IMPLEMENTATION OF 5S IN MANUFACTURING FIRM TO REDUCE DELIVERY TIME OF A PRODUCT

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Abstract:
5S is a basic tool for cleaning, sorting, organizing and providing necessary groundwork for work place improvement. The system helps to organize a workplace for efficiency and productivity via monitoring an organized environment. This paper deals with the implementation of 5S methodology in the small scale manufacturing firm, located in Navi Mumbai, Maharashtra. The problem of delay for dispatching machine on time, which were affecting relations with customer, is addressed. It has shown reduction in this delay after implementation of 5S. The use of planning tool and fishbone diagram are also demonstrated.

1. INTRODUCTION:
For any organization, today's competitive world demands strong commitment to customer service, as it will help in building long term relationship. Delay in delivery of product or service affects it adversely. In this situation, strategic use of some tools as JIT (just in time), 5S etc. can make significant improvement. The 5S represent a simple “good housekeeping” approach to improving the work environment. In general, the 5S approach includes the controls the work floor conditions rather than the worker’s behavior. It is relatively inexpensive for the company to implement. Besides making worker's job easier and safer, it promotes daily activity for continuous improvement. It encourages a proactive approach that prevents problems and waste before they occur. It is a practical method for dealing with the real problems that workers face every day. This paper addresses use of this technique in a manufacturing industry. The work related with improvement in workplace efficiency is discussed in next section.

2. RELATED WORK:
The work on use of Just in Time concept for Aluminum foundry industry is reported [1]. It explores the adaptation of manufacturing approach to metal foundry, where raw materials are imported in highly unstable economy. In this paper the JIT implementation at Aluminum Foundry is described with various JIT elements like kanban, production scheduling, setup time reduction, lot size analysis, lead time analysis, work force and office culture and 5S implementation. Dalcin and Naci[2] discussed effect of just in time production system from cost and management accounting perspective. They have mentioned various tools for the production system to avoid error. Tools like top management commitment, pull method reliable relationship with few suppliers, clean and orderly work environment etc. are discussed. A brief review about the Just in Time technique and its benefits on successful implementation is provided by Chaudhari and Patel [3].

The use of fish bone diagram or cause effect diagram intended towards evaluating the supply chain and business process of Hospital is seen[4]. It reveals problem areas as lack of proper equipment, faulty process, misdirected people, poorly managed material, improper environment and inefficient management. Fish bone diagram is also used to identify various root causes for radiator rejection due to fin opening problem in radiator manufacturing[5]. After detailed study of radiator manufacturing process and data gathering, problems chosen to embrace upon was fin opening because it contributed heavily around 7% to 8% of total production. To reduce the rejection related to fin opening, identified causes have to be prioritized and attended. The refrigerator manufacturing system have used cause-effect diagram to analyze the defects in refrigerator lining process[6]. Mohiuddin Ahmed and Nafis Ahmed shows application of cause-effect diagram and pareto principle for minimizing rejection of raw materials in electric lamp production process[7]. According to the Pareto analysis, in the stem making process vital few defects are responsible for 87.27% of total defects. It states more importance should be given to these vital few defects and root cause of these defects. According to the root cause, the corrective action is recommended in order to reduce defects to minimize the rejection of raw materials. One of the paper seeks to examine the root cause analysis management for a manufacturing industry [8]. This highlights about the tools which are used in root cause analysis and the methodology of root cause analysis. Mallikarjun Korpadu, and K. Venkata Subbaiah studied problem solving management using six sigma tools and techniques[9]. They explains how lean and six sigma tools and techniques can be effectively used for doing proactive problem solving management with higher benefit along with improved efficiency and effectiveness.

The 5S framework is an extension of works on just-in-time production systems. One of the paper deal with the implementation of 5S methodology in the small scale industry [10]. By following the 5S methodology, it shows the significant improvements to the safety, productivity, efficiency and housekeeping. The improvement before and after 5S implementation is shown by pictures in the paper. Case study showing an implementation of 5S technique in a manufacturing organization is also seen[11]. This represents an application of 5S technology in one of the MNC in Maharashtra which is the leading manufacturer of the luggage bags in the world. The aim of the implementation of this technique is to enhance productivity, safety, efficiency through effective workplace management which results motivation to team work and transferred the organization drastically, right from working conditions to the employees working satisfaction. Implementation of 5S in various organization is reviewed[12]. This paper explains the methods and techniques of 5S to increase the efficiency of all processes in the company. Special emphasis has given to the implementation of 5S system and elimination of losses in the company. It can be observed that
introducing 5S rules brings the great changes in the company. Saad Shaikh and et.al shows 5S work done in past and methodology rules of performing each S of 5S[13]. Successful implementation improves the quality, productivity and efficiency of the organization; it also has positive effect on overall performance. Study of implementation of 5S techniques in plastic molding industry in Nagpur Maharashtra is discussed[14]. It shows significant improvements in safety, productivity, efficiency and housekeeping. It also intends to build a stronger work ethic within the work man and engineer. A case study on performance improvement through 5S in small scale industry is also discussed[15]. Ten week study is carried out in the company. The result after implementations states that production system efficiencies improved from 67% to 88.8% in successive week. Out of the available various lean manufacturing techniques, 5S offers good potential for required improvement. Lingareddy Harsha, and et.al. discussed 5S as a tool and strategy for improving the work[16]. This strategy helps in minimizing the time of manufacturing and also increases the area work place. Thus, the solution found by approach solely minimizes several kinds of wastes in process which finally helps in the development of the organization.

3. 5S METHODOLOGY:
The program gets its name from five activities beginning with the letter S, which were derived from Japanese words. It helps in building a foundation for continuous improvement. The words are Seiri, Seiton, Seiketsu and Shitsuke. Seiri (Sort) is the first step of 5S which removes all surplus items from work center which are not needed for the immediate continual operations. At this stage it is decided what is really needed and what is not. The red tag system is used to identify items that have flagged for removal from a work area. When it finds an item that is either not known or is not needed in a process, it is tagged. The red tag acts as a signal to everyone else in the area that someone intends to move the item out of the work area at some point in the future. This leads to a discussion about the item, and ultimately, a decision about whether or not the item stays or goes. Seiton (Set in order) is second step taking the stored items and putting them where they best support the function they provide. Workers should be motivated to place items at their point of use and improves the workplace visual management. Once the unneeded is thrown away sorting and set in order has taken place, now it is time to sanitize. This is some time referred to as Seiso(sweep or shine) stage where teams thoroughly remove clutter and fix equipment or building component. The next stage Seiketsu (Standardize) requires that the improvements of the previous three phases are maintained. It is about organizing and cleaning of the production area. The benefits of above four phases of 5S are powerful, visual and easily measured. However, without self-discipline, success of a 5-S program is momentary and may revert back to the previous messy state. This is ensured by last stage, Shitsuke (Sustain).

4. IMPLEMENTATION OF 5S:
The company produces 'Blow Fill and Seal' and 'Form Fill and Seal' machines as well as its parts, required for pharmaceutical industry. They were facing problem of delay for dispatching machine on time due to some reasons. Due to which relations with customer was getting affected. The task was to find out those reasons and solve them. Along with that various problems in the processing was also needed to be disclosed and then avoiding the same for next time. Minimizing the time required is the major objective of the work. For this planning and scheduling was done. Detailed process planning gives idea about sequence of operations in the company. Sequencing of tasks for each department was made, but could not be shown here as it being property of company. Following figure 1 shows the various task and there duration which has scheduled.

![Figure 1. Gantt chart for scheduled tasks.](image)

The causes for the problems are worked out using fish bone diagram, one such diagram for hydraulic system is shown in figure 2.

The critical causes and action taken on these problems are shown in table 1. Three problems were identified viz. improper pressure in hydraulic system press, incorrect part delivery, and assembly delay.

<table>
<thead>
<tr>
<th>Critical causes</th>
<th>Action plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improper fitting</td>
<td>Check and test it before assembling it</td>
</tr>
<tr>
<td>Oil level</td>
<td>Proper fitting of all parts and lining</td>
</tr>
<tr>
<td>Clogging in the lining</td>
<td>Checking all leakages and fitting</td>
</tr>
<tr>
<td>Defective equipment</td>
<td>Avoid clogging</td>
</tr>
<tr>
<td>Pressure setting</td>
<td>Add tags to each and every meeting parts do that wrong fitting of parts will not take place</td>
</tr>
<tr>
<td>Wrong fitting of pipelines</td>
<td></td>
</tr>
</tbody>
</table>

| Wrong or incorrect part delivery | |
| Communication gap | Printed design with proper and visible specification |
| Machine worn out and no maintenance which affect machine capabilities | Regular cleaning and preventive maintenance (5S implementation) |
| Material supply delay | Proper specification and requirements |
| Wrong decision making | Proper care in Material purchase and ordering |
| Involvement of worker in quick decision making | |

Table 1. Causes and actions on problems
Assembly delay

- The coordination inside the firm is one of the major cause of delay
- Work station design or working condition
- Worker attitude
- Delay in Decision making
- Involvement of each and every one, to get more ideas regarding any problems.
- Clean and organized workplace increases productivity
- Decision making should be fast which may reduce process time

Seiri (Sort) defined what is and isn't needed in the area to do the job. Instead of tackling entire office, one area or zone of workspace that needs to be organized was chosen. This means looking through each and every workstation, cupboard, shelving unit, filing cabinet, under and behind desks and so forth. Many items that are not required on a day to day basis is looked to remove. It's time to begin sorting and purging.

Figure 2. Fish bone diagram for Hydraulic system problem

Decision making is extremely important in the Sort phase. Decision has to be made of items, which is no longer needed. For example, paper that can be released will either recycle or shred. But for pieces of equipment, gadgets, supplies or other items one of the following is considered.

a. Recycle.

b. Listing the item(s) in a company to see who else in the company might be able to use it. The items are listed in the company under category of Tools, Components, Parts, Sub assemblies, and Spare parts.

c. Company-wide free garage sale is arranged for the extras in a designated area. Many times things that are no longer needed by one person can be put to use somewhere else within the company, thus saving money on buying new items.

d. Trash. Figure 3 shows the collection of all unwanted items collected in one area.

e. Define a Red Tag Area for unwanted items as shown in figure 4.

Seiton (Set in order): The work area is organized based on a place for everything and everything in its place. According to research, the average individual spends 150 hours each year looking for misplaced information. It can be avoided by assigning a “home” for everything. Locations for files, tools, equipment, supplies, etc. are designated and labeled. Items are kept in an orderly fashion for easy access. This could be done by asking ourselves few questions as “Where does it make the most sense to store this item?” , “How will I recall this file when looking for it in my filing cabinet or on my hard drive?”, “Is this an item that I use frequently?”

For the mold assembly station some compartments had made below the table to get easy access to the fasteners and essential materials, tools as shown in figure 5. Worker requires the tools for machine assembly stations in various positions, so tool box, which can be easily carry from one place to another, is made in use. In store room listed items like fasteners, parts etc. are arranged as shown in figure 6. Labeling shelves, binders, cabinets and filing cabinets is one more way to make sure items are assigned a home as shown in figure 7.
Seiso (Shine): A clean space consistently insures quality and efficiency. 5S Seiso is as important in the office as in the production areas, a clean well organized office can also quickly show when things are going wrong. After implementation, machines continue to work like new ones, break down decreases and lower costs of maintenance of equipment, adding value to the end product. It’s about keeping your work environment neat in its appearance, allowing you to better focus on your job.

Seiketsu (Standardize): Systematize exactly what needs to be done. Best Practices are identified and documented, so that it can be followed by everyone. The check list as shown in figure 8 was prepared for cleanliness of the work space and machines. Standardizing our office practices through 5S Seiketsu can give huge benefits with regard to efficiency and lead time reduction. Checklist of everything is created as well as documentation of its shipping and follow up is done. It includes a photo of what it looks like when assembled. The checklist is posted in the area where the supplies are stored and assembled.
Shitsuke (Sustain): 5S Shitsuke in the office is the same as in the production area. Sort, Straighten and Sweep becomes natural because as the value in sustaining and maintaining a well-organized, efficient office space can be seen. One will realize that a little 5Sing goes a long way in creating a productive work environment. Once a person learns decision-making skills, along with the ability to straighten or set things back in order, they will begin to develop a natural tendency to maintain or sustain an area. It is recommended that each department develop a 5S Audit worksheet as shown in figure 9. Which can be posted for employees to sign off on at the end of each day. This visual indicator helps everyone to do their part in maintaining clutter-free offices.

Figure 9. Audit sheet

5. RESULT & DISCUSSION:
The tools and methods are used to implement 5S in production. Following table 2 depicts the result of the work done before implementation and after implementation. From table 2, notable difference in the time required for the same machines is observed. It can be seen that implementation of 5S is saving 8 days of the entire machine manufacturing process. Process became well planned and sequenced due to scheduling of tasks. By finding out the causes of problems and their effect we have saved time during the assembly (02 days) and trial phases (02 days) of the cycle which impacts more on the total time that is 50% of total time saved.

<table>
<thead>
<tr>
<th>Task description</th>
<th>Implementation Duration</th>
<th>Task description</th>
<th>Implementation Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planning</td>
<td>2</td>
<td>Dry run</td>
<td>02 02</td>
</tr>
<tr>
<td>Design</td>
<td>15</td>
<td>Parameter setting</td>
<td>01 01</td>
</tr>
<tr>
<td>R/m order</td>
<td>10 09</td>
<td>Cycle set</td>
<td>01 01</td>
</tr>
<tr>
<td>Purchase</td>
<td>40 40</td>
<td>Moil mount</td>
<td>03 02</td>
</tr>
<tr>
<td>Electrical</td>
<td>30 30</td>
<td>Empty bottle</td>
<td>02 02</td>
</tr>
<tr>
<td>Out source</td>
<td>26 26</td>
<td>Parameter set</td>
<td>01 01</td>
</tr>
<tr>
<td>Machining</td>
<td>26 25</td>
<td>Filling trial</td>
<td>01 01</td>
</tr>
<tr>
<td>CNC</td>
<td>15 15</td>
<td>Fine tuning</td>
<td>02 02</td>
</tr>
<tr>
<td>Sub assembly</td>
<td>04 03</td>
<td>Final trial</td>
<td>02 02</td>
</tr>
<tr>
<td>Assembly</td>
<td>15 13</td>
<td>Dispatch</td>
<td>03 02</td>
</tr>
<tr>
<td>Trail</td>
<td>08 06</td>
<td>TOTAL</td>
<td>113 105</td>
</tr>
</tbody>
</table>

6. CONCLUSION:
5S is easy to use but maintaining it is the difficult task. Its implementation is mostly successful by positive co-ordination of top level management to all level of employee. It was observed the reduction in delivery time is significant. Besides that, best practices are established for finding defects. Planning and scheduling gives a standard framework to the process and exact time required can be calculated as well as where is problem that can be easily identified. Use of fish bone diagram for solving problems issimple and easiest way which highlights all critical problems and their effects on system.

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