

Guidelines for the formulation of a new quality management system model for design firms

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Abstract

The globalisation of markets, the change in consumer behaviour, the new equation for the formulation of prices and the increasingly tougher competitiveness have stimulated the Brazilian construction design firms to increasingly adopt Quality Management Systems as an alternative to improve their internal systems and for offering products with higher quality. However, the model of Quality Management System which is being adopted by these firms has not generated the expected benefits.

There is an evident difficulty in the adaptation of these systems to the characteristics of the design firms, which in general are small businesses and have a low turnover when compared to that of contractors. The implementation and maintenance of these systems has become too expensive for them and has not allowed them to join the Project Quality Plan in a harmonious way, due to the difficulty in overlaying the Quality Management Systems of the various project players.

This paper intends to formulate brief guidelines for a new Quality Management System Model which takes into consideration the real necessities of design firms; their organizational structure; the management of their interface with other players; and which would make viable their introduction within the context of the Project Quality Plan, so as to generate profits not only for them, but for all of the participants in the production chain.

It is expected that this new model will help to reach the strategic goals of the projects; which will allow better control of costs, delivery time and quality of the final product; increase the integration between design and production; improve the manner in which the needs and expectations of the clients and the project players are satisfied; and increase competitiveness of the project firms and the final product quality.

Keywords

Design firms management; design process management; quality design

1 Introduction

Organizations all over the world are facing a new reality. Today new word is “change”. And in civil construction it would not be different, with ever more competitive scenarios – where the price is set by the market – organizations are under pressure to restructure and be equipped with new tools and techniques to survive under this new order.

It is well known that design activities have a great influence on the performance of a building during its use, and more than this, it determines, to a great extent, the possibility of real financial gains during its construction by reducing wastage, decreasing the building pathology indexes, improving the corporate image of the company, leading to an increase in the number of sales, etc.

Today, despite the evident importance of the design process in civil construction, there are still no deep and thorough studies on the incompatibilities and difficulties of adapting current models of Quality Management Systems to design firms. The fact is that there is a serious problem in adapting these tools and techniques to the organizational realities of design firms which have very special characteristics and will be better analysed further on.

Innumerable studies on techniques and methods for improving the design process have been conducted and interesting results obtained. We believe that these results could have a wider practical application and generate greater benefits if the managerial style of the design firms, that wish to introduce these new techniques and methods, are taken into account.

The success of any proposed improvement to the design process is closely linked to the general performance of the design firm in question. Therefore, elements and functions connected to the management, such as the organizational culture, entrepreneurship, organizational structure, decision taking, leadership, information system, etc., if well developed and implemented, significantly influence the development of design activities, providing the ideal conditions for the development and implementation of improvement programs and methodologies focused on the design process itself.

Due to the importance of design in the general context of civil construction and of the difficulty in adapting current models of Quality Management Systems to the reality of design firms, this paper aims to present initial guidelines for the formulation of a management model for design firms, which will consider their organizational characteristics, carried out from a theoretical consideration based on bibliographical exploratory research. This study is still ongoing as a research for a doctorate in the Civil Construction Engineering Program of Escola Politécnica, University of São Paulo, Brazil.

2 The role of design in the construction process

In strategic terms, design has to achieve the organizational goals of the various components that make up the project: financial return, improvement of the client image, increased share, etc. While in operational terms design should set out the physical characteristics of the product (scheme design and definite design), its execution method (design for production and site design), facilitate the introduction of technological

innovations, reduce the existence of building pathologies, guarantee quality characteristics, rationality and constructability of the product, allowing for its better use, reduction in execution lead time of the works and a reduction in total costs.

Greater attention to the design activity has led to the awareness of the importance of taking decisions for the solutions involving the execution and technology of the product while still in the conception phase. This procedure allows for the reduction in interference and subjective decisions in the execution phase, giving greater coherence to the aims and goals initially planned, greater production speed, easier compliance with the planning and rationalization of resources management, etc.

A good performance of the design process depends on diverse factors of different kinds and amplitudes: the existence of a complete briefing of clients' needs, an increase in effort in the initial conception stages of the project, simultaneous collaboration among the various specialties of building design, development of precise construction details aimed at the execution phase, integration between the conception phase and the production process and, mainly, the existence of a management infrastructure at the design firms that allows for the development and realization of the previous items.

Two important dimensions can be attributed to the design: both as a product and as a service. In the product dimension, the design is represented in the form of documents containing technical and geometrical details, which can be taken as the final product and, still as a process, seeking solutions to the construction problems of the building product, in order to meet the necessary needs and requirements. While in the service dimension, the design must be seen as an integral activity of the production process, responsible for the development, organization, registration and transmission of physical and technological characteristics specified for a construction which are to be considered in the execution phase.

The efficient application of these new definitions results in a significant transformation in the structure of the design activity, meaning a structural change in the methodology of its development and consequently an adjustment to the management system of the design firms.

The design process can assume the fundamental responsibility for adding efficiency and quality to the product if it is incorporated in an advanced and adequate manner to the planning of the production process and used to induce rationalization and reduction of costs.

So design must have information of technological matters (construction details, location of equipment, quality control, etc.) or managerial nature, serving as support to the planning and scheduling of the works. The design firm has to offer minimum conditions for the designers to be able to give the design the characteristics that meet all the technical and managerial demands concerning the site works.

3 Recent advances in the design process

An important tool for the improvement of the performance of the design process is the **concurrent engineering** philosophy. This philosophy seeks to integrate, in the conception phase of the project, all of the intervening factors, so as to generate, in this initial phase, decisions related to the design based on the experience of all the players acting in the project, who will work as a team, considering quality, cost, time and clients' requirements, with the main goal of reducing time between the development of

new products and their launching, establishing a price and quality that allow the conquest of a larger market share. Requirements for good simultaneous engineering performance depend on the existence of an organizational environment with minimum management conditions.

The construction technology is “built-in” the execution processes by design. However, the reality of building sector practices shows that the design itself does not always incorporate the construction technology effectively used on the building site. In most cases, the design limits itself to the definition of the product without incorporating its construction methods and processes, the material and the equipment.

Recently in the building sector, a considerable growth was observed in the use of **design for production**. This tool defines the construction techniques to be employed in the construction process and the designed construction details. The objective of this kind of design is to minimize the uncertainties in production, by the anticipation of execution activities, being applied to various sub-systems of the building, allowing a detailed local view in terms of pre-studied solutions and a general view of the entire sequence of execution.

The basic function of design for production is the transmission of all the conditions that involve the construction technology chosen, in order to aid the execution phase of the project as complete as possible, thus avoiding improvisation, stoppages, re-work and the implementation of a non-planned solution during the execution.

Design for production also aims to reduce costs, which is one of the major concerns of entrepreneurs; it also seeks to optimise the production process allowing better productivity and quality of services.

Another technique that has been the object of recent studies in Brazil is **design co-ordination**. It is a multi-disciplinary activity that should be practiced by experienced professionals, in an impartial and unbiased fashion, representing foremostly the following basic objectives: to orient the design team and guarantee compliance with the clients’ needs; to guarantee coherent and complete designs, that is, without conflict among the specialties and without points being left undefined; to coordinate the design development, distributing tasks and establishing deadlines, as well as disciplining the information flow between the players involved in the project, transmitting and consulting data, organizing integration meetings and controlling the quality of the “design service”; and to decide between alternatives for the solution to technical problems, especially in the interface among specialties.

Fruchter et al. (1993) emphasized that **computer tools** can provide significant support to the communication of design concepts and problems among specialties. Besides, people involved in the design and execution of a building normally work for different companies and the group of participating firms varies from one design to another. The peculiarities of each design hinders the establishment of work routines. It is necessary to coordinate the contributions of each participant because of the existence of a vast amount of information.

Galle (1995) and Teichholz and Fischer (1994) highlight that changes in design made by one participant introduce conflict, as they are not automatically reflected in the drawings, reports and databases of the other participants. Without procedures for development that can register and review drawings, errors are expected. The additional time required for these procedures adds costs to the development process besides time itself. Consequently, according to the authors, using a common model, which aims at integrating all the participants, could limit the impact of these problems and increase

productivity, highlighting the need to seek concrete alternatives to the controlled channelling of information between designer-designer and designer-site teams.

The use of a **database on construction technology** has also been shown to be an interesting tool in the design process. It must be permanently updated and must contain information, in a graphic or written form, relative to the technological characteristics and the construction solutions used, being an integral part of the general information system; it must be also available for use in design activities for all professionals in the design firm.

4 Problems in the design process

There is frequently a separation between design and construction activities, where design is generally understood as a simple isolated tool, as its deadline and cost are generally compressed, having an almost merely legal content, on the verge of becoming simply indicative and postponing a large part of the decisions for the production phase.

In building construction, the design of different specialties are generally developed in parallel by the various designers (architecture, structures and installations) being united only at the execution of services. This procedure generates a series of incompatibilities that compromise the quality of the product and cause enormous losses of materials and productivity.

Buildings are becoming ever more complex due to the demands of the clients, new materials and technologies. One part of the complexity of modern designs is related to the product and the other part to its production process. The technical and economic conditions that limit the development of a construction project are specific to each new design and the previous experience of designers does not often cover particular aspects that the client sees as imperative (Tatum, 1989).

The decisions as to the form, functionality and construction methods are taken at the conception and design phases of the project and at these phases the promoters and designers usually work with little information; this factor increases the variability and uncertainty inherent in the process. The great variety of performance requirements and components required by the construction designs also contribute to the increase in complexity as the greater the complexity of the product, the greater the complexity of the process. Because of these factors, it could be said that design has a problem of poor definition from its beginning.

In the design process, in general, the information is spread without any structure or classification, leading to many problems between the parties involved (Aouad et al., 1994). The constant change of suppliers, the dynamic relationship between the agents and their different interests (their personal aims and their distinct needs) are factors that make it difficult for the process to be flexible and also tend to increase the difficulty of exchanging information.

Also to be considered are the different professional formations, that influence this process, as generators of problems in design activity. Due to these differences, each professional or group of professionals develop different perceptions in relation to nomenclature and to the content of design activities. Besides this, these professionals are generally found physically distant and, usually, there is no clear relationship between the functions and the responsibilities of each actor involved.

According to Glavan and Tucker (1997), the design problems can be listed from the following macro-groups: plan drawing (interference, discrepancies, omissions and errors); programming (lack of necessary information, the need for further information on some detail from the designer and the need for drawings to complete the services); design conception (design errors and design changes) and specifications (need to clarify information, incorrect specifications and changes in specification during the process).

The design deficiencies can bring serious consequences for the construction process, to the extent of making the project unfeasible. According to Tilley and Barton (1997), a low quality design can generate the following effects: reduction in the efficiency of the construction process, increased risk to the construction contract, increased costs for both the contractor and the end client and increased lack of quality in the project.

The following factors can still be pointed out as difficulties in the implementation of changes connected to design activity: lack of specification for product characteristics, establishment of very short deadlines, lack of technical requirements to orient the architect, development of the design in a compartmentalized manner, difficult relationship between the contractor and the design firm, incoherent payments to designers, thorough review of the detailed design only in its almost final form, areas of supply, planning and costs don't give adequate support for the decisions to be taken at the design stage and the absence of feedback and the registration of solutions given for construction problems during the execution.

Table 1 shows the main difficulties faced by the design sector in relation to quality, according to the Brazilian Program for Sector Quality – PSQ.

Table 1 – Difficulties in the design sector (Adapted from PSQ, 1997)

Systemic difficulties	- Engineering and architecture courses do not match market requirements; - Illegal exercise of the profession, deficient inspection from the regional counsels of the professions linked to construction; - Lack of incentives for research; - Low level of requirement from public and private clients regarding design quality; - Sharp fluctuation in market demand.
Structural difficulties	- Fragmented sector, with large number of active professionals and fragmentation of the design development process; - Absence of methodologies for tracking the demand for design, which would allow adequate planning for the mobilization of professionals at all levels of the sector; - Lack of integration between the design and production process and the civil construction production chain.
Sector difficulties	- Lack of adequate methodologies for quality management in the design development process; - Lack of investment capacity for the improvement of the production process: qualification of human resources, computerization and development of own methodologies; - Difficulties in keeping teams; - Low level of integration with other professionals involved due to clients' hiring methods; - Difficulties in following the evolution of construction technology; lack of integration with technological leaders; - Lack of standardization of procedures among clients; - Lack of technical norms based on performance requirements of the building and its parts.

The development of a new model for Quality Management System for design firms would certainly contribute to the improvement of this scenario by reducing several of the problems mentioned above, bringing substantial minimization of waste and building pathologies, allowing compliance with deadlines and the manufacture of products (buildings) with quality compatible with clients' expectations, generating more competitiveness for the building sector organizations and making a contribution towards the achievement of their strategic objectives.

It is important to stress that this work is only the beginning of considerations regarding the formulation of this new model for quality management of design firms, focusing mainly on the improvement of the management structure and, therefore, a synthesis of the scientific uneasiness which led to a doctorate research on the theme.

5 Guidelines for management of design firms

We believe that it is not possible to achieve all the potential benefits from the proposed changes to design process if we give less importance to the management infrastructure of the companies which are responsible for its production. The changes in design methodology may generate significant productivity gains, but this requires a new organizational structure and the modernization of management tools.

Like all other organizations, design firms behave in a systemic manner, interacting with the surrounding project environment (see Figure 1). They cannot have their subsystems analysed separately because they are interactive and inter-dependent. The work of these subsystems as a whole is the generator of the necessary synergy to achieve organizational objectives. Therefore, it is as important to study and to analyse the design process, as it is to study and to analyse the other subsystems of a design firm.

The design process represents the "production subsystem" in a design firm, therefore, it is very important to study the other subsystems of the company (human resources, materials, finance, marketing, information system, etc.) besides other managerial elements such as organizational structure, leadership and entrepreneurship, organizational culture, etc., in order to unite the minimum conditions for the design to be efficiently and effectively developed and that its improvements can be successfully implemented.

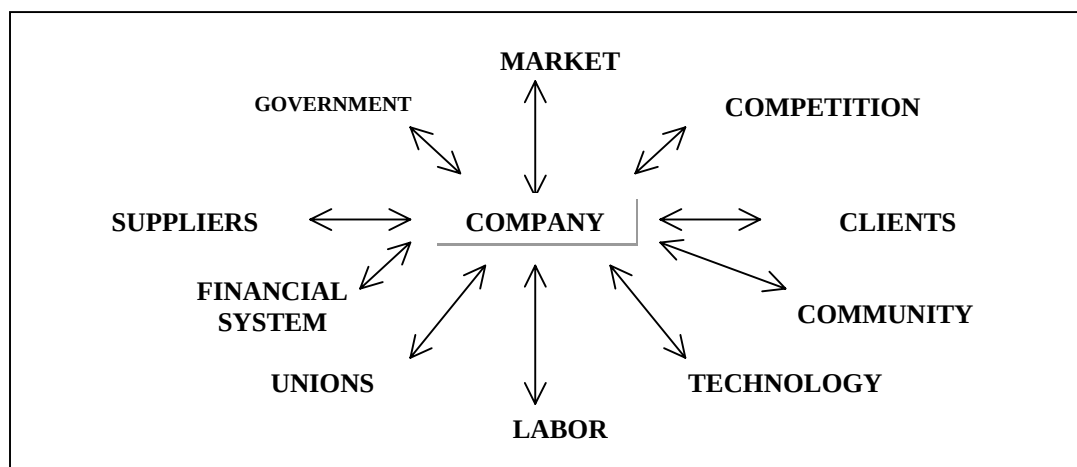


Figure 1 – A company system environment

The organizational structure of a company is an orderly set of responsibilities, authorities and decision processes, as well as defining how the tasks within the organization are to be allocated, who reports to whom and which formal coordination mechanisms and interaction standards are to be followed.

From this point of view, it can be concluded that the definition of the organizational chart depends on the company's perception of the environment where it is located and which should be in line with its strategies. The changes planned for the organizational structure can be considered one of the most efficient means of performance improvement within a company system. When an adequate organizational structure is established, it allows: better identification of tasks; better organization of functions and responsibilities; availability of adequate information, providing actual feedback to employees; the adoption of performance measures compatible with the company's objectives; and motivational conditions for the employees, contributing, to a large extent, to the good operation of the existing quality system.

Another aspect to which due importance is not yet given during the development and implementation of a Quality System, mainly in design firms, is the management of subcontracted services. Despite the respective explicit requirements of the existing models, which can be certified or non-certified, there is still a lot to be done in the design sector as, in general, subcontracting has been wrongly considered as a means of financial gain without the actual onus of the transfer of responsibility for the service.

Generally, product specification is not clearly defined by the contracting party, and on many occasions it is subject to the subcontractors conditions. The assignment of technical and financial responsibilities, in general, is not understood or agreed upon by the parties in a clear and well defined manner. On many occasions, a service is rendered without the subcontractor assuming its technical and legal responsibilities, or providing maintenance support and guarantee for defects of a badly rendered service. Nevertheless, this is a situation that must be avoided by the parties entering into agreement and which must be seriously considered in the Quality Management Systems.

Most firms are of micro and small sizes, where owners act both as management and in the technical production of services. This peculiarity gives these organizations high dependency on the level of entrepreneurship and leadership of its owners, which is also a characteristic that is not being taken into consideration during the implementation and development of Quality Management Systems.

Entrepreneurs make all the difference between the success or failure of a company. They promote integration which combines the talents of the technicians with the marketing and management elements, establishing new products, processes and services. Without them innovation remains in a rhythm which is inadequate for an highly competitive environment.

The entrepreneur cannot be separated from the company, both are part of the same team and should be perceived as one. The owner and the company employees influence the company entrepreneur "personality" and, therefore, can substantially contribute to the success of the Quality Management System.

In the design activity, contrary to the traditional manufacturing sector, there is no possibility to clearly separate the production process from the rendering of services – they can be confused. Thus, in the rendering of services environment, the Quality Management is basically centred on the interaction with the final user and with the contracting party. It is in this process that the quality appears.

It is difficult to maintain within a company, services of the same standard of quality, because in the same team there could be differences in the quality of the processes due to the different capabilities of each individual and also differences in the interaction with clients.

The greatest difficulty in the search for excellence is the constant modification of the client's behaviour. Their requirements are constantly changing and the improvement effort, in the face of changing targets, makes achieving excellence even more difficult. A policy for system feedback must be created using the final clients' complaints and assessment by the contracting parties, so as to further improve the performance standard of the service/product being offered.

Generally speaking, the generic guidelines proposed in this paper, arising from the considerations of the inter-dependency of the design with the management of the companies that produce it, are the following:

- Adjustment of the Quality System to the size and resources of the company;
- Systemic visualization of the design process, considering its interactions with the surrounding project environment and taking into account the other subsystems that make up the design firms;
- Matching of the design firm organizational structure to the design process characteristics in civil construction;
- Development and implementation of a methodology for the management of third-party services which will guarantee the quality and distribution of responsibilities;
- Consideration of the level of entrepreneurship and the leadership style existing in the design firms, which in general have a high level of dependency on their owners;
- Consideration of the design firms as producers as well as service rendering companies; recognizing that their professionals have distinct capabilities and characteristics and that, therefore, need efficient training tools and orientation for their work routines;
- Consider the clear identification of the clients' requirements as a basic element for the good performance of the design process;
- To improve the company information system, also including the use of communication between designer-designer and designer-client as well as the management of documents as indicators of the capacity to render design services;
- Institution of systematic feedback so as to make the continued improvement of the design activity and the quality management system as a whole viable.

6 Conclusion

Our conclusion is that it is possible to improve the performance of construction projects with relatively reduced investments – if compared to the investments that would be necessary in the construction phase – through management and improvement of quality within the design firms. Therefore, a more systemic, managerial approach, which takes into account the peculiarities of design firms, is essential to guarantee significant progress in civil construction projects.

This paper was not meant to be a treatise on design firms management or even on the design process in civil construction. Its main aim was to present generic and introductory guidelines for matching the management system of the design firms to the needs of its own production process.

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