

Implementation of 5S Methodology in a Manufacturing Industry

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Abstract— 5 S is a step wise method to remove unnecessary items, reduce the searching time of the items, inspect while cleaning, standardize arrangement to avoid misplacing and sustain all the above through self discipline. This simple housekeeping methodology has helped effectively reduce waste and improve productivity. It has gained popularity in India through the past decade and has helped many industries improve without much capital investment. This paper highlights the step by step implementation guideline required for successful exercise of 5s as a part of the daily management practices. It shows the method to implement each pillar of the 5S Methodology- Seiri, Seiton, Seiso, Seiketsu and Shitsuke in the industry in order to bring about an overall improvement in its performance. The result of implementation of each step of the 5S Methodology at Sphoorti Machine Tools Private Limited, Bangalore, India has also been shown in this paper.

Index Terms— 5S Methodology, Application, Seiri, Seiton, Seiso, Seiketsu, Shitsuke

1 INTRODUCTION

Globalization and innovations in technology have immensely increased the level of competition especially in the past two decades. To stay in the business arena every company needs to reach or exceed the customer expectations at lowest possible prices. Improvements and innovation breakthroughs have become a necessity to stay in business rather than just mere tools to improve profitability of a company. Hence, concepts like Six Sigma, Lean Manufacturing, Continuous Improvements, Quality Circles (QCs), Just-in-Time (JIT) are gaining popularity these days.

Lean Manufacturing is the hymn of survival and success of any organization through minimizing the waste (Muda). 5S Methodology is one of the basic and the most important tool to implement Lean Manufacturing. It is a system to regulate the work flow by systemizing the workplace, thus supporting the culture of continuous improvement [1].

2 LITERATURE REVIEW

“A place for everything and everything in its place” is the mantra of the 5S methodology. 5S is a system to reduce waste and optimize productivity through maintaining an orderly workplace and using visual clues to achieve more consistent operational results. The term 5S refers to 5 pillars of visual workplace as mentioned. These are Seiri (Sort), Seiton (Set in order), Seiso (Shine), Seiketsu (Standardize) and Shitsuke (Sustain) [2]. It is firstly important to understand why it is necessary to implement each pillar of the 5S methodology.

- Seiri is necessary because:
 - The factory becomes extremely crowded and hard to work in.
 - Lockers, shelves and cabinets for storage get in the way of communication
 - Time is wasted in tools, parts searching
 - Excess Stock hide production problems
 - Unneeded items and equipment make it harder to improve process flow
- Seiton is necessary because it helps eliminate many kinds of waste in the workplace:

- Motion Waste - Person sent to find cart searched full factory
- Searching Waste - No one can find the key to the tool cabinet
- Waste of Human Energy - Frustrated worker gives up searching for template after two hours
- Waste of Excess Inventory - Desk drawers are full of papers and stationary supplies
- Waste of defective products - Items not kept back in the same location so worker picks up wrong piece for assembly
- Waste of unsafe condition - Boxes of material kept in the walkway, causing someone to trip and get injured
- Implementation of Seiso avoids certain problems like
 - Puddles of oil or water lead to slippages and injury
 - Cutting shaving, dirt can get mixed up in the production resulting in defects
 - Cutting shaving can get into peoples eyes and create injury
 - Windows are so dirty so no sunlight enters - Defects are less obvious in the dark
 - Filthy work environment lowers morale
- Implementation of Seiketsu avoids problems like
 - Conditions go back to their old undesirable levels even after company wide implementation of 5S
 - At the end of the day piles of unneeded items are left from the day's production and lie scattered.
 - Tool storage sites become disorganized and need to be put in order at the end of the day.
 - Cutting shavings constantly fall on the floor and need to be swept frequently
 - Even after implementing 1S and 2S, soon the office is cluttered with more stationary supply than needed.
- Implementation of Shitsuke avoids problems like
 - Unneeded items begin pilling up as soon as sorting is completed.
 - No matter how well Set in Order is planned and implemented, tools and jigs do not get returned to their designated places after use.

- o No matter how dirty equipment becomes, little or nothing is done to clean it.
- o Items are left protruding into walkways, causing people to trip and get injured.
- o Dirty machines start to malfunction and produce defective goods.

The strategy devised by Hirano depicts that the implementation should be carried in such an order that the simpler and basic methodologies should be installed first. Hirano describes the sequence of implementation in the following fig.1 [3].

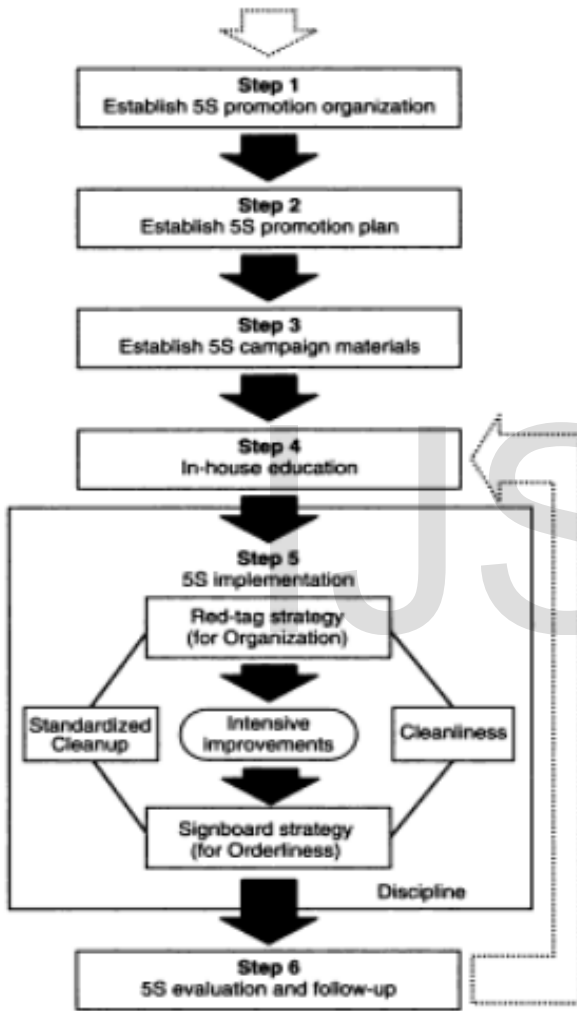


Fig.1 Hirano's 5S Implementation Strategy

Skaggs described some benefits of implementing 5s as a source of reduction of wastes and no value adding work activities while simultaneously increasing the productivity and efficiency of the workplace. The most interesting aspect of 5s is that it doesn't require specialized personnel for its implementation [4].

3 IMPLEMENTATION OF 5S METHODOLOGY

3.1 Seiri

Seiri means to remove all items from the workplace that are not needed for current production / operations. This is done with the objective of saving and recovering space. The implementation of Seiri is done in the following manner:

- The company has to be divided into several small zones such that every inch of space in the company is included when all zones are combined. Assign coordinators for each of these zones. The zone will include garden, security cabins, toilets, cafeteria, etc. also
- Identify a red tag holding area. Red tagged items are those which are considered to be unnecessary in a particular area/zone. Red tag holding area is the area set aside for use in storing red tagged items that need further evaluation. There are two types of red tag areas:
 - o Local Red Tag area - Each Department / Zones / Area can have individual red tag area to avoid mix up of items with other areas
 - o Central Red Tag Area - One red tag area for the whole company
- Define the red tag. Red tag is a paper tag with the following information:
 - o What is the item?
 - o How much Quantity?
 - o Why is it removed out (damaged, excess, etc)?
 - o What is approx value?
 - o Section from where the item is removed?
- Establish the frequency of doing red tagging
- Do the red tagging. It is done in the following manner:
 - o Every person asks himself/herself regarding all the items around his / her workplace
 - o Is this item needed?
 - o If it is needed, is it needed in this quantity?
 - o If it is needed, is it required very frequently?

In case, the answer to any of the above questions is no, then remove the item from the workplace. The flow chart for the target items for red tagging is as shown in fig.2.

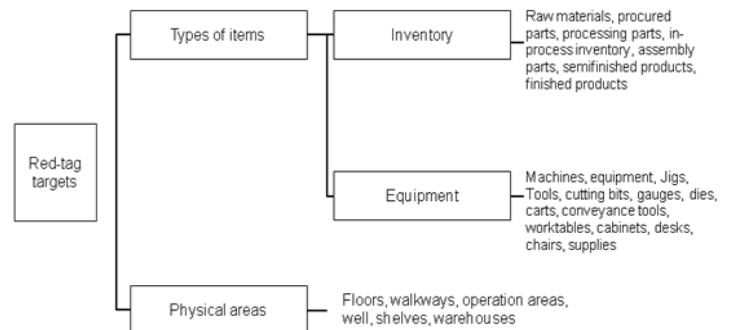


Fig. 2 Flow Chart for the target items for red tagging

- Review the red tag items. The review team would consist of senior members who can take decisions on disposal; it must include personal buying new items. Steps in reviewing include:
 - o First a "purchase ban" on all items red tagged till inventory lasts
 - o Review the items accordingly

- o Keep the item where it is
- o Move the items to a new location
- o Store the item away from the work area
- o Hold the item in the local red tag area for evaluation
- o Disposal of the item
- Disposal of red tagged items is shown in table 1.

Table 1 Disposal of red tagged items

Treatment	Description
Throw it away	Dispose of as scrap or incinerate items that are useless or unneeded for any purpose.
Sell	Sell off to other companies items that are useless or unneeded for nay purpose.
Return	Return items to the supply company.
Lend out	Lend items to other sections of the company that can use them on a temporary basis.
Distribute	Distribute items to another part of the company on a permanent basis.
Central red-tag area	Send items to the central red-tag holding area for redistribution, storage, or disposal.

Example:

Seiri implemented at Sphoorti Machine Tools Pvt. Ltd.

- Zone Identification: The fig. 3 shows the different zones identified at Sphoorti
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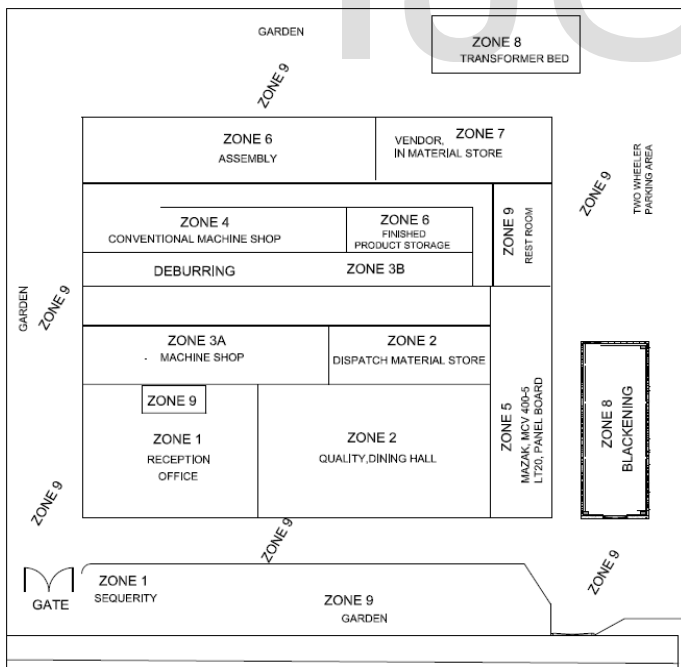


Fig. 3 Zonal Division at Sphoorti

- Red Tagging
Fig. 4 shows the central red tag area at Sphoorti



Fig. 4 Red Tag area at Sphoorti

3.2 Seiton

Seiton means to arrange needed items so that they are easy to use and label them so that anyone can find them and put them away. The implementation of Seiton is done in two phases in the following manner:

Phase I: Deciding Appropriate location

- Principles of Storing Jigs, tools, Dies for waste elimination
 - o Locate the items in the workplace according to their frequency of use
 - Place frequently used items near the place of use
 - Store infrequently used items away from the place of use
 - o Store items together if used together, and in sequence if used in sequence.
 - o Devise a "Just let go" arrangement for tools (eg. suspend the tools)
 - o Make storage space larger than the item so that easy to put back
 - o Eliminate the variety of jig, tools and dies by creating multi function jigs, tools and dies.
 - o Store tools according to function or product based on the type of usage
- Principles of Motion Economy for waste elimination
 - o Start and end each motion with both hands moving at once
 - o Both arms should move symmetrically and in opposite directions
 - o Keep trunk motions to a minimum
 - o Use gravity instead of muscle
 - o Avoid zigzagging motions and sudden change in direction
 - o Move with a steady rhythm
 - o Maintain a comfortable posture with comfortable motions
 - o Use the feet to operate on and off switches for machines
 - o Keep materials and tools close and in front
 - o Arrange materials and tools in the order of their use.
 - o Use inexpensive methods for feeding in and sending out materials
 - o Stand at a proper height for the work to be done

- Make materials and parts easy to pick.
- Make handles and grips in easy to use and efficient shapes and positions
- 5S Map to decide locations. Steps in making a 5S Map:
 - Make a floor plan or area diagram of the study area
 - Draw arrows in process flow sequence. For every operation there is one arrow.
 - Search for areas of waste based on principles shown earlier.
 - Make new 5S map. Draw arrows again. (Use several iterations till most efficient one is reached)
 - Find out the feasibility and time period to make the layout change
 - Implement the new layout by moving parts, tools, machines etc.
 - Continue to further improve the layout

Phase II: Identifying location

● Signboard Strategy

The signboard strategy uses signboards to identify what, where and how many.

- Location indicators (where does the item go)
- Item indicators (what item goes here)
- Amount indicators (how many items go here)

● Painting Strategy

The Painting Strategy is a method for identifying locations on floors and walkways. Factors to keep in mind while using painting strategy are:

- U-shaped cell designs are more efficient than straight production lines
- In process inventory should be positioned carefully for best process flow
- Floors should be leveled or repaired before painting
- Walkways should allow for safety and smooth flow especially at the turns
- Divider lines should be 2 or 4 inch wide
- Paint color must be standardized. Colors should be bright

● Colour coding Strategy

Colour coding strategy can be use to indicate which items is used for which part. Examples:

- Different colours can be allotted to different oils and the oil bath to be marked the colour of the type of oil to be used
- If certain items are used for making the same part then the items can be colour coded the same colour and kept in a location having the same colour.
- Inventory levels can be colour coded to indicate the critical, designed, reorder and excess levels

● Outlining Strategy

Outlining is a method to show which jigs and tools are stored where. Outlining means drawing outlines of jigs and tools in their proper locations

Example:

Seiton implemented at Sphoorti Machine Tools Pvt. Ltd.

- Deciding appropriate locating: The appropriate location for storage of fixtures near the machine is shown in fig. 5

Fig.5 Storge of Fixtures



- Identifying Location by the usage of signboard, painting, colour coding and outlining strategy is shown in fig. 6



Fig.6 Identifying Location

3.3 Seiso

Seiso means to keep everything swept and clean. This is done with the objective of inspecting for problems and taking faster corrective actions. The implementation of Seiso is done in the following manner:

- Determine Shine targets
 - Storage space, Equipment or Empty Space
- Determine Shine assignments
 - Divide job based on area of cleaning
 - Divide job based on time of cleaning
- Determine Shine Methods
 - Choose the right tools
 - Shining should take 5 minutes
 - How much to shine should be defined
- Prepare tools
 - Keep tools near location of shine
- Start to Shine
 - Clean thoroughly

Example:

Seiso implemented at Sphoorti Machine Tools Pvt. Ltd. The teams at Sphoorti successfully implemented Seiso and the result is as shown in the fig. 7.



Fig.7 Seiso implemented in office area

3.4 Seiketsu

Seiketsu means to create a consistent way of doing tasks and procedures. This is done with the objective of ensuring that the condition does not deteriorate back to the condition it was before implementing 1S, 2S and 3 S. The implementation of Seiso is done in two phases in the following manner:

Phase I: Making it a habit

- Decide who is responsible for 3 S activities
 Everyone must know exactly what they are responsible for doing and exactly when, where and how to do it. For this 5S maps with responsibilities and frequency and 3S cleaning instructions on area of 3S is used.

- Integrate 3S duties into regular work duties
 Here, visual 5S (abnormal conditions are seen at a glance) and five minute 5S (efficient and quick solutions are given for doing cleaning) are adopted on a daily basis.

- Check on how well 3S conditions are being maintained
 Audit must be done at regular interval to check the maintenance of 3S conditions.

Phase II: Prevention

- Prevent unneeded items from accumulating
 Normally, unneeded items keep accumulating at the workplace. These have to be cleared regularly doing 1S. To avoid this, find out “why” the unneeded item is even entering the workplace and try eliminating the cause.

- Prevent things from having to be put back

There are two ways to this:

- o Make it difficult to put things in the wrong place
 This relies heavily on discipline and visual controls
- o Make it impossible to put things in the wrong place
 Use 5 W and 1 H approach and eliminate the need to put back as shown in table 2.

Table 2. Use of 5W and 1H

What?	<ul style="list-style-type: none"> • Is wrong • Is causing the problem
When?	<ul style="list-style-type: none"> • Does it happen
Where?	<ul style="list-style-type: none"> • Is the problem (Location)
Who?	<ul style="list-style-type: none"> • Does it • Is responsible for it
Why?	<ul style="list-style-type: none"> • Does it happen • Does he do it this way
How?	<ul style="list-style-type: none"> • Else could it be done • Do we improve the situation

To successfully apply this approach the following strategies are adopted:

- Suspension
 Suspend the tools with a spring balancer. Once the use is over the operator “just let’s go” and the tool goes back to its desired position
- Incorporation
 Here create a flow of goods such that jigs, tools and measuring instruments are smoothly integrated into the process and hence stored in the place of usage
- Use Elimination
 There are three ways to achieve this

- Tool Unification
 This means combining the functions of two or more tools in a single tool.

- Tool substitution
 This means use use something other than a tool to serve the same function

- Method Substitution
 Eliminate the method used to avoid using tools

Example:

Seiketsu implemented at Sphoorti Machine Tools Pvt. Ltd. Sphoorti successfully implemented Seiketsu. The fig 8 and 9 show the arrangement of files before implementation of Seiketsu and after the implementation. In the first arrangement there are possibilities of missing files. But in the second case it is much easier not to go wrong while placing and retrieving the files.



Fig.8 Before implementation of Seiketsu



Fig.9 After implementation of Seiketsu

3.4 Shitsuke

Shitsuke means to make it a habit of properly maintaining correct procedures. It is done with the objective of achieving higher productivity and better quality through higher employee morale. To implement this:

- Awareness - All need to understand what 5S is about
- Time - Time has to be allocated to do the 5S
- Structure - A Structure has to be formulated on how and when 5S activities will be done
- Support - Management support needed in acknowledgement, leadership and resources.
- Rewards and recognition - Efforts need to be recognized
- Satisfaction and Excitement - This needs to be shared in the entire organization

Tools to implement Shitsuke:

- 5S Slogans
- 5S Posters
- 5S Photo Exhibits
- 5S Newsletters
- 5S Maps
- 5S Pocket manuals
- 5S Department tours
- 5S Competitions

Example:

Shitsuke implemented at Sphoorti Machine Tools Pvt. Ltd.

The fig.10 shows the trend chart for efficiency production area. It is a tool that shows how effectively 5S has been implemented and how well the improvements are being sustained.



Fig. 10 Trend chart for Efficiency

4 CONCLUSION

Continuous improvements have become especially important in the Indian scenario in the past decade. The reason behind this is the low availability of finance and the necessity to achieve global quality standards within the available resources. To achieve this many companies are adopting techniques of lean Manufacturing. Implementation of Lean Manufacturing has become one of the key strategies to achieve cost cutting. The goal of Lean Manufacturing is to minimize all types of waste or non value added activity through incorporating less human effort, less inventory, less time to develop product and less space to become highly responsive to customer demand, while at the same time producing good quality products in the most efficient and economical manner. The 5S system is a good starting point for all improvement efforts aiming to drive out waste from the manufacturing process and ultimately improving a company's bottom line production by improving products and services and lowering costs. Many manufacturing facilities ranging from SMEs to large scale industries have opted to follow the path towards a "5S" workplace organizational and housekeeping methodology as part of Continuous Improvement or Lean Manufacturing processes in order to achieve higher levels of quality through minimization of waste. This concept is especially attractive to older manufacturing facilities looking to improve their bottom line production without the need for capital investment. Sphoorti Machine Tools is one such industry which sought for improvement in productivity and by successful implementation of 5S methodology has found increase in productivity and hence profit levels. The secondary benefits of implementing 5S methodology included higher enthusiasm and punctuality among the workers and safer working conditions.

There is also great scope for improving this methodology. Now, the 5S concept is evolving into a 7S Methodology. There has been a prolonged debate since past few years whether to add 'Safety' and 'Security' as the two new S's or not. Therefore, we can say that this methodology is still evolving and a lot of innovations to implement this methodology are also coming up.

APPENDIX

Company Overview

Sphoorti Machine Tools Pvt. Ltd. was incorporated in February 1996 and started its manufacturing activities with two Vertical Machining Centers. It is a part of the Ace Micromatic Group of Companies. This company is certified by TUV SUD South Asia Private Limited and has obtained quality management system for manufacture & supply of machine metal tools & accessories in ISO 9001:2008. Over the years the company has undergone many stages of developments to emerge as one of India's leading manufacturers of Tool Discs and Tool Holders for CNC Turning Centers and Turn Mill Centers.

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