# CLIENT REQUIREMENT MANAGEMENT IN BUILDING PROJECTS

**Luciana I. G. Miron[1], Carlos T. Formoso [2]**

## ABSTRACT

In recent years, concern with value management has increased in construction, mainly due to the increasing demand for quality from clients and to the increasing complexity of construction projects. This has resulted in changes on the roles of construction organizations and professionals. In this context, the success of a project depends strongly on how the requirements are prioritized and communicated to the design team throughout the product development process.

This paper describes the main results of a research study that aimed to establish a set of guidelines for managing client requirements in building projects throughout the product development process. Two case studies involving construction companies acting as the product development co-coordinators were carried out. The first was concerned with the development and construction of a house building projects for the lower middle class. The other one was carried out in a fast, uncertain and complex industrial project. For both cases, multidisciplinary product development teams were formed. They were in charge of several tasks throughout the project such as to identify the objective of the project, to plan and control the product development process, to devise the design brief, and to make design decisions, taking into account the production system requirements. The main contributions of the study are concerned with the introduction of systematic client requirements management in product development, and the application of tools for collecting data and supporting decision-making.

## KEY WORDS

Client requirements, value generation, building product, multi-disciplinary team

[1] M.Sc. Ph.D. Candidate, Building Innovation Research Unit (NORIE), Federal University of Rio Grande do Sul (UFRGS), Av. Osvaldo Aranha, 99, 3º andar, Porto Alegre, RS, CEP: 90.035-190 Brasil. FAX:+ 55 51 316 4054, e-mail:lumiron@cpgec.ufrgs.br

[2] Ph.D., Associate Professor at the Federal University of Rio Grande do Sul, Av. Osvaldo Aranha, 99, 3º andar, Porto Alegre, RS, CEP: 90.035-190 Brasil. e-mail: formoso@vortex.ufrgs.br

## CONCEPTUAL BASIS

### VALUE AND VALUE GENERATION

Value generation in construction has been discussed from various viewpoints in the domains of quality management, architecture, marketing, design science, strategy, and microeconomics. For that reason, the scientific understanding of value generation is still fragmented, but the pursuit of unification has started (KOSKELA, 2000).

In order to understand value generation it is important to discuss the real meaning of (the word) value, which varies according to the context and very often is taken for cost and price. The different meanings of value are related to the evolution of its concept along history. According to Sandroni (1994), the distinction between **use value** and **exchange value** was firstly established by Aristotle[3]. The former is related to the physical characteristics of goods that enable them to be used by people in order to fulfill any kind of necessities, either material or ideal. The latter indicates the proportion in which goods are interchangeable for money, in a direct or indirect way.

According to Markus and Arch (1973), money is simply a convenient scale against which effort, sacrifice, human value, labor, risk, danger and a host of other factors may be measured. However those authors emphasize that such factors are not more than objectives for desire, satisfaction or sensation. They argue that people's evaluation of value is not only non-linear but also varies from person to person and group to group and it is not even static for any individual. Under conditions of risk or danger or poverty, an individual's judgment on a certain increment of money will be quite different from his/her judgment in the absence of these conditions (Markus & Arch, 1973). This criterion is linked to Aristotle's distinctions as established relationships between the exchange (money) and the use (material or ideal utility) of a certain product by the customer.

An evolution of the understanding of value is reflected in current marketing approaches referring to customer value as an organizations' strategy driven to target customer attraction an retention (Woodruff, 1997; Kotler, 1991; Saliba & Fischer, 2000).

Saliba and Fisher (2000) developed a basic model to determine the perceived value by customers as a ratio between the perceived benefits to be received from a product and the perceived sacrifices incurred to acquire and use of the product (formulae 1). Furthermore those authors emphasize the customer attitude of comparing the perceived value of alternative products and select the product with the greatest perceived value.

$$\textbf{Perceived value} = \frac{\textbf{Perceived Benefits}}{\textbf{Perceived Sacrifices}} \qquad (1)$$

Customer's perceived benefits are concerned with the expected product performance as it enables the customers to achieve their goals and purposes in use situations (Woodruff, 1997). Besides, the product acquisition also brings benefits for the customer in terms of symbols that communicate social position and power by means of status, image, exclusivity, respect and comfort (Saliba & Fischer, 2000).

---

[3] Greek philosopher (383-322 a.c), the first to approach the economics problems from an analytical point of view.

By contrast, the total sacrifice includes the sum of the purchase price, exchange costs, start-up costs and post purchase costs, among others (Saliba & Fischer, 2000). Therefore, the product value, as the customer perceives it, involves complex interactions among the customer's trade-offs, facing a large set of positive and negative attributes. This relationship is the basis of the definition of value adopted by De Marle (1992): *value is directly related to ability of a product or service to satisfy our needs and it is inversely related to cost*.

The concept of value referred so far deals with the relationships between customer and product (perceived, acquired, used, exchanged). Nevertheless, value can also be related to transformation itself, that is, the conditions for production in which inputs are converted into outputs (products).

Some early economists, such as Petty[4], Smith[5] and Ricardo[6], were responsible for introducing labor in value content, until Marx[7] defined value based on the labor time socially needed for producing goods (Sandroni, 1994).

Rima (1970) explains Marx's definition of value as a deduction of the relationship between the labor and time involved in the production of goods and its exchange relationships. However that author states that there is an evident constraint: waste of labor time on the production of goods does not increase their value (Rima, 1970). The economic view of production is the basis of Walras[8] theory, in which production is the transformation of factors into products (Koskela, 2000). In fact, Walras establishes the exchange value based on the use and amount (quantity) of goods, analyzing the general exchange balance through the price mechanism.

Independently of the economic view of production, either based on the classic theory of labor value or on goods utility, those studies indicate ways to increase the industrial productivity

The managers of manufacturing-orientated organizations tend to concentrate on getting high production and wide distribution (Kotler, 1991). The problem with this approach is that the increase in process efficiency does not always correspond to a greater perceived value by the customer. For this reason, several companies have changed their strategic position, aiming to become a different type of organization: the customer-driven company (Whiteley, 1991). The fundamental difference in this approach is that the organization search for high quality products not according to its own definitions, but based on the customer's definition. They search for this quality in two dimensions, the quality of the product itself and the service quality, each one of them requiring different capabilities and strategies (Whiteley, 1991).

Koskela (2000) proposed five principles for the value generation cycle: (a) ensure that all customer requirements, both explicit and latent, have been captured; (b) ensure that relevant customer requirements are available in all phases of production, and that they are not lost when progressively transformed into design solutions, production plans and products; (c) ensure that customer requirements have a bearing on all deliverables for all roles of the

---

4 William Petty (1623-1687)
5 Adam Smith (1723-1790)
6 David Ricardo (1772-1823)
7 Karl Marx (1818-1883)
8 Marie-Ésprit Léon Walras (1834-1910)

customer; (d) ensure the capability of the production system to produce products as required; and (f) ensure by measurements that value is generated for the customer.

Based on Koskela's principles for value generation, this paper aims to establish a set of guidelines for managing client requirements in building projects throughout the product development process.

## CLIENT

There are several participants involved in a project and several terms are used to designate them. According to Kamara et al. (2000), the client is considered as a "body" that incorporates the interests of the buyer of construction services, prospective users and other group interests. A client can be made up or represent many parts. These parts, or stakeholders, have vested interests in, and different perceptions of the outcome of the facility to be constructed (Kamara et al., 1999).

In addition, it should be considered that all clients (stakeholders) and participants in the product development process in construction could have, according to the reality of each project, supplier-customer relations that alter or even reverse during the process evolution. Therefore, in order to make the client requirements management feasible, it is necessary to identify the main clients involved and define their requirements throughout the project.

## CLIENT REQUIREMENTS

The designer's predictions of the product usage and performance may not always match the user's expectations and actual usage (Hasdogan, 1996). However, the strong relationship between value and client requirements, especially user requirements, demands a better understanding of the nature of these requirements.

In order to match the client's needs and expectations, first they have to be identified and understood. The identification of these requirements can be done through surveys (questionnaires and interviews), customer satisfaction and post-occupancy evaluations, besides analysis of data on product maintenance.

From the conception of a project, the key objective should be to capture the clients' needs (either explicit or implicit), to interpret them into requirements and to manage the conformity of technical solutions in different phases of the design and construction processes (Huovila and Séren, 1998).

## PECULIARITIES OF THE BUILDING PRODUCT

In a wider sense, a product corresponds to a set of goods and services resulting from any individual, enterprise or nation productive activity (Sandroni, 1994). This set constitutes something that can be offered to satisfy a need or desire (Kotler, 1991). Besides the fulfillment of its primary necessity, a building has different levels of needs to be satisfied. For instance, convenience and social distinction are among the many requirements to be fulfilled (Muth, 1975). For this reason, the building product (especially housing) has attributes that normally generate a more complex purchasing behavior in the customer: it is a very expensive product, has unique characteristics, and is usually considered to be of long term use. The customer behavior is, in this case, a result of the product complexity itself.

The set of goods that constitute the building product[9] can be divided into two elements, the **building** and the **land** (Topalov, 1979). The building is produced by means of production (machines and raw materials) and labor-force through the initial application of capital (money) by the real state developer. A building for a specific use is a product that should conform to a wide range of performance requirements, such as safety, habitability, durability, and economy.

The land, that supports the building production and location, has a unique character - it cannot not be reproduced (Topalov, 1979). According to Topalov (1979), although any industrial activity needs a base, building construction is the only industrial sector in which every project uses a new ground.

In the urban context, the main difference among the fractions of land in different areas is their location (Muth, 1975). Location relates to performance requirements, and will affect the benefits to be perceived by the customer.

This creates a key problem in product development: how to obtain one of its essential resources, the land. When there is resistance from the part of owners, market prices tend to raise (Topalov, 1979). Additionally, the possession of land often results in the accumulation of capital by owners. By contrast, the land ownership establishes a great variety of social relations (Topalov, 1979). For instance, having the ownership of a land or a real estate indicates the owner's social position.

Therefore, the purchase of a building product includes different levels of exchange cycles:

- One involves the building quality attributes themselves, which are related to the product and production design. This includes layout, habitability, safety, construction technology, capability of the production system and maintenance, among others.
- The other is concerned with the location quality, which will be looked for by the real estate promoter, according to the target client purchasing power.

The building quality is accompanied by services that also affect the value perceived by the client.

## CLIENT REQUIREMENTS MANAGEMENT

The systematic management of information on client requirements consists of finding the knowledge applicable to a problem situation and formulating it in project objectives and constraints. Client requirement management consists of the identification and analysis of requirements, definition of priorities and making information available about the client's needs and preferences. Such tasks can potentially result in a better definition of possible design solutions, consequently increasing the perceived value by the client. Concurrently, a great challenge for a designer is to define the best solution to meet the client's needs (considering all parts represented by the client, specially the final customer) (Kamara, 1999).

Client requirements management is closely related to the company strategy in the market, since it starts by the definition of a target customer and a type of product. The product

[9] Topalov (1979), in the original text, approaches the housing product, but in this paper its concept is extended to the building product.

definition is a crucial part in the selection of the site, considering its size and location, and the building facilities to be added.

## RESERCH METHOD

### OVERVIEW

This paper describes the main results of a research study that aimed to propose a set of guidelines for managing final client requirements in building projects during the product development process. Two case studies involving small sized companies from the South of Brazil were carried out as part of an M.Sc. research project. Table 1 presents the research objectives, activities and sources of evidence.

Table 1: Research objectives, activities and sources of evidence

| Main research objective | Specific research objectives | Activities involved in requirement management | Sources of evidence |
|---|---|---|---|
| To establish a set of guidelines for managing final clients requirements in building projects during the product development process | To adapt and to develop tools for the identification, analysis and prioritization of the building client requirements | Capture of client requirements<br>Requirements identification | Interviews<br>Critical incident technique<br>Post-occupancy evaluation |
| | | Capture of client requirements<br>Analysis and prioritization of requirements | Perceptions of product development professionals<br>Post-occupancy evaluation<br>Document analysis<br>Tree of objectives<br>Design brief<br>Multidisciplinary-team meetings |
| | To establish forms of the information flow control during the product development process in building projects | Requirements flow control | Performance indicators of design and production planning (PPC)<br>Design brief<br>The product development process log<br>Web site and project extranet<br>Multidisciplinary-team meetings |

The first case study was undertaken in a house-building company. This case study resulted in the proposal of some preliminary guidelines for client requirements management, emphasising the house-building project context. The second case study was carried out in an petrochemical industrial project undertaken by a construction company specialised in industrial and commercial projects for private clients. This study was the basis for a second learning cycle, resulting on a set of guidelines for client requirements management.

Both case studies involved the work of multidisciplinary teams during the product development process. These teams included staff from the construction company, as well as designers, consultants, sub-contractors and client representatives. They were in charge of

several tasks throughout the project such as to identify the objective of the project, to plan and control the product development process, to devise a design brief as complete as possible, and to take into account the production system requirements in the design of the facility as early as possible.

### DESCRIPTION OF THE COMPANIES

Company A carries out both the development and construction of house-building projects, usually with the financial support of the Federal Government Savings Bank (*Caixa Econômica Federal* - CEF). The project definition is subjected to the constrains of CEF. These projects typically start when a development opportunity is identified: the company buys a piece of land and hires external designers to developed the design. Its product development team is formed by the company director, an administrative manager, a design manager and a production manager. Most of the construction work is sub-contracted, and typically one to three projects are launched every year.

The company had previously developed a model for managing the process management, as part of another research project (Tzortzopoulos and Formoso, 1999). In that project , a number of procedures and tools for client requirement management were developed, such as a check-list for design brief, and a post-occupancy evaluation tool. Those procedures were adapted and used in this study.

Company B is a medium size company that is mostly involved in fast, complex and uncertain industrial e commercial building projects. This company had recently expanded the scope of its services - instead of carrying out only site production, they also started to get involved in the management of the product development process. Its product development team was formed by one company director, a production planning coordinator (acting as product development manager), and one production engineer. The company had an ISO-9002 certified quality management system, which had as its core a very effective production planning and control system.

## RESULTS

### CASE STUDY 1 (COMPANY A)

The first case study was divided into two main stages. The first stage involved exploratory interviews with professionals involved in product development, and the post-occupancy evaluation of two house-building projects (**Solar** and **Vital**) previously built by Company A. Seven people were interviewed: the company director, the administrative manager, the production engineer, a CEF loan manager, a realtor responsible for selling company products, and two architects responsible for the design in those two projects. Two tools were applied in the post-occupancy evaluations, the critical incident technique (Bitner et al., 1990) and a questionnaire. Both of them were applied to the final users of those two projects.

The second stage involved the work of a multi-disciplinary team, named Project Definition Group (PDG), during the early design stages of a house building project. All permanent members of the team were staff from the construction company, although occasionally external participants, such as designers and consultants, were also invited to the meetings.

Figure 1: Solar house-building

Figure 2: Vital house-building

The information obtained through the interviews provided an overview of the company performance in the real estate market and the customers' needs for two product types - horizontal terraced house condominiums, and four story apartment buildings, both of them for the lower-middle class.

The lack of data about the market demands was pointed out in the interviews as a major difficulty in the development of new products. However, the housing shortage in the region, makes the housing market a very attractive one, specially for the lower and lower-middle classes.

Based on the results of interviews and post-occupancy evaluation, the company defined the main strategic objectives for the new projects. These were, in general terms: (a) low cost, since there was a well defined maximum sales price, (b) good aesthetics, (c) functionality and (d) low maintenance cost.

The work of the Project Definition Group was most important activity in customer requirements management. This team had weekly meetings in order to make decisions about the design of ongoing projects and the conception of new ones.

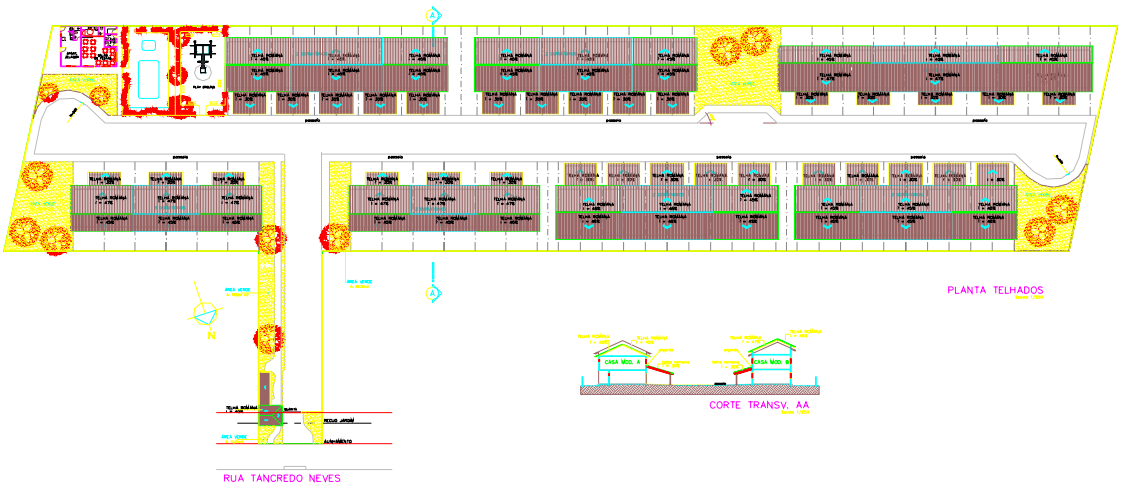


Figure 3: Project A

This research study was focused on the development of two specific projects. **Project A** consisted of a condominium of sixty houses of two and three bedrooms. **Project B** consisted of a two-bedroom apartment building.

During the PDG meetings, several problems were detected:

- The work of architects were often interrupted due to the lack of key information about the project. This was mainly caused by delays in decision making;
- There were gaps in the company competitive strategy which slowed down project definitions;
- There was a lack of milestones for the product development processes. That caused delays and time waste, adding even more variability in the process;
- Lack of commitment from the chief architect, responsible for **Project A**. He did not took part in the project definition meetings and sometimes did not follow the decisions that were made;
- Postponement of design development, since the company director was not sure about the suitability of the product to the market.

This case study resulted in the proposal of some preliminary guidelines for client requirements management. These guidelines are concerned with the application of tools for collecting data and supporting decision making, as well as the establishment of the project definition group and its insertion in the product development process.

## CASE STUDY 2 (COMPANY B)

The second case study was divided into two main stages. First, exploratory interviews with the client representatives which were involved in the design of the petrochemical laboratory to be built.

The second stage involved the work of a multi-disciplinary team, during the first eight weeks of the product development process. This team had a weekly product development planning and control meeting. This meeting involved one director, the production planning and control coordinator (who chaired the meetings), the production engineer, several sub-contractors and designers, and client representatives.

Based on the interviews, the main strategic objectives for this project were defined: (a) fast product development and production; (b) low cost; (c) functionality; and (d) good aesthetics.

The work of the multi-disciplinary team had a strong link with the production planning and control team, due to the overlapping between the design and the production stages. Based on the look-ahead planning constraint analysis at the building site, some short term goals were established for the design team in the weekly meeting.

The main problems identified in the work of the multi-disciplinary team were:

- The work of designers were often interrupted due to the lack of information from the client or from other designers;

- Some client requirements were changed late in the product development process, causing re-work in both design and production. This was caused by the fact that the product development team was not able to assess properly the degree of design maturity (O'brien and Smith, 1994);
- There conflicts between the interests among the clients representatives. There were three clear groups: laboratory users, maintenance staff; and investment decision makers;
- There were conflicts among the main suppliers, specially between the architect, who was directly hired by the client, and the construction company.

## SET OF PROPOSED GUIDELINES

The proposed guidelines are divided into three categories, each one of them has a specific focus within client requirements management: (a) requirements capture; (b) requirements flow control; and (c) value assessment and information storage. The requirements capture is related the translation of client needs and expectations into product requirements and objectives. The requirements flow control involved the monitoring, refining and fulfilling of client requirements during de product development process. The value assessment and information storage included measurement of the perceived value and creation of a project database.

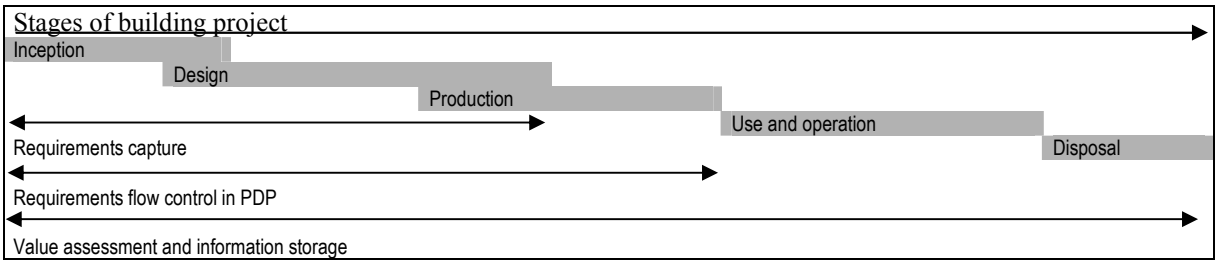


Figure 4: Requirement management and the main stages of building project (adapted from Kamara et all., 1999)

The guidelines related to the client requirements capture are concerned with the following topics:

- Identification of the main clients: this is the first step in requirements management. Several clients may exist in any project. In the industrial project, they were identified by interviewing client representatives. In the house building project, the main source of information was the post-occupancy evaluation of previous projects.
- Identification of client requirements: according to Koskela (2000), ensuring that all client requirements, both explicit and latent, have been captured is one of the principles of the value generation cycle. This must include not only the final customers but also internal and intermediate clients (For instance, the National Savings Bank in the house building sector). A wide range of procedures and tools

can be used, such as post-occupancy evaluation questionnaires, the critical event technique, and direct contact with final customers.

- Identification of the decision-makers: this is important to organize the product development process in order to speed up the decision-making process. This depends on the timing of design release and budget appraisal, and on the effectiveness of design planning.
- Formalization of the supplier-client relationships: the product development effectiveness depends directly on the commitment of all parts involved. The responsibilities, and the scope of work for each part must be clearly defined.
- Definition and dissemination of project objectives: the requirements that have been identified must be structured into project objectives. The tree of objectives, proposed by Cross (1994), is an effective tool for schematically representing the project objectives in a hierarchy. This contributes to ensure that relevant client requirements are available in all phases of product development, and that these are not lost when progressively transformed into design solutions, production plans and products (Koskela, 2000).
- Monitoring the degree of project maturity: a design is mature when it is complete enough to allow release of information (e.g. briefs, design decisions, details, budgets, plans) to downstream activities (O'Brien and Smith, 1994). This definition can be extended to project definition as a whole.
- Consideration of the production system requirements: according to Koskela (2000), it is necessary to ensure the capability of the production system to produce products as required. This means that the production system requirements must be considered in product development decisions. In both studies this was mostly done by involving production managers and sub-contractors in the product development process. Moreover, this was made easier when the subcontractor was a subsystem supplier.

The flow control requirements are strongly related to the principle of "ensuring that client requirements have bearing on all deliverables for all roles of the client", proposed by Koskela (2000). These are the guidelines that have been established:

- Requirements flow planning and control: the product development planning and control system must be able to trace design solutions to project objectives.
- Product development process co-ordination: this co-ordination is responsible for the product development planning and control process, and must encourage the interaction between the design and production teams. It also plays a key role in evaluating the project degree of maturity, making planning meetings effective, defining the scope of contracts, and negotiating budgets.
- Implementation of multidisciplinary-teams: this requires opportunities for interaction between client representatives, designers, construction managers, and sub-contractors. In fast projects, a weekly product development meeting is usually

necessary. If the product development team is too large it is necessary to organize a set of meetings involving different design clusters.

- Implementation of information systems: these play a key role in the product development process by expediting and making more reliable the exchange of information between members of the product development team.

Finally, the guidelines related to value assessment and information storage were divided into two groups:

- Measurement of the client perceived value: this is related to the principle of "ensuring by measurement that value is generated for the client", proposed by Koskela (2000). Several tools, such as post-occupancy evaluation interviews, and questionnaires can be used. It is important that this information is effectively fed back to the product development team.
- Creation of a database on the client perceived value: information on the client perceived value for different projects must be stored in the data base. This should be organized as a self-contained project description that can be easily accessed and understood by new project participants in the future.

## CONCLUSIONS

The work of PDG provided an improvement opportunity for the product development process, by the concurrent consideration of aspects related to both design and production: client requirements, project objectives, production system capability, and requirement flow-down control in the product development process.

Data collection and display on customer requirements should not be limited to the initial stages of the product development process, but need to be carried out throughout the process. In fact, the lack of information about the requirement, may cause delays and rework in the project - this may be potentially aggravated when the developer does not have a clear strategic definition of the project.

The study indicated that client requirements management must be considered from the initial phases of building projects. It also suggested that the use of relatively simple client requirements tools for capturing and controlling requirements has a positive effect in product development. Moreover, the development of the case studies provided an opportunity to make a contribution for the understanding of the nature of product development in concurrent construction projects.

## REFERENCES

BITNER, Mary Jo. The service encounter: diagnosing favorable and unfavorable incidents. *Journal of Marketing*, v. 54, p. 71-84, January 1990.

CROSS, Nigel. *Engineering design methods*: strategies for product design. 2nd ed. London: Wiley, 1994. 179p.

HASDOGAN, Gülay. The role of user models in product design for assessment of user needs. *Design Studies*, v. 17, p. 19-33, 1996.

HUOVILA, Pekka; SERÉN, K.J. Customer-oriented design for construction projects. *Journal of Engineering Design*, v. 9, n. 3, 1998.

INTERNATIONAL COUNCIL FOR RESEARCH AND INOVATION IN BUILDING AND CONSTRUCTION (CIB) WORKING COMMISSION (W60). *Working with the performance approach in building: report.* Rotterdam, Netherlands: CIB Publication, 1982. 30p. nº 64

KAMARA, J.M. et al. Client requirements processing in construction: a new approach using QFD. *Journal of architectural engineering*, ASCE, New York, v. 5, n 1, p. 8-15, Mar. 1999.

KAMARA, J.M. et al. Establishing and processing client requirements: a key aspect of concurrent engineering in construction. *Engineering, Construction and Architectural Management*, v. 7, p. 15-28, 2000.

KOSKELA, L.. *An exploration towards a production theory and its application to construction.* 2000, 296 f. Thesis. (Doctor of Technology). Technical Research Centre of Finland - VTT. Helsinki, 2000.

KOTLER, Philip. *Marketing management : analysis, planning, implementation, and control.* 7.ed. Englewood Cliffs, New Jersey : Prentice Hall, 1991. 756p.

MARKUS, T.; ARCH, M. Optimization by evaluation in the appraisal of buildings. In: *Value in building*. London: Hutton e Devonald, 1997.

MUTH, Richard F. *Urban Economic Problems*. New York: Harper & Row , 1975.

O'BRIEN, C.; SMITH, S. J. Design maturity. In: SYAN, C.S. ; MENON, U. (ed). Concurrent engineering: concepts, implementation and practice, London: Chapman & Hall. 1994. p 75-87.

PROJECT MANAGEMENT INSTITUTE STANDARS COMMITTEE. *A Guide to the Project Management Body of Knowledge*. North Carolina: PMI, 1996.

RIMA, Ingrid Hahne. *Readings in the history of economic theory*. New York, etc.: Holt, Rinehart & Winston, 1970. 303 p.

SALIBA, Michael; FISHER, Caroline. Managing customer value: a framework allows organizations to achieve and sustain competitive advantage. *Quality Progress*, v. 33, n. 6, p. 63-69, June 2000.

SANDRONI, Paulo. *Novo Dicionário de Economia (New Dictionary of Economics).* São Paulo: Best Seller, 1998. (in Portuguese)

TOPALOV, Christian. *La urbanización capitalista (The capitalist urbanization)*. México: Edicol, 1979. (in Spanish)

TZORTZOPOULOS, Patrícia & FORMOSO, Carlos Torres. *Considerations on the application of lean construction principles to design management.* In: INTERNATIONAL GROUP FOR LEAN CONSTRUCTION CONFERENCE, 7., 1999, Berkeley, *Proceedings*... Berkeley: University of California, 1999.

WHITELEY, Richard C. *The customer driven company.* Business Books, 1991. 308p. WOODRUFF, Robert B. Customer value: the next source for competitive advantage. *Journal of the Academy of Marketing Science*, Tennesse, v. 25, n. 2, p 139-153, 1997.

YAZDANI, Baback; HOLMES, Christopher. Four models of design definition: sequential, design centered, concurrent and dynamic. *Jounal of Engineering Design*, v. 10, n. 1, 1999.