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5S methodology implementation in the laboratories of an industrial engineering university school

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ABSTRACT

This article examines the experience in 5S methodology implementation in order to optimize the work and safety of the university engineering laboratories, in such a way that the results obtained can be extended to other, similar centers. The research project developed has created an organization culture of all resources in the practice laboratories. A working model was defined to create a 5S structure and an implementation process has been established. With the 5S methodology implementation, the school laboratories have become industrial laboratories; they have been adapted to the conditions of security and organization that are usually found in the metalworking industry. Learning, control and maintenance of the resources and activities involved are performed in less time and with a considerable reduction of cost. There is also an increase in available space available for the location of the resources.

1. Introduction

'Some of our most essential skills in engineering arise out of engagements not only with formal representations, but also with tools, materials and other people' (Johri and Olds, 2011). The continuously improving component parts are, somehow, a way to improve the performance of the entire process.

5S is a work space management method which emerged in Japan as a consequence of the application of the *kaizen* culture (continuous improvement in the personal, family, social and professional life). The original concept of the 5S has socio-historical and philosophical roots (Kobayashi, 2005). Many of the usual practices in Japan are characterized by having a part of philosophy and another part of technique, e.g. *kendo*, or Japanese fencing (that has its origin in *kenjutsu*) or *judo* (*jujutsu*), the Japanese 'art of gentle, soft, supple, flexible, pliable or yielding', which is used to coach the body and mind through the discipline (Sugiura and Gillespiere, 2002). This approach also applies in Japanese administration, which encompasses both the management philosophy and management techniques (Gapp et al., 2008).

In the beginning, 5S methodology was used to develop an integrated management system which developed in the total production maintenance (TPM) (Bamber et al., 2000). On the other hand, in the West 5S has a minimal use and is associated with an activity of maintenance (Becker, 2001).

The 5S Practice is a technique used to establish and maintain a quality environment in an organization (Khamis et al., 2009). The application of the 5S methodology in a business as a *kaizen* process was first implemented in 1980 by Takashi Osada (1989, 1991). Osada raised the need for the continuous improvement philosophy of professional behavior through the integration of *seiri*, *seiton*, *seiso*, *seiketsu* and *shitsuke* in the workplace. The Toyota production system (TPS) is a clear example of the application of the 5S principles (Monden, 2012).

At this time, the improvement requirement in different organizations may be affected by different complexity of systems. Furthermore, it is really important to know which method can help us begin the process of continuous improvement in order to achieve increased productivity and safety of the workplace through participation and knowledge of the involved staff. It is why such university methodologies are considered as essential tools for the development of future professionals, especially engineers (Sheppard et al., 2008), and there is no doubt that one of the best ways to assimilate a methodology is through routine use.

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In many organizations, the ultimate goal is the implementation of a quality management system – QMS (Dulhai, 2008), which requires that the organization adequately responds to proposals for quality through commitment, initiative and motivation of the staff, which allows the organization to achieve greater competitiveness.

The 5S methodology is not seen in the same way in all countries. For example, as you can see in Kobayashi et al. (2008), Japan emphasizes 5S as a strategy for business excellence, requiring participation both at work and in the home; in the other hand, 5S in the UK and US is viewed as a system or tool for the workplace only. In some countries, the implementation of 5S methodology is a simple way to comply with the minimum requirements for health and safety in the workplace. This relationship has led to the possibility of extending the scope of the 5S through the incorporation of a new S, 'safety and health' (Zelinski, 2005).

Lixia and Bo (2011) point out the main misunderstandings and errors of Chinese enterprises in implementing 5S via investigations in manufacturing enterprises. This resulted from the failure of 5S management and proposed steps to carry out 5S programmes successfully, namely how to make 5S a culture.

The present research project, developed in an university environment, responds to the continuous improvement process implementation and the need to optimize available resources used in different laboratories for trials and practice. During the project deployment we have released two initial obstacles which, in addition, have marked the development of the project:

1. How should the improvement be approached, controlling costs and trying to simplify the implementation process?
2. How can the use of resources be increased during the laboratory practice (productivity), with safety and the minimization of risk?

For an improvement, it was decided that the basis should be to organize, sort and maintain in perfect condition all the involved resources. On the other hand, the productivity increase in the resources used, and the improvement of the workplace should come through the definition of a systematic management plan that maintains and improves that process.

To overcome these barriers, it is proposed that 5S is the ideal method for properly learning the knowledge related to quality, through the identification and commitment of all staff with the work equipment and facilities. This awareness generates an attitude and behavior change, which guarantees the start-up process of the Total Quality Management.

There are several 5S implementation studies in Chinese Universities from its involvement in the international ISO 9000 quality certification (Osada, 1989; Pheng, 2001), as well as previous experiences of local 5S implementation in educational centers (Zhang, 2005). In terms of the 5S application in university laboratories, which use teaching resources similar to the employees in industry, a detailed study of the implementation process is required; participants have special characteristics that force reconsideration of the usual stages of the standard implementation methodology (Maharjan, 2011; Borrego et al., 2009).

The selected laboratories for this project meet certain characteristics which help the students to understand and develop the 5S methodology. The first characteristic which makes these laboratories suitable for 5S implantation and practice, is that they are teaching spaces where there is a real interaction with the student, i.e. the student is the protagonist, handling different resources with total independence. He has to take his environment into account and know how to develop his work so his activity is productive. The second characteristic that makes them suitable is that they are an example of small-scale industry, where students will have the opportunity to apply this methodology once they finish their studies and join a company (Chi, 2011).

The research project has focused on the detailed analysis of the 5S methodology implementation model in the Sheet Metal Forming and Cutting, Integrated Manufacturing Systems, Welding and Metrology laboratories in order to achieve risks reduction and profitability. This environment is characterized by the variety of available teaching resources and its use by those with particular requirements.

In the laboratories, technical resources have functional characteristics similar to the resources employed in the industry, as machine-tools, fastening and cutting tools, metal materials, engineering hardware and software, etc. These resources require a use methodology based on the order and forecast that will guarantee a high level of safety (Fig. 1).

2. Development and methodology

The 5S methodology has been used in all kind of laboratories (mechanical, biological, pharmaceutical, etc.) in different parts of the world (Altamirano, 2013; Ananthanarayanan, 2006; Chitre, 2010; Mallick et al., 2013; Pentti, 2014; Purdy et al., 2013).

The methodology used for the 5S implementation involves two phases and several stages for each element of the 5S, so it is especially important that all the organization levels have been integrated in the process. As we said above, the 5S′ are the initials of five Japanese words which represent each of the five stages that make up the methodology (Osada, 1989; Kobayashi, 2005):

(1) *Seiri* (organization, sorting). Remove all unnecessary tools and parts. Go through all tools, materials, and so forth in the plant and work area. Keep only essential items.
(2) *Seiton* (setting an order of flow, streamlining). Arrange the work, workers, equipment, parts, and instructions in such a way that the work flows free of inefficiencies through the value added tasks with a work division necessary to meet demand.
(3) *Seiso* (shining, cleaning). Clean the workspace and all equipment, and keep it clean and tidy ready for the next user.
(4) *Seiketsu* (standardize, visual control). Ensure procedures and setups throughout the operation promote interchangeability. Normal and abnormal situations are distinguished, using visible and simple rules.
(5) *Shitsuke* (sustain, discipline and habit). Make it a way of life. This means commitment. Ensure disciplined adherence to rules and procedures.

Fig. 1. Safety obtainment procedure.