

Implementation of 5S in a Mechanical Workshop at University of Johannesburg: A Case Study

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Abstract

The 5S technique is a powerful and effective lean improvement tool which can be applied to any organization to reduce waste, increase efficiency, and organize the workplace. The purpose of this paper is to report on the research work conducted on implementation of 5S technique in a Mechanical Engineering workshop at University of Johannesburg with an aim to improve efficiency, quality and productivity; reduce abnormalities and wastages; and enhance overall performance. In a case study where unorganized arrangement of everything such as improper storage form, misplaced and incorrectly stored tools, and haphazard placement of unnecessary equipment and materials, the 5S technique has been implemented. A time study and work measurement techniques were used to measure how long it takes to look for a single item before and after implementation to evaluate the effectiveness of the implementation. This case study makes use of pictures from before and after implementation of the Ss, observations of time interval for searching a single tool using time study, as they relate to workplace organization and efficiency respectively. Increased efficiency and productivity, organized workplace, and elimination of abnormalities resulted as major outcomes of the implementation of 5S in this study.

Keywords

5S, Efficiency, Productivity, Lean, Wastages

1. Introduction

In the history and making of 5S; Sakichi Toyoda, Kiichiro and Taichi Ohno, developed 5S methodology after they made several efforts to minimize processing time for ship production (Chang and Chen 2014). The efficiency and improved working conditions in any industry or organization can be achieved easily by implementing 5Ss. 5S is a methodology of creating and maintaining a well organized clean, effective and efficient working environment (Michalska and Szewieczek 2007). The 5S philosophy focuses on simplification of the work environment, effective workplace arrangement and reduction of waste while improving productivity, ergonomics and overall efficiency (Patel and Thakkar 2014; Chavan et. al 2017). The educational institutions have been isolated on most implemented strategies because they are not considered as complex as the manufacturing and production organizations as they are given much attention. To bridge that gap, 5S has been implemented to some service organizations such as food and beverage companies, hotels, and hospitals of which it was a great success.

The machines, tools, equipment, instruments and workplace items/accessories sometimes cause chaotic working areas if not properly managed. The department of Mechanical and Industrial Engineering at University of Johannesburg has different settings such as offices, laboratories, workshops as well as classes with different setups, layouts and arrangements. Such a big setup and layout variation need engineering and scientific techniques for pleasant arrangement of the workplace to avoid abnormalities, minimize fatigue and stress, and improve working efficiency. It is therefore recognized that the 5S concept and its implementation can be a major resource for the department in that direction. The 5S Japanese terms are namely, Seiri, Seiton, Seiso, Seiketsu and Shitsuke (Gapp et

al. 2008). These terms describe how to organize work space for efficiency and effectiveness by identifying and storing the items to be used, maintaining the working area and its equipment, and sustaining the new order.

The benefits of the 5S technique are: improved quality, productivity, health and safety; reduced wastages; and pleasant/organized workspace. The term 5S basically represents the five disciplines for maintaining visual workplace to minimize total loss of time and unnecessary movements.

The 5Ss terms are as following (Randhawa and Ahuja 2018):

1. Seiri- organizing the working area by getting rid of the unnecessary stuffs. An example could be eliminating old files, forms and eliminating tools or any materials that have not been used within the past years.
2. Seiton- maintaining neatness that is achieved by straightening offices and work areas.
3. Seiso- cleaning plant and equipment to eliminate dirtiness that can hide or obscure variabilities.
4. Seiketsu- standardizing locations for tools, files, equipment, and all other materials.
5. Shitsuke- maintaining discipline in implementing the prior 4Ss.

2. Objectives and Literature Review

The utilization of 5S in an educational institute has hardly been approach so far. The implementation of 5S methodology in the workshop and laboratories at the department of Mechanical and Industrial Engineering at University of Johannesburg is new and hasn't been attempted before. This paper reports the work done so far as a part of the complete research where the overall objectives are as follows:

1. To implement 5S concept with related strategies.
2. To minimize the abnormalities.
3. To minimize idle time and reduce wastages.
4. To standardize machines, tools, equipment, files, and other items by classification and coding.
5. To introduce principles of ergonomics for better working positions of the staff.
6. To correct visible and invisible faults found within the workspace.
7. To improve overall efficiency and productivity of the department.

2.1 Literature Review

Gapp et al. (2008) studied 5S within a Japanese context, and according to them the 5s is used as a core management approach. With this approach 5S can be used to engage improvement activities within various environment including: homes, schools, communities and workplaces, regardless of the organizations size or type (De Mente, 1994). Ramesh and Ravi (2016) implemented 5S as a route for safety management in an organization. With safety in place, the number of accidents usually are reduced or unseen because all work areas are visible and free hazards. The involvement of senior managers and supervisors in the safety management of the workplace drives a very positive impact on the safety performance. Whereas Lingareddy (2013) used 5S as a tool and strategy to improvise the workplace, it helped the organization in minimizing time for manufacturing and increased the free area of the workplace. Most Japanese companies claimed that the 5S benefit is not only for improving their physical environment but also improving their thinking processes as well. Randhawa and Ahuja (2017), surveyed literature in 5S implementation methodologies, their study further analyzed the practice of 5S becomes a supporting activity or in some cases as a base foundation for the implementation of other lean tools such as TPM, TQM, JIT, TPS and ISO standards (Teeravarapug et al., 2011; Chen and Tan 2013; Kushwaha 2015). These researchers also identified the most significant barriers of 5S implementation which are poor communication between top management and shop floor employees, lack of attentiveness and inadequate training programs etc.

2.2 Research Gaps

The research gaps found for this study are as follows:

- There is a lack of work on implementing 5S technique in the offices and laboratories simultaneously.
- There are limited graphical data presentations of before and after implementation scenario.
- The implementation of 5S in educational institutions is rarely applied, in-fact its rather unknown.
- Most studies have not been able to display accompanying strategies with 5S.

3. 5S Implementation and Outcomes

Following have been the major steps for 5S implementation in the present work:

1. An awareness drive was undertaken first.
2. Places and areas to be focused were identified.

3. Machines, tools, and other items were enlisted with an aim to standardize.
4. Appropriate classification and coding were done for the purpose of organizing and simplifying of what goes where and when would fit.
5. Work study, time study, and other quality management tools and techniques were used.

The work so far has been done on implementation of Ss in the workshop:

SEIRI (sort)

Seiri is the first of the 5Ss, it deals with sorting all the tools, materials, and other equipment in the workplace. Important and equipment is stored accordingly, which reduces the hazards in the workplace (Chavan, et al., 2017). Seiri allows sorting out the necessary items from the unnecessary and red tagging so to be aware of what goes out and what comes in. In the pictures below, Seiri was implemented in week 1 and segregation of the materials and tools was the goal. This step involved separating the unnecessary items from the necessary and the “red tag” here in this instance is the blue tanker bins for waste and the unnecessary items are placed there.

SEITON (set in order)

Seiton aims at “place for everything and everything in its place”. When sorting has been complete, the specific location is defined for the useful material and located in the predefined order (Deshpande, et al., 2015). The main objectives of Seiton are forming a regular workplace strategy, avoiding time loss while searching the material and mistake proofing work (Patel and Thakkar, 2014). This step involved extra sorting of the items. All like items are located at a place in the shelves and lockers.

SEISO

The third S which is Seiso means to clean or shine in the workplace. After Seiton and Seiri were implemented successfully, cleaning the workshop was the next step. The cleaning of the shelves, lockers and the dusty tools were cleaned, the floor is cleaned. Anything which contained dirt and dust was cleaned and placed rightfully, as the pictures shown below.

SEIKETSU (Standardize)

In the fourth step, “Seiketsu” meaning to standardize the workplace. In Seiton the items were already set in order then after cleaning they were placed back in their rightful places. In this step the shelves are then labeled according to their stored items, this is to reduce confusion when searching for a single tool.

SHITSUKE (sustain)

Shitsuke means to sustain order prior to the 4S. To maintain good order and assurance that everything runs smooth and every step or order is followed. In this step a briefing of what 5S is was given to the workshop staff and training provided to them so they are fully equipped on running the workshop. New orders and workshop rules were also developed.

The implementation of 5S at the department of mechanical and industrial engineering firstly took place at workshop G308. This is a mechanical workshop clustered with heavy machines, equipment, tools and materials. It is divided in two parts, where the first part is a machine (manual and cnc lathe and milling machines) keeper and the other part is storage for materials and tools for the machines.

In the first week of implementation much work was done in the workshop as it was completely unorganized. The state of the workshop was unpleasing and jam-packed to do anything. The area of interest was the non-placement of all the materials and tools within the storage area. As shown in Fig.1, the pictures below show the initial condition of the workshop.



Fig.1 Workshop structure and arrangement before 5S implementation.

In week one, it was all about strategizing and planning a way forward for this particular workshop because it was messy and so very unorganized. The first S, Seiri which means to “sort” started off with sorting everything out and according to its importance at the workshop. This involved segregating all the unwanted and unnecessary materials. The stuffs that were no longer in use for the workshop, and the ones which served no purpose at all were taken out of the shelves first and put aside in the blue bin, to show that they do not belong inside anymore. Plus, the materials and tools that were still to be used by the students and other academics were placed in a different zone area for later proper placement. That is to apply Seiri in the workplace and the shelves were sorted.

After Seiri was implemented and all the materials and tools separated, the shelves had improved and more organized. This is part two of implementing Seiri or it is called Work-In-Process (W-I-P). The pictures as shown in Fig.2 were taken during the sorting stage in week two, and some of the materials and tools left are the necessary items within the workshop. The shelves have more space now to prove that so many items were placed there carelessly.





Fig.2 Week 2: Seiri (work in process).

There were so many wastages happening in the workshop reason being time consumed doing unnecessary work such as looking for a tool all over the place, space utilization by placing unknown tools anywhere and eliminating waste carelessly. With 5S implementation, efficiency and productivity are likely to improve drastically. The condition of the workshop is disorderly and out of action. Tools and other materials were all misplaced which meant more time would be spent looking just for 1 tool. The table below describes the ratings for each tool search time interval a worker spent looking for a tool before implementation. The searching time is linked to efficiency and productivity. The longer it takes to search for the tool the more efficiency gets affected. Each tool search interval time is measured using a time study stop watch. A worker is observed 5 times for each tool, and total is divided by 25 as standard percentage for each tool.

Table 1. Before Seiri implementation

No.	Name of the tool	Interval time *100/25	Efficiency
001	Spanner (5/8)	$(4.73+3+5+4.24+4.25) * 100/25$	84%
002	Screwdriver	$(4+0+5+3+3) * 100/25$	60%
003	Combination wrench	$(5+4+5+4.66+4.66) * 100/25$	93%
004	Plier	$(1+0+0+0.33+0.34) * 100/25$	6.69%
Overall efficiency			60.92%

Table 2. After Seiri implementation

No.	Name of tool	Interval time *100/25	Efficiency
001	Spanner (5/8)	$(4.73+3.51+5+4.25+4.26) * 100/25$	87%
002	Screwdriver	$(4+0+5+3+3) * 100/25$	60%
003	Combination wrench	$(5+4+5+4.66+4.66) * 100/25$	93.28%
004	Plier	$(4.23+5+2.33+3.25+4.34) * 100/25$	76.6%
Overall efficiency			86.15%

In the before phase the results are unsatisfactory and unduly deteriorating. The searching time show the lowest score before implementation because of its messy condition this meant that a worker usually take up most time searching. When implementation was in place, much difference surfaced within the workshop and improved efficiency. Comparing the overall efficiency from before implementation of 60.92% to after implementation which is 86.15%, the difference of 25.23% was achieved.

In the fifth week, the workshop was already shaped according to the standard of the tools, machines, equipment and all the materials to be used. The second S that is Seiton was to take place since everything was sorted out in previous weeks. With Seiton, orderliness is achieved in the workshop. In this stage the sorted items were put in order and according to their importance. For example, specimens, spanners, bolts and cutting discs were separated from each other for the purpose of setting them in order. In the pictures below (Fig. 3), it is the orderliness of the specimens. They were placed in the bottom of the shelves since they are heavy and might compromise the whole shelves if placed on top.



Fig. 3 Orderliness of specimens

That is the work done in week 5. Other materials and tools were also placed in accordance. Space utilization was efficient and effective. Productivity is at ease and has improved, although this was in the store room so far, but the efforts made gave life to the workshop. The current state of the workshop looks standardized and the order is maintained.

As Seiton, Seiketsu and Shitsuke followed in week 6 to 10. All tools and materials have been located at a place in the shelves and lockers since not everything can be shelved, so lockers were also used to store items like oil cans, rubber belts and abrasive cloths. After Seiton was completed, the shelves are labelled accordingly because that's what Seiketsu entails as an activity. Coding and coloring can be used as well, and in this case different color papers will be used to differentiate occupied shelves.

With Shitsuke, the staff and workers of the workshop were given training on what is 5S and how to keep it running for smoother operations. New workshop rules were also implemented because no one knew 5S before so to ensure its continuous improvement, workers were also given duties and schedules on standardizing and sustaining 5S. The pictures below given as Fig.4 depict the Seiketsu steps, as everything is now standardized.



Fig.4 Seiketsu steps.

4. Conclusion

This paper reported some important aspects of implementation and effectiveness of 5S technique in a mechanical workshop of University of Johannesburg. The successful implementation of 5Ss has minimized the department's abnormalities; reduced idle time and waste; enhanced the work place appearance and efficiency. A tremendous improvement in efficiency from 61% (before implementation) to 86% (after implementation) has been recorded. Implementing the 5S at the department of Mechanical and Industrial Engineering is a success and pave the way for future work that targets to improve wherever possible in other laboratories, offices, and workspace for the mechanical department. Upon success, it is hoped that this work can further be taken to the whole university.

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Biographies

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