

Wayfinding in the passenger terminal of Brasilia International Airport (AIB)

L.G. Ribeiro^a, C. Mont'Alvão^a

^a Pontifícia Universidade Católica do Rio de Janeiro (PUC-Rio) – Ergonomics Lab (LEUI): Rua Marquês de São Vicente, 225, sala 715F, Gávea-Rio de Janeiro/RJ – CEP: 22453-900, Brazil

Abstract

This research is about behavior-environment relation, based on ergonomics principles. It was carried out a case study in the passenger's terminal of Brasilia's International Airport (AIB) using the ergonomics' methodology. The aim of this research was to evaluate the passenger's constraints during departure, arrival and connection's processes. According to its importance, the problems detected in the first stage had shown strong clues about the orientation's problems as the major passenger's constraints. Thus, the wayfinding's topics were analyzed on the second stage of the research. The results had shown the lack of the layout and information's systems of the terminal's environment in the Brasilia's Airport. The wayfinding attributes of the environment become difficult the spatial understanding. Considering these deficiencies, the ergonomic recommendations were about to change the signs systems and to modify the layout.

Keywords: Design Study; Applied Ergonomics; Information Design; Building and Construction; Aviation

1. Introduction

As most of public buildings, the airports have characteristics that may raise difficulties in their use. The environment of airports can cause physical, psychological and social constraints in their users, which can result in discomfort and distress. So, it is very important to study the airport's influence on the way that users' activities progress.

Ergonomics investigates, besides other aspects, the relation between humans and environments. It is known that the larger and more complex is the environment, the relation between individuals and space become more complicated. Therefore, to make useful data from the behavior-environment relation, collected according ergonomic methods, may contribute positively to minimize the difficulties from the influence of built environments on user's behavior inside a public environment as an airport.

This article intends to analyze a passenger terminal according to ergonomic methodologies. Focusing on the relationship between environment-behavior, we tried to highlight the constraints suffered by users inside the passenger terminal of Brasilia International Airport President Juscelino Kubitscheck (AIB).

2. Behavior-environment relation: wayfinding aspects

The relation between humans and environments is one of the ergonomic fields and is known as environmental ergonomics. Environmental ergonomics make use of studies related to environmental comfort and environmental perception.

One kind of human behavior related to environmental perception is locomotion. After obtaining certain information,

the individual traces a plan to move on space. The oriented movement is resulted from a goal. To determine this objective, the executed task is important - the task will define the sequence of activities and the places where each activity can be accomplished.

The information contained on the environment is important to orient the user. All process of environment perception that was used to orient individuals on space is, nowadays, focused on studies called Wayfinding. Wayfinding, according to Arthur and Passini [1], approaches three distinct aspects: Making decisions, it refers to action planning; decision execution, consist in transforming a plan into action; and Information processing, it means environment perception and the transformation of information into mental images. These three aspects are all related and they aid to individuals to move of oriented way.

The studies of wayfinding consider many factors. Environment information should be clear and environmental legibility, according Lynch, is very important. Considering these aspects, information systems, according Bins Ely et al. [2], will determine the individual orientation level. The environment with a more comprehensive layout, supplied with reference elements and objects with defined functions, facilitate to users orientation. In the measure that the size and the complexity of the environment increase, additional information becomes necessary.

These data are important when evaluating the efficiency of the passengers' terminal, focusing the relation between users and the terminal, the tasks involved, the environment configuration, besides all existing informational systems. Therefore, it's first necessary to raise all characteristics of the terminal chosen.

3. Brasilia's International Airport President Juscelino Kubitschek (AIB)

The International Airport of Brasilia President Juscelino Kubitschek (AIB) possesses structure for international flights operation, but with more number of domestic flights. AIB was recently "modernized" by Infraero (company that administers most Brazilian airports), which made this airport ideal for an analysis of the influence of built environment over user's behavior.

The new terminal project constitutes an underground, a ground floor and two more floors. On the underground is terminal's industrial area. The ground floor is dedicated to arrival, and first level to departure.

Through the passengers terminal of AIB about 570 thousand people circulates per month. Among these, about

336 thousand are passengers, 220 thousand companions and 5.700 employees of the airport community. Daily, there are 22 thousand people.

4. Methodology

Ribeiro & Mont'Alvão [3] states that "studies in the field of ergonomics seem very useful on the investigation of the relationship between humans and built environment, since we intend to privilege the human part". "Ergonomic studies are based on the combined application of several knowledge to obtain data of humans and its work" (Ribeiro & Mont'Alvão) [4].

To investigate the environment interface, this research applied the ergonomic methodology created by Moraes & Mont'Alvão [5] known as "ergonomic intervention". This methodology is in four phases. The two first stages are about collecting data used to ergonomic recommendations, and the two final steps are about project and validation. This research has used the two first stages.

The methods and techniques used on the stages were observations, behavioral registrations, evaluation scales and questionnaires.

The passengers composed the investigated population. So, the ergonomic study focused on the main activities accomplished by them: the departure, arrival and connection's processes to domestic flights of AIB.

Every environment regarding those processes was analyzed. On the departure process, the investigation ranged from the airport access, to the aircraft access by departure bridges and/or remote departure. For the arrival process, the investigation has included from the arrival of the aircraft, by the access bridge or by remote arrival, to the transportation to the city. For the connection process, it was focused on environments that are part of the two previous processes, defined by the transition from one to the other.

5. First stage

The first stage consists in introductory evaluation. Casual observation was applied, using photo machine to record the problems observed. After that, it was applied with users an evaluation scale towards to take levels of gravity, tendency and urgency of problems.

5.1. Results

As already published at Ribeiro & Mont'Alvão (2004a),

the airport has presented, on the first stage of the research, some problems of orientation and dislocation of passengers through the terminal:

- Long distances;
- Confusing signs;
- Confusing sound calls;
- Difficult to see the TV monitors;
- Insufficient information at the departure area.

"Wayfinding problems were regarded the main causes of constraints suffered by users of AIB. According to Arthur and Passini [1], the wayfinding difficulties found, on the context of modern life, expose the individual to an unnecessary frustration and stress. The authors highlight that the stress caused by the frustration of to be lost doesn't kill, but added to other stressful factors of modern life can contribute for the development of problems related to stress, as heart deficiencies, high pressure, headaches, and others" (Ribeiro & Mont'Alvão) [4].

Therefore, being presented at prior stage as the main problem and the cause of constraints, the wayfinding behavior through the terminal to accomplish the departure connection and arrival processes, were studied and deepened at the second stage of the research.

6. Second stage

6.1. Participants

It was decided to focus only the passengers, considered the main airport users. The passengers analyzed were only those who didn't have any kind of special needs.

The sample selection was nonprobability sampling. Among the nonprobability sample selection this research focused on the purposive sample. According to Shaughnessy e Zechmeister, (1994), apud Moura [6] "uses participant that, on the researcher opinion, has specific characteristics desired to be reflected on the sample".

It was not possible to determine a constant sampling of the population because of airport movement. In the same way, according the researcher's limitations, it was not possible to apply all research techniques at the same time. So, to each accomplished investigation a specific sample was selected, so that in each applied procedure it was obtained a different sample of the population.

The samples used in each technique were stratified according to three researched processes and to gender. The sample was selected during the course of the research, according to the data collected in the application of different techniques, as shown table 1:

Table 1
Sample's stratification

Applied technique	Minimum sample	1st Division: Process	2nd Division: gender
Behavioral Registry (monitored dislocation)	90	Departure: 30	Male: 15 Female: 15
		Arrival: 30	Male: 15 Female: 15
		Connection: 30	Male: 15 Female: 15
Test Questionnaire	75	Departure: 25	Male: variable Female: variable
		Arrival: 25	Male: variable Female: variable
		Connection: 25	Male: variable Female: variable
Questionnaire	180	Departure: 60	Male: 30 Female: 30
		Arrival: 60	Male: 30 Female: 30
		Connection: 60	Male: 30 Female: 30

6.2. Materials and Procedure

6.2.1. Behavioral Maps

The behavioral maps accomplished were the "monitored movement", as described in Ribeiro [7] and Ribeiro & Mont'Alvão [3]. The technique consists to monitor users' movement. The researcher observes the participant the whole time. The behaviors to be registered were defined previously.

The behavioral map was accomplished in the following way: the route of each participant were observed and drawn on a previously prepared map of the studied environment. A different map was used with each observed participant. The pre-defined behavioral events were logged in a notebook, and a mark was made at the map to note where each event took place, for example: "he looked at a signal" or "he stopped, looked around and returned". The beginning and end of each one was registered.

A single researcher made the monitored movement at the passengers' terminal of AIB. The passengers didn't know about the observations, demanding a neutral discreet posture from the observer.

6.2.2. Questionnaire

The questionnaires were applied to passengers while they were waiting for the flight, in case of departure and connection, and at the baggage claim area, in case of arrival. The researcher delivered the questionnaire paper to the subject and withdrew himself, in order to create a more

comfortable environment to answer. A few minutes later the researcher collected the questionnaires. All questions referred to four groups of questions:

1. User profile – it refers to personal characteristics of respondents, as gender, age and educational level; and some other personal characteristics of the respondent;
2. Airport usage – Questions about AIB passenger experience at the airport; The frequency of use and activities developed while they wait for departure and arrivals;
3. Dislocation and orientations through the airport – It refers to the way passengers move and plan to move inside the airport, how they orient themselves.
4. Evaluation of the AIB airport – The passengers could express their opinion about the quality and efficiency of the airport related to the spatial orientation process.

First, a test questionnaire with 30 passengers was accomplished, to validate the questions. After necessary corrections, the definitive inquiry took place.

On the definitive questionnaire results, a correlation test was applied (test χ^2) to know which approached variables would have co-related results. With the test result it was possible to affirm which variables suffered the influence of another specific variable.

6.3. Results

The results of the behavioral map were first tabulated into a route map and presented on a flow map form, where the most adopted itineraries and the critical points are evidenced. After that, the observed behaviors were analyzed and the results put on a graphic about the difficulties faced by users. In addition, the questionnaires results were essential to ratify some behavioral maps data.

6.3.1. Flow map

The flow map illustrates all itineraries of each investigated process – departure, arrival and connection – highlighting the places with a more intense flow.

During the departure process the areas of higher flow were the check-in lobbies and the departure lobbies. The path from the check-in counter, on the right side, to the departure lobby was also very frequent.

The flow map of the connection process highlights the access corridor, the satellite security and the satellite as places of higher flow. The flow to the arrival lobby and to the entrance door, added, give a total of 12 occurrences. This

flow corresponds to passengers who intended to wait for their flights out of the restricted area, where there's a food court and more options of entertainment.

At the arrival process the flow map illustrates the main direction of the arrivals: satellite – escalator (going down to arrival room) – arrival room – arrival lobby.

A subject that stood out through the study of courses was the inversion, among the users, of the expected itinerary, in other words, when it was imagined that the passenger would go through a single path towards the final destiny (departure gate or airport exit), he opted for the inverse path, for several reasons, as for instance to circulate at random just to spend some time.

6.3.2. Orientability Graphics

The orientability graphics α the results of values attributed to the participant behavior during its movement. The values vary from 1 to 4, where 1 indicates the best situation and 4, the worst.

The orientability level allowed measuring the efficiency of the informational systems of the environment through the user's guiding difficulty level. Among the total population observed (N=104), 52% faced some kind of problem during the course: 18% level 2, 18% level 3 and 15% level 4.

Considering all three processes together – boarding, arrival and transit – the results of the monitored dislocation allowed to evaluate the oriented process as one, and to distinguish which process caused more problems to passengers.

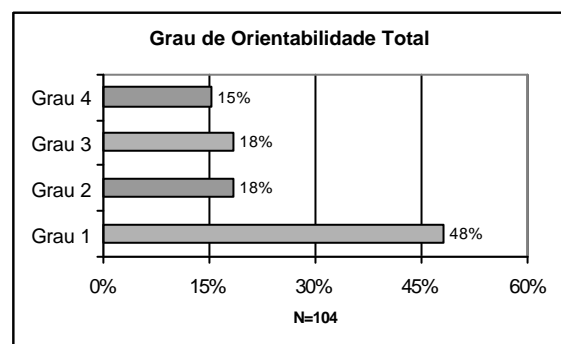


Fig. 1: Orientability Level Graphic

6.3.3. User Profile

The number of respondent passengers were 180, being 90 males and 90 females. The predominant age was from 24 to 51 years old. Most of them went to university.

6.3.4. Airport Usage

The frequency of passengers' flights highlighted a particularity of the AIB. The boarding and arrival passengers usually travel more than 12 times per year. Most of transit passengers usually travels one or two times a year. Most of respondents travel mostly for business/ work.

About the familiarity with the AIB, most respondents visit the airport from 1 to 6 times a year.

6.3.5. Movement and Orientation through the Airport

To understand the way passengers navigate through the airport, one of the questions addressed to them was, in their opinion, what is the main source of information used to find their destiny place? It was observed that the passengers use mainly the sign plates, but other fonts of information are also used. To go to the check-in area, for example, the elements that compose the area (as the counters) were more used than simply follow the sign plates. At the transit process, to find the boarding gate, besides the signs, the passenger usually asks someone else, or even follows other passengers that are taking the same connection flight. To find the arrival room, passengers ask and follow other passengers besides following sign plates instructions.

The transit process seemed to be the most complicated to passengers: 35% of respondents got lost while on transit.

The variable "disorientation" shows the importance of the level of familiarity of the passenger with the airport. This familiarity may be influencing the passenger orientability results. When we isolate those passengers who got lost at the airport, only 19% of them were "first flight passengers", meaning there was their first time at AIB, and 81% of the disoriented have already been at AIB at least once. Although the "environment familiarity" variable and the familiarity with the whole airport travel process may distort the results. To avoid this kind of influence, a χ^2 test was made through Microsoft EXCEL 2000, to evaluate the existence of some kind of relation between variable "familiarity" and variable "disorientation". The test didn't indicate any relationship between those variables. Therefore, the familiarity at AIB does not facilitate the wayfinding.

6.3.6. Airport Evaluation by Passenger

Most respondents considered the airport signs very efficient. A few passengers indicated the signs as inefficient, but only during transit process.

To analyze the attributed values given by those passengers who had orientation problems, another χ^2 test was made. The test indicated a relation between disorientation variable and the airport signs evaluation. Those who had problems of disorientation tended to attribute a

lower level of efficiency to the airport signs, and vice-versa.

7. Discussion

The characteristics of the terminal built environment, according to questionnaires and behavioral registry, may be considered inadequate and inefficient considering the passenger wayfinding. AIB possesses a complex flow and its environments are not well defined and characterized, blocking the space comprehension not letting the passengers build their own symbolic space, where they can plan their navigation.

7.1. Recommendations

According Braaksma e Cook [8], there are three ways of making corrections to ensure a better visibility inside an existing terminal: change the existing sign system – cheaper solution – or physically distort the terminal layout so elements become more visible – expensive solution. There's also the option of combining both.

Therefore, considering the inefficient visibility of elements found at AIB terminal, a few recommendations fits on Braaksma and Cook third solution. It is essential to make physical alterations or just modify the sign system.

Considering the study, we recommend the installation of informational systems that considers the entire process of wayfinding. All information should be highlighted. Some of the suggestions are:

- Use signs together with environment maps, with different colors and texts.
- Considering that a user will only search for the sign when lost, a visible map with "you're here" sign may help on most places where disorientation occurs.
- Sign plates should consider the perspective (visual angle), speed of reader (when walking through the terminal) and visual blocking caused by a crowded environment. Maybe use the sign plates on the sides.
- Flight status panels, especially at the boarding gate, are important to passengers on connection - panels should be redesigned.
- Repetition is a good way to obtain information – it's important to repeat information when users need to walk through long distances, so they don't feel confused.

These recommendations should be implemented. To validate the recommendations it's necessary to make a

posterior analysis.

8. Conclusion

This research indicated that the quality of wayfinding process of the passenger's terminal offered by Brasilia's International Airport Presidente Juscelino Kubitscheck is weak. To investigate the passenger's terminal through ergonomic methods highlighted the influence of built environment over passengers' behaviors. The use of ergonomic methodology to investigate the passenger's terminal offered a realistic panorama of the built environment influence over human behavior.

Every human behaves and make decisions according to the environment they are inserted and executes tasks. When questioned about their attitudes, people usually don't relate their actions to the environment. Throughout this research, it was noticed that people do not register their decisions. Spatial comprehension is automatic and involuntary. Only those who find more profound problems "notice" the environment deficiencies.

Therefore we believe that environment-behavior studies contribute to the quality of built environments of passenger terminals. It's important that designers considers these aspects while developing terminal projects, trying to minimize constrains suffered by users, according to ergonomics.

References

- [1] Arthur, P.; Passini, R. Wayfinding: People, Signs and Architecture. Ontario-Canadá, Focus Strategic Communications Incorporates, 2002, Reimpressão de: Toronto-Canadá, McGraw-Hill Ryerson, 1992.
- [2] Bins Ely, V. H. M., Dischinger, M., Mattos, M. L. Sistemas de Informação Ambiental – Elementos Indispensáveis para Acessibilidade e Orientabilidade. Anais do ABERGO 2002 – VI Congresso Latino-Americano de Ergonomia e XII Congresso Brasileiro de Ergonomia. Recife, 2002.
- [3] Ribeiro, L. & Mont'Alvão, C. Ergonomia no ambiente construído: teoria e prática. Capítulo do livro "Ergodesign do Ambiente Construído e Habitado 1" ed. iUsEr, Rio de Janeiro: 2004.
- [4] Ribeiro, L. & Mont'Alvão, C. A importância do processo de orientação espacial (wayfinding) para o projeto de sinalização. Anais do 6º Congresso Brasileiro de Pesquisa e Desenvolvimento em Design - P&DDesign 2004. , São

Paulo, Outubro/2004.

- [5] Moraes, A. & Mont'Alvão, C. Ergonomia: conceitos e aplicações. Rio de Janeiro: iUser, 2003.
- [6] Moura, M. L. S. de. (org) Manual de Elaboração de Projetos de Pesquisa. Maria Lucia Seidl Moura, Maria Cristina Ferreira, Patrícia Ann Paine. EdUERJ, Rio de Janeiro, 1998.
- [7] Ribeiro, L. Ergonomia no Ambiente Construído – Um Estudo de Caso em Aeroportos. Dissertação de Mestrado, PUC-Rio, Rio de Janeiro, 2004.
- [8] Braaksma, J. P., Cook, W. J. Human Orientation in transportation terminals. ACSE Journal of Transportation Engineering 106, 189-203, 1980.