

## **DESIGN REVIEW: A METHODOLOGICAL TOOL FOR DESIGN MANAGEMENT**

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### **Abstract**

*Hospital buildings are considered to be an example of technical complexity, having particularities that distinguish them from other buildings with similar characteristics. They have a large number of functions that many times are conflicting among themselves. These buildings are in a process of constant transformation due to the speed of medical technology development, which creates new technical needs that were not considered in the early design stages.*

*This paper presents, through a case study, the results of a design review, performed in the design of an important hospital in the city of São Paulo. This research has pointed out several problematic points like design incompleteness, lack of compatibility and communication among design team members and the need of complementary hiring of several designers. The results of this review demonstrated the effectiveness and the efficiency of design review as a powerful management and diagnosis tool to support design coordination. At the end of the design review, a design coordination team was hired by the client, hence improving the management arrangement and solving several problems.*

**Keywords:** building design, design coordination, design review, hospital design

## **THE DYNAMICS OF THE HOSPITAL SECTOR IN BRAZIL**

The hospital sector has been going through constant evolution and transformation. This process has enhanced along the last decade. According to Costa (2002), the sector has been having a growing concern about costs and has been under pressure to introduce new technologies and services.

According to information by Costa (2002), the Brazilian hospital net is constituted by 7.435 hospitals. 30% of them are public and the other 70% are private, leading us to a total of 503.000 beds. 90% of these hospitals are part of the *Sistema Unificado de Saúde* (SUS) (Unified Health System), 94% of them provide primary and secondary assistance, 5% provide tertiary assistance and 1%, quaternary assistance. According to Lahma & Kelner (2005), the

market of design and hospital construction is currently outlined in 90% of rehabilitation and 10% of new constructions.

The entrance of national and international players in the market has intensified the competition in the sector, forcing the hospital institutions to modernize and to adopt marketing strategies to seek differentiation. The creation of concepts such as hospital hostelry, which has comfort, and the humanization of the environment as main goals, is recent and brings the need of architectural design improvement, adding esthetical and marketing concerns to it, besides its technical characteristics and specificities. Recently, new health businesses have been arising, such as: check-up and preventive medicine, differentiated assistance to elders, services of high-complexity diagnosis, nursing homes, and so on.

The designers responded with an array of design innovations and upgrades for the new concepts, including the following: larger private patient rooms, acuity-adaptable rooms, larger windows, larger patient bathrooms with double-door access, hand-hygiene facilities, decentralized nursing substations, noise-reduction measures, health information resource center for patients and visitors, staff gym, art for public spaces and patient rooms (Berry et al. 2004).

Hospital design, according to Bross (2006), must change its approach, shifting from a concept that concerns only about being part of a program of needs (design briefing) and technical rules to one that supports the definition of a hospital business strategy. (Picture 1)

Traditionally, a hospital was seen as a place of long permanence, while, in fact, new types of facilities, focused on patients undergoing low risk procedures and short permanence, started to appear (Bross 2006).

Bross (2006) estimates that we are quite close to observing rearrangements in the facilities. According to him, hospital bed availability will decrease progressively, since the period of hospitalization has been decreasing and the occupation rate is increasing. The author gets to the conclusion that, with the same number of beds, it will be possible to assist a larger number of patients, which will make mainly the large hospitals to remodel their facilities, once they will produce more, with fewer beds.

These changes will lead the users to realize that health systems must always act more on the promotion of health and on the prevention of diseases, which will, in a paradoxical way, decrease the rate of hospitalization. These changes, supported by the growing use of the telemedicine resources, lead to an impact on the organization of the hospital facilities, substantially altering the way of designing and organizing the design team.



*Picture 1: New approach of the hospital design*

## **THE MANAGEMENT OF A HOSPITAL BUILDING DESIGN PROCESS**

The great complexity of the hospital buildings, according to Silva (2006), attributes greater influence of the design process to the performance of the building.

All the resulting effort of this process of transformation lies directly on the professionals of the design, since the architects and engineers have the growing need of knowing the new medical technologies that will cause an impact on the organization of the building, and also of foreseeing situations of growth.

Silva (2006) came up with a wide diagnosis of the management process of the design of Rio de Janeiro city. This study points out the deficiencies of the management systems as well as the need of remodeling the design process. According to the author, the design is developed in an isolated way and without the formal character of the design coordinator; the practice of design feedback does not exist and design conception is many times carried out only by the intuition and the experience of the entrepreneur and the architect.

Besides the lack of design coordination, there are deficiencies in work management. The mere follow-up of the work is systematically confused with work management, and that is usually carried out by the author of the architectural design.

The lack of specialized companies in the professional management of hospital work has been bringing to this market design professionals who try to organize work management amateurishly without an adequate methodology.

In other cases, the management is assigned to the hospital maintenance engineering staff, whose members lack the proper skills and have a heavy work schedule, resulting in disastrous interventions that are, many times, difficult to solve.

Concerning this issue, Costa (2002) alerts to the large number of architectural design professionals, compared to the amount of professionals of engineering design (especially the ones inside the premises), and to the lack of specialized companies in construction work management.

## **CASE STUDY IN A HOSPITAL IN THE CITY OF SAO PAULO**

The analysis object of this case is the design developed by an important hospital institution in the city of Sao Paulo.

The following case study has been carried out since October, 2007. The first author of this paper has been working on the design as a coordinator and also as a manager of the refurbishing work that is being carried out in this hospital. This is about the oldest private hospital in Sao Paulo (1903), which belongs to a religious congregation of sisters. Nowadays, it is an important general hospital, which performs simple procedures and counts on a maternity ward and an emergency unit. At the same time, it deals with complex procedures, and renders diagnosis services by means of imaging techniques.

The first author of this text was initially hired to manage the hospital refurbishing work. The hired and analyzed repair work had different natures. The first one, of historical nature, aims at the restoration of the facades of the historical buildings of the hospital, such as the cloister, chapel and the sisters' house. The second contract covered the remodeling of a storey to introduce a unit of Hebiatrics.

In the first contacts with the author, the hospital showed its discontentment with the deadline and the construction costs. A diagnosis of the existing conditions was made in order to check the points of improvement and implementation of work management process.

Many deficiencies of the process occur along project stage and are negatively repeated in the subsequent stages. They are summarized on Table 1.

<i>Table 1: Diagnosis of the Design and Construction Processes</i>	
<b>CAUSES</b>	<b>EFFECTS</b>
Lack of design coordination.	The designers work individually because, despite the intermediation performed by the hospital staff, it lacks a series of coordination conditions that need to be followed. For this reason, the design solutions are incomplete and insufficiently optimized.
Insufficient design detailing.	In many cases it was observed that the design of the facade restoration needed intervention of the field architects to enlighten design incomplete details and information.
Hiring of the construction works before having all design plans concluded, conciliated and validated by the Hospital.	Design is always late when compared to site work demand. Because of that, the activities suffer constant interruptions. Problems that were not solved in the design, lead to direct interventions in the repair work, resulting in higher costs.
Insufficient or inexistent conciliation between the different specialties of the design.	Example: a steel structure projected with different measures from the ones in the architectural design and that was being hired anyway.
No contracts all the complementary design plans.	Example in the entertainment area of one of the buildings, in which the architectural design plans and steel structure were hired even though the design plans for the fittings on the premises had not been hired yet.
Disorganization in the flow of the design documents.	Distribution of the files by common e-mail.
	Delays in distribution (there were observed cases of a longer than a week delay between the file reception and the distribution to the executors).
	Difficulties and slowness in sending plottings.
Lack of specification of the revision content.	Just the placement of sentences like “general review” on the rubber stamps is enough to make it more difficult for the executors to realize where and why the revisions of design plans occurred.

CAUSES	EFFECTS
Lack of updated version control.	The lack of a distribution control of files, according to a master list, can lead to the problem of having a contractor working with the non-updated version of the design plans.
Deficiency in the process of validation of the design by the hospital and consequent clearance for execution.	<p>In many cases, it is not clear whether the design execution is or is not authorized; in addition to that, the decision of executing it is put on hold by the hospital itself, waiting for internal processes of validation.</p> <p>One of these examples was the delay of more than thirty days to clear the manufacturing of all the hebiatrics carpentry due to the internal process of solution validation.</p> <p>Another example: the complex procedures of the topographic checking of aluminum frame rental that could be simplified, without putting the quality of services at risk.</p>
Deficiencies in the scope of hiring of designers.	<p>The proposal made by these very professionals is used as a scope of hiring. The proposal is incomplete and leaves gaps for further discussion concerning the demanded level of design detailing and conciliation as well as the number of drawings to be produced. It is recommended the creation and revision of specific scopes to hire designers.</p>
Informal communication among all the agents.	Lack of systematic register of tasks and responsibility attribution, and of deadlines for the conclusion, lack of a structured design flowchart.
Deficiency in the work management system.	A lack of a formal work management system was observed in both: the Hebiatrics unit, as well as in facade restoration. Without a formal planning tool, represented by an executive schedule, the deadline and the outcome control are jeopardized, increasing the chances of delays to occur.
Design process and work management carried out by the Hospital maintenance engineering staff	A great part of the above mentioned problems happened due to deficiencies in the management system, which was carried out by the maintenance staff, because, though they had specific knowledge of their needs, they lacked management skills for an adequate performance.

The problems that were found generated Contract Addenda due to failures in the contract scope (*incomplete or insufficiently well-defined*) because it was based on incomplete design plans or on the not totally conciliated ones.

Due to the relatively short deadline for the work execution of the Hebiatrics unit (three months), it was verified that, though the architecture design was reasonably well developed and detailed, it has not been properly aligned with the other design plans. Besides, it needed adjustments owing to the appearance of interferences on the work site, facts considered to be normal, as it concerns the remodeling of an old building that lacks *as built* plans.

Many of the conciliation problems that were verified were being solved directly with the suppliers and contractors on the work site, and without the cooperation of the architect and the designer of the premises.

This procedure adopted by the hospital, though apparently bringing more promptness, had many different and serious problems as a consequence, such as:

- Punctual solution of problems, without taking into consideration the impact of these changes on the whole, which might lead to a cascade effect, of successive adjustments.
- Excessive increase of production costs, because the solution of design problems, carried out directly by the suppliers, has consequently higher prices than the ones obtained in the stages of tendering and procurement.
- Work delay, which results from the necessary measures to adequate the changes to all the involved contractors.
- Non-involvement of design professionals that were hired exactly to solve the problems that were found.
- Lack of communication among the involved design professionals.
- These conclusions lead to the recommendation of changes in the Design Process Management procedures, bearing in mind the definite solution of this kind of problem in the construction work.

### **Recommendations to improve the design process**

When facing the exposed diagnosis of problems, it was concluded that many of the above mentioned and experienced problems had their origin in the earlier stages, before work development itself. (Melhado,1994).

For this reason, it was recommended the adoption of some practical measures, at relatively low costs, since they demand only organizational changes. Changes that will have some immediate results, apart from some others, medium and long term ones.

Among the measures to be implemented in order to improve the processes, the ones that have the major priority are:

- **A review of the existing design plans:** this recommendation aims to verify the adequacy, conciliation and conclusion of the design plans, which are part of the general plan of the hospital construction work and that exist in order to preventively detect the problems that may be solved at lower costs than the ones in the construction work stage. This work might generate some extensions such as plans revision, hiring of complementary design and validation of the already existing design. Soibelman et. al (2003) present the following five key findings on design review processes:

- [...] Effective design review processes add value by saving time and money over the entire design and construction process,
- The team responsible for design review should include representatives of all project stakeholders: owner, user, architect, engineer, construction

contractor, operation and maintenance staff, and major equipment vendors,

- There is a lack of established standard in measuring the design review process,
  - To provide effective oversight of design review processes, the owner's interests are better served when the in-house staff can fulfill the functions of a smart buyer, and
  - The ongoing evolution in information technology and communications offers opportunities to improve design review processes.
- **The adjustment of the construction schedule to the one of the design:** the main recommendation was that work must just be hired with complete and validated design and hiring and remuneration criteria must be well defined, in the necessary advance. It was suggested, on the issue of process review, the establishment of a construction schedule aligned with the design schedule.(Manziona, 2006)
  - **Implementation of the design coordination:** based on the earlier exposed and detailed issues, it was recommended that the hospital delegates the design coordination to specialized companies, so that they could take the customer's role – to define and validate solutions – and not the manager's role.
  - **Hiring of a design extranet:** in order to organize the information stream of this environment of design the hiring of an extranet assumes a prevailing role.
  - **Improving the definition of the scope of hiring project designers:** the most usual models of design contracts are just concerned about hiring at the lowest possible price and controlling the stages of conclusion without, however, beforehand establishing the goals to be achieved. Little importance has been given to the accurate definition of the scope of hiring. For this reason, there are doubts about the products that need to be delivered in each one of the stages, resulting in contractor's discontentment, who assume to be paying for incomplete services, and for the designers, who believe having delivered what had been agreed. Therein, each one should review and question the scope of hiring of the different design plans.
  - **Reinforce the design staff, considering the engineering design plans for all the specific needs:** hospital design plans take into consideration specific aspects, besides the ordinary ones, such as: acoustic sealing, study on propagation of light and glass frames. These design plans help detailing the main design plans, refining points that have not been foreseen.

### **Obtained outcome**

After the presentation of the diagnosis and recommendation, the hospital adopted all the given suggestions, starting from the most important one: hiring the design coordinator.

This was specially justified so as to organize the design management of all the hospital general plan of growth.

The general plan foresees much retrofit and expansion work for a period of three years, such as: chemotherapy, cardiology intensive care unit, blood center, laboratory, radiotherapy, childcare E.R., adult E.R., convention center, vertical enlargement of one of the complexes and the construction of underground parking lots.

Given the amount and the simultaneity of the current design, a resident architect for permanence in the hospital was hired as an extra resource.

As a first measure, the coordination suspended the hiring of new work to carry out the critical analysis, checking and validation of the design plans of the chemotherapy and the Intensive Care units and the blood center (which had already been classified as concluded by the design staff).

### **Outcome of the Validations**

It was observed that the design plans had just been discussed and approved by members of high administration level. The evaluation carried out by these agents, considered especially the conceptual and strategic aspects of the design, not taking into account the operational details. However, it was observed that the lack of validation by the operational nursing and medical teams led to many alterations during the execution of the building, especially in the furniture and facility details.

These design plans were analyzed once again by the customers, but, on this opportunity, a united evaluation was carried out by the elements from the management and representatives of the operational sectors.

This analysis, deeper than the previous ones, showed that many of the operational problems had not been effectively solved in the architectural and facility design. In other words, the design plans did not fully respond to the customer's needs.

The maintenance sector of the hospital also validated the design, and it observed omissions of the existent infrastructure nets in the hospital complex, especially on the facility design plans. The solutions given by the facility designers were generic, especially in the air conditioning design, leaving the problem-solving process to work stage.

### **Design Review and Checking Outcome**

The main issue in all the design review was the lack of adjustment of the facilities design, since they were many times conceived without taking into consideration all the necessary information about the client's needs and about the existing infrastructure.

About the architecture design, one of the main problems verified was the practice of adjusting design plans on the site, a practice that is defended by the client and the architect, that often results in wrong solutions, or in information omissions, leading to a direct impact on the deadline and on the construction costs.

In a general overview, the observed problems could be divided into four types of categories, according to the criteria proposed by Codinhoto & Ferreira (2004).

**Table 2:** Problems sorted into categories, according to the criteria by Codinhoto & Ferreira (2004)

<b>Type of problem</b>	<b>Definition</b>
Conciliation	Interferences and geometrical inconsistencies.
Constructability	Inconsistencies related to the performance and the execution of the systems and among the sub-systems.
Coordination	Inconsistencies related to the control of communication, time, scope, costs and integration among designers.
Specification	Omissions, contradictions or non-existence of information related to the product.

### **Conclusion**

The adopted procedures led to a new cycle of design review, causing a three-month delay when compared to the initial date established by the hospital. This delay, however, resulted in a significant improvement of the design plans and coherently in the service hiring tables. The work is currently on the stage of budget issuing by the construction companies, and it is expected that, after this process, all the actions will reflect positively on work flow, meeting the established deadlines and costs.

The problems checked in the study case are not isolated examples, since they are typical in the civil construction design sector. The characteristics of the hospital segment, which require



great technical and hospital business knowledge, enables the establishment and development of companies and professionals dedicated exclusively to the health sector.

Those changes implemented in the hospital building result from technical development and from new business models that have been arising and that require constant adaptation. To support all the dynamics of such continuous transformation process, it is essential to change the culture and the current management methods of the design process.

For this new work model, a new design process management posture is needed, one that takes into account multidisciplinary work, integrating design professionals and clients by means of design coordinator character and not of a sole specialist any more. As for the design plans, it is essential that more investment is made for a complete design development and its validation by the client, thus changing the culture of adopting a basic design plan and expecting on-site problem solution.

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