Impacts of Standardization Process in the Brazilian Space Sector: a Case Study of a R&D Institute

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Abstract: The main focus of this paper is to evaluate the impact of standardization process in a R&D Institute of the Brazilian space sector. The research has tried to identify the several organizational changes associated to the implementation of NBR 15100:2004 (a specific standard for quality management systems for the aerospace sector) that have been implemented since the middle of 2005, in one of the institutes in charge of research and development in the space sector. In order to identify those changes, researchers that are participating directly in the NBR 15100 implementation were interviewed. The results of research have demonstrated a major impact on organizational, relationship and human resources.

Keywords: Standardization, NBR 15100, space sector, concurrent engineering.

1 Introduction

The Brazilian State, under coordination of Brazilian Space Agency (AEB), has been participating in the national and international space context in several projects, such as: partnership in the construction of satellites (CBERS), participation in the International Space Station (ISS), microgravity programs and others. The Brazilian participation in the microgravity projects is fomented through the project, production and launching of sounding rockets, accomplished nationally. Besides sounding rockets, the Program of National Space Activities (PNAE) has as objective to project, develop and manufacture in the Brazilian industry the Satellite Launch Vehicles (VLS). In 2003, during the assembling process of VLS-03 at the launch tower, located at Alcântara Launch Center (CLA), an accident happened impacting in many losses. As result of the accident report, were established actions, and one of them was the implementation of a quality management system standard, edited by Brazilian Association of Technical Standards (ABNT) in 2004, in the institute of R&D in charge of VLS project. The standardization adopted was the NBR 15100 (Quality Systems, Aerospace Model for assurance of quality in the project, development, production, installation and services) [1].

Therefore, this paper has as objective to evaluate associated impacts with the adoption of standardization in the Institute of R&D. The paper is organized in five

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items, initially a brief historical of the quality system standardization in the aerospace sector is described and the NBR 15100:2004 characteristics. In the next item the applied research methodology is explained and the obtained results are described and analyzed. Finally, the conclusions are described.

2 The Standardization in the Aerospace Sector and the NBR 15100

In the middle of the 90's, the aerospace industry recognized that the international standard ISO 9001 did not assist the minimum requirements of its sector. Most of 1st level organizations, in the supply chain of the sector, were increasing additional requirements to ISO 9001, when they asked them for their suppliers.

In this context, the authorities of aerospace companies in the United States, Europe and Asia organized the International Aerospace Quality Group (IAQG) with the intention of minimizing the complexity of international integration process of aerospace components, sub-systems and systems. In 1999, the IAQG, together with the Aerospace Technical Committee of ISO [2], organized the first international standard for aerospace supply chain, denominated SAE 9100 [3]. It was based on the ISO 9000 plus aerospace requirements. So, the IAQG and ISO established the basic conditions for the alignment of requirements in the aerospace supply chain and the specific demands of production [4].

Following the international perspective, the aerospace sector in Brazil created the CB-08 (Brazilian Committee of Aeronautics and Space), with the objective of standardize the sector regarding materials, components, equipments, project, production, evaluations, maintenance of aircrafts, subsystems, aerospace infrastructure and space vehicles. Therefore, the CB-08 worked out, in 2004, a standard technically equivalent to SAE AS 9100, registered at ABNT as NBR 15100:2004 (Quality System - Aerospace - Model for assurance of quality in project, development, production, installation and associated services). It was ratified by IAQG and were established the most favorable conditions for the insertion of Brazilian aerospace production in the international chain.

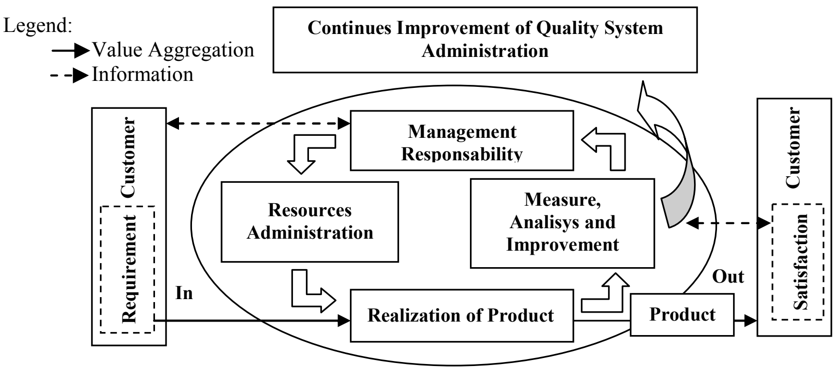

Figure 1. Model of quality management system based in process [1].

The fig. 1 above describes the model of quality management system of NBR 15100 based in a continuous improvement process [1]. The process begins by the identification of the customer's needs and the evaluation of the service capacity, considering the references of product and/or service compliances. Afterwards, those needs are translated in technical requirements that guarantee the product effectiveness, observed the aerospace regulatory restrictions. Then, the established configuration is documented, as well as the resources used for the production process, operation and maintenance of the product. The production is controlled by monitoring devices, to analyze the process conformity levels with the product requirements, and identify opportunities for preventive actions and improvements.

The main characteristic of NBR 15100, is the continuous improvement of quality management system, through the use of quality policy, quality objectives, audit results, data analysis, corrective and preventive actions and critical analysis of administration system. In that sense, the organization has to show evidences of the commitment with the development and implementation of quality management system as well as with the continuous improvement process, such as: to communicate to the organization the importance in assists the customer's requirements, to attend the governmental regulations, and to supply the necessary resources. It is important to mention that SAE AS 9100 and NBR 15100, are characterized as consensus standards, in other words, both of them are of voluntary adhesion, and do not substitute the regulatory requirements adopted by the aerospace production. In Brazil, for instance, they are subject to the Brazilian Regulations of Aerospace Quality (RBQA), whose objective is to assure, through requirements and procedures, that the demands of product contracts and conformities are assisted.

3 Research Methodology

According to Eisenhardt [5], case studies can include a single or multiple cases, as well as they are driven in several analysis levels. Our research was characterized as a single case study, trying to deepen in the selected case, through the study of a governmental Institute of R&D related to the Brazilian space sector [6].

In order to elaborate a questionnaire for the interviews, was utilized a model developed by Nadle, Gestein and Shaw [7], and the relationship network perspective [8]. In this model, the variables that have influence in the results are classified as external, when they can not be controlled directly by the organizations, and as internal variables, such as: the technology, the human resources, and the organizational structure and work organization. Modifications in the internal variables, that represent the organizational basic elements, can be considered decisive for changing the process and the way that the tasks are accomplished [4].

In the research, were analyzed the following areas of impact:

- Organizational Impacts - aspects regarding communication process (responsibility, content and diffusion), authority (hierarchical structures, command and control) and the tasks (formalization); and

- Technological Impacts - aspects regarding infrastructure (machines, equipments and instruments) and process information (communication protocols and hardware infrastructure and software); and
- Human Resources Impacts - aspects regarding labour volume (direct and indirect) and the competences (qualification profile, knowledge and requested attitudes); and
- Relationship Profile Impacts - aspects regarding internal interactions (volume and characteristics) and external interactions (volume and characteristics) [8].

The research questionnaire was applied in interviews with researchers that participated in the institute routines, before and after the accident, as well as, are participating directly of the NBR 15100 implementation process. It is considered before the accident, dates previous to August, 2003, and after the period from July, 2005 to December, 2006. It was used as research strategy some affirmative phrases and the interviewees evaluated the approval or disapproval degree, according to the Likert scale, in levels that varied from 1 to 5 (I disagree absolutely, I disagree, I do not agree and nor disagree, I agree and I agree absolutely) [9].

4 Description and Result Analysis

According to the results obtained in the interviews, below follows the graphic related to organizational and technological impacts.

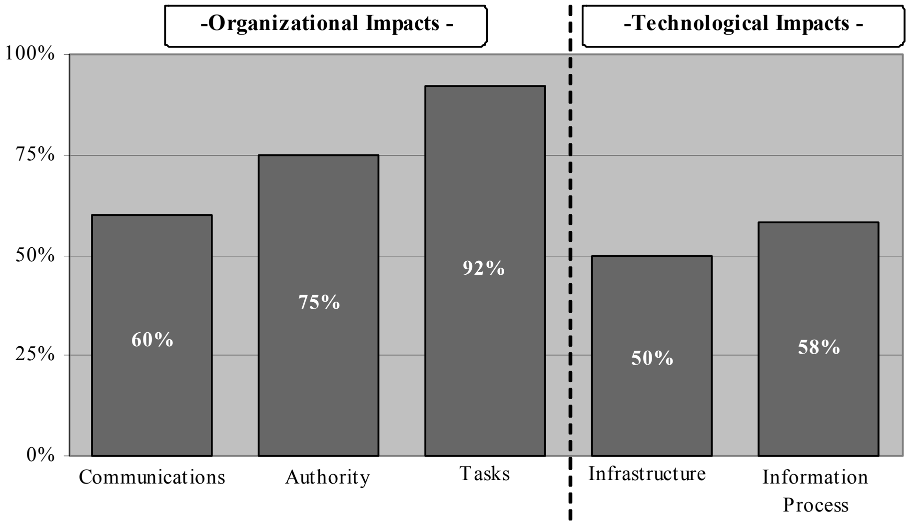

Figure 2. Organizational and Technological Impacts

It is important to emphasize that the affirmative phrases of the questionnaire were evaluating if the impact was relevant, in other words, an affirmative answered "not agree or not disagree" represented, in the majority of the answers, a positive impact but not so relevant to be considered as "agree or agree absolutely" by the interviewees. So, the interviewees mentioned that there was a better communication inside the organization, specifically regarding quality objectives.

The communication process was improved with more representatives of quality and assistants in the divisions and facilitating the diffusion of the NBR 15100 requirements. The interviewees affirmed that relevant modifications happened to provide larger authority, but without significant changes in the hierarchical structure. Finally, regarding tasks, were detected changes, mainly in the type of formalization, demanded for accomplishing the new quality standards.

Regarding technological issues, in the infrastructure of machines, equipments, and software / hardware were identified impacts, but still lack to complement them.

Below, follows the graphic of the impacts in human resources and the internal and external interactions.

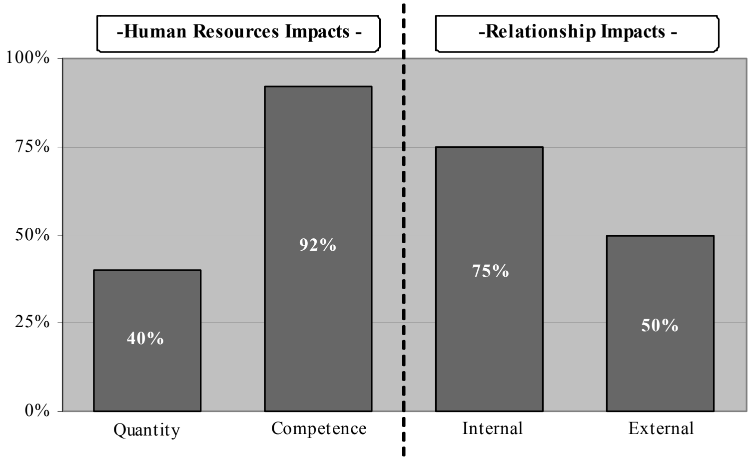

Figure 3. Human Resources and Relationship Impacts

Because of the NBR 15100 implementation more researchers had begun to participate in the activities of quality. On the researcher's profile competence occurred changes because of new quality activities demanded by the standard requirements. Those answers are ratified by the increase in the number of hours performed on quality training, such as: course of internal auditors, quality management systems and standardization.

Internally the quality representatives and their assistants interact more intensely, through weekly meetings to discuss subjects related to the standard implementation. This socialization process promoted a larger change of tacit and explicit knowledge among the participants, facilitating the implementation process in the Institute's divisions. Finally, in external interactions, it was observed that the standardization is beginning to confirm its importance in partnerships of the Institute with other organizations.

Also, according to the NBR 15100, item 7.3.1 – Planning of Project and Development -, the organization has to manage the interfaces among different groups involved in project, and development to assure the communication effectiveness and clarify the designations of responsibilities, and all of it have to happen during all stages of the project life cycle, in order to attend the requirements related to the product. This affirmative is similar to concurrent engineering definition. As Loureiro [10] defines “Concurrent engineering is a systematic approach of simultaneous and integrated projects of products and its related process, manufacturing, and staff. This approach intends to prompt developers to consider, in the early project stages, all elements of product life cycle, from conception up to discharge, including quality, cost, term, and user requirements.”

5 Conclusions and Final Considerations

The paper tried to identify and analyze the impacts caused by the implementation process of NBR 15100, in a governmental Institute of R&D, in the Brazilian space sector.

The methodology applied was a single case study. It was effective, because it has given us an opportunity to deep in the researched subjects. Besides that, the researchers have been implementing the quality standard and, also, were working at the Institute by the time that the accident happened. All of these have provided us a valuable source of data.

The most important impacts observed were related to the organizational, relationship and human resources. In the organizational impact, tasks and authority, demonstrate that the process of quality management system is permeating on several process in the Institute. The NBR 15100 implementation is emphasizing the importance of quality function in the professional profile of each researcher, independently if his/her original work is in quality or not. Also, it is important to mention the impact regarding internal relationship promoting the researcher works as a team since the beginning of the project life cycle. So, a standardization process has demonstrated a direct impact in the attitude of the researcher changing from an individual work to teamwork. Indirectly the standardization is creating an environmental situation facilitating a concurrent engineering approach.

In order to generalize the results for other institutions, new researches are suggested in organizations that have been going through by a quality standardization process. Finally, despite NBR 15100 implementation, has begun no more than 18 months, it was possible to observe the beginning of a cultural change in the functional quality vision, in other words, from a departmental quality to a (yet embryonic) Total Quality Vision.

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