HEALTH CARE ARCHITECTURE IN SÃO PAULO, BRAZIL: EVALUATING ACCESSIBILITY AND FIRE SAFETY IN LARGE HOSPITALS

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Abstract

This article describes and discusses procedures of scientific and technical interest for applying the Post Occupancy Evaluation (POE), especially certain questions related to accessibility and fire safety in specialized and complex hospital buildings. For this purpose, the building occupied by the Orthopedics and Traumatology Institute (IOT) of the General Hospital (Hospital das Clínicas) of the University of São Paulo(USP), Brazil was chosen, as this institute is one of the most important health centers in Latin America in its specialty. With approximately 25,000m² distributed throughout nine floors, the IOT offers services of a public nature to about 1,000,000 patients each year. Approximately 200 physicians and 890 nurses work in this building. The research described here was carried out in 2005 and involved teachers and graduate students of the Faculty of Architecture and Urbanism of the same University of São Paulo. The work consisted of the application of various methods for evaluating performance in use and the final results were organized in a concise, user-friendly way in discovery maps. These maps, which bring together synthesis of the different evaluation standards regarding the building (opinions of users and appraisal specialists, the pertinent legislation, and recommendations for each critical point by floor and by sector), are a valuable tool for decision-making by the building's managers in terms of interventions, remodeling projects, expansion and the implementation of improvements.

Keywords

Post-occupancy evaluation; large hospital facilities; Brazilian health care architecture; accessibility; fire safety.

Introduction

Post Occupancy Evaluation of Hospitals in Brazil

Although the POE has been used in academic circles in Brazil since 1984 (Roméro; Ornstein, 2003), only in the 1990s did research in the field of performance evaluation begin, more specifically in relation to POEs focused on hospital buildings. Especially important in this process were studies published by Preiser (1998) on hospital systems in the USA, Europe and Israel. Preiser, an architect (Preiser; Vischer, 2005), and Bechtel (1997), an environmental psychologist, introduced the concept of inter-disciplinarity between architecture and urbanism and other subjects, and the need to include users' perceptions in research on built environments. Architects should be concerned not only with the health of buildings, but also, and especially, with the physical and mental health of the people who occupy them. The difficulties in applying the

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POE to highly complex buildings in Brazil, such as hospitals, resulted in the delay of research in this field. In addition, difficulties arose in accessing institutions of this type, especially in the case of private hospitals. One reason for this obstacle is the stress that *in loco* research can cause in environments of this nature and also because of the implications of the negative aspects which might be found.

For these reasons, few M.A.'s dissertations and Doctoral theses based on the POE applied to hospitals have been concluded, and few other studies have been published in this area by schools of architecture and urbanism in Brazil. Those that have appeared are basically concerned with flows and circulation (Kotaka; Fávero, 1998), sustainability, environmental comfort, and functional aspects in general ((Visconti, 1999); (Del Rio; Ornstein; Rheingantz, 1998); (Cavalcanti, 2002); (Sampaio, 2006)). The report by Kohlsdorf (1995) might also be mentioned here, as it provides an important analysis of the morphological performance of hospital buildings on the basis of performance evaluation. In addition, it takes into account the potentials of orientations, identification and the capacity for stimulus which this type of architecture induces in people. More recently, Castro, Lacerda and Penna (2004) made advances in the systematic application of POE tools in buildings related to health care on the campus of the Oswaldo Cruz Foundation (Fiocruz) in Rio of Janeiro, including demonstrations of a diagnosis resulting from the use of so-called discovery maps, described by Zeisel (2006) and by a group of researchers in the Graduate Program in Architecture (ProArq) of the Faculty of Architecture and Urbanism of the Federal University in Rio of Janeiro (FAU-UFRJ), coordinated by Dr. Paulo Afonso Rheingantz. With the experiences of ProArq-FAU-UFRJ, Fiocruz became the first large institution in the field of research, education and treatment in public health to bring together an in-house technical team in POE to provide information regarding interventions and guidelines for new building designs, based on procedures for managing environmental quality. Also, in the 1990s a few large Brazilian cities came out with specific guidelines for hospital designs. The city of Rio de Janeiro, the second large Brazilian urban environment, was one of them.

In this regard, the POE applied to the Orthopedics and Traumatology Institute of the General Hospital is of special significance, not only because of the importance of this public institution as a teaching hospital and the service it provides to the population, but also because the study consists of a virtually unprecedented POE, focused on questions of accessibility and fire safety. For this study the authors sought to use multi-method and multi-technique approaches aimed at guaranteeing the reliability of the entire research process. The result was a floor-by-floor discovery map that synthesizes the opinions of users and specialists, diagnoses, laws and regulations, and pertinent proposals for solutions whenever appropriate.

Accessibility and Fire Safety

In Brazil, as well as in other places in the world, accessibility – meaning the existence of democratic venues that can be made use of by anyone, regardless of any physical, sensorial or cognitive limitations – consists of a process that is implemented in a sequence of stages. The process begins with the perception of the need to ensure social inclusion, followed by decisions to put it into practice. Next, specific social measures must be taken based on the realization that it is essential to structure a legal framework that emphasizes equal opportunities. The process should also include other less theoretical aspects concerning the various technical areas.

Over the years, this set of measures and processes gradually took shape through a series of international guidelines that inspired specific legislation in different countries. In Brazil, the first technical standards on accessibility in buildings and spaces of public use, called NBR 9050, arose in 1985 and were revised in 1994 and 2004.

Fire safety is a topic that has been studied since the early 20th century and has gone through considerable scientific development since then, especially as a consequence of major losses caused by occasional but disastrous fires. In Brazil, the first most significant measures were taken only in the mid-1970s, after the occurrence of two major fires in high-rise buildings in the city of São Paulo. It can still be said today that the laws and regulations currently in effect, which set down the minimum conditions of fire safety in the country, are scarce and often ineffective.

In addition, the lack of knowledge and concern among users of buildings makes the problem worse, because it results in deficiencies generated by the lack of maintenance of the protection equipment that is already in place and by the lack of preparation of the public to face emergency situations.

In the last two decades, a number of technical and normative documents have been published in relation to both accessibility and fire safety. Academic work has also played an important role in publicizing these areas of knowledge, providing information to architecture and engineering professionals at least partially bridging the gap caused by the failure to treat such topics in Brazilian schools of architecture.

The Case Study

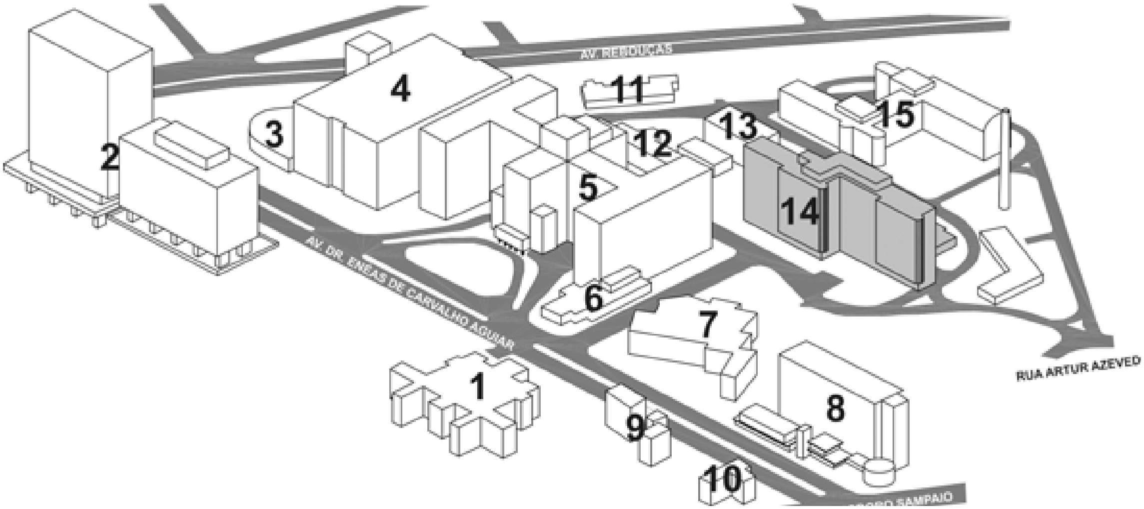
Description

The Orthopedics and Traumatology Institute dealt with in this study was opened in 1953. It is generally referred to as the IOT and is a member institute of the largest hospital complex in Latin America – the São Paulo General Hospital [Hospital das Clínicas]. This complex is considered one of the most important centers in Brazil for producing technical and scientific information, and is thus a center of excellence and reference in the field of treatment, education and research in the health care area.

The hospital complex itself was opened in 1931 and today it occupies an area of 340,000 square meters, with approximately 2000 beds, 36,000 surgeries, 1.2 million out-patient services, and 66,000 hospital admissions per year. It comprises thirteen health institutions, including nine hospitals, the School of Nursing, and the Faculty of Medical Sciences of the University of São Paulo (USP), as shown in Figure 1.

The IOT was built to address the infantile paralysis epidemic (polio) in Brazil in the 1950s, and it provided all necessary orthopedic technology at the time for treating this disease and its sequels, although it treated fractures as well. Built on the model of modern architecture, it consisted of eight above-surface floors and an underground floor, providing a total of 20,000 square meters of built area with capacity for 300 beds and 400 rooms (1). Currently the IOT has 25,000 square meters of built area comprising seven specialized laboratories, 890 employees, 3,500 clinical consultations, 4,500 emergency cases and 500 surgeries per month and a clinical staff of over 200 physicians. With the eradication of polio, the institute began addressing demands for treatment, research and education related to other major orthopedic pathologies and disorders.

Nonetheless, the building retains many characteristics of style, construction structure and volume that were virtually original at the time it was built. Its floor plan in “T” format is divided into Wings A, B, C, and D (see Figure 2). Wings A and B are symmetrical, with eight floors interconnected by a central lobby called Wing C, where the elevators and stairways of common use for Wings A and B are located. Wing D currently houses the biomechanical laboratory, experimental surgery, animal laboratory and the prosthesis shop, and includes the basement floor, a ground floor and two higher floors. The Annex Building was designed and built later to address the need to expand the institute’s services and facilities. The first stage of the Annex was concluded in 1972 and the second in 2005.



1 – FACULTY OF MEDICAL SCIENCES OF UNIVERSITY OF SÃO PAULO (FMUSP)
2 - HEART INSTITUTE (INCOR)
3 - REBOUÇAS CONVENTION CENTER
4 - OUTPATIENT BUILDING (PAMB)
5 - CENTRAL INSTITUTE (IC)
6 - RADIOLOGY INSTITUTE (INRAD)
7 - SCHOOL OF NURSING
8 - CHILDREN’S INSTITUTE (ICR)
9 - TROPICAL MEDICINE INSTITUTE
10 - FORENSIC MEDICINE INSTITUTE
11 - NUCLEAR MEDICINE INSTITUTE
12 – MEDICAL RESIDENCE
13 - ADMINISTRATION BUILDING
14 - ORTHOPEDICS AND TRAUMATOLOGY INSTITUTE (IOT)
15 - PSYCHIATRY INSTITUTE

Figure 1: Schematic Drawing of the General Hospital Complex of the Faculty of Medical Sciences of University of São Paulo.

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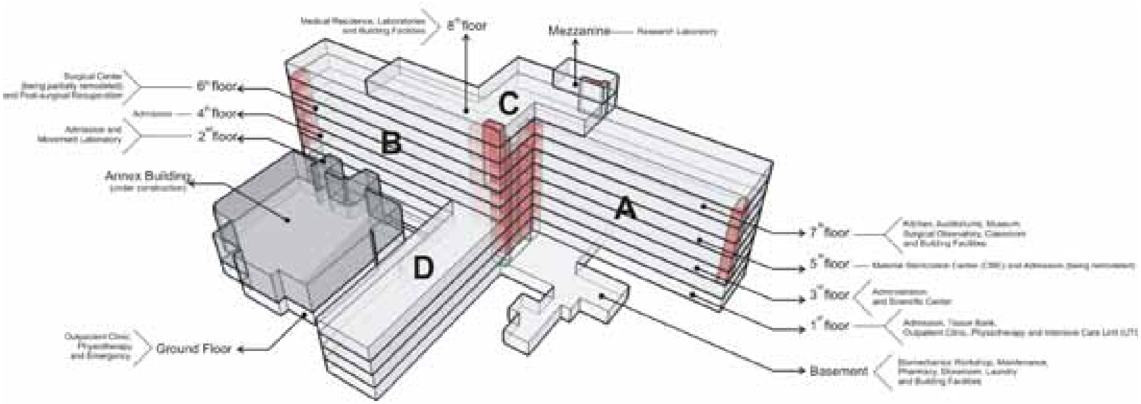

Figure 2: Schematic Drawing of the IOT Building and its Uses by Floor.

Evaluation Methods and Techniques

The present study began with a planning stage, which included the organization of the teams, scheduling of visits, scheduling and distribution of tasks, reconnaissance of the space, contact with key people, authorizations, walkthroughs, data gathering, annotations, drawing up of questionnaires, photographic records, physical measurements, structured and semi-structured interviews, and focus groups. Quantitative and qualitative studies were combined in order to expand the results.

At the end of the process all results were shown on the discovery maps, also referred to by Zeisel (2006) as discovery matrixes, as a way to synthesize and visualize the diagnosis, the recommendations and the pertinent standards and regulations, thus identifying the points that require interventions of short (most critical), medium or long term. This representation had the main objective of facilitating the understanding and reading of the results by those who will make the decisions and who are not familiar with the matters at issue. The flowchart of the process is presented briefly in Figure 3.

Results of Post Occupancy Evaluation

Diagnosis of Physical Performance

The IOT building has undergone several adaptations in the area of access, such as in some restrooms and certain ramps and parking places, but they have not always complied with the standards provided in the standard currently in effect, namely, NBR 9050: 2004 (ABNT, 2004).

In general, the areas of circulation, access doors, admittance and surgery areas, as well as elevators, have dimensions that enable persons in wheelchairs to maneuver or be maneuvered. However, problems were found with the stairways, with inadequate dimensions, railings and floors, and the absence of visual or tactile signs. In some environments of restricted use, access is hampered by narrow or heavy doors,

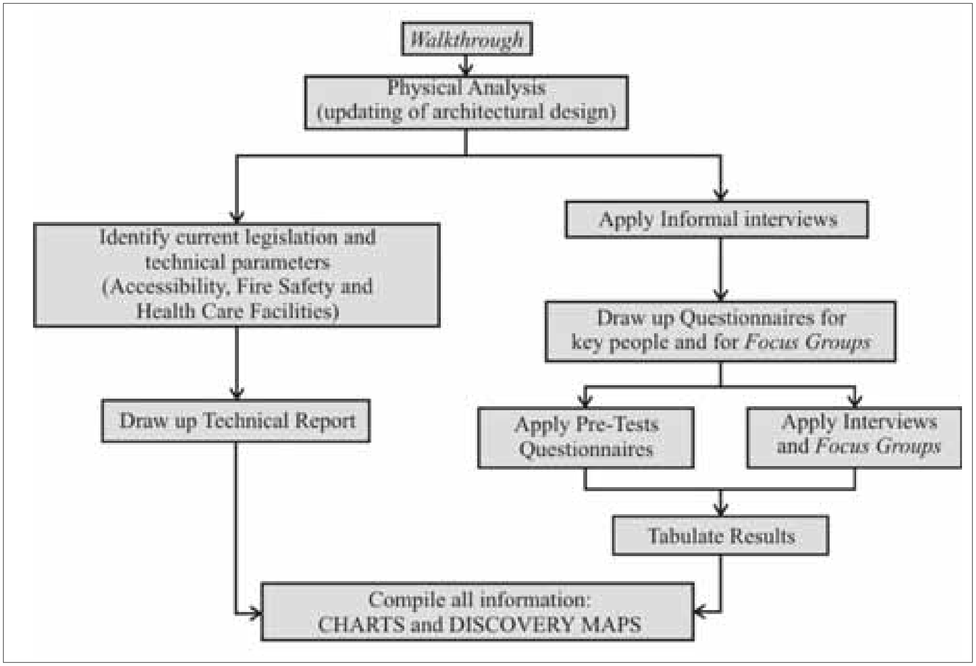

Figure 3: Flowchart of the Process for Developing a Post Occupancy Evaluation (POE) Mechanism.

door handles that are difficult to manage, and poorly arranged furniture.

The building's characteristics of construction and use classify it as having low likelihood for fires to begin or spread because there is little accumulation of flammable material and adequate building and finishing materials are used in the circulation and admittance areas (floors and walls). However, the emergency exits for vertical circulation were indicated as being hazardous for the occupants because the building has an open central stairway (Wing C) that would allow the propagation of gases and smoke. The same is true for the shafts of building installations that are not sealed off.

The side stairways (located at the end of Wings A and B, as can be seen in Figure 2) cannot be used as escape routes because they are not enclosed either. Access to them is obstructed by glass doors, they do not have the proper dimensions and the proper directional signs in place, and they discharge one floor above the exit to the ground floor. The essential fire safety equipment, such as extinguishers, hydrants, manual alarms and emergency lights, is duly installed, but there were no records of regular inspections and tests. The building has no automatic sprinkler system or fire detectors, due to the fact that only recently have building codes begun requiring such equipment in this type of occupancy.

Verification of Users Satisfaction

The diagnosis made by the researchers was not always confirmed by the users in their responses to the questionnaires. This ambiguity is frequent, possibly due to a wide range of factors, such as lack of information by the users about the topic approached, superficial observation of the space, different levels of involvement with the location, and possible defects in the structure of the questionnaire itself.

Structured interviews enabled the detection of more specific aspects related to the use of the spaces and factors regarding the activities carried out, aspects which would probably not be noticed otherwise. The opinions expressed in the two focus groups held with nurses were compatible with the technical opinions of the researchers. The groups also cleared up doubts as to the functioning and use of the spaces. The unstructured interviews held during the study were also very important. A part from indicating problems that were not perceived in the first collection of data, they enabled the observation of the everyday life of the various categories of users who work there, and produced opinions that contributed to the analysis of the questionnaires.

Results

The results in the final report (Gill et al., 2005),

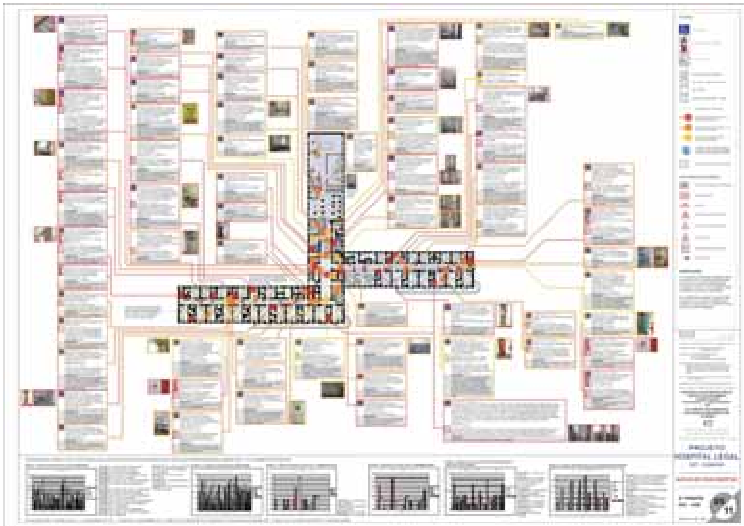

Figure 4: Example of Discovery Map (Floor plan of the 2nd Floor of the IOT).

Figure 5: Section of the Discovery Map for the Second Floor of the IOT Building.

FLOOR	LOCATION	FOCUS	RESULTS OF THE METHODS AND TECHNIQUES APPLIED IN THE RESEARCH			DEGREE OF IMPORTANCE	PROPOSAL	OBSERVATIONS
			Walkthrough		Interviews / questionnaires / focus groups			
			Problems Detected	Technical standards to be complied with				
2nd	Central Hallway	Accessibility	Absence of directional signs indicating the infirmary in Wing A	NBR 9050 (Item 5.5), which provides a number of recommend-ations to be followed regarding visual signs	The signs in the central hallway of the IOT were classified as Very good and Good by most of the nurses and students interviewed (See Graphs 1 and 2 in the Discovery Map of this floor).	Low	A sign pointing to Wing A should be placed at this location. The sign should also indicate in detail the type of activity conducted there (important information for visitors). The signs should also be available in Braille, and the format of the sign (colors and dimensions) should comply with Technical Standard NBR9050 (Item 5.5).	Although this question shows a low level of importance it can be easily solved.
			There is no sign indicating the location of the central stairway	NBR 9050 (Items: 5.13; 5.14.1.2, Figure 63; 5.14.2), which recommend, respectively, the presence of visual signs for steps, tactile alert signs on the floor, and tactile directional signs on the floor	----	High	Place visual and tactile alert and directional signs near the stairway	-----
	Central Hallway	Fire safety	Central stairway has a low protective railing (h=0.97m while the technical standard establishes h=1.05m) and there is no railing in some sections.	IIT No. 11 (Item 5.8.2.1) São Paulo City Building Code (Section 12.3.3.1), which contains recommend-ations regarding hand-railings and protection ratings.	Whereas most of the nurses interviewed considered the situation of the railings in the central lobby (= the central stairway) as Very bad, most students considered it Good or Regular (See "Appendices," Graphs 3 and 4 on the Discovery Map for this floor). In an interview, maintenance employees of the IOT informed the researchers (stated in the interview as the reason for the conditions of the stairway) that most people who use this central stairway move slowly, as they are users with difficulties, such as elderly patients or persons with physical handicaps.	High	Place a handrail with 2 heights (0.70 and 0.92m) along entire extension of the Central stairway. It should be easy to hold (4.5mm).	The central stairway is not classified as an escape route in case of fire, as it is not enclosed and could cause accidents in a fire situation (many people going down the stairway quickly), because the steps are slippery, the vertical span is completely open, and there are no handrails.

Table 1: Example of Synthesis of Results (Diagnosis and Recommendations) - 2nd Floor (partial).

summarized in tables, and allowed an initial visualization of the situation through one or more tools and techniques of the POE. One example is presented in Table 1, where a given degree of importance (low, medium or high) is attributed to each aspect in terms of the degree of priority for implementation. Discovery maps were drawn up based on the contents of these tables, as exemplified in Figures 4 and 5, which constitute a graphic synthesis of the research results.

Table 2 shows the number of evaluations and recommendations proposed. It can be seen that many more aspects regarding accessibility were detected than those related to fire safety. However, the priority given to fire safety is proportionally higher than that given to accessibility. This situation is perfectly understandable as problems related to fire safety are not usually specific for the various floors, but rather a characteristic of the building as a whole, in contrast to questions of accessibility, which vary from one specific place or situation to another.

Place	Focus	Degree of Importance	Frequency
Surrounding Area	Accessibility	High	4
		Medium	0
		Low	0
	Fire Safety	High	0
		Medium	0
		Low	0
Basement	Accessibility	High	3
		Medium	0
		Low	0
	Fire Safety	High	1
		Medium	1
		Low	0
Ground Floor	Accessibility	High	4
		Medium	4
		Low	1
	Fire Safety	High	1
		Medium	0
		Low	0
1st Floor	Accessibility	High	1
		Medium	1
		Low	0

Place	Focus	Degree of Importance	Frequency
	Fire Safety	High	1
		Medium	0
		Low	0
2nd Floor	**Accessibility**	High	26
		Medium	**43**
		Low	17
	Fire Safety	High	11
		Medium	3
		Low	0
3rd Floor	Accessibility	High	21
		Medium	31
		Low	11
	Fire Safety	**High**	**13**
		Medium	1
		Low	0
4th Floor	Accessibility	High	21
		Medium	35
		Low	18
	Fire Safety	High	11
		Medium	2
		Low	0

Place	**Focus**	**Degree of Importance**	**Frequency**
5th Floor	Accessibility	High	4
		Medium	2
		Low	5
	Fire Safety	High	7
		Medium	6
		Low	0
6th Floor	Accessibility	High	5
		Medium	4
		Low	4
	Fire Safety	High	7
		Medium	6
		Low	0
7th Floor		High	6
		Medium	5
		Low	0
		High	2
		Medium	7
		Low	0
8th Floor	Accessibility	High	4
		Medium	1
		Low	1
	Fire Safety	High	11
		Medium	2
		Low	0
Total	**Accessibility**	**High**	**99 (35%)**
		Medium	**126 (45%)**
		Low	**57 (20%)**
	Fire Safety	**High**	**65 (70%)**
		Medium	**28 (30%)**
		Low	**0 (0%)**

Table 2: Quantitative Synthesis of the Evaluations, with their Respective Priorities.

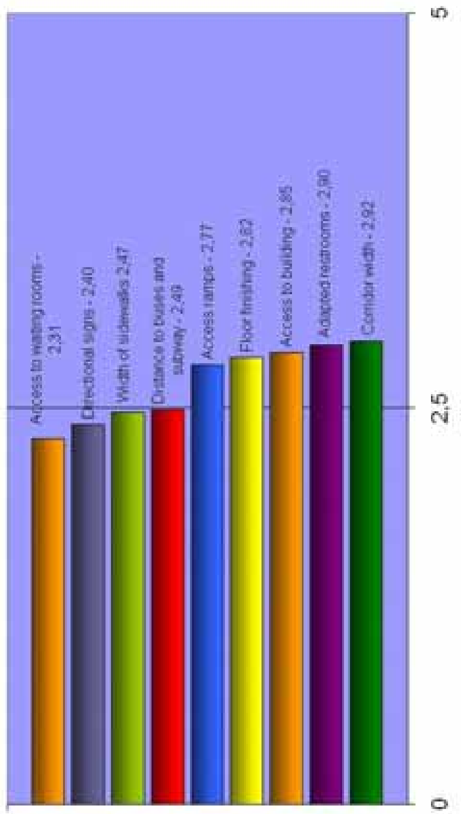

Figure 6: Users' satisfaction level regarding access points:

The graph shows an example of results obtained (average values in a score from 1 (bad) to 5 (excellent)) from applying the questionnaires incorporated into the discovery maps, and they clearly complement and corroborate the information gathered from the users' opinions.

Final Considerations

Methodological Procedures

As a result of this study, the authors consider that the methodological procedures of the POE addressed to the quality of management of the designing process in hospital buildings should include the following stages:

During the pre-test stage, analyze all possible shortcomings inherent to the application of the POE in a hospital where users are constantly subject to varying levels of stress;

Planning of the application of the POE and the intended results;

Development of solutions arising from the results of the POE, through architectural designs, design of furniture and equipment, and visual communication;

Definition of how the results visualized on the discovery maps can be presented to and discussed with the community of users, thus leading to subsequent truly collective designs;

Definition of procedures to guarantee that discovery maps are applied regularly and continuously to feed a databank (with diagnoses and solutions) based on POEs with the purpose of managing quality in the designing process;

Verification of the possibility of using the solutions shown on the discovery maps as benchmarks or references of quality in other hospital environments.

Quality of the Management of Designs in Hospitals in Brazil

Technological advances and more regulations in the area of fire safety took on greater visibility worldwide during the 20th century, but in Brazil the topic was first included in the São Paulo City Building Code only in 1975, and the first São Paulo State Fire Safety Regulations were issued by the Fire Department only in 1983.

The accessibility became a requirement in building regulations and codes in Brazil in 1980, but with isolated laws and segmented approaches. Only in 1992 did the legislation become more demanding and consolidated, with the São Paulo City Building Code, for example, which required compliance with Brazilian Technical Standard NBR 9050: 1985, regarding the adaptation of buildings and spaces for handicapped persons.

Several difficulties had to be faced in order to effectively adapt the spaces of the IOT building, due to its physical complexity and questions related to public management – which requires specific institutional measures to be backed up by the existence of financial resources for carrying them out and maintaining them. Nonetheless, this study has shown that such implementation is possible, provided that it is carried out in stages according to an order of priorities (high, medium and low) and, especially, with the involvement of its managers and employees, and that of the community, through clear proposals, open discussions of ideas that culminate in a collectively drawn up project.

The authors believe that, through the research carried out at the IOT building, it was possible to demonstrate the ways by which proposals for the needed interventions in hospitals can be evaluated and presented. Such an evaluation is particularly important in public hospitals, where processes of identifying problems, establishing priorities for interventions and obtaining financial resources are usually dissociated. By carrying out a POE, these aspects can be more easily combined, creating synergy that will facilitate management and foster a better environment for the hospital's employees and users.

It was also seen that, in the case of hospital buildings and similar architectural designs (such as day hospitals, diagnostic units, emergency facilities, etc.), it is important and effective to apply the POE focused on the topics of *accessibility* and *fire safety,* which often overlap in terms of problems and solutions.

Therefore the authors see excellent opportunities for expanding this POE methodology to the entire complex of the São Paulo General Hospital. In fact, this process has already begun through a second case study, this time involving the Psychiatry Institute (IPq), also located at the General Hospital (GH) campus. Due to the size of the GH complex, and for the POE to be effective in producing of long-lasting results, it is likely that the best solution would be to prepare a group of professionals from the GH to systematically apply this methodology so that periodic evaluation of the buildings and open areas around them become systematic and routine events.

At least at the beginning, the existence of an external mechanism for evaluating the results should be also beneficial for implementing the proposed culture of evaluation. In addition, in the case of Brazil, the Hospital Accreditation Program could become a mechanism for refining the POE for hospitals. Among this program's objectives is that of "Improving the quality of treatment through the means of periodic accreditation of both public and private hospitals," as well as "Instituting internal mechanisms of self-evaluation and continuous refinement of the quality of the medical treatment provided by hospitals" (Novaes, 1999: 07).

Mechanisms such as the Hospital Accreditation Program create a procedure of self-evaluation in consonance with the objectives of the POE, and can be used in conjunction with it in the effort to improve the quality of use, circulation, treatment and safety of the complex.

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Notes

(1) Information available at the website of the General Hospital Complex of the Faculty of Medical Sciences of University of São Paulo: www.hcnet.usp.br [August 10, 2006].

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