2.2 São Paulo/Congonhas Airport

Two surveys were made at Congonhas Airport, on June 28th, 2011 (Tuesday) and November 18th,
2011 (Friday) during daytime at domestic baggage claim areas. The Baggage Claim area has five carousels, four of them with 27 meters of perimeters and the other around 20 meters. 199 passengers were surveyed at this airport.

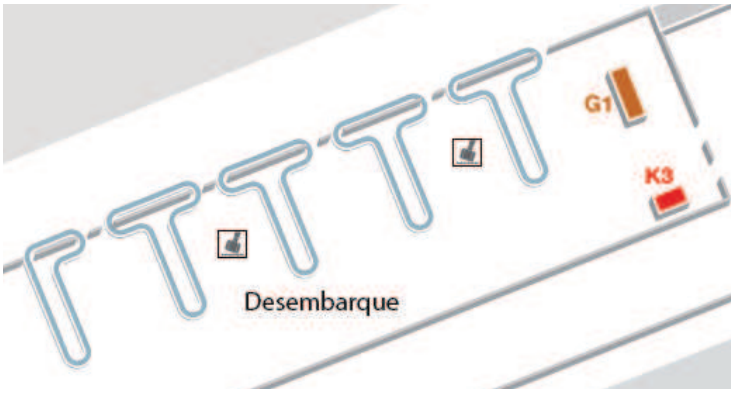



**Figure 3: Baggage claim area at Congonhas Airport. Source: Infraero**

3.1.3 Fortaleza/Pinto Martins International Airport

Field research was conducted on July 12th, 2011 (Tuesday), during daytime at baggage claim areas. The area has three baggage carousels. The perimeter of each carousel is around 27 meters (Figure 4). In the survey, carousel 4 was also used sporadically by domestic arrival. The total of passengers surveyed was 70 passengers.

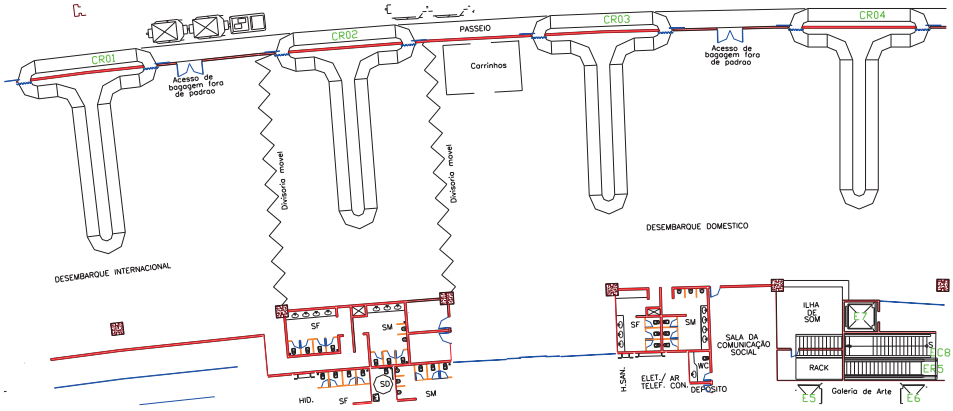



**Figure 4: Layout baggage claim area at Pinto Martins Airport. Source: Infraero**

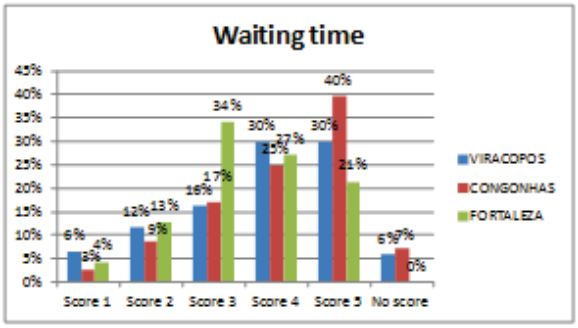
### 3.3 Profile of Passengers and Statistical Treatment of Data

*Viracopos:* of the passengers interviewed, 60% were male and 40% female. Regarding the reason for travel, 49% of the passengers were on a business trip, followed by 43% of passengers traveling for leisure, and the rest of the passengers were traveling for other reasons (family, combined, etc).

*Congonhas:* of the passengers interviewed, 53% were male and 47% female. For this airport, 56% of those interviewed were traveling on a business trip and 39% for leisure.

*Fortaleza:* among the interviewed passengers, 56% were male and 44% female. 69% were on a leisure trip and 29% on a business trip.

Figure 5 presents the passenger opinions (scores 1 to 5) concerning waiting time and space available at the baggage claim for the three airports surveyed.



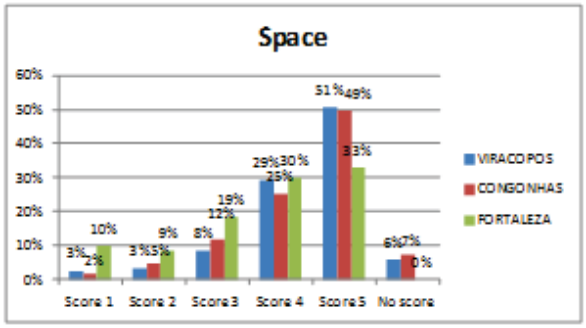




**Figure 5: Passenger ratings of level of service indicators of waiting time and space available**

Results of waiting time measurements are presented in Table 4.

**Table 4: Average Waiting Time (min:sec) at Baggage Claim**

| | Viracopos | Congonhas | Fortaleza |
|---|---|---|---|
| **Average Time** | 08:30 | 06:35 | 07:35 |
| **Standard Deviation** | 04:08 | 03:36 | 04:00 |
| **Minimum time** | 00:39 | 00:10 | 00:35 |
| **Maximum Time** | 18:27 | 17:21 | 17:49 |

Tables 5, 6 and 7 present level of service indicators as a function of the amount of luggage per passengers for each airport. It can be noticed that the waiting time increases as a function of the amount of luggage. With regard to the scores given by the passengers, the average is relatively high. The scores for the space can also be considered good, with overall average of 4.

**Table 5: Indicators as a Function of Number of Luggage per Passenger (Viracopos)**

| Quantity | | Average Values | | |
|---|---|---|---|---|
| **Luggage** | **Passengers** | **Waiting time** | **Waiting Time Rating** | **Space Rating** |
| | | **min:sec** | **1 to 5** | **1 to 5** |
| **1** | **95** | 08:08 | 3.66 | 4.15 |
| **2** | **48** | 09:20 | 3.62 | 4.47 |
| **3 or more** | **11** | 08:04 | 4.27 | 4.73 |

**Table 6: Indicators as a Function of Amount of Luggage per Passenger (Congonhas)**

| Quantity | | Average Values | | |
|---|---|---|---|---|
| Luggage | Passengers | Waiting time | Waiting Time Rating | Space Rating |
| | | min:sec | 1 to 5 | 1 to 5 |
| 1 | 155 | 06:50 | 3.96 | 4.27 |
| 2 | 17 | 05:48 | 4.24 | 4.32 |
| 3 or more | 8 | 07:16 | 4.25 | 4.38 |

**Table 7: Indicators as a Function of Amount of Luggage per Passengers (Fortaleza)**

| Quantity | | Average Values | | |
|---|---|---|---|---|
| Luggage | Passengers | Waiting time | Waiting Time Rating | Space Rating |
| | | min:sec | 1 to 5 | 1 to 5 |
| 1 | 40 | 07:37 | 3.40 | 3.53 |
| 2 | 20 | 08:34 | 4.08 | 4.13 |
| 3 or more | 4 | 07:35 | 4.13 | 3.38 |

Figure 6 presents measured waiting times for the 161 monitored passengers at Viracopos Airport. Excluding those whose original destination was Guarulhos (diverted passengers), 76.4% waited for baggage within the time limit "minimum acceptable" (less than 12 minutes); 22.3% were within the limit "acceptable to the maximum" (between 12 and 18 minutes);1.3% were above the limit "acceptable to the maximum". IATA recommends that 90% of passengers should wait less than 20 minutes for luggage. As can be observed, all the passengers monitored at Viracopos were processed within these limits. However, passengers diverted from São Paulo airport were not able to get their luggage within the recommended IATA waiting time limits.

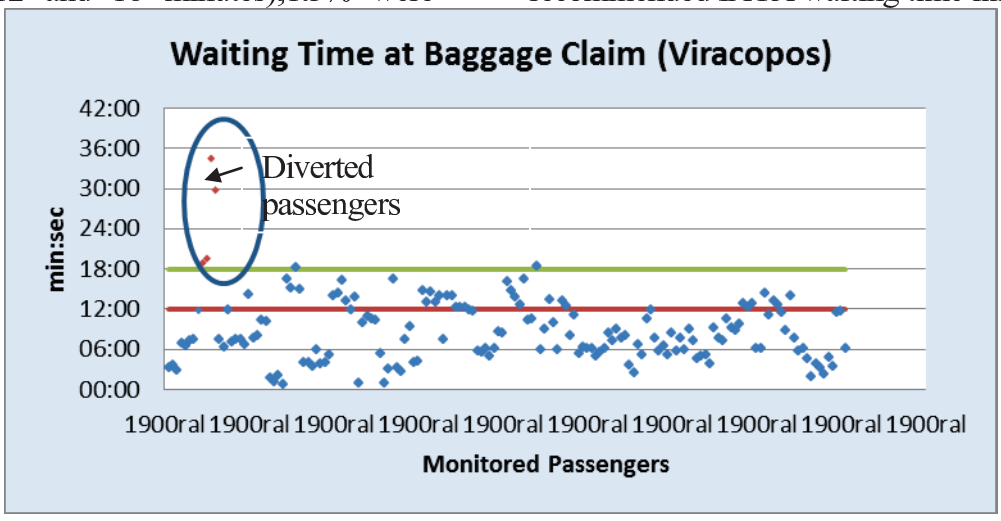



**Figure 6: Waiting time at Campinas/Viracopos International Airport**

Figure 7 presents the waiting time of 199 passengers observed at São Paulo/Congonhas airport. Among the passengers interviewed, 91% of them waited within the "minimum acceptable" time limit (less than 12 minutes); 9% were within the limit "acceptable to the maximum" (12 to 18 minutes).

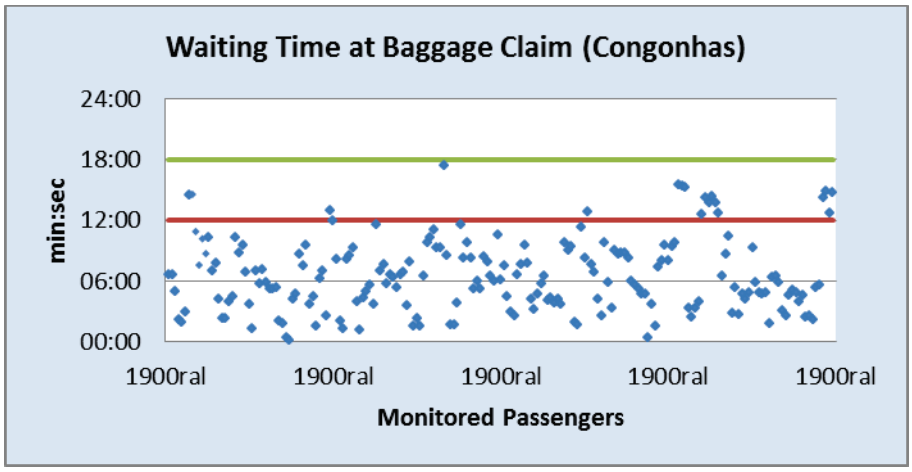



**Figure 7: Waiting time at São Paulo/Congonhas airport**

Figure 8 presents the average waiting times of 70 passengers observed in Fortaleza/Pinto Martins International Airport. Among the passengers interviewed, 87% of them waited within the "minimum acceptable" time limit (less than 12 minutes); 13% were within the "acceptable to the maximum" limit (12 to 18 minutes).

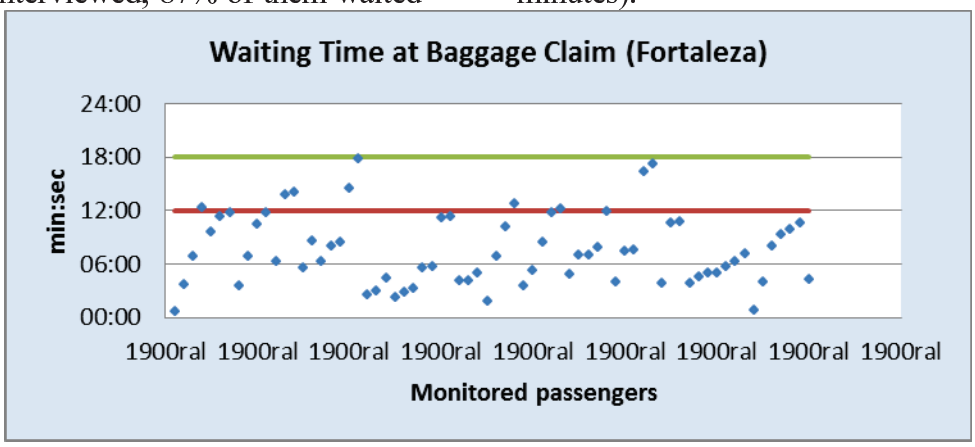



**Figure 8: Waiting time at Fortaleza/Pinto Martins International Airport**

### 3.4 Regression Analysis

Regression analysis was employed to establish a causal relationship between passenger opinions (rated from 1 to 5) and the waiting times monitored. Equation 2 presents the proposed function for Viracopos airport.

$$waiting_time_score = 5.2477 - 0.002992\,(waiting_time)$$

(Equation 2)

The model presented a R2 = 0.952 and significance of independent variable as 1%. These statistical figures indicate that the model is suitable for analysis. Similar equations were developed as well for Congonhas and Fortaleza airports, with similar statistical goodness of fit indicators.

Values 1 to 5 (scores obtained from passengers surveys) were used as at Equation 1 (and at additional equations for Congonhas and Fortaleza), aiming to identify which waiting times correspond to ratings 1, 2, 3, 4 and 5, respectively. These proposed standards for Viracopos, Congonhas and Fortaleza airports were compared with each other and with standards proposed for Calgary International Airport, Canada; a similar study was conducted in 2004 at this north-American airport, at the baggage claim area for domestic passengers of West Jet, a Canadian airline (Correia and Wirasinghe, 2010). Particularly, this airline holds some similarities with the main airline at Viracopos (Azul Airlines), including the concept of low cost low fare. Additionally, the founder of Azul Airlines was also the founder of West Jet. Table 8 presents the proposed standards for Viracopos, Congonhas, Pinto Martins and Calgary airports.

**TABLE 8: Proposed level of service standards**

| Level of Service Rating | Waiting Time at Baggage Claim (minutes) | | | |
|---|---|---|---|---|
| | Viracopos | Congonhas | Fortaleza | Calgary |
| 5 | < 1 | < 2 | < 1 | < 1 |
| 4 | 1 - 7 | 2 - 7 | 1 - 6 | 1- 14 |
| 3 | 7 - 13 | 7 - 12 | 6 - 12 | 14 - 20 |
| 2 | 13 - 18 | 12 - 17 | 12 - 17 | 20 - 26 |
| 1 | >18 | >17 | >17 | >26 |

Analyses of results presented at Table 8 are provided as follows:

*Viracopos:* waiting times for baggage claim should not exceed 1 minute in order that passengers at Viracopos airport rate the service as excellent (Rating 5). Waiting times within the 1-7 minutes limits would be associated with Rating 4. Waiting times longer than 18 minutes would yield Rating 1. Compared to the values found for the Calgary airport in Canada, it is clear that passengers at Viracopos are generally more demanding than Calgary passengers.

*Congonhas:* waiting times for baggage claim should not exceed 2 minutes to have level of service excellent (Rating 5). Waiting times within the 2-7 minutes limits would be associated with Rating 4. Waiting times longer than 17 minutes would yield Rating 1. Compared to the values found for the Calgary airport in Canada, it is noticed that passengers at Congonhas are less demanding regarding high satisfaction standards (rating 5). However, for the other levels, it is noticed that passengers at Congonhas are more demanding than the Calgary passengers.

*Fortaleza:* in order to achieve an excellent level of service, the waiting time for luggage should not exceed 1 minute. For a service with a rate equivalent to 4, for example, that time should not exceed 6 minutes. A service considered "bad" happens when the waiting time exceeds 17 minutes. As compared to the values of the other airports, including Calgary in Canada, it is clear that passengers from Fortaleza are more demanding.

Comparing Calgary and Viracopos, Congonhas and Fortaleza standards, we can identify some similarities. However, the passengers of Brazilian airports are slightly more demanding than Calgary passengers. One policy implication of this finding is that airport operators and airlines in Latin America should make an effort to provide a high level of service for passengers, the same (or even better) as provided in North America. On the contrary, it is a common opinion among airport professionals in Latin America that Latin passengers "accept" a lower level of service than North American passengers.

## 4. CONCLUSIONS

Over 400 passengers were monitored and surveyed at three major Brazilian airports at the baggage claim facilities. Statistical

analyses were employed to find a causal relationship between passenger opinions and waiting times at baggage claim areas. Additionally, levels of standards (1 to 5) were proposed for these three airports. Subsequently, these levels were compared with an airport in Canada. Contrarily to the "common opinion", the results indicate that domestic passengers at Brazilian airports are slightly more demanding than domestic passengers in Canada. We were unable to get more data and more airports due to resource and time constraints. This is why the results should not be adopted directly. Yet, the methodology to develop level of service standards proposed by this paper are useful for airport planners and managers, in order to evaluate level of service and to propose alternatives for improving customer service.

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