A CRITICAL VIEW OF BRAZILIAN CONSTRUCTION WORKERS
AND STANDARDIZATION

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ABSTRACT

The current Brazilian construction industry scenario is supported mostly by workers without specific qualifications, and despite some of them being illiterate and non-unionized; they maintain the current Brazilian construction industry scenario. These characteristics usually imply low productivity and low final product quality, resulting in poor market competitiveness. The improvement of the workers’ capabilities is very important in this industry, since building technology is based on an intensive use of manpower. However, efforts towards the improvement of workers’ capabilities are, very often, limited by their characteristics and limitations. This paper presents a critical analysis of this issue in Brazil, based on the Brazilian National Program for the Improvement of Quality and Productivity in the Housing Industry (PBQP-Habitat), followed by the results of a case study discussing the successful strategies used by a specific building company to overcome the challenges produced by this reality. This experience shows the benefits of standardization theories for practices aiming at production, quality and profit improvement.

Keywords: Quality, Standard, Standardization.

1.0 INTRODUCTION

The current scenario of the Brazilian construction industry is mostly supported by workers without specific qualification, some of them illiterate and non-unionized. In some cities in the state of São Paulo, almost 70% of the construction workers are illiterate and their productivity is 20% lower than literate workers. The former waste more brick and cement and cannot keep their job for a long period of time (Netto, 1997). These characteristics usually imply low productivity, high level of variability in the production process, low final product quality, and difficulties to meet deadlines and agreed costs, resulting in poor market competitiveness for the employer firm.

According to Mayr (1999), there is a tendency in Brazil to attribute low productivity in the building sector to a low educational level and to poor or no specialization at all of the workers. On the other hand, the McKinsey Company, a management consulting firm, compared the Brazilian’s with the international practices and concluded that the illiteracy of the workers does not directly influence their productivity. That firm suggests that higher productivity is reached using well defined work methods. The McKinsey’s report also highlights Brazilian construction firms that reached high levels of productivity in spite of the above mentioned difficulties with workers, due to an effective training program (Mawadiye, 1999).
However, in most cases, efforts towards the improvement of workers’ capabilities are, very often, limited by the workers’ characteristics and limitations. For this reason, some companies are developing alternative strategies to succeed in this business. Standardization is one of the successful practices in this scenario due to its contribution to the improvement of the workers’ mastery of the work methods and the company’s competence to meet the product quality requirements.

Standardization is a process that comprises the development of procedures and referential material for a specific process or operation, aiming at reducing the possibility of variability. (Santos, Formoso and Tookey, 2002).

The objective of this paper is to identify strategies for the standardization process used in a specific building company that could be transferred as good practice to the housing industry, in spite of the Brazilian reality of construction workers and the related issues of the Brazilian National Program for the Improvement of Quality and Productivity in the Habitat (PBQP-Habitat) context.

2.0 THE BRAZILIAN NATIONAL PROGRAM FOR THE IMPROVEMENT OF QUALITY AND PRODUCTIVITY IN THE HABITAT (PBQP-H)

Aware of the problems mentioned above, the Brazilian Federal Government created the PBQP-H, with the purpose of establishing guidelines to induce building companies to launch a Quality Management System (QMS). The Program goal is to qualify the companies, in a progressive process, allowing improvements in the use of materials; qualification and development of the construction workers; technical standardization; and the evaluation of new technologies.

The main objective of the program is to promote the qualification of the entire production chain of the construction sector and create the basis of a new scenario in two main topics: quality in the habitat and productive modernization.

The certificate issued by PBQP-H has also been required in public construction auctions and for access to bank housing financing programs as a document of quality assurance. (PBQP-H, 2008)

The firm that applies for a PBQP-H certificate has to fulfill the requirements imposed by the program, such as standard procedures, a QMS, hours of training for the workers, and other requirements. After that, it has to hire an external auditing firm to evaluate if the requirements have been carried out. Then, the firm receives a certificate with the dates of emission and validity, and the rating of the firm. These certificates fulfill a progressive process in which a company can begin with rating D, meaning that it is committed to the quality improvement of its processes, and can evolve to letters C, B and A. Along this progressive stage, the demands for quality requirements increase.

Although the intention of the PBQP-H was very noble, represented by the rising number of construction firms, design offices and materials suppliers adopting the program, a recent analysis of the documents indicated that, in general, the program is more focused on the results of the final product, giving less importance to the quality and efficiency of the process. Most of the indicators established by the program were also concerned with the quality of the final product, even if the intermediate product was not produced with accuracy, minimum waste of materials or good execution practices.

Work qualification is usually assessed by the program through the amount of hours assigned for training, which has been shown to be an inadequate process to qualify both construction workers and the final product.

Therefore, in spite of the difficulties with workers and a not-so-effective quality program, some firms in Brazil have managed to overcome these challenges and succeeded in their projects, achieving profits and advancing the delivery of their buildings, with the implementation of standardization process.
3.0 BACKGROUND

3.1 Standardization

Standardization must be seen as a process that includes setting, communicating, following and improving standards, embedded in a continuous improvement context (Productivity Press Development Team, 2002).

Kondo (1991) presents, in his writings, three main components that make up the standard:

- Goal or objective to be reached;
- Restrictions, procedures that guarantee the safety of the workers involved and the quality of the final product; and
- Methods for efficient work performance.

Imai (1997) defines standard as a combination of rules that must be followed to enable the achievement of a pre-set goal. This author emphasizes that the adherence to this standard does not imply in freezing work methods. Quite the contrary, according to Imai (1997) the adherence to standards sets a unique referential and improves the transparency and the communication between the workers with the same goal, stimulating the continuous improvement of those standards.

Monden (1998) defines the Standard Operation as a pursuit of work balance, which is described as a state of predictability of the work cycles and the time spent on them. In the manufacturing of a product, the standard operation involves the establishing of a standard work sequence and the inventory control at a minimum quantity of materials necessary to perform the work sequence.

Kondo (1991) in his studies stated that the use of repetitive methods may inhibit the creativity of the employees, but in his opinion the use of standard manuals are recommended since the characteristics of these manuals are compatible with the worker’s amount of knowledge.

In another perspective, Liker (2004) argues that standardization is the necessary foundation on which tomorrow’s improvement will be based, considering standardization as the best method of execution at that moment, but which is to be improved tomorrow.

In this paper the process of standardization will be considered a complex process that comprises the definition of the standard; communication; adherence; and continuous improvement; and not a fixed way of work.

3.2 Standard Documentation

Hino (2006) describes effective communication as a process in which a person understands the message or knowledge that has been passed on, and emphasizes that this process is hard to be successful without the standard procedures. He stresses that written documents are indispensable for an accurate communication process, justifying that human culture came from the written word and in the same way the culture of a firm must be passed on in written documents. Finally, according to Hino, written documents have an important role in the standardization process; it is the key to the effective implementation of the program.

Hino (2006) made a comparison between Toyota standardization process and Human genetics, affirming that the procedures are like the genes and the written documents like the DNA. The existence of these practices provides the transfer of the knowledge retained in the genes from generation to generation enabling the continuous evolution of the firm.

The same author calls those documents “a standard way of work” or “standard work” assuring that the documents contain the best practice for that specific work, until a better method comes up, in a continuous improvement process.
3.3 The Human Element and Motivation

Kondo (1991) affirms that motivation is the key to get the expected results when working with people and dedicated himself to the understanding of motivation and accomplishment of goals. In his conclusions, motivation is essential for work and the key to active high productivity. Kondo describes work as the conjunction of creativity (the joy of thinking), sociability (the joy of sharing pleasure and pain with colleagues) and physical activity (the joy of physical work). He explains that work is an activity (physical activity) that produces something of value (creativity) for other people (sociability).

The same author mentions that motivation to work is closely related to creativity and argues that standardizing work is inconsistent with motivation, since it restricts the scope of creativity and ingenuity on the part of the people engaged in the work.

On the other hand, Treville and Antonakis (2005) emphasize the importance of the workers' participation in the definition of their own duties. According to these authors, this practice increases the worker's motivation since it provides a better practical comprehension of tasks to be done and gives the feeling of property of the method. These factors stimulate their commitment with the standardizing work and continuous improvement.

The same authors explain that the intensive participation in the work method definition and in the process of its continuous improvement enable the motivation of the workers even in restricted job environments.

3.4 Transparency

Transparency of a production process is mentioned by Santos (1999) as the ability of the process to communicate with the workers. In standardization, transparency shows the rules for the execution of a task.

Santos, Formoso and Tookey (2002) support the use of an adequate language in presenting information relative to the standards and the need of displaying them in the place and at the time demanded.

The results of their studies pointed out incompatibility between the written language used in the documents and the workers capabilities, highlighting the importance of the use of visual language at the work place, in the training, and the development of prototypes to improve the communication of the standard.

Koskela apud Stalk and Hout (2000) point out that transparency should be applied in the main production line to help control and improvement, making the process visible and comprehensible to all the employees. Non-visible processes increase propensity for error, reduce visibility of the errors and reduce motivation for improvement.

3.5 Basic Stability

One of the main objectives of the standardization process is to reduce the occurrence of variability. Smalley (2007) states that the reduction of variability can be guaranteed with the achievement of the basic stability of the process. He describes basic stability as a predictable state of cycle time, assured by the constant availability of the 4M's. The so-called 4Ms are: man-power, (Worker); machines; materials; and method (standardizing method).

Saffaro (2007) based research on parameters proposed by Currie (1997) and Ballard & Tommelein (1999) to define the elements that should make up the standard method. These authors suggested a set of parameters that should be taken into account in the improvements of the production process. The elements of standard method according to Saffaro (2007) are: work content; method design (sequence and simultaneous operations); set up operations; batch size;
minimum resource unit (minimum team); space and access; production capacity; equipment, materials; shared resources (crane, storage, work space); and work in progress.

Therefore, according to Saffaro (2007) the standardizing method includes the other 3Ms (machines, materials and man-power) mentioned by Smalley (2007). The standardizing method, which is the best known combination of these elements, and their availability at the beginning of task execution contribute to the stability of the production process and, consequently, to low variability.

It is also important to highlight that according to Imai (1997), the improvement of the standard usually takes place after a period of process stabilization. This author emphasizes that the period of process stabilization is a requirement for improvement, due to the evolution of knowledge allowed to workers.

4.0 RESEARCH METHOD

4.1 Method Delineation

The research design used in the present study was a case study. The study was carried out on a specific nineteen floors building site being managed by a Brazilian building firm in Londrina, the state of Paraná, Brazil.

The research problem identified was the unskilled workmanship of the workers in the construction sector and the low effectiveness of the Brazilian QMS proposed by the PBQP-H and the research question was “How can the company overcome these challenges through a standardization process”? The pursuit of this question should allow the identification of strategies for the standardization process that could be transferred as best practice to the housing industry.

Initially, an informal interview was conducted with the regional manager and the two engineers responsible for on site production. The main purpose of the data collection in this phase was to reach a deeper understanding of the global standardization process, as well as to know how the documents were created and how the training programs were developed.

In the second phase, the researchers interviewed the quality manager of the firm with the aim of evaluating how the standard procedure was defined. Issues, mainly, regarding the workers participation and the means adopted to define the standard, were investigated.

Finally, in the third phase, tasks such as masonry, painting, external cladding, and execution of the concrete structure were selected and separately studied. For each of these tasks, the analysis focused on evaluating the communication media of the standards for the workers, their adherence to the standard procedure and its continuous improvement. The evidence sources adopted were: (a) the analysis of written documents (standard procedures); (b) the researchers’ observation of the workers’ training process; and (c) the researchers’ observation of the activities monitored on site. Informal interviews were conducted with the sub-contractor manager and with the workers while they were doing their job on site. This other evidence source was important to confirm the researchers’ interpretations from the direct observations carried out on site and also to analyze the motivation and individual issues that could affect the adherence to the standards, such as rewards offered, close discussions with managers on site and self-confidence due to the presence of managers on site.

It is important to highlight that all the phases of the standardization process (defining, communicating, adhering and improving the standard) were investigated. Table 1 presents a synthesis of the topics that were investigated as well as the tools adopted to collect the data.
Table 1. Data Collection Plan

Research Problem
Unskilled workers in the construction sector and the low effectiveness of the Brazilian QMS proposed by the PBQP-H

Research Objective
To identify strategies for the standardization process that could be transferred as best practice to the housing industry

<table>
<thead>
<tr>
<th>Stage of the Data Collection</th>
<th>Topics</th>
<th>Tools Adopted</th>
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<tbody>
<tr>
<td>First Phase</td>
<td>1- Analysis of the context. (understanding the global standardization process, how the documents were created and how the training programs were developed)</td>
<td>Interview with the regional manager and with 2 production engineers from the building site.</td>
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<td>Second Phase</td>
<td>2- Evaluation of the standard definition process.</td>
<td>Interview with the quality manager of the firm.</td>
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<td>Third Phase</td>
<td>3- Evaluation of the standard documents and their details.</td>
<td>Reading of the written documents about the chosen activities.</td>
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<td>4- Analysis of the communication media of the standards for the workers.</td>
<td>Interview with the workers and Training supervision.</td>
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<td></td>
<td>5- Analysis of adherence to the standard.</td>
<td>Data collection on site</td>
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<td></td>
<td>6- Analysis of the improvement process and the benefits of the standardization.</td>
<td>Interview with the sub-contractor manager and with 2 production engineers from the building site.</td>
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<td></td>
<td>7- Analysis of motivation and individual issues.</td>
<td>Interview with the workers while doing their job</td>
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<td>Interview with the sub-contractor manager.</td>
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5.0 THE COMPANY

The company has a solid name in the construction sector, especially due to its competence in the meeting of costs and time estimates, which result in the reliability of project delivery. This competence was acquired mainly through the well-founded knowledge and understanding of its production process and through the effectiveness of the standardization process.

The company began its business in the sector of industrial buildings, but in the past 10 years approximately, it has been growing in the residential construction sector, focusing on multi-storey buildings. In 1999, the firm obtained the ISO 9002 certification, and in 2004 was rated A, certified by the PBQP-H.

The firm had a successful standardizing process characterized by: well-defined and effective quality inspection procedures; a detailed standard method registered in its QMS; an effective adherence to the standard methods by the workers; deep concern with work security; and a stable cycle time which allowed small quantities of work in progress.

Approximately 90% of its workers are sub-contracted, which could have a negative effect in the final product quality. Despite this, the building studied presented a high level of quality in the execution of the analyzed procedures; clean workstations; and well trained professionals.
6.0 RESULTS AND DISCUSSIONS

Table 2 presents a description of the firm actions observed in all the stages of standardization process, showing the adherence to the characteristics presented in the literature review.

Table 2. Standardization in the Studied Firm

<table>
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<tr>
<th>Theoretical Standardization</th>
<th>Firm Actions</th>
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<tr>
<td>Definition of the standard</td>
<td>The definition was made by the technical board of the company, with little cooperation from the sub-contracted workers.</td>
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<td>- After the elaboration of the document, it was sent to other engineers of the firm for their approval.</td>
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<td>- After this, the document was included in their online system for consultation, and a printed version was left at each building site of the firm.</td>
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<td></td>
<td>- The objectives and goals regarding time were not clearly presented in this document, albeit it being an important strategic issue for the company.</td>
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<td></td>
<td>- Complementary documents were adopted in order to instruct the workers to fulfill the cycle time of the task (Figure 1).</td>
</tr>
<tr>
<td>Communication of the standard</td>
<td>- The communication of the standard was carried out by means of a training program.</td>
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<td>- The training was developed in a room at the building site and consisted of the reading of the standards to the workers. This training was essentially focused on safety and quality procedures.</td>
</tr>
<tr>
<td>Adherence to the standard</td>
<td>- The adherence to that standard communicated in the training was guaranteed by the monitoring of the trained worker in the first steps, and then with the filling in of technical reports of the task.</td>
</tr>
<tr>
<td>Improvement of the standard</td>
<td>- The improvement was made by the workers' supervisors and the engineer identifying better work methods. Once that possibility was identified, it was sent to the technical board and other engineers for testing.</td>
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<td>- After that, the improvement was documented and adopted by the entire firm.</td>
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<td>- The manager of the sub-contractor stimulates the workers to propose improvements in the work method by means of financial rewards.</td>
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</table>

Data collected on site and the interview with the regional manager and with the production engineers showed that task planning on site and a rigorous cost control was vitally important to the company due to its competitive strategy being focused on the reliability of delivery of its projects. The researchers observed some contextual factors that affected the standardization in the company and positively contributed to its competitiveness. These factors are:

- The standardization comprises not only the proper execution of tasks but also management directives such as work station layout; on-site supply procedures; and material storage and its flow through the site;
- The importance given to planning enhances the availability of materials on time and improves the conditions to perform the task according to the standard;
- The acknowledgment that quality of the process matters in addition to the final product quality. The two production engineers emphasized that the firm has a strong belief that the final product quality results from the quality of the process, which in turn depends on the close control on site;
- The adherence to a standard procedure (standard work method) is recognized by the managers as a mean to achieve a stable cycle time (goals) and, consequently, to meet the time set previously for clients. As mentioned before, the reliability of project delivery is one of the most important competitive forces of the firm. In fact, the guidelines established by the PBQP-H emphasize the coherence of standards (goals and methods) and the firm's quality values. As the company attaches the quality values to its competitive forces, it enhances its competence edge.
- The close partnership between the company and the sub-contractors reduces labour turnover and, consequently, improves adherence to standards. The regional manager pointed out that the main reasons for the effective partnership is the assurance of continuous work flow; management support to sub-contractors; fair prices agreed upon with sub-contractors; the
great care the company takes with the workers’ safety and skill (training); and the financial support on special occasions.

Other factors identified in the case study were:

- The standard document of the firm emphasizes the need for a clean work floor, reinforcing transparency concepts. This practice enables a better visual control of the production and the detection of possible errors;

- Small batch size facilitates quality control activity developed by the technical board (production engineers, foreman and the manager of the sub-contractor) because it reduces the parts of product to be monitored, the amount of data collected and anticipates errors. Although, small batches imply small quantity of work in progress and, consequently, low variability. The variability reduction requires the availability of the elements mentioned in topic 3.5, i.e. the adherence to the standard method. It means that the effectiveness of the QMS depends on the implementation of all stages of the standardization process;

- Although the company attaches great importance to resource supply, the adherence to the standard method design (sequence of the operations) registered in the written document of the external cladding was hampered by the lack of some equipment. This event reinforces the fact that the availability of the elements that make up the method (topic 3.5) is a requirement for standardization. It also indicates that the availability of the elements that make up the standardizing method affects each other's availability causing unexpected behaviour of the production process which leads to high variability;

- The regional manager highlighted the importance of achieving the exact cycle time previously stipulated in the planning stage, no more nor less, even if the production capacity of the crew allows it. The sub-contractor managers are instructed to set up a crew to reach this goal (cycle time). This demands deep knowledge of the production capacity of the workers and the availability of other method elements (topic 3.5), both favoured by standardization. Therefore, the competitive strategy of the firm, which is focused on the reliability in delivering its projects, made standardization a requirement;

- Rewards were offered to the workers who came up with solutions that could increase the quality of their product (intermediate products) and improve their productivity. Good solutions were discussed with the workers and incorporated into the standardizing method. The manager of the sub-contractor reported that this practice makes the adherence to the improved method easier since communication occurs naturally. This assertion brings another reason for worker participation in setting or improving the standard besides that proposed by Treville and Antonakis (2005) such as better practical comprehension of tasks and the feeling of property of the method;

- Courses were offered, in the evening, for those workers who wanted to learn other skills and get better pay. It is a practice to stimulate personal development and to keep the worker motivated;

- Prototypes have been used for evaluating the amount of materials and the storage area for better flow throughout the work station; for checking the compatibility of the different designs; and for identifying solutions for the adequate interface between finishing tasks. Prototypes were useful to improve the understanding of some method elements, but were poorly exploited as a means of communication with the workers, as proposed by Santos, Formoso and Tookey (2002).
7.0 CONCLUSION

The results of this research demonstrate the importance of the standardization to QMS effectiveness. It was emphasized that standardization is a process that includes setting, communicating, adhering and improving standards. Standard, on the other hand, is made up of three components: goal, restrictions (constrains to execute the task) and the method (instructions for an efficient accomplishment of the task).

The directives that characterized the context studied were governed mainly by the competitive strategy of the company. Therefore, the goals of standardization must be linked to the competitive strategy of the company. This factor makes standardization a requirement for the competitiveness of the company. In this sense, the company’s quality values must be in agreement with its competitive values. Although the PBQP-H emphasizes a well-defined link between the goals of the standardization and the company’s quality values, apparently the purpose that has been taken into account when companies adhere to the PBQP-H has been the quality assurance document which allows their access to bank housing financing and their participation at public auctions.

A set of elements was adopted to represent the method. The availability of the elements of the method was identified as a requirement to the adherence to standards. In this sense, contextual factors like planning, management of flows on site and partnership proved to be of great importance since they guarantee the availability of the elements that make up the method. Actions concerned with workers’ motivation such as offering rewards, training and also task monitoring by supervisors (production engineers, foreman and sub-contractor manager) were seen to affect the adherence and the improvement of the standard. The intense participation of the workers in setting the standardizing method must be better analyzed with the aim of stimulating other means of motivating the workers. According to literature, workers’ participation in the definition of the method to carry out their own duties contributes to the voluntary adherence to standards and to self-control, reducing the need for intense monitoring by supervisors.

REFERENCES