Degree of Importance of Airport Passenger Terminal Components and Their Attributes

This paper applies the Analytical Hierarchy Process (AHP) to determine the importance that users assign to the various components of an airport passenger terminal (APT) and their attributes. A survey of departing passengers was employed to obtain the user perceptions at São Paulo/ Guarulhos International Airport, the biggest airport in South America. The results indicate that the most important components of an APT for departing passengers are the check-in counter and the departure lounge.

By Michelle Bandeira, Anderson Correia and Chan Wirasinghe

Introduction

Airport managers have to struggle with the decision of prioritizing resources. Although they are motivated to offer a reasonable level of service (LOS) to passengers, there is a growing worldwide tendency for cost reduction. In this scenario, an effort to determine the importance that passengers attribute to airport components will be useful, as it will be one indication of where airport managers should invest their limited resources such as funds, employees and their own attention.

This paper provides a methodology to obtain the importance that passengers assign to the various components and attributes of an airport passenger terminal (APT). The Analytical Hierarchy Process (AHP) is employed in order to obtain quantitative weights representing the relative importance of components and their attributes (processing time, courtesy, etc). We can suppose, through the process of pair-wise comparisons between the components and their attributes, that these weights could be further used to obtain a global LOS measure of an APT as a function of the LOS of individual components (check-in, departure lounge, etc).

Literature Review

Several air transport agencies have proposed level of service (LOS) standards for airport passenger terminals, including the ACI – Airports Council International (ACI, 2000), IATA - International Air Transport Association (IATA, 1995), FAA – Federal Aviation Administration (TRB, 1987) and Transport Canada (1979). Despite their efforts, the proposed LOS standards have been widely criticized (Müller and Gosling (1991); Ashford (1988); Correia and Wirasinghe (2004)). One of the main issues is the lack of passenger input in determining the standards. In addition, these studies do not indicate the degree of importance of each APT component or attribute to the overall level of service. Thus, it is impossible to obtain an overall APT level of service for a given group of passengers (e.g. departures) using those manuals.

Photo 1: *Denver's Airport Passenger Terminal*

Correia and Wirasinghe (2004) provide a comprehensive literature review on airport LOS measures. It was concluded that obtaining the degree of importance of the APT components and their attributes was critical. Correia (2005) and Correia, Wirasinghe & de Barros (2006) took steps to develop such measures, using objective variables, i.e. variables that can be measured using a physical scale: time, space, distance, etc. They used multiple least squares regression analysis to regress an overall LOS identified by passengers (dependent variable) against individual component LOS.

This paper intends to analyze LOS as a function of objective and subjective

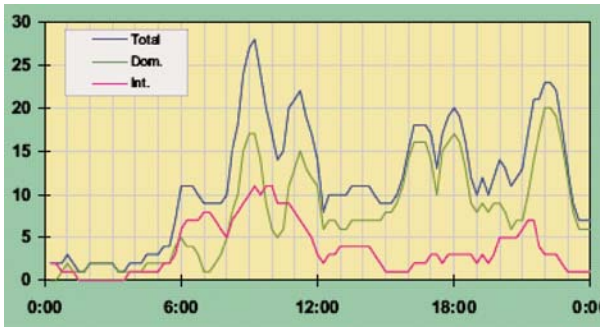

Figure 1: *Average daily aircraft movement at São Paulo International Airport (Source: Infraero, 2000)*

Components	Characteristics
Parking	Courtesy, Security, Availability of Parking Spots
Departure Hall	Security, Orientation, Information, Comfort, Services
Check-in	Processing and Waiting Time, Courtesy
Departure Lounge	Courtesy, Comfort
Concessions	Courtesy, Variety of Stores

Table 1: *Components and their Attri-butes as proposed by an Expert Panel*

measures, such as courtesy and comfort. The AHP method was selected for the analysis, since it is able to incorporate both objective and subjective measures. The weights found for each component and their respective attributes will indicate the degree of importance that passengers attribute to them.

Data Collection

A passenger survey was taken at São Paulo/ Guarulhos International Airport in the period of November 9th-15th, 2006. Over 100 randomly selected passengers were interviewed at the departure lounge during peak hours (08:00-10:00 and 17:00-19:00) as identified from the average daily aircraft movements at São Paulo Airport (Figure 1).

The Airports Council International level of service manual (ACI, 2000) was employed to pre-select the most important components and characteristics of components, according to the opinion of managers of 512 ACI airports. Final selection of variables to be included in the model was concluded with specialists of the Department of Air Transport and Airports of the Aeronautical Institute of Technology (ITA) during meetings in May-July 2006.

Table 1 presents the proposed variables indicated by the expert panel.

A questionnaire was developed, in which passengers could compare the importance of one component (or attribute) over another component (or attribute). This process is called pairwise comparisons. For instance, passengers were asked to indicate the degree of importance of courtesy compared to comfort at the departure lounge. The scale provided to the user will be explained in the next section.

The number of factors to be analyzed should be kept into a minimum, in order to prevent passengers getting confused. Additionally, the questionnaire should be simple because passengers in the departure lounge usually do not have too much time to answer it. A pilot survey was done to test the questionnaire. One of the conclusions was that too many questions led the passenger to answer the last ones without much consideration.

The management of São Paulo/ Guarulhos International Airport did not allow the surveying of passengers about the importance of security screening and passport control. Thus, these components were not included in the analysis.

Several socio-economic variables were collected during the survey in addition to the passenger ratings of the importance components and their attributes:

1.gender; age; family income;
2.airline; destination (national or international); purpose of trip (business, leisure, or combined);
3.annual frequency of air trips; degree of familiarity to major Brazilian airports.

These socio-economic variables will be useful in future research to analyze groups of passengers that have common characteristics (same destination, similar family income, etc). It might be the case that given groups of passengers have different perceptions of the importance of components and attributes.

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

***Figure 2**: n x n square matrix*

The AHP – Analytical Hierarchy Process

The Analytical Hierarchy Process was first presented by Saaty (1980). It is one of the first multi-criteria decision methods. Its main objective is to represent the decision model in the most realistic way, including subjective and objective factors. Using this method, it is possible to structure a problem through hierarchical levels and make alternative comparisons through a quantitative importance scale. Table 2 presents the fundamental scale of the method.

According to Table 2, the maximum degree of importance of a given component or attribute is 0.90. That will happen when this component is extremely more important than another component.

The AHP method consists of an n x n square matrix, where rows and columns are associated with the n criteria (e.g. the APT components and their attributes). The *Aij* represents the relative importance of row i criteria over column j criteria (Figure 2).

If all passenger judgments are consistent for any i, j, k,

Degree of Importance		Saaty	
Comp. 1	*Comp. 2*	*Scale*	*Importance Degree*
0.90	0.10	9	Component 1 is extremely more important than Component 2
0.80	0.20	7	Component 1 is very important compared to Component 2
0.70	0.30	5	Component 1 is important compared Component 2
0.60	0.40	3	Component 1 is less important compared to Component 2
0.50	0.50	1	Both components have the same importance
0.40	0.60	1/3	Component 2 is less important compared to Component 1
0.30	0.70	1/5	Component 2 is important compared Component 1
0.20	0.80	1/7	Component 2 is very important compared to Component 1
0.10	0.90	1/9	Component 2 is extremely more important than Component 1

Table 2: *Comparison among the scale used in this research with the scale of Saaty.*

$$a_{ij} \times a_{jk} = a_{ik}$$

In practice, these values can be slightly different from what is expected. However, the method allows a given degree of inconsistency (see Gomes et. al., 2004), which will be evaluated here to check if it is within acceptable limits.

Verbal judgments are transformed into a quantitative scale as indicated in Table 2. Such values are normalized through Equation 2. The priorities vector of sub criteria i (*Aij*) related to criteria (*Ci*) are calculated through Equation 3.

$$v_i(A_1) = \frac{a_{ij}}{\sum_{i=1}^{n} a_{ij}}$$

$$v_i(A_j) = \sum_{j=1}^{n} vi(A_j)/n$$

Where,
i: 1, ..., n;
v: vector;
A: criteria of second level (sub criteria – e.g. courtesy);
n: number of criteria of the a given level.

Equations 4 and 5 provide the weights of importance of criteria.

$$\varpi_i(C_i) = \frac{C_{ij}}{\sum_{i=1}^{m} C_{ij}}$$

$$\varpi(C_i) = \sum_{j=1}^{m} \frac{\varpi_i(C_i)}{m}$$

Here,
j: 1, ..., m
w: vector representing the weights of importance
C: criteria being evaluated
m: number of criteria at a given level

Finally, the AHP-Group method will be employed in order to obtain the results for a group of s decision-makers, in our case, 103 passengers (Gomes et. al, 2004). Given a group of s decision-makers, where each one is represented by the parameter k, k=1,..., s, the weights of criteria should be calculated by Equation 6.

$$\bar{\varpi}_f(C_i) = \sqrt[s]{\prod_{k=1}^{s} \bar{\varpi}_f(C_{ik})}$$

Here,
i: 1, ..., m (number of criteria)

A questionnaire was developed in which passengers are asked to determine the importance of one APT component/attribute over another using the Saaty scale. All calculations were done according to the theoretical framework described in this section. The results are presented in the next section.

They were obtained by application of the methodology previously presented in this paper. According to the Saaty scale (Table 2), the sum of values on a given level should be close to 0.90 (depending on the degree of consistency).

According to Figure 3, the check-in counter (0.33) is the most important component for departing passengers that have been interviewed at São Paulo/ Guarulhos International Airport. The most important attributes

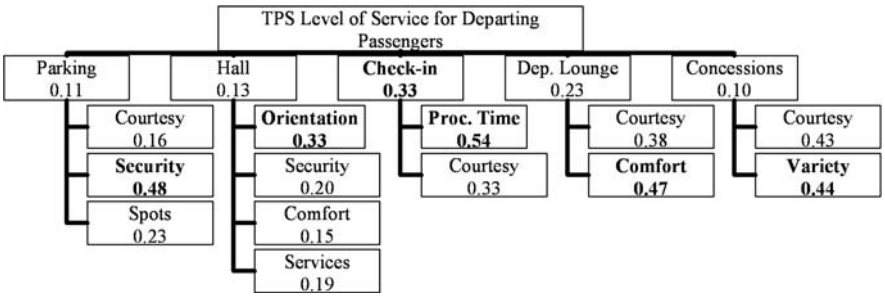

Figure 3: *Weights of Importance for Components and Its Characteristics*

Descriptive Analysis of Passenger Responses

A brief descriptive analysis was accomplished using data obtained from passenger responses. In this case, the most common passenger groups are represented by: male passengers, age 21-30 years old, family income of US$ 10,000-20,000, frequency of travel – twice a year, familiarity with São Paulo airports only (domestic airport and international airport), business passengers, flying GOL airlines, and flying to domestic destinations.

The next section presents the degrees of importance, which are valid for passengers at São Paulo/ Guarulhos International Airport. The results might differ from the perceptions of passengers flying at different airports, especially if their socio-economic profile differs significantly from those surveyed.

Degrees of Importance of Components and Their Attributes

Figure 3 presents the weights indicating the degree of importance for the group of 103 interviewed passengers. for each component are presented in bold. For instance, security is the most important attribute for the parking component with a degree of importance of 0.48.

The values of Figure 3 could be further employed to obtain a global LOS measure for departing passengers at the APT. In this case, the AHP method must be used to rate the LOS for each component. Note that the degree of importance and rating are different things: for instance, a passenger might consider the check-in counter the most important component; however he/she could evaluate it as the component with the relatively worst LOS at the APT, in comparison with the remaining components.

Conclusions

The work presented here represent a new step in airport passenger terminal level of service modeling, since it indicates the quantitative degree (weight) of importance of APT components and their attributes. Further research is being developed in order to analyze these weights as a function of socio-economic characteristics (family income, destination, etc).

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About the Authors

Michelle Bandeira and Anderson Correia work at the Aeronautical Institute of Technology, São José dos Campos, SP – Brazil. Chan Wirasinghe works at the Schulich School of Engineering, University of Calgary, Canada.