

# **DESIGN PROCESS AT PUBLIC COMPANIES DEALING WITH HOUSING PRODUCTION: EVALUATION BY MEANS OF A CASE STUDY**

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## **ABSTRACT**

This paper evaluates the housing design process, at public companies, and suggests ways to improve it. The evaluation results come from a case study developed at CDHU, a very large Brazilian company dealing with housing building production.

Interviews with designers, accesses to the company rules and to its home pages provide the basis for understanding the design process. The authors focused on a specific housing program, named “Empreitada Global” or EG, adopted at 76%<sup>4</sup> of the company production during the last seven years.

Understanding the design process flow was considered to be the first step to attain the goal of this research. After its description, an analysis over the design process is conducted and suggestions are made in order to help avoid detected problems. All the actions proposed are discussed in terms of advantages and difficulties expected on the action implementation.

## **KEY WORDS**

Design process, public housing program

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<sup>4</sup> According to data obtained in November, 2001

## INTRODUCTION

Housing deficit is one of the greatest problems in Brazil. According to Fundação João Pinheiro (2001), today this deficit is of about 6.7 million of the new housing and 83.2% of this deficit concerns families that earn within US\$ 87,00 per month. So there is a great need for better efficiency in the housing production for poor families. This efficiency is related both to costs and to productivity.

Design process is an important point to achieve better efficiency in the building supply chain. Its performance has great influence on the success of subsequent processes in construction projects, and also on the quality of the final product, since design is a decision instrument over the product features and consists in information for production. (Melhado 2001; Formoso et. al.1998). In this case we can analyze design process from the point of view of the Lean Construction because we can suggest some activities for reducing activities are not value adding, such as activities cause rework, due to errors, omissions and uncertainty (Huovila et al. 1997).

For improving the process performance we can develop a model for managing the design process. This model can potentially bring a number of benefits, such as (Formoso et. al 1998):

- The fact that a stable, consensual and explicit model of the design process exists makes it easy to identify the necessary improvements, e.g. simplification of the information flow, reduction in the number of steps, etc.;
- All actors involved in the process are able to understand the process as a whole, their roles and responsibilities (Cornick, 1991). This increases process transparency and tends to improve communication among actors;
- It is possible to increase the effectiveness of the information flow, since the necessary information for performing each activity is formally established, as well as the information that must be produced by each activity. This tends to improve the quality of design and creates the possibility of reducing the duration of the design stage;
- It becomes easier to devise and implement tools for measuring and controlling product and process performance;
- An effective feedback on the process is facilitated, since the design tasks are monitored and registered systematically, including the design related tasks performed during the production and the building operation stages. The data collected during those two stages can be used for feeding back future projects and the company strategic planning process.

Melhado (1994) suggests some principles for the process organization, which are:

- Adequacy of relations between design and project planning, design and supply, design and production, design and use and maintenance, within the principles of quality, increasing the competitiveness of the company;
- Systemic character of the design activity, tied with the project and the company external relations and considered as a subsystem of the set; ·
- The strategic, physical and technological study for the production are included in project activity;

- Availability of information that will compose a technology constructive bank<sup>5</sup> to support design elaboration;
- Design as a service that generates a product (design);
- Design development by a multidisciplinary teamwork iteratively coordinated .

Huovila et al. (1997) suggests some principles for the process organization too, which are:

- Reduce uncertainty, which is one of the main causes of rework, specially in the early stages of design. This can be done by increasing the effort in terms of clearly defining the project restrictions and the requirements of internal and external clients;
- Reduce waiting time by decomposing adequately the design tasks so that they can be properly planned, and also allow the transfer of information to be made in smaller batches;
- Reduce the effort needed for information transfer through team work, and by rearranging the design tasks.

Considering the mentioned need to increase housing production efficiency to see to poor families, as well as the advantages involved and principles in the design process development, this work analyzes a public company who has been working towards the visibility of its work flow in its design processes.

Companhia de Desenvolvimento Habitacional e Urbano do Estado de São Paulo – CDHU, object of this study, has been developing models to represent its forms of design development. That is, it presents some differentiated forms of design process, in accordance with production, which are: “Global Enterprise (EG)”, “Integral Enterprise (EI)”, “Mutirão” and “Habiteo”.

In sequence some company features (classification, origin, performance and size) will be presented. After, design process activities will be presented and we will discuss about current process considering principles presented by Melhado (1994) and by Huovila, as well as discuss about some improvements matching expected advantages and difficulties for its adoption. Finally, some considerations are done about the position of the company front to the fetching for process improvements, as well as, consideration about its difficulties and failures.

## **THE COMPANY**

CDHU- Companhia de Desenvolvimento Habitacional e Urbano do Estado de São Paulo – is a State Government Company connect to housing/ loan department - “Secretaria da Habitação”- wich is responsible for the housing policy of São Paulo State.

The Company was funded on 1949 and it has already received several names, as follow: CECAP, CODESPAULO and CDHU. Nowadays CDHU has the highest popular housing building production rate in Brazil (Secretaria da Habitação, 2002). This Company has the aim to do housing programs all over São Paulo State territory exclusively for families with monthly income ranging from US\$87 to US\$ 870.

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<sup>5</sup> System permanently updated that contains graphics and written information related to the features of the applied constructive technology (MELHADO 1994).

Moreover, CDHU also assists the urban development according the policies created by “Secretaria da Habitação”.

The Company administers about U\$239 millions a year and it has already built and commercialized more than 300 thousand houses in about 1700 housing groups in over 500 cities. It has produced approximately 10 million squared meters of built area (CDHU, 2001). Over 1 million people dwell in these housing groups. CDHU’s production totalize 64 million squared meters, of built sites, under construction sites and pieces of land owned by her. Just to have an idea , São Paulo State is responsible for US\$18 million of GNP, has 10,4 million houses, its extension is approximately 249 thousand squared kilometers where 37 million people live (Census 2000-IBGE; Governo do Estado de São Paulo, 2002).

CDHU uses various production features - “Global Enterprise (EG)”, “Integral Enterprise (EI)”, “Mutirão” and “Habiteto” – and the chosen one is the Global Enterprise (Empreitada Global).

## DESIGN PROCESS

The Company follows Hammer and Champy (1994) process definition, which is: Process is an activity group carried out in a logical sequence with the objective to produce goods or jobs that are worthwhile for a specific group of customers. The design process, in turn, is not understood only as house conception activities, but it also includes transactional and organizational activities (planning activities, partnership negotiations, management integrated to external agents, land acquisition, enterprise regulation / legalization etc.). It is important to emphasize that these activities are not design process componentes, but have interfaces with one.

The activities that compose the current process are described below:

- **Request formalization:** this activity holds the formal request receiving at the regional CDHU office, its local analysis and sending to the CDHU headquarters. In this request the Program objectives are specified. At the moment of receiving land, Community Association and Technical Support indicated by Association documentations must be presented.
- **Acceptance analysis:** it evaluates the forecast preliminary costs, the available resources, if the pre-established parameters ad guidelines are fulfilled; it also evaluates the Community Association ad technical support. This step also elaborates a preview judge (acceptance or denial)
- **Land qualification:** in case the request has been accepted in the previous step, the preliminary physical analysis and land agrarian documentation, master plan validation of remainders, remainders documentation verification that will be to dispose and land physical-urban inspection and analysis according to technical requirements.
- **Project alternative study:** this step is parallel to the previous one and holds: the land occupation potential analysis, partnership/responsibility proposal for the infrastructure and complementary work<sup>6</sup> execution, alternative proposal for illegal land occupation, land price, preliminary proposal of the viable curves

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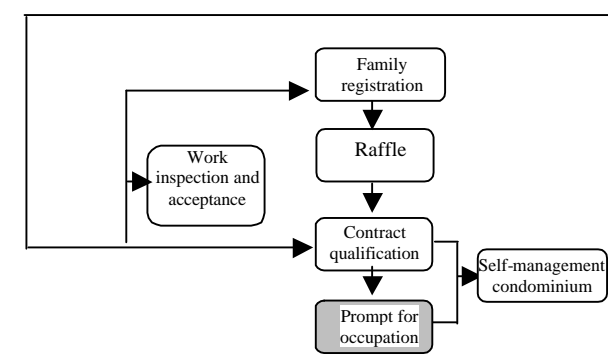
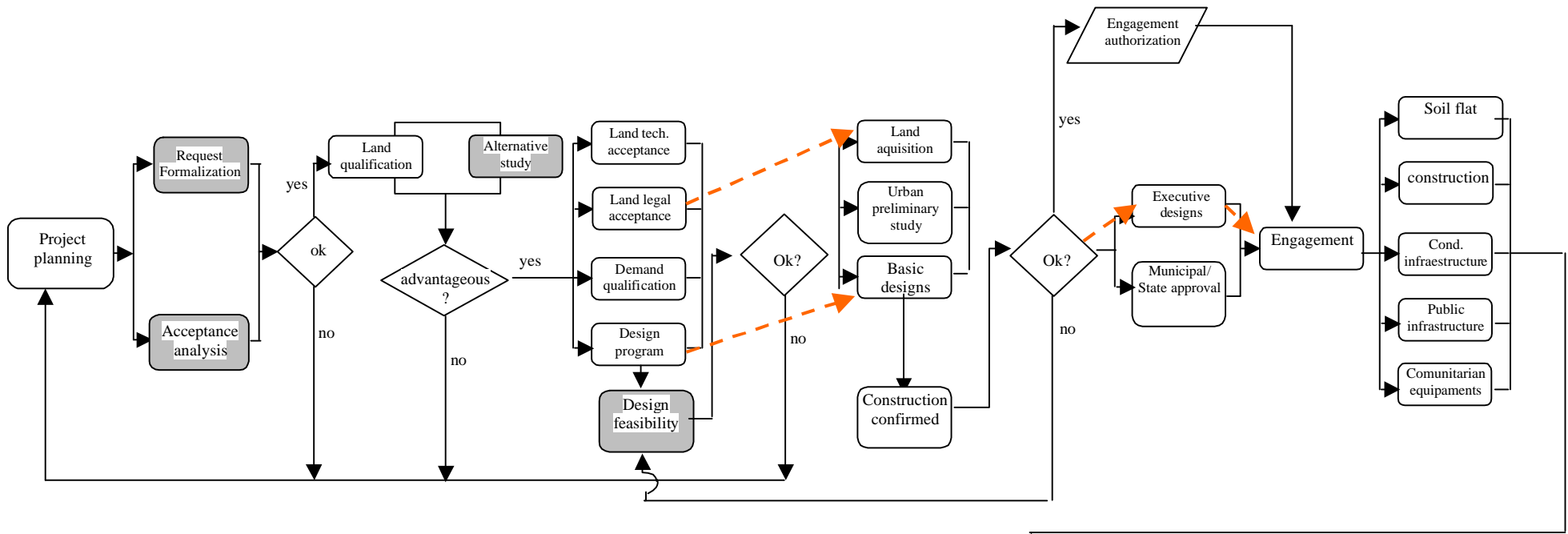
<sup>6</sup> Complementary work is stream canalization, retaining wall etc.

for each alternative commercialization, alternative qualification considering previous results (potential occupation x order of costs magnitude x demand) and, finally, the most adequate alternative recommendation.

- **Land technical acceptance:** if previous result was favorable for design development then it is done altimetry survey, soil investigations, result analysis to carry on the land technical acceptance.
- **Land legal acceptance:** simultaneously to land technical acceptance, property agrarian study and action proposal for solution related with landowner, property and the urban legal requisites are performed.
- **Social and economic demand qualification:** concurrently land technical and legal acceptance, local social and economic data are analyzed considering existing data or specific research, afterwards the capacity of municipal population indebtedness is proposed.
- **Design program:** the objective is to achieve design program elaboration (institutional and equipments areas, architectural typology choice, complementary works dimensioning)
- **Preliminary design feasibility :** in this activity, a important step for design process is the final report elaboration of the social, technical, economical and financial preliminary design feasibility as well as document formalization specifying design main features.
- **Land acquisition:** in this activity document analysis for land donation, removal of the people that live on the this land, procedure orientation and follow-up for land donation law approval, promulgation by mayor an its publication are performed.
- **Contract for design elaboration and urban preliminary study:** it is mass plan elaboration and procedures for design office engagement, procedures for design building contract, building and urban preliminary study elaboration.
- **Basic designs:** it is urban basic design elaboration and acceptance by CDHU, soil flat, public and condominium road system drainage, public and condominium water supply net, public and condominium sewer net, landscape gardening, architectural, structural, wiring and hydraulics installation basic design. After that a report elaboration for works estimate is done.
- **Executive designs:** if the feasibility is confirmed after previous activities then executive design elaboration is done as well as visual programming, gas condominium and telephony net executive design.
- **Municipal/State approval:** it holds the design elaboration approval and the project formal permission.
- **Soil flat:** it is the plateaus location, site landmarking and soil flat execution.
- **Construction:** it is construction implanted and legal drawing with location of the concluded foundations.

- **Condominium infrastructure:** it is condominium draining, condominium water, sewer, electric energy and telephony nets.
- **Public infrastructure:** it is the public road system and draining, pavement, public water supply net, sewer, electric energy, telephonic nets and legal infrastructure net drawing.
- **Communitarian equipments:** it is the implanted and proper operation of communitarian equipment
- **Work inspection and acceptance:** it is the analysis, check list, review, acceptance and cataloging of the legal drawing; technical inspection of the concluded works and information of its commercialization installment inhabitability definition, term of acceptance issue, and work receiving by CDHU.
- **Family registration:** it holds the authorization for commercialization; registration rule definition, elaboration and publication of the invocation proclamation; family registration; accepted and excluded family report issue.
- **Raffle:** it consists of the preliminary commercialization plan and accept family raffle.
- **Contract qualification and signature:** it is the families' qualification, final commercialization plan and individual contract signature.
- **Prompt for the housing group occupation:** it is the handbook elaboration, lectures, as well as the real occupation inspection of the housing units 30 days after the contract signature.
- **Condominium self-management:** it consists of the orientation ad dwellers organization in order to achieve full self-management.

Follow below the illustration of the EG design flow of the CDHU:



- - - - -> Inadequate way, but many times happen
- Current flow process with improvement proposals
- Current flow process

## **ANALYSIS OF CURRENT PROCESS AND DISCUSSION OF WAYS FOR IMPROVING**

Considering the previous illustrated model as well as statements of interviewed professionals, critical analysis made by authors and based in principles for an organization of process presented by Melhado (1994), it was possible to present some analysis concerning referred process, as follow:

- **Adjusting of relationship between design and planning, design and supplying, design and execution, design and using/maintenance:** a critical point related to this aspect is the failing in integration among several departments, designs (Architecture, Structure etc.) and theirs phases. This implies in reworks as in design elaboration as in works execution; difficulty in technical and technologic decisions by designers due imposed restriction by other technical and technologic designs definitions, in mid of other undesirable results.
- **Systemic Character of Design Activity:** it was verified that process feedback occurred in an incipient way. An example is the activity of post occupation (APO), beside of being presented activity in idealized process by company, it was not incorporated as an effective form of Current process. Another aspect is the large data base of physical and Financial indicators that company developed of executed designs. By the way, it is not used the systemic analysis of this indicators in order to designs feedback of other projects.
- **Studies of strategic, physical and technologic means:** the idea of study of strategic, physical and technologic means is incorporated in its process. By the way, it can be observed some difficulties related to this aspect, such as: concentration of those analysis in CDHU Headquarter team in São Paulo City, elevated levels of bureaucracy in sub-process referred to this analysis, implying in additional onus to project and process slowness.
- **Multidisciplinary Team and Interactive Coordination:** a critical point detected was an absence of multidisciplinary team in decisions related to design, as well as its interactive coordination. Can be understood design coordination not only a design controlling activity but activities of adjustment and manning of conflicts between them and orientation of a design team in order to guarantee the attendance of clients necessities. Multidisciplinary team can have corporate representing, architectural, structural, wiring and hydraulics installation designer, engineering related with the work, lean construction consultants and, casually it is can have professionals from other areas which is supply, planning and budget representing. Then this team discuss about design solutions in order to reach the best solution for the project aims and involved agents.
- **Design as a Service:** when design is considered design a service, the participation and involving of designers are extended to execution and post occupation. In this sense, the designer activity does not finalize with your specific design delivery but extents to orientation of its execution in job site



and during its useful period. Besides CDHU does not adopts this item in an effective way.

Based in the discussion about current process presented previously follow some improving suggestion as well as difficulties related to implementations and expected advantages.

Improving	Difficulty	Advantages
<b><i>Elaboration of production design</i></b>	<ul style="list-style-type: none"> <li>• Establishment of one more sub process to design process.</li> <li>• Increase of cost in design elaboration stage.</li> </ul>	<ul style="list-style-type: none"> <li>• Decrease in waste of construction material.</li> <li>• Major productivity in execution stage;</li> <li>• Improving in communication for intention contained in Product Design</li> <li>• Improving in final product quality</li> <li>• Improving in management of jobsite provisional facilities.</li> </ul>
<b><i>Developing of activity of design coordination</i></b>	<ul style="list-style-type: none"> <li>• Creation of one more function in organization chart of company</li> <li>• Increase of cost in design elaboration stage.</li> <li>• Number of involved agents, generating difficulty the conciliation among all viewpoints and interests.</li> </ul>	<ul style="list-style-type: none"> <li>• Decrease of difficulty in designs definition.</li> <li>• Decrease in conflicts among specific areas.</li> <li>• Improving in information flow among several agents.</li> <li>• Improving in satisfaction of internal and external clients.</li> <li>• Improving in final product quality.</li> </ul>
<b><i>Multidisciplinary Team Developing</i></b>	<ul style="list-style-type: none"> <li>• Construction agents (production representation) starts in process only after bid stage, avoid the participation of this agent since the beginning of process.</li> </ul> <p>Number of involved agents, generating difficulty the conciliation among all viewpoints and interests.</p>	<ul style="list-style-type: none"> <li>• Improving related to constructively and construction optimization.</li> <li>• Improving in final product quality</li> <li>• Time reduction along the process;</li> <li>• Decrease of reworks in projects.</li> <li>• Improving in satisfaction of internal clients.</li> </ul>

<b><i>Simplification of information flow, reduction of step number</i></b>	<ul style="list-style-type: none"> <li>• Necessity of several discussions among involved agents for reaches a consensus.</li> </ul>	<ul style="list-style-type: none"> <li>• Information flow improvement between the several agents</li> <li>• Process management improvement;</li> <li>• Time reduction along the process;</li> <li>• Improving in satisfaction of internal and external clients.</li> </ul>
<b><i>Process feedback, tools elaboration and implementation for measuring and controlling of the design and process performance (Post Occupation Evaluation-APO<sup>7</sup>- and indicators network implementation etc)</i></b>	<ul style="list-style-type: none"> <li>• Establishment of more sub processes to design process.</li> <li>• Increase of cost in design elaboration stage.</li> </ul>	<ul style="list-style-type: none"> <li>• Process continuous improvement from evaluation of adopted solutions</li> <li>• Entrance data generation for other projects</li> <li>• Improving in final product quality</li> <li>• Improving in satisfaction of internal and external clients.</li> </ul>

## CONCLUSIONS

The CDHU is a company that has mobilized in the fetching for achieving bigger quality in its processes. An example this is the work flow definition of the design process. This work was led for its Development Project Direction and collaborated the news concept inclusion in the design process. Another advantage is every process agents visualize and understand all the process, sub process and sub products.

However, the Company still has a lot of difficult and faults points along its design process. It can cites: elevated levels of bureaucracy established through process; concentration of strategic, physical and technologic analysis in CDHU Headquarter team in São Paulo City; failing in integration among several departments, agents and designs; incipient process feedback; difficulty on the information flow.

Discussing about this critical points the authors considered some improvements proposed, such as: elaboration of production design; developing of activity of design coordination; multidisciplinary team developing; simplification of information flow, reduction of step number; process feedback, tools elaboration and implementation for measuring and controlling of the design and process performance.

From the analysis of the advantages brought for these improvements against the difficulties in its implementation, it is perceived that the first ones become visible front to the last ones. However, it must pay attention about the necessity of more quantitative analysis of these advantages, or either, before its implementation it must be done the

<sup>7</sup> According to Ornstein; Roméro (1992) apud Coelho (2000) the Post Occupation Evaluation (APO) is a knowledge area that matches evaluation technique and inhabitants point of view.

analyzing of the necessary features, the execution time of the proposals, at last, it must be traced an action plan in order to get bigger results for the process efficiency.

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