

THE DESIGN PROCESS RESEARCH IN BRAZIL FROM 1995 TO 2007

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ABSTRACT

The research concerning design process has grown significantly in the last decades in Brazil, therefore, the scientific production on this subject has increased, even though few studies were developed to understand the researches produced in this area.

This paper aims to know the scientific production concerning design process in Brazil from 1995 to 2007; consequently, an investigation was made on papers published at Entac (1995;1998;2000;2002;2004 and 2006) and the Brazilian Conference on Building Design Management (2001; 2002; 2003; 2004; 2005; 2007). The selected papers were analysed according to the year of publication, research themes (Initial Information; Sustainability; Design management; Design process; Quality; Information Technology; Interface between design and building construction process; Post-occupancy and Design management firms) and elements of research (aims, elements studied, place of the research and actors of the research).

Key words: design process, management, strategy.

CIVIL CONSTRUCTION IN THE BRAZILIAN INDUSTRY: CONTEXT

Before discussing the evolution of the design process research in Brazil, it is necessary to know the context of the building sector in this country. According to Abiko et al. (2005), to do it, it is essential to ask the following questions: How did the internal construction market evolution occur in the last years? Which factors are responsible for the construction industry growth?

The construction sector is one of the most representative economic sectors in Brazil, mainly because, on average, it employs 5% of the total formal employees in the country, furthermore the sector participated with 5.3 % of the GDP (Gross Domestic Product) in 2007 (IBGE-March 2008).

Relating to the characteristics of the sector, it is divided into two segments: building construction and infrastructure construction. According to Abiko et al. (2005), the main characteristic of the building construction sector is connected with high consumption of building construction material, comparing with the infrastructure sector, for example. Furthermore, the most representative activity of the building construction segment has been housing.

According to FIESP (Industry Federation of the State of São Paulo), the sector is part of a large industry called CONSTRUBUSINESS. Building construction and infrastructure construction companies and also industries responsible for manufacturing construction materials and service firms related with construction (sales, design, trademark, etc..) are the segments of this industry.

Concerning the factors that have been responsible for the industrial growth, as stated by Abiko et al. (2005), the civil construction in Brazil has been strongly influenced by the other industry activities. According to the authors, in decades in which the GDP increased (1970 to 1979 – GDP average 8.5%), the figures showed expansion in the civil construction industry (1970 to 1979 – CC GDP average 10.00 %), on the other hand, when the GDP decreased (2000-2004 – average GDP 2.5 %), low numbers were verified related with activities in this civil construction industry (2000-2004 – CC GDP average 1.0 %)

THE DESIGN ACTIVITY IN THE BRAZILIAN BUILDING CONSTRUCTION SECTOR

In Brazil, design is classified as a service and most design firms, according to MERCOSUL resolution n° GMC 59/98 and the parameter of *Estatuto da Microempresa e Empresa de Pequeno Porte* (Lei 9.841/99), are classified as micro- companies (1-5 employees) or small companies (11-40 employees).

According to Souza & Melhado (2003), the responsibility configuration of civil construction project in Brazil is different from other countries such as France, for example. The Brazilian Designers have low participation in the construction stage and there are not professionals responsible for the safety co-ordination and technical control. In most cases, the Resident Engineer and the General Building Construction Coordinator have been responsible for the whole process, from the design stage to the end of the construction .

As to the building product, the contractor hardly ever sends Designer Professionals a set of specifications of the construction product, including performance. In most situations, the initial design information is transmitted by the Building Entrepreneur to Designers informally, and this has been the main reason of problems during the construction process and post- occupancy in Brazil.

According to Melhado & Manzioni (2007), the multidisciplinary design process in this country has been managed by informal methods, through inadequate planning techniques and low-use of information technologies and, as a consequence, problems related with schedule and quality have occurred. The only tool used by Designers for planning their design process is the Gantt Chart, represented solely by a list of tasks with the start and finish dates, with no concern about the relation between the preceding tasks and resources.

For the authors, the same has happened to the management of multidisciplinary design team (architectural building, structure building, electrical and hydraulic fittings, etc). All actors of the team want to design their own part and it is difficult to provide an integrated approach. About the management of this process, the main problem has been related with the professional (Design process co-ordinator) who should manage the process (scope, time, resources, relation between tasks, quality) instead of simply being concerned about designs compatibility.

In Brazil, during the construction process a design professional is rarely hired to consult the construction building team during the production process. When this consulting is part of the contract scope, the obligations are just: meeting with the construction building team to clear doubts about the design or to verify the design solutions proposed in production and, when necessary, review these solutions. In most cases, design professionals are contacted again just at the end of the building construction process, before occupancy, when they are hired to work on as-built design.

DISCUSSION ON THE DESIGN PROCESS FROM 1995 TO 2007

This paper was prepared through a kind of qualitative research on articles published at one of the most representative congresses about building construction research in Brazil named ENTAC – Encontro Nacional de Tecnologia do Ambiente Construído and Brazilian Conference on Building Design Management organised by The Brazilian Network on Design Management.

The papers investigated are classified into nine subjects, as follows :

- ✓ **Initial Information:** information and procedures necessary to characterise the construction product , besides the necessary information to start and later continue the design process, such as market research and customer requirements;
- ✓ **Sustainability:** the link between the design activity and sustainability, besides eco-efficient design solutions including the choice of clean technologies and components;
- ✓ **Design management:** related with the Design process co-ordinator activity, as this is the professional that aims to support the Building Entrepreneur on the multidisciplinary design process to provide an integrated approach, as well as to promote quality to the design process by management tools;
- ✓ **Design process:** the design process in the design firm, besides tools, techniques, experiences and management;
- ✓ **Quality:** design process quality, such as procedures and tools. The papers about quality system management are part of the Management Design Firms subject;
- ✓ **Information Technology:** related with information technology tools to design process and its management;

- ✓ **Interface between design and building construction process:** associated with design decisions and the production building process, such as choice of technology, components, production design and also the relation between construction team and designers;
- ✓ **Post-occupancy :** related to building post-occupancy researches with the users of the building. These data are used as entrance information for future projects, also verifying design solution performance;
- ✓ **Design Management firms:** process related with management and performance of the design firms, such as strategic planning, organisational structure, human resource management, costs management, information system, quality system management and associated services.

This division is supported by Melhado (2005), when the author describes the phases of design process. According to the author, the design process starts when the construction product is proposed by the Building Entrepreneur; also in this phase, the characteristics of Building Product and the scope of the project are developed. The designer work begins at this moment and initial information, as well as parameters concerning sustainable decisions, should be made in this phase.

In the following phase of the project, the work of the multidisciplinary design team (architectural building, structure building, electrical and hydraulic fittings, etc..) begins and the Design process co-ordinator should manage the teams, their activities and interfaces, collaboratively. Furthermore, information technology tools are used, and the design process and design quality should be managed within the design firm.

During the building production process, according to Melhado (2004), the design process is continuous and the feedback from the production building team about the design solutions, as well as from the users of the building about the performance of the product through post-occupancy research should occur in this phase.

Papers published at Entac (1995;1998;2000;2002;2004 and 2006) and at the Brazilian Conference on Building Design Management (2001; 2002; 2003; 2004; 2005; 2007) were analysed and their aspects were researched as follows:

- ✓ **Year of publication:** The annals of each conference were investigated and the evolution of the research on the design process in Brazil was analysed;
- ✓ **Research Theme:** All papers were classified according to nine themes (Initial Information; Sustainability; Design management; Design process; Quality; Information Technology; Interface between design and building construction process; Post-occupancy and Design Management firms);
- ✓ **Elements of research:** The papers were analysed and classified due the aspects related with the research such as: aims of the research, elements studied, place of research and actors of the research.

Not all papers published at Entac (1995;1998;2000;2002;2004 and 2006) and the Brazilian Conference on Building Design Management (2001; 2002; 2003; 2004; 2005; 2007) referring to design process were selected, even though the excluded papers were connected to the main theme; they were refused due to their irrelevance to the subject of the paper and, in other cases, it was impossible to classify the article in one of the nine themes proposed.

Table 1: Papers selected at Entac proceedings from 1995 to 2006 about design process

Theme	1995	1998	2000	2002	2004	2006
Initial Information	2	2	8	9	5	7
Sustainability	0	0	1	1	2	2
Design management	3	0	2	5	7	7
Design process	1	5	1	3	5	5
Quality	3	2	5	1	0	0
Information Technology	1	1	1	2	8	7
Interface between design and building construction process	3	11	3	4	3	3
Post-occupancy	8	8	7	5	3	13
Design Management firms	0	2	0	1	2	1
TOTAL	21	31	28	31	35	45

Analysing the Entac Conference, an increase is verified in papers published about design process in general from 1995 to 2006, and also the amount of research referring to each subject is another interesting aspect observed. In 1995 and 1998, there were not any papers published about sustainability, for example; on the other hand, since 2000, there has been an increase in the amount of papers about this subject, the same occurring with information technology, with the numbers of papers increasing since the first edition of the conference.

However, the opposite occurred concerning quality; the number of papers published decreased from 1995 to 2002 and also in 2004 and 2006, no papers were published referring to this subject. Concerning initial information and also design management, the amount of papers published about these subjects has been constant, as well as about post-occupancy. With regards to this subject, most papers published in all Entac editions from 1995 to 2002, were related with post-occupancy. The same happened in 2006. Concerning design management firms, not many papers were published in Brazil, despite the importance of this subject at present.

Table 2: Papers selected at Brazilian Conference on Building Design Management Proceedings from 1995 to 2006 about design process

Theme	2001	2002	2003	2004	2005	2007
Initial Information	0	5	3	8	5	10
Sustainability	0	1	2	2	2	5
Design management	7	4	6	7	9	8
Design process	1	5	6	10	7	0
Quality	4	2	3	7	4	2
Information Technology	4	10	11	8	6	14
Interface between design and building construction process	12	8	9	9	7	5
Post-occupancy	2	0	5	2	2	4
Design management firms	3	1	8	3	8	2
TOTAL	33	36	53	56	50	50

Concerning the Brazilian Conference on Building Design Management, referring to sustainability and design management, the same is observed as in Entac. With regard to information technology, there was variance in the number of papers, although most of the papers published were related with this subject in most editions of this conference, except in 2001 and 2005.

Similarly, Entac papers referring to quality have decreased and the number of post-occupancy papers has kept constant. Relating to Design management firms, in 2003 and 2005, the number of papers was significant when compared with other subjects.

Table 3.1: Summary of papers about selected at Brazilian Conference on Building Design Management from 1995 to 2006 and of Entac proceedings from 1995 to 2006 about design process

Theme	Period	Typologies of Buildings	Aims of research	Aspects studied	Methodology	Actors of the research	State
Post-occupancy	1995-2000	Residential building: Popular Housing Institutional Building: Schools	✓ To understand the profile user.	✓ Functionality; ✓ Performance; ✓ Dimensions; ✓ User requirements.	In most of the papers that analysed post-occupancy, the Exploratory Research was the methodology adopted through Case Study.	✓ Designers ; ✓ Users.	✓ SP; ✓ RS; ✓ RJ.
	2000-2003	Residential building: Popular and Middle-class Family Housing.	✓ Feedback to quality management system of construction companies.	✓ User requirements; ✓ Users building guide.		✓ Designers ; ✓ Users; ✓ Construction Company; ✓ Building Entrepreneur.	✓ SP; ✓ RS; ✓ RJ; ✓ CE.
	2004-2007	Residential building: Popular and Middle-class Family Housing; Institutional Building: Schools, Hospitals and Companies.	✓ To guide the design process; ✓ To collect information aims to improve the design process.	✓ User requirements; ✓ Technologies; ✓ Pathologies.		✓ Designers ; ✓ Users; ✓ Construction Company; ✓ Building Entrepreneur	✓ SP; ✓ RS; ✓ RJ; ✓ CE; ✓ MG.
Initial Information	1995-2007	Residential building: Popular and Middle-class Family Housing;	✓ To collect information aims to format the construction product.	✓ User requirements;	In most of the papers that analysed initial Information , the Exploratory Research was the methodology adopted through Cases Study.	✓ Designers ; ✓ Users; ✓ Building Entrepreneur	✓ SP; ✓ RS; ✓ RJ; ✓ CE; ✓ PR; ✓ SC.
Sustainability	2000-2005	Residential building and Institutional Building.	✓ To discuss aspects related with the design process.	✓ Decisions concerning construction material and systems.	In most of the papers that analysed sustainability , the Exploratory Research on the Brazilian Civil Construction Sector practices was adopted.	✓ Designers ; ✓ Users.	✓ SP; ✓ RS; ✓ RJ; ✓ PR.
	2006- 2007	Residential building and Institutional Building.	✓ To discuss aspects related with the design process; ✓ To analyse efficient-echo building.	✓ Decisions Aspects, construction material and systems; ✓ Building in use.		✓ Designers ; ✓ Users;	✓ SP; ✓ RS; ✓ RJ; ✓ PR.
Theme	Period	Typologies of Buildings	Aims of research	Aspects studied	Methodology	Actors of the research	State

Design management	1995-1998	-	✓ Researches about usual practice of design management;	✓ Multidisciplinary Design team; ✓ Procedures.	In most of the papers that analysed design management, the Exploratory Research on the Brazilian Civil Construction Sector practices was adopted through Cases Study.	✓ Designers;	✓ RS; ✓ SP.
	2000-2007	-	✓ Researches about design management usual practice ; ✓ Development of tools to design management;	✓ Current Engineering; ✓ Planning tools; ✓ Collaborative tools;		✓ Designers; ✓ Construction Company; ✓ Building Entrepreneur; ✓ Design Co-ordinator.	✓ RS; ✓ SP; ✓ SC; ✓ RJ; ✓ MG; ✓ CE.
Design Process	1995-1998	Residential building: Popular and Middle-class Family Housing.	✓ Modelling The design Process.	✓ Architecture Design,	In most of the papers that analysed Design Process, the Exploratory Research on the Brazilian Civil Construction Sector practices was adopted through Cases Study.	✓ Designers	✓ SP; ✓ SC; ✓ RS.
	2000-2002	Residential building: Popular and Middle-class Family Housing; Institutional Building: Hospitals and governmental.	✓ To model the design Process; ✓ To develop tools to control the design process; ✓ To understand the information flow during the design process.	✓ Architecture Design.		✓ Designers ; ✓ Building Entrepreneur.	✓ SP; ✓ RJ; ✓ SC; ✓ RS.
	2000-2007	Residential building: Middle-class Family Housing; Institutional Building: Hospitals and governmental.	✓ To develop tools to control the design process; ✓ To understand the information flow during the design process. ✓ To discuss the higher education of Brazilian designers; ✓ Multidisciplinary design process; ✓ Decisions about technology during design process ;	✓ Architecture Design ✓ Multidisciplinary design team; ✓ Tools; ✓ Technology; ✓ Facilities; ✓ Education.		✓ Multidisciplinary design team; ✓ University; ✓ Users; ✓ Construction Company.	✓ SP; ✓ RJ; ✓ SC; ✓ RS; ✓ PR.

Theme	Period	Typologies of Buildings	Aims of research	Aspects studied	Methodology	Actors of the research	State
Quality	1995-1998	-	✓ To achieve the provisions of ISO 9001 on design process; ✓ Design process, technology and quality.	✓ Architecture Design; ✓ Tools; ✓ Procedures	In most of the papers that analysed quality on design process post-occupancy, the Exploratory	✓ Designers; ✓ Construction Company	✓ SP; ✓ RS; ✓ RJ; ✓ CE; ✓ SC
	2000--2007	-	✓ Implementation of quality management system in design firms	✓ Tools; ✓ Procedures.	Research was the methodology adopted through Case Study.	✓ Designers	✓ SP; ✓ RS; ✓ RJ; ✓ CE; ✓ SC.
Information Technology	1998-2000	-	✓ Implementation of technology to design (AUTO CAD); ✓ Information System in design process.	✓ Design tools	In most of the papers that analysed information technology, the qualitative research was the methodology adopted through Case Study and Analyses of Documents, Tools and Models of Work..	✓ Designers	✓ RJ; ✓ SP; ✓ RS; ✓ PR.
	1998-2007	-	✓ Documents Management; ✓ Information Technology applied to design process; ✓ Extranets; ✓ Design planning and management tools; ✓ Information flow;	✓ Management and planning tools; ✓ Design tools		✓ Designers; ✓ Construction Company.	✓ SC; ✓ SP; ✓ RS; ✓ RJ; ✓ PR.

Theme	Period	Typologies of Buildings	Aims of research	Aspects studied	Methodology	Actors of the research	State
Design management firms	1998-2007	-	✓ Organisation of “design office” for technology; ✓ Quality System Management in design firms; ✓ Organisation of design firm viewing competitiveness; ✓ Design Management firm;	✓ Information system and design; ✓ Quality system; ✓ Design firm and competitiveness; ✓ Relation with Building Entrepreneur and Construction company; ✓ Management model to design firm; ✓ Information System for design firm.	In some of the papers that analysed post-occupancy, the Exploratory Research was the methodology adopted through Case Study. Other papers were developed through action research.	✓ Designer; ✓ Building Entrepreneur; ✓ Construction company.	✓ RJ; ✓ SP; ✓ RS; ✓ CE

According to **Table 3**, it is possible to observe the evolution of researches on design process from 1995 to 2007. Analysing papers concerning post-occupancy, most of them emphasised residential buildings, more specifically, popular housing and aim to understand the user profile and, later, to use this information for quality management system of construction companies and finally to guide the design process. With regards to initial information, such as post-occupancy, most of the papers referring to residential building aim to collect information concerning user requirements to format the construction product.

Concerning sustainability, just after 2005 aspects such as eco-efficiency were researched and, before that, the discussion about sustainability referred to decisions about the choice of materials and systems. The discussion about the relation between sustainability and design process only started in 2000, and the number of papers was small if compared to other subjects; on the other hand, the papers about sustainability have increased in the last years.

Repeated researches were verified concerning design management process usual practices; despite that, from 2000 papers about tools development and methodologies, such as current engineering, for example, have been published. As design management subject, researches about information technology on design process have been repeated. Most of the published papers have discussed the tools used in design practice, such as Auto Cad, for example. In spite of the importance of tools, researches related with management of information flow during the design process, for example, have been neglected.

The number of papers published concerning design process quality has dropped since 2004. This has probably happened due to the “quality movement” occurred in the Civil construction sector from 1997 to 2004; most of the papers published in this period were related with implementation of quality management system in design firms.

As post-occupancy, the researches on the design process subject have progressed. From 1995 to 1998, the papers aimed at modelling the design process, and the typology of building studied was the middle-class family residential building. After 2000, researches started to develop tools to control the design process and to understand the information flow during the design process. In that occasion, the design process of institutional buildings was studied and the building entrepreneur was involved in the researches, together with the designers. In the last years, researches have been developed concerning the education of architects and engineers who would work as designers, the multidisciplinary design process and decisions concerning technology during the design process.

Referring the research methodology adopted, most of the papers were made by qualitative research, through Case Studies, Documents Analyses or Work Models. Most of the papers analysed were based on a bibliographic revision, mainly by Brazilians authors.

CONCLUSION

It was verified that there was much to research about design process in Brazil; however, researchers should take care about theme repetition, because there were themes that were exhaustively studied, by way of example, research about used practices to co-ordinate the design process. In this case, there is a lot to research about tools and methodologies for this practice. Instead, there are repeated cases about negative experiences in co-ordination of design process.

Another aspect verified concerned the discipline of design studied. Most of the papers analysed referred to architecture design process. There is a small number of researches about the other design process disciplines, such as structure building, electrical and hydraulic fittings, etc. Another interesting aspect is about the typology of buildings studied; most of the cases are residential building as opposed to the studies about design process of institutional buildings, industries, etc.

The number of papers published about quality has dropped, as mentioned, but this is a worrying aspect because quality is not a resolved aspect in the civil construction sector in Brazil, such as the management of construction companies and, mainly, design firms.

In the last two years, considering the Brazilian Construction Sector Increases (Housing, Industry, Infra Structure) there is an important demand of studies and research concerning the design process, which aims to improve the professional practices of work, development of tools (communication, management, information technology and design process), and also continuous education to Architects and Engineers who work with design process in the Brazilian Construction Sector.

Analysing the papers published in the CIB World Building Congress 2007- Construction for Development, referring to the Architectural Management, an interesting aspect is verified related to the Design Process Management Researches. Papers from authors, such as Heintz & Overgaard, Paterson et al., Adeyeye et al. and Gray et al and Emmitt and Otter, discuss design process management from the point of view of information and communication management during the design process. About design management firms, authors such as Groz et al. and London & Chen, discuss the importance of intellectual Capital and Human Resources Management to the design process.

Comparing these papers with the Brazilian papers studied, a gap is verified in the Brazilian Research referring to the link between design process management and the information and communication management. There is a large number of paper related with usual and failure design management professional practices in Brazil against the need of researches related to innovative information technology tools to improve the communication and information management of the design process.

Another interesting aspect comparing the papers published in the CIB World Building Congress 2007 - Construction for Development and Brazilian papers is the one referring to the focus on the human resources in the design management firms' researches. The number of Brazilian papers related with the design management is low, comparing with the other themes. According to Oliveira (2005), there is no way to improve the design process management if the design environment where it is produced, the design firm, is totally disorganized; like most of the Brazilian design firms are. Additionally to this point of view, if the intellectual capital of the design firms is neglected, the quality of the design process will probably be worse than the result expected.

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