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A method for evaluating the level of service arrival components at airports

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ABSTRACT

This paper considers the variables influencing the level of service of the operational arrival components at airports using variables that include demand characteristics, terminal layout, the number and type of carousels, waiting time and space available. The analysis combines user monitoring techniques, data collection, simulation models, design of experiments and linear regression. Five major international airports in Brazil are used as case studies.

1. Introduction

While the level of service at airports has been examined in some detail, few studies have addressed disembarkation-related aspects of their operations and the absence of a method by which to assess the factors that influence the level of service of these aspects. Given this gap in the literature and the importance of providing an adequate standard level of service in a passenger terminal, this paper focuses on the analysis of the arrival components of airports. The intention is to contribute to the body of knowledge on this subject as well as to test a method that combines different techniques.

2. Data

There are a number of elements that can affect perceptions of the level of service when arriving at an airport. Here we focus on baggage handling and documentation; factors such as signage, availability of moving "pavement", and toilets are not considered. Transportation Research Board (TRB) (1987), for example, lists a number that can influence baggage claim service quality and capacity, including the equipment configuration of the baggage claim area, the staffing practices, the numbers of bags per flight, passenger characteristics and the form of baggage inspection, and factors influencing perceptions of service and the capacity of immigration; the number and position of the cabins, the space available for queues, the average processing time per passenger, flight origin and the number of disembarking passengers. Further, bodies like the International Air Transportation Association (IATA) (1995, 2004) have recommended standards for various comments of arrival services. These and other parameters used for benchmarking are set out in Table 1.

To examine indicators of arrival service quality in Brazilian, five airports are considered, primarily on the basis of location, and passenger demand and characteristics as case studies; São Paulo/Guarulhos International Airport – SBGR (domestic arrivals), Rio de Janeiro/Galeão International Airport – SBGL (international arrivals); Brasília International Airport – SBBR (domestic arrivals) Campinas/Viracopos International Airport – SBKP (domestic arrivals); and São Paulo/Congonhas Airport – SBSP (domestic arrivals). Four hundred and ninety seven passengers were the observed and on-site infrastructure surveys were used to collect data.

In basic terms, among the 56 inbound passengers observed at passport control at Rio de Janeiro/Galeão International Airport, 82% experienced a waiting time within the limits of the minimum-to-acceptable range set out by IATA, 10% a queue waiting time within the limits of acceptable-to-maximum, and 8% a waiting time above the maximum recommended. Monitoring passengers around the conveyor belts, found a tendency to concentrate more in the central area, about 45%, and at the starting end of the carousel, about 20%.

3. Airport infrastructure and characteristics of demand

We make use of simulations to allow the testing of alternative scenarios regarding factors influencing passenger waiting time for baggage reclaim, both in the domestic and international sectors.[1] The inputs used as the basis for this are seen in Table 2.

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[1] *Tecnomatix Plant Simulation* software, a discrete event simulation tool, is used.

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Table 1
Levels of arrival service components.

Planning element	Evaluation criteria	Recommendation by	Levels of service standards				
			A	B	C	D	E
Passport Control	Space – Single queue (m^2/occupant)	IATA (1995, 2004)	1.4	1.2	1.0	0.8	0.6
	Queuing time (min)	IATA (2004)	Short to acceptable: 0–7 Acceptable to long: 7–15				
Baggage Claim	Space (m^2/occupant)	Transport Canada (1979)	>1.6	1.4	1.2	1.0	<0.8
		IATA (1995)	2.0	1.8	1.6	1.4	1.2
		IATA (2004)	2.6	2.0	1.7	1.3	1.0
	Claim frontage (m)	Correia and Wirasinghe (2010)	>1.73	0.23–1.73	<0.23	–	–
	Waiting time (min)	Correia and Wirasinghe (2010)	<1	1–14	14–20	20–26	>26
		IATA (2004)	Short to acceptable: 0–12 Acceptable to long: 12–18				

A = excellent level of service; B = high level of service; C = good level of service; D = adequate level of service; E = inadequate level of service; F = unacceptable level of service (IATA, 1995).

Table 2
Input data.

	Baggage claim	Passport control
Passenger and baggage flow	(i) List of flights for the day of the simulation and their time of arrival, (ii) passengers disembarking per flight, (iii) time of arrival of the passenger at baggage claim after the arrival of the aircraft at the airport, according to the type of disembarkation and (iv) time of arrival of baggage at baggage carousels after the arrival of the aircraft at the airport, according to type of disembarkation.	Time of arrival of the passenger at the passport control sector after arrival of the aircraft at the airport.
Passenger profile	(i) Number of passengers without luggage, (ii) number of passengers with one item of luggage, (iii) passengers with two items of luggage and (iv) occupancy of passengers around the conveyor belt.	Percentage of Brazilian and foreign passengers per flight.
Operational procedures	(i) Conveyor belt loading time, (ii) identification of the passenger terminal where disembarkation takes place by airline company and (iii) allocation of flights per conveyor belt.	Definition of the best type of distribution with respect to processing time.
Facility configuration	(i) Identification of aircraft parking as remote or loading bridge type and (ii) number and perimeter of conveyor belts.	(i) Cabins available per nationality of the passenger (Brazilian or foreign) and (ii) queues per nationality of the passenger.

Table 3
Input: alternative scenarios.

Aircraft sizes	Narrow-body aircraft (A320 and B737) were associated with an average number of 175 seats, Boeing 757 (B757) winglets with an average of 185 seats and wide-body (B767) with an average of 280 seats.
Load factor	Load factors of 60%, 70%, 80% and 90% were considered.
Interval between flights	Flights allocated to the same conveyor belt were tested at the following intervals: (i) one flight every 10 min, (ii) one flight every 15 min and (iii) one flight every 20 min.
Passenger profile	It is assumed that there were no transferring passengers in the system and that all passengers had baggage to claim (35% of these passengers had two items of luggage and 65% had only one item of luggage). It was assumed that 40% of passengers used trolleys.
Conveyor belt length	(i) 30 m, (ii) 35 m, (iii) 40 m, (iv) 50 m and (v) 65 m.
Difference in arrival times of passengers and baggage at the conveyor belt	(i) 0 min, (ii) 6 min (the luggage arrives at the conveyor belt 6 min after the passengers), (iii) 12 min (the luggage arrives at the conveyor belt 12 min after the passengers) and (iv) 18 min (the luggage arrives at the conveyor belt 18 min after the passengers).

Seven hundred and twenty scenarios for domestic arrivals were simulated. The index of service is seen as the desired response in each simulation, with a particular focus on waiting time and the space available in the baggage claim area. Various combinations are constructed with respect to the input data (Table 3).

Other inputs required used in the simulations are held constant, notably the conveyor belt layout, speed and direction of rotation, the rate of baggage loading/unloading from cart to feed belt, the pattern of passenger positioning around the conveyor belt, the direction of arrival of the passengers to the conveyor belt and 3.5 m of space available around the conveyor belts. Table 4 shows 240 simulation scenarios that represent combinations of the parameters with respect to a narrow-body aircraft in terms of Brunetta and Romanin-Jacur's (1999) index of service (IOS).[2]

[2] IOS = $A/(AP^{*}WT)$, where A is the area available around the carousels for baggage claim (m^2), AP is the number of arrival passengers (unit) at the carousel at peak time, and WT is the average waiting time (h).