A PROJECT REPORT

ON

"IMPLEMENTATION OF 5S ON STORAGE ROOM IN A PIPE FITTING INDUSTRY"

Submitted to

UNIVERSITY OF MUMBAI

In Partial Fulfilment of the Requirement for the Award of

BACHELOR'S DEGREE IN
MECHANICAL ENGINEERING

BY

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Plot No. 2 3, Sector - 16, Near Thana Naka,
Khandagaon, New Panvel - 410206

2018-2019

AFFILIATED TO

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Department of Mechanical Engineering

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CERTIFICATE

This is certify that the project entitled

"IMPLEMENTATION OF 5S ON STORAGE ROOM IN A PIPE FITTING INDUSTRY"

submitted by

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is a record of bonafide work carried out by them, in the partial fulfilment of the requirement for the award of Degree of Bachelor of Engineering (Mechanical Engineering) at ***Anjuman-I-Islam's Kalsekar Technical Campus, Navi Mumbai*** under the University of MUMBAI. This work is done during year 2018-2019, under our guidance.

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Project I Approval for Bachelor of Engineering

This project entitled ***" IMPLEMENTATION OF 5S ON STORAGE ROOM IN A PIPE FITTING INDUSTRY"*** by ***Students Name*** is approved for the degree of ***Bachelor of Engineering in Department of Mechanical Engineering.***

Examiners

1. .....
2. .....

Supervisors

1. .....
2. .....

Chairman

.....

Declaration

I declare that this written submission represents my ideas in my own words and where others ideas or words have been included, I have adequately cited and referenced the original sources. I also declare that I have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in my submission. I understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

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ABSTRACT

5S is a basc foundation of lean manufacturing systems.The purpose of the case study is to use 5S tool to assist small scale manufacturing organization to become more productive and more efficient. A simple approach has been adopted to create the teams for implementing 5S. In the frames of case study, it has been analyzed that implementation of '5S' resulted in overall improvement of the organization

The aim of the implementation of '5S' in the organization is to enhance the productivity, safety, efficiency through effective workplace management. '5S' in simple terms is a Japanese technique consisting of five 'S' terms namely Seiri (sorting), Seiton (set in order), Seiso (shine), Seiketsu (standardize) and Shitsuke (sustain). As importance role of 5S implementation in today's organizations, this study aims to review previous studies about benefits of 5S implementation and its efficiency in organizations. Consequently, 5S can support the objectives of organization to achieve continuous improvement in performance and productivity.

Keywords: 5S, Red Tag, Audit, Elimination of waste, Organizational effectiveness.

Contents

List of Figures

List of Tables

Chapter 1

Introduction

This chapter overall discusses the introduction of the 5S implementation in Allied Engineering pvt ltd.In this part the briefing of the background, problem statement, scopes and objectives of the project are discussed.

1.1 Background

The 5S framework was originally developed by just-in-time expert and international consultant Hiroyuki Hirano. The 5S framework is an extension of Hirano's earlier works on just-in-time production systems. The 5S represent a simple "good housekeeping" approach to improving the work environment.If employees don't feel valued within the overall company culture, perhaps the change required falls outside the limits of a housekeeping improvement program.

1.2 Project Scope

5S effects on performance in similar organizations, review requirements of the implementation and deployment of 5S practice, and review of the key success factors for organizations that have been successful in implementing of the 5S and other quality management and store keeping systems. The methodology used can be extended for more factors by involving more reviews to get more accurate results.

1.3 Project Goals and Objectives

1.3.1 Goals

The goal for this project is to let people realize about the importance of good housekeeping, especially in manufacturing plan. Many people think that housekeeping should be done by housewives at home, and cleaners at work. They do not realize that they, too, play an important part in keeping their houses/workplaces clean. More

importantly, they do not know how much they can gain for themselves by just practicing good housekeeping. Whether work in an office, the factory, the warehouse, the laboratory or any other place, housekeeping is relevant to every people.

1.3.2 Objectives

The main objective of the present work is to simplify clean and sustain a productive work environment at Allied engineering pvt ltd. 5S is a system which will reduce waste and optimize productivity through maintaining an orderly store and using visual cues to achieve more consistent operational results.

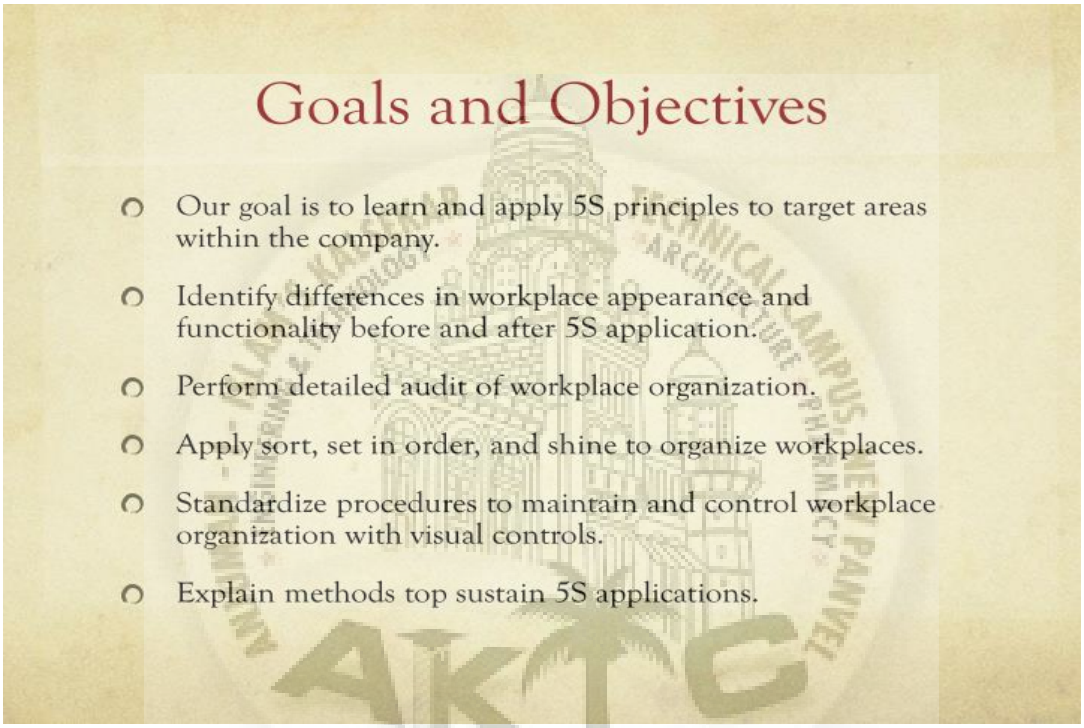


Figure 1.1: Objectives of a normal 5S System

Chapter 2

Literature Survey

2.1 Implementation of '5S' Techinique in a manufacturing organization: a case study

The aim of the implementation of '5S' in the organization is to enhance the productivity, safety, efficiency through effective workplace management. The need for the implementation of '5S' in the organization came into existence due to unorganized work-stations, uncomfortable working environment and the excessive wastes in the company. Hence to get rid-off of the above factors, there was an urgent need for the successive implementation of '5S' in the organization.
RESULTS:
The paper aims for demonstrating the detailed implementation of '5S' in the organization which resulted in:
1. Proper workplace management for better use of working area.
2. Time saving in searching for tools and materials due to proper location and identification.
3. Huge cost saving from waste and unwanted materials.
4. Increased morale of the workers due to enhancement of working environment.
It is relatively a simple technique which can be easily applied in any organization and the results of it are rapidly visible.

2.2 Implementation of 5S Methodology in a Manufacturing Industry

5S 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. 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.

RESULTS:

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 re-sources.

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.

The secondary benefits of implementing 5S methodology included higher enthusiasm and punctuality among the workers and safer working conditions.

2.3 Reducing Material Searching time by implementing 5S in Stores Department of Manufacturing Industry

Lean manufacturing is basically a manufacturing with minimal waste or scrap in terms of time, activity, motion and resources and is aimed to reduce all types of wastes at all level of manufacturing, so that the quality products can be introduced to market at minimum cost in minimum time. This paper explains the implementation of 5s methodology in stores department of an electrical component manufacturing industry to improve the efficiency of all processes of the company. It can be seen that implementing the 5S system will leads to the major beneficial changes in the Industry as well as also improve sits working environment, for example improving the routine working, improving the visual identifications, reduction in the scrap, less searching time, less nos. of accidents, safety, security etc.

RESULTS:

By performing the technical suitability, economical justifications and feasibility analysis, we have suggested the recommendations of these tool to induct for the medium scale enterprises confidently. In this study by Implementing the 5S and PEEP the material searching time can is reduced to 50 seconds from 214 seconds,also the storage area is improved to 1407 Sq. m from 978 Sq. m. The working procedures and working area is improved and by clear identification and effective visualization any area within the stores can easily reachable and accessible in lesser time as compared to before.

2.4 Review on Implementation of 5S in Various Organization

This paper explains the methods and techniques of 5 S uses to increase the efficiency of all processes in the company. Special emphasis will be given to the implementation of 5S system and elimination of losses in the company. It can be observed

that introducing the 5S rules bring the great changes in the company, for example: process improvement by costs reduction, increasing of effectiveness and efficiency in the processes, maintenance and improvement of the machines efficiency, safety, security, quality and reduction of the industry pollution, proceedings according to decisions. Essential thing is to divide activities on some main steps and to maintain the continuous improvement. This method can be used in all companies. Its result is the effective organization of the workplace.

RESULTS:

The 5S implementation leads to the improvement of the organization in many ways for instance. The implementation of the 5S system of rules leads to the following effects regarding the improvement in quality:

1. Visible results within a short period of time (2-3 weeks),
2. Workers get used to order and discipline,
3. Labelling draws attention to change that is about to occur,
4. Reduction of physical effort, less accidents during the production process,
5. Increase of the workers professional training, better organization of activities.

2.5 An Application of 5S concept to organize the workplace at a small scale manufacturing company

The purpose of the case study is to use 5S tool to assist small scale manufacturing organization to become more productive and more efficient. A simple approach has been adopted to create the teams for implementing 5S. Tool searching time from shop floor has been reduced from 40 minutes to 5 minutes. '5S' audit has been conducted in the organization. '5S' audit score has been increased from 7 (week 1) to 56 (week 16). 5S is powerful tool and can be implemented in various industries whether it's micro, small, medium or large. Implementation of 5S has large horizontal development and can be implemented in all the workstations of the organization. The publications and case study presented in this paper will be useful to researchers, professionals and others concerned with this subject to understand the significance of 5S.

RESULT:

The 5S event was a part of the lean initiative at the manufacturing facility. Several changes were made to the layout, operating procedures, tool organization, material handling and cleaning schedules. The first phase, sort, resulted in removing unwanted items, broken tools and cabinets, unused parts and scrap materials. Unused inventory was returned to purchasing, rarely used tools and items were assigned a new location and scrap items were discarded.

2.6 REVIEW ON STUDY AND IMPLEMENTATION OF FIRST 'S' OF '5S' IN COLLEGE WORKSHOP

The research work approved out to apply the 5S method of lean developed to solve the difficulty of WORKSHOP at JDCOEM with the aim of good space exploitation and exclusion of devastate in the workshop. The objectives of the project are organize the workplace , limitation of the time of seeking required things such as tools, equipment and stationery, safety development ,clean workplace. Also remove doubling of superfluous and unnecessary materials.
RESULTS:
This work shows, by use of easy Japanese Lean tool calculable improvements at shop floor. This work is going done at JDCOEM, Nagpur, college workshop to recover working equivalence, by eliminating non- value added behavior, wastages, etc. First 'S' i.e. Seiri will be productively implement in college workshop and result will show efficient sorting all elements in workshop, and unnecessary materials will group together as in red tag zone.

2.7 Implementation of 5s methodology for performance improvement in a medium scale industry: A case study

This case study deals with the 5S implementation in an industry of OK plastics public limited company, which is located in Addis Ababa, Ethiopia. This paper explains the methods and techniques of 5 S use to increase the performance of all processes in the company. After implementation of 5s, it can be observed that introducing the 5S rules bring the great changes in the company, increasing the efficiency and effectiveness of the processes, improvement of the layout, productivity, improve the quality, and working conditions in the company.
Conclusion:
The 5S implementation leads to the improvement of the quality of the products and organization become self-disciplined. The implementation of the 5S system gives the following effects regarding the improvement in quality such as workers get used to ordering and discipline, reduction of physical effort, eliminates unused, unwanted material from the storage room, fewer accidents during the production process. The final conclusion is that overall change is 85 percent which means increased up to 30percent after implementation of 5S.

2.8 Process Efficiency Improvement in Small Organization through Lean Supply Chain Approach

This paper aims to identify the performance factors and their characteristics in SMEs organizations, for which the case study is considered in public organization, where the 5s is applicable to the file searching process and the efficiency is achieved through the reduction of process time in simple manner and the same will effect on the supply line also to the customer end. In this way 5S techniques would strongly support the main objectives of SMEs organization to achieve continuous improvement and higher performance.
Conclusion:
Implementation of lean manufacturig principle to the supply chain line activities can helps to reduce the waste in the small and medium enterprises for the betterment of the customer or publics through the reduction of manpower and their errors in terms of time, quality and perfection towards the customer views in smooth manner and also strong data management and their documentation can successfully achieved for the longer services to the publics with minimum expenditure is the main motive of this work.

2.9 A Case Study: 5s Implementation in Plastic Pipes Manufacturing Company

The research work carried out to apply the 5S methodology of lean manufacturing to solve the problems of a Plastic Pipes industry in India with the aim to increase the efficiency of all processes and elimination of losses in the company. The objectives of the paper is to reduce the process wastes, smooth the process flow and maintain proper quality control, improve storage facilities, safety, security and process cost savings in a company through case study. Before and after picture are taken for the applying 5S methodology in a company. 5S implemented has been carried out in storage department and extruder department.

2.10 A Case Study: 5s Implementation in Ceramics Manufacturing Company

The research work carried out to apply the 5S methodology of lean manufacturing to solve the problems of a ceramic industry in India with the aim to increase the efficiency of all processes and elimination of losses in the company. The objectives of the paper is to reduce the process wastes, smooth the process flow and maintain proper quality control, improve storage facilities, safety, security and process cost savings in a company through case study. Before and after picture are taken for the

applying 5S methodology in a company. 5S implemented has been carried out in storage department and insulator department. After implementing of 5S in the storage department the space saving is 12.91also certain process wastes are reduced. In insulator department the workplace became efficient and effectiveness.
Conclusion:
Due to implementation of 5S and visual management system (GAMBA), there was improvement in space utilization, safety of the employees, less scope of error, increased productivity, and improved inventory system, also increasing of machines' efficiency, maintenance the cleanness of devices, maintenance and improvement of the machines' efficiency, maintenance the clean workplace, easy to check, quick informing about damages (potential sources of damages),improvement of the work environment, elimination of the accidents' reasons in the company.

2.11 The "5S" Strategy by Using PDCA Cycle for Continuous Improvement of the Manufacturing Processes in Agriculture Industry

The present work is dedicated to study and implement 5S Methodology. In this work, proper system will be analyzed to reduce the wastes, reduction in cost, processes, and increase decision making power by implementing 5S techniques. Apart from this, theoretical results compared with original data from industry before and after implementation.
Conclusion:
In this paper we calculate the Takt Time of assembly line, we found that it is 35.91 and calculate cycle time of this Industry before implementation and we found that it is 50 minutes. After implementation of 5'S in this Industry we again caculate the cycle time of assembly line area, it is 41.50 minutes. And we find that after implmentation of 5'S we reduce the cycle time of assembly line work.

2.12 Implementing 5S Strategy in an Assembly Line

This paper explains the concepts of 5S in detail. The paper considers a particular problem in a construction equipment assembly line and explains the difficulties caused by the problems. Later, the problems are dealt with by illustrating the types of solutions that help us achieve 5S in a workplace and discuss how the particular solution can be successful in eradicating the problem present.
Conclusion:
All the problems caused due to the lack of organization in the tool box and the feeder box can be eradicated by implementing the solutions that have been proposed and therefore eliminating the non-value added activities and in turn increasing the pro-

ductivity of the manufacturing industry.

2.13 Effectiveness of 5s Implementation in Lean Construction (Commercial Building Construction Project)

This paper managed the execution of 5s approach in the little scale industry. By following the 5s philosophy, it demonstrates noteworthy changes to wellbeing, profitability, effectiveness, and housekeeping. The enhancements when 5s usage is appeared by pictures in the paper. It additionally means to fabricate a more grounded hard-working attitude inside the administration and specialists who might be relied upon to proceed with the great practices. Esteem stream mapping is utilized first to guide the present state used to distinguish wellsprings of waste and to recognize lean instruments to wipe out this waste. VSM is a pencil and paper representation instrument that demonstrates the stream of material and data as an item advances through the esteem stream. VSM fills in as a beginning stage to encourage administration, specialists, providers, and clients perceive waste and its sources.
Conclusion:
This strategy is new in the civil industry. This system is effective than the existing methods that are by and by use in development part. Work examining result are demonstrating impressive figure as a contrast with standard day by day efficiency. This sort of circumstance can help perform proficient working. Chiefs can without much of a stretch distinguish helpfully and squandered beneficial time alongside the primary driver. Time-motion study to remove any kind of waste, and creation of overall better work environment for everyone through 5S.

2.14 Process improvement by using '5S' in manufacturing unit: A case study

This article presents the case study of studying on implementing 5S in small manufacturing unit. From this project, the impact of 5S implementation are reduce inventory, efficient on workplace usage, reduce time for searching spare part, reduce water spilled, reduce un stabilization, cleaning and checking machine condition, improve working condition, increase discipline, follow procedure, and better relationship among employee.
Conclusion:
In conclusion, the 5S system implemented in this manufacturing unit is found to be adequate due to the many benefits such as the wastes, scraps and losses were minimized, over production stocks were controlled with flexible work stations. The factors that manufacturing unit from implementing the 5S system are identified as ineffective inventory management, lack of quality improvements and quality control

and lack of employee participation and top management commitment. Implication of this study suggest that further research needs to be done on more manufacturing unit so as to have more conclusive findings on 5S implementation and barriers faced by the that manufacturing unit entrepreneurs.

2.15 Implementing 5S Methodology

The paper presents a continuous improvement strategy, process-oriented and aiming to improve manufacturing at any workplace.5S is a basic foundation of Lean Manufacturing systems. It is a tool for cleaning, sorting, Organizing and providing the necessary groundwork for workplace improvement. This research effort dealt with the basic idea of implementing 5S methodology. By following the 5S methodology, this research effort may show significant improvements to safety, productivity, efficiency, and housekeeping.

Chapter 3

Methodology of 5S

3.1 What is 5S?

'5S' is one of the Japanese techniques which was introduced by Takashi Osada in the early 1980s. It is basically a workplace management methodology which helps for improving working environment, human capabilities and thereby productivity. The word '5S' represents the 5 discipline for maintaining visual workplace. '5S' is workplace management to minimize the loss of time and unnecessary movements as well. 5S is a workplace organization method that uses a list of five Japanese words: Seiri, Seiton, Seiso, Seiketsu, and Shitsuke. These have been translated as "Sort", "Set in order", "Shine", "Standardize" and "Sustain". The list describes how to organize a work space for efficiency and effectiveness by identifying and storing the items used, maintaining the area and items, and sustaining the new order. The decision-making process usually comes from dialogue about standardization, which builds understanding among employees of how they should do the work. The 5s are as shown.

Figure 3.1: Wheel diagram of a simple 5S system

3.2 SEIRI - SORTING

It means sorting things that are necessary from those that are unnecessary and keeping quantity of necessary ones minimum and at an accessible location [1]. Red tagging is done to the items which are unnecessary. Unnecessary items are disposed of, or stored in a remote location and are redeemed if required in Future [2]. A proper name and one-location storage should be assigned to each and every item in order to reduce confusion, resulting in maximum efficiency.

Benefits of sorting:
1.Process Improvement by cost reduction
2. Management of Stock materials becomes easy
3. Flow of workplace is smooth and continues
4. Time wastage by losing equipment's is less

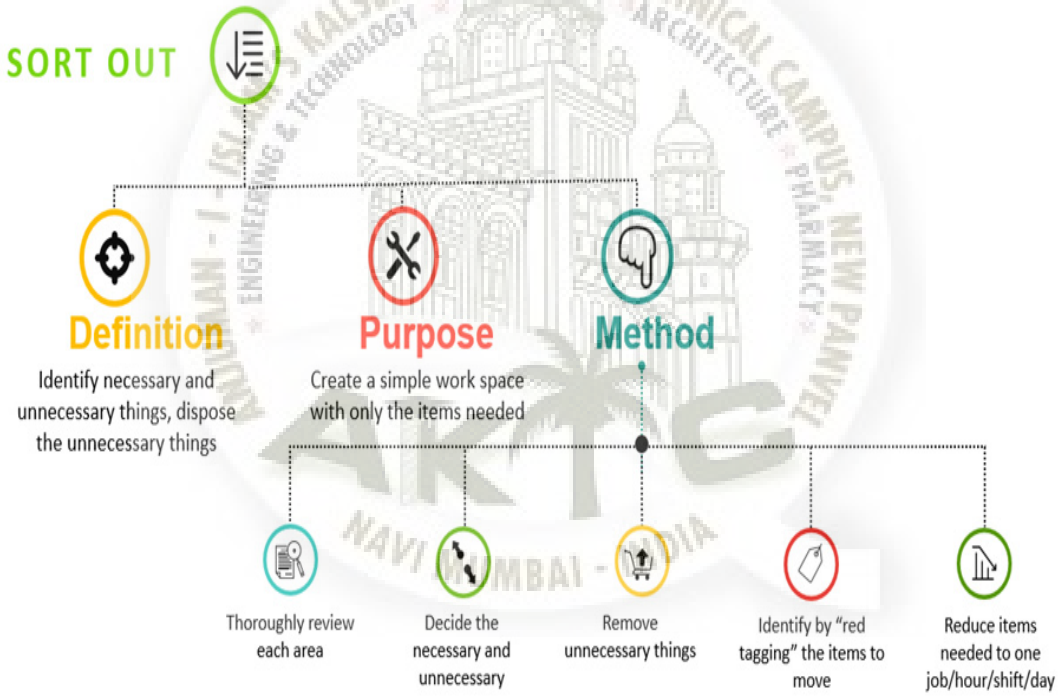


Figure 3.2: 1S SORT

3.3 SEITON - SET IN ORDER

It means "A place for everything and everything must be in its place". It is to make the arrangement of necessary items in good order so that they can be easily picked up for use. It is a study of efficiency. It is a question of how quickly you can get the things you need and how quickly you can put those away [6]. This means preparing the necessary items neatly and systematically so that they can easily be taken and returned in the original place after use. Tools, equipment, and materials must be systematically arranged for the easiest and the most efficient access. There must be a place for everything, and everything must be in its place.

- Decide place for everything that you need.
- Give proper identification to it for ease of search.
- Keep everything at its defined place after use.
- Make sure every time that everything is at its place.

Figure 3.3: 2S SET IN ORDER

3.4 SEISO - SHINE

It means cleanliness, which should be the concern of everybody in the organization. Cleaning should be done by everyone in the organization, right from top management to the bottom. Cleaning should be done not only for the sake of cleaning but for a purpose [6]. To maintain a good image of cleanliness, everyone should be individually responsible for cleaning. Zone wise responsibilities should be given to the employees. Cleanliness is also helpful to notice damage on equipment. A good, neat and clean working place provides motivation for effective functioning [7].
Some points to remember during Shine process:
- Always keep cleanliness at your workplace.
- Tools should be kept clean always after its use.
- Areas should be properly marked or painted.

Figure 3.4: 3S SHINE

3.5 SEIKETSU - STANDARDIZE

It means making the first 3s a routine practice by implementing clear procedures for Sorting, straightening and scrubbing. Regular 5s audits should be done and scores against each S should be displayed. Display through photographs should be encouraged. The emphasis is on visual management and 5s standardization [6].

• Define standard method/way of doing the work i.e. prepare standard operating procedure (SOP).
• Do the work in that method/way only?
• Maintain the discipline in your work

Figure 3.5: 4S STANDARDIZE

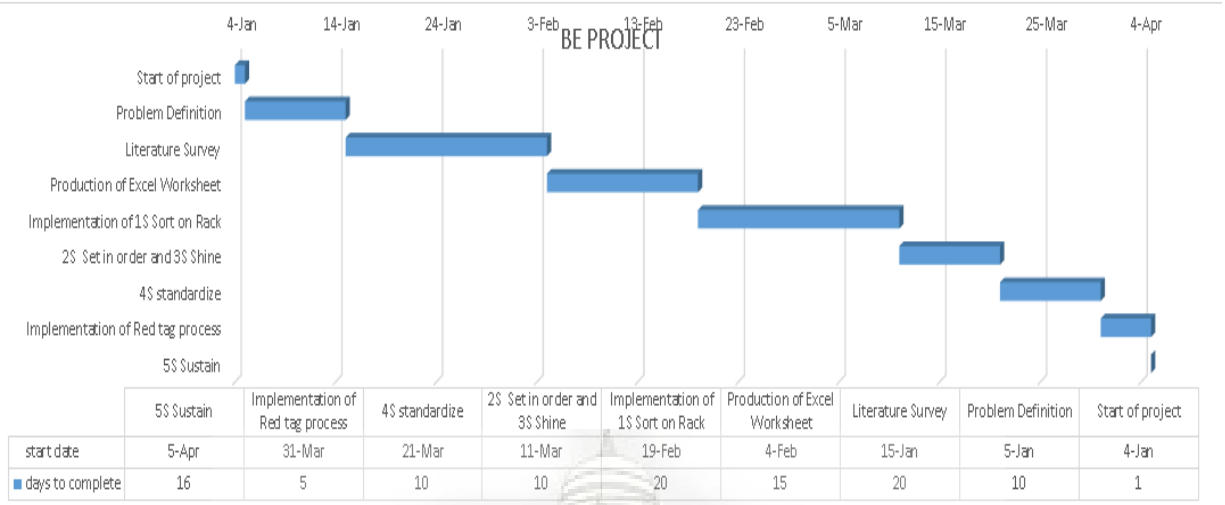
3.6 SHITSUKE - SUSTAIN

It means to promote, communicate and train in the 5s to ensure that it is a part of the company's corporate culture. It is right to keep practicing 4s activities until they become habitual [7].

- Maintain consistency in the method of doing work.
- Stick to the '5S' rules for proper workplace management.
- Encourage the participation of all, for consistency in '5S' activities.
- Perform '5S' activities periodically.
- For sustaining the '5S' technique effectively and to strictly adhere to it in the organization, internal audits as well as surprise audits are conducted periodically.

Figure 3.6: 5S SUSTAIN

3.7 Project Timeline



	5S Sustain	Implementation of Red tag process	4S standardize	2S Set in order and 3S Shine	Implementation of 1S Sort on Rack	Production of Excel Worksheet	Literature Survey	Problem Definition	Start of project
start date	5-Apr	31-Mar	21-Mar	11-Mar	19-Feb	4-Feb	15-Jan	5-Jan	4-Jan
days to complete	16	5	10	10	20	15	20	10	1

Figure 3.7: This chart shows how our project progressed week wise

The project start date was 4th january. Problem definition and literature survey were done to understand the problem and to find a solution to it. 5S was the solution and research papers were found on it. The idea of implementing 5S was proposed and was agreed upon. Working on the 5s technique ”sort” took a lot of time and was completed on 11th march 2019. Excel worksheets were made to include flow charts and audit sheets. working on 2S set in order and 3S shine took 10 days and the techniques were implemented with ease. 4S standardize took 10 days to maintain and make flowcharts and explain it to the workers.Red tag process was implemented on 31 march and it worked perfectly.The last 5S Sustain was implemented on 5 april and the project was successfully completed.

Chapter 4

IMPLEMENTATION OF 5S

4.1 SORT

4.1.1 Sorting of storage Rack

It means sorting things that are necessary from those that are unnecessary and keeping quantity of necessary ones minimum and at an accessible location.[3]
The figure below shows the storage rack in the room. The rods were kept as such with no labelling whatsoever and were taken out randomly for manufacturing. The rods and pipes were seperated by a common parameter that is their material grade. Although there were other parameters such as change in shape, diameter and apothem , sorting could be done efectively solely based on the grade. The grade was divided into stainless steel, brass and MS.

Figure 4.1: The storage rack with rods and pipes arranged before sorting

The grade of the material was classified based on colour of the pipe which is as follows:

RED- stainless steel 316
BLUE- Stainless Steel 316L
GREEN- Stainless Steel 304

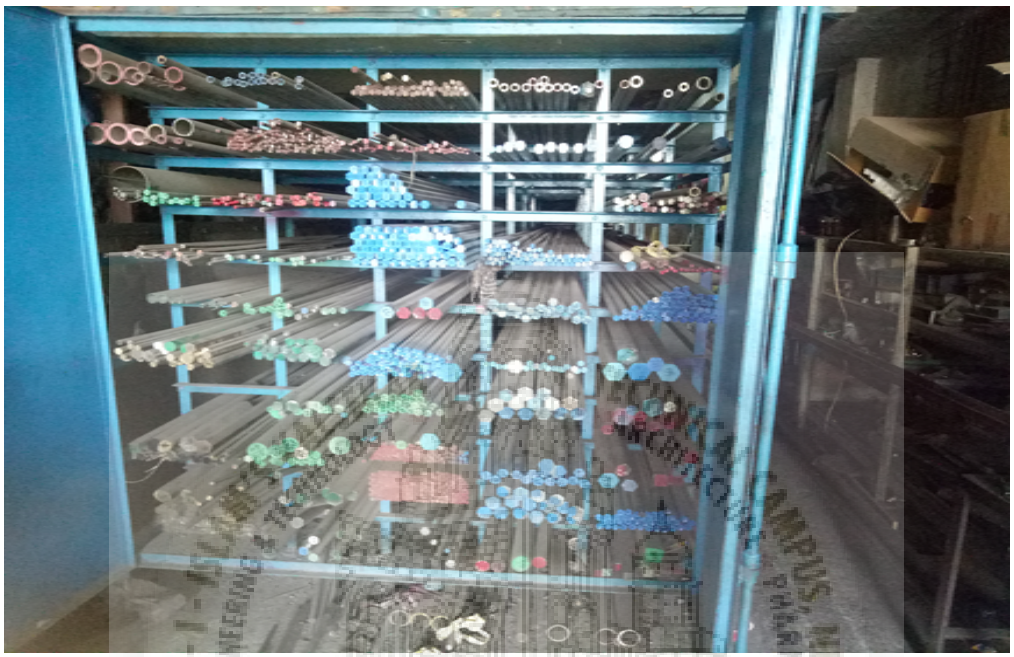


Figure 4.2: The storage rack after sorting based on colour grade of the material

Above figure shows how the sorting process was done. The materials were sorted based on their colour grade and shapes. The rack consisted of 5 columns and 10 rows. It was decided to arrange pieces together that have similar shapes together and are in bulk. The rack was arranged with the help of the workers and was in implementation immediately.The sorting process was done to the rack very efficiently and it improved the overall productivity of the industry also.

4.1.2 RED TAG PROCEDURE

The red tag system is simply a communication tool used to identify items that a person has flagged for removal from a work area. While the tagging is most frequently done during sorting, it can be done at any time.[9] The figure below shows excess materials left after the production is over. This rack contains excess and defective material and is left untouched. Red tag should be implemented for these rods and pipes so that their is space available and waste is disposed off.

Figure 4.3: Before Red Tag Implementation

In a nutshell, when a person finds an item that they either don't know what it is, or is not needed in a process, they tag it. 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.[10] In the industry the manager confirms whether the part is necessary for future use or will be a waste material. This does take up valuable time but it is a necessary factor in saving space and to improve the industries efficiency.

Figure 4.4: After Red Tag Implementation

Figure 4.4 shows how red tag was implemented for excess and defective material. The rods and pipes of small diameter and width were tagged and allowed to be accessed later and determine whether they are excessive or defective parts. These parts and tagged during the production stage and does not affect the productivity of the industry. This technique is used so that space is available for more parts and scrap materials can be disposed of fast.

The red tag used consists of name of the person who tagged the piece, date as to when he tagged it, reasons for tagging it and write if it is a defective or excess piece.The figure below shows a general layout of the red tag.

Figure 4.5: Red Tag layout

4.2 SET IN ORDER

It means "A place for everything and everything must be in its place". It is to make the arrangement of necessary items in good order so that they can be easily picked up for use. It is a study of efficiency. It is a question of how quickly you can get the things you need and how quickly you can put those away.[6]

Figure 4.6: Flanges and thermowells before setting in order

Above figure shows the state before setting in order was implemented. The workers and operators had to search for flanges and thermowells for manufacturing of product. The flanges were kept on racks in a disorganized manner.

Figure 4.7: flanges and final product kept in boxes for storage space

Figure 4.7 shows the arrangement of flanges and the final product at the right place for sending out to customers. The final product were kept in crates to allow ease of movement and then stored in batches before processing it out.

Figure 4.8: Flanges organized and thermowells kept in crates

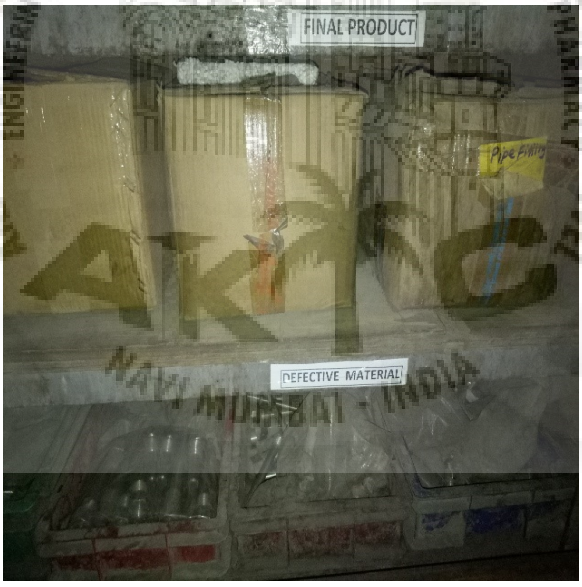


Figure 4.9: Final Product for shipment kept in boxes

Figures 4.8 and 4.9 are flanges and thermowells kept in boxes and crates. This process of setting in order so that everything is in place is very effective in developing 5S techniques. The overall efficiency of the industry increases with such methods and helps in faster production rate.

4.3 SHINE

It means cleanliness, which should be the concern of everybody in the organization.[6] Cleaning should be done by everyone in the organization, right from top management to the bottom. Cleaning should be done not only for the sake of cleaning but for a purpose.[7]

Figure 4.10: Scrap materials and extra parts

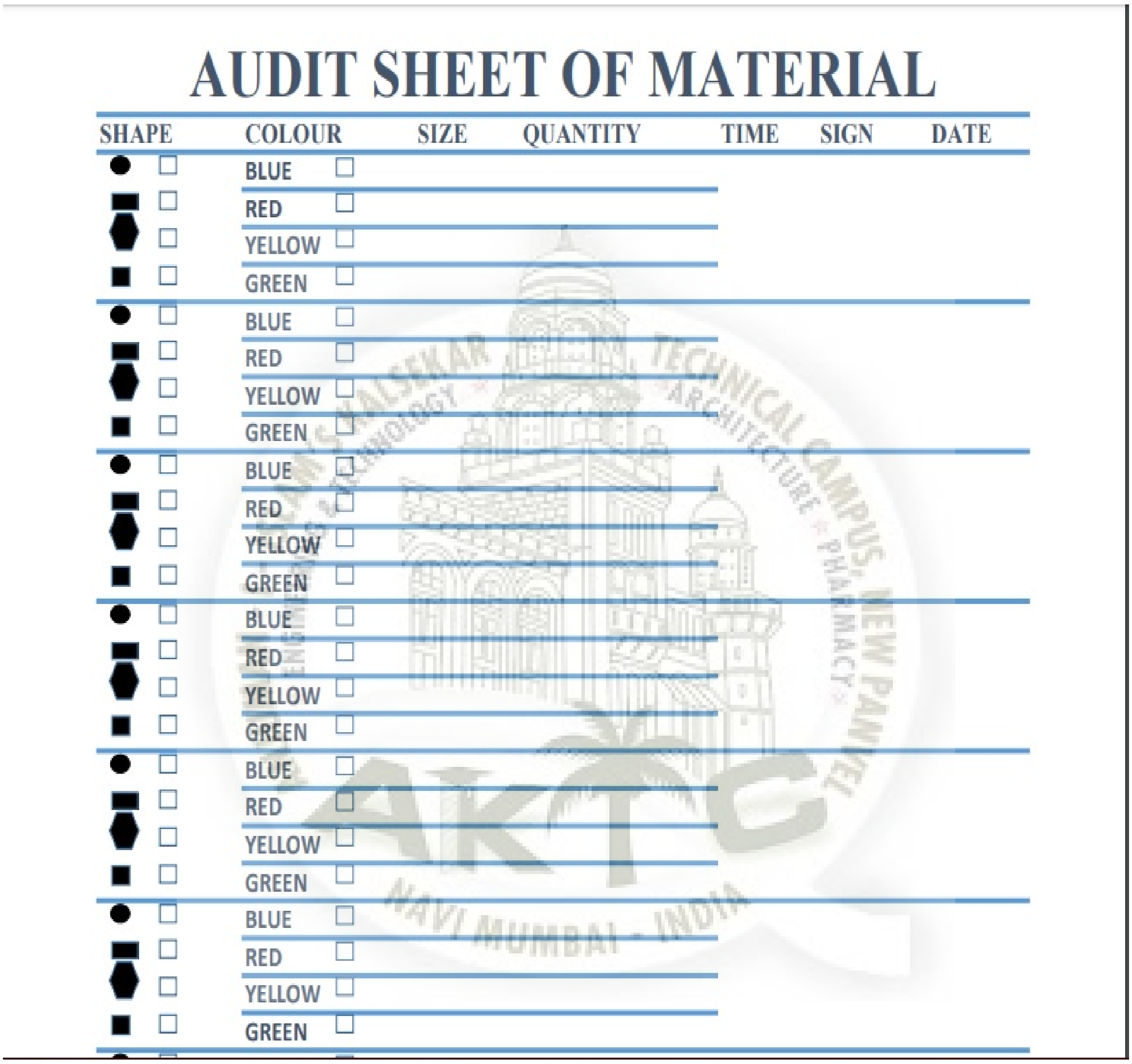
Figure 4.11: Removal of scrap materials

The figures shows before and after state of using 5S shine technique to remove materials taking up space and to improve work flow of the industry. Shine also helps in motivating workers to do job more effectively.

4.4 STANDARDIZE

4.4.1 AUDIT SHEET

It means making the first 3S a routine practice by implementing clear procedures for Sorting, straightening and scrubbing. Regular 5s audits should be done and scores against each S should be displayed.



AUDIT SHEET OF MATERIAL

SHAPE	COLOUR	SIZE	QUANTITY	TIME	SIGN	DATE
● ☐	BLUE ☐					
▬ ☐	RED ☐					
⬢ ☐	YELLOW ☐					
■ ☐	GREEN ☐					
● ☐	BLUE ☐					
▬ ☐	RED ☐					
⬢ ☐	YELLOW ☐					
■ ☐	GREEN ☐					
● ☐	BLUE ☐					
▬ ☐	RED ☐					
⬢ ☐	YELLOW ☐					
■ ☐	GREEN ☐					
● ☐	BLUE ☐					
▬ ☐	RED ☐					
⬢ ☐	YELLOW ☐					
■ ☐	GREEN ☐					
● ☐	BLUE ☐					
▬ ☐	RED ☐					
⬢ ☐	YELLOW ☐					
■ ☐	GREEN ☐					
● ☐	BLUE ☐					
▬ ☐	RED ☐					
⬢ ☐	YELLOW ☐					
■ ☐	GREEN ☐					

Figure 4.12: AUDIT SHEET

An Audit sheet was made for workers to not down the entry and exit of rods or pipes in use to improve efficiency and improve management of storage rack. The audit sheet works such that the worker using the piece fills the details and submits it to the manager for inventory management. This will help in maintaining a standard for using stock and create easy tasks to be performed.

4.4.2 Flowchart

A flowchart of the storage rack where each colour represents the grade and type of material. The figure shows the different variations of grade, type and colour of

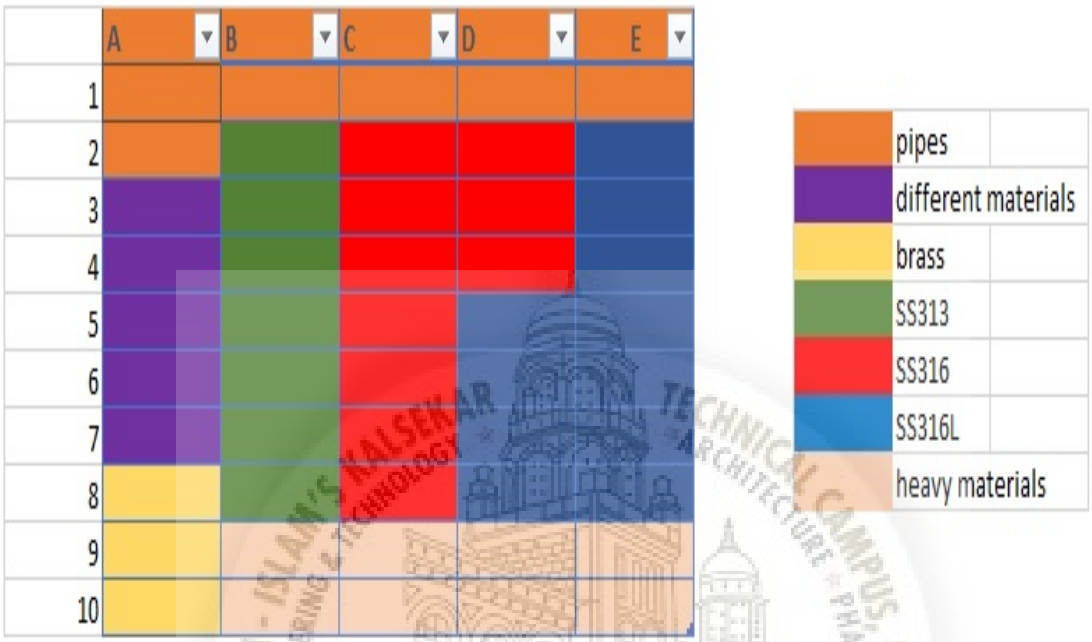


Figure 4.13: Flowchart

the rods and pipes stored in the storage rack. This flowchart is kept as a standard way of keeping the rack maintained when new pieces are ordered. The placement of materials according to this flowchart will help in keeping a pattern for use every time. although the flowchart is used temporary due to change in shapes and grade of material, the current chart is a basic layout of what the storing pattern is to be.

4.5 SUSTAIN

It means to promote, communicate and train in the 5s to ensure that it is a part of the company's corporate culture. It is right to keep practicing 4s activities until they become habitual.[7] The workers were given specific instructions on how to

Figure 4.14: Maintaining batches for thermowells

maintain the batches of pipe fittings. The involvement of workers in understanding the basic concept of the 3S was appreciable. The above figure shows how we explain

Figure 4.15: Explaining workers on CNC

to the workers about set in order of tools and equipment's after use. It was necessary to adhere to these techniques so that no tool is lost when u need it. This makes it easier for them to look at the right place and there is no interruption in work flow.

Figure 4.16: flowchart explanation and calculations

Figure 4.17: Improving the Production rate

Explaining to the workers once is fine but in long time exposure , it will lead to them not following the techniques and will stop the 5S system.Without management's visible commitment to 5S, it is difficult to get lower level employees to fully commit to making 5S a success. Managers should be involved in 5S through activities such as:

1.conducting 5S inspections
2.listening to, talking with, and offering advice to employees
3.providing 5S related seminars for employees
4.participation in 5S promotional events

Chapter 5

Evaluation Of 5S

5.1 5S Rating system

5.1.1 Sort

Seiri is the first S in 5S system, which is basically deal with the availability of materials and process of product manufacturing. For calculation of Seiri rating, we allot 4 criterion regions for seiri arrangement, and decide that the sub system should achieve minimum 3 marks out of 4 because it tends us to define that the system will be in issue when it is above 50 percent active.
Following are the Seiri rating criterion:
(1)Material availability: Give 1 mark if material is fully available or give 0 marks if material is not fully available.
(2) Defective goods: If there are X items which contains Y items as defective, Then the marks will be Fraction of fine goods = [1- Y/X]
(3) Operating condition: Operating condition is an important aspect for the arrangement of material and tools, because without the comfort of operator the best process arrangement also has zero value. Give 1 mark if operating condition is under control and give 0 marks if operating condition is not under control.
(4) Elimination of waste: Elimination of waste is also an important aspect for Seiri rating. Let total N no of waste are listed but only M were eliminated the marks of elimination process will be Fraction of waste elimination = [1- M/N] Now add all five marks and get total rating of Seiri out of 5.
If the Seiri system will get less than 3 marks then do the arrangement again because if it is got below 3 marks it means it has very poor condition of analysis.

5.1.2 Set in Order

Seiton is second S of 5S system which deals with the proper arrangement of equipment and tools on the shop floor. The main objectives of Seiton are forming a regular workplace, avoiding time loss while searching the material and mistake proofing work. Following are the Seiton rating criterion.

(1) Sequence rating Let there are A no. of tools are in proper sequence and B no of tools are not in proper sequence. Then sequence rating will be Fraction of proper sequence = [1- B/A]

(2) Material arrangement rating this criterion basically deals with the providing of raw material and accessories for the particular operation. Let D be the lack of material and C be the total material required, then Fraction of material available = [1-D/C]

(3) Tool arrangement rating: This criteria shows the consistency if the system about providing service for proper fulfilment of tooling requirement. Let P be the no. of irregular process and Q be the total no. of process. Fraction of consistency to tool arrangement: [1- P/Q]

Now do sum of all the above three criteria and note it as the rate of the Seiton system. This rate should have minimum value of 3 points, if not then system will set again or need analysis again.

5.1.3 Shine

In order to realize effective tasks, it is essential to create a clean and regular working and living environment. This is because dust, dirt and wastes are the source of untidiness, indiscipline, inefficiency, faulty production and work accidents. We can handle cleaning practices by two approaches: "general cleaning of workplace" and "machine, hardware and tool cleanliness". Seiso process indicates the "Renovation of the work place". Seiso system contents the following criteria:

(1) Process path clean: If the path of process is clean then allot 1 point and if not give 0 point.

(2) Proper environment for working condition: Working environment include the ergonomics of the worker like proper souse of light and air, which makes the worker continuously fresh and energetic and make him stay away from errors during operation. Working condition rating will be Let J will be total aspect for favorable condition and I be the no. of fail arrangement. Fraction of environment: [1-I/J].

(3) Safety from accident: Let K be the total no. of accident chances and L be the total no for accidents occurs. Then safety rate will be Fraction of safety: [1-L/K].

(4) Cleaning consistency: Let E be the total no. of cleaning required and F be the cleaning not done say inconsistency. So consistency rate will be Fraction of consistency = [1-F/E].

After adding all the above four criteria the rate of Seiso system can be recorded. This rate should have minimum value of 3 points, if not then system will set again or need analysis again.

5.1.4 Standardize

Seiketsu is generally means for make a peak standard which should be achieve by the manufacturing process practice. Standard should be communicative and easy to understand.

Seiketsu rating will be found by calculating the average of previous three S, because standard of any system will rise and fall by mean rate depending factors.

Seiketsu Rating= Seiri rating + Seiso rating + Seiton rating

5.1.5 Sustain

Shitsuke (Sustain) is the last S of the 5S system which is deal with the regularity of maintaining the standard of the organization for the particular process, which is only done by regular practices and by following the proper instruction of machine operating. By doing regular following of accurate of instruction we can maintain the machine condition at its peak level, which may help for better production and stay away from breakdown.

(1) Removing small faults through the aid of cleaning.
(2) Providing the execution of visual control.
(3) Providing the performance of protective activities.
(4) Granting the responsibility of the machine to the operator.
(5) Formation of a disciplined company.
Shitsuke rating will be depending on the previous four S because without that the regularity will not maintain. Therefore Shitsuke rate will be the average of previous four S ratings.

5.2 Evaluation of Week 1

The following table shows the parameters taken by inspecting the workplace and processes. It shows the readings of first week of the month.

Total Items (X)	540
Defective Items (Y)	6
Waste Eliminated in KG (M)	59.96
Total Waste in KG (N)	62.1
Total Number of Tools (A)	7
Tools Not in Proper Sequence (B)	3
Total Material Required (C)	108kg
Lack of Material (D)	24kg
Total No of Irregular Processes (P)	4
Total Number of Processes (Q)	10
Total Number of Fail Arrangement (I)	24
Total Aspect for Favorable Cond. (J)	60
Total Number of Accident Chances (K)	6
Total Number of Accident Occurs (L)	1
Total No of Cleaning Required (E)	12
Total No of Cleaning Not Done (F)	6

Table 5.1: Week 1 readings

5.2.1 Evaluation of Week 2

The following table shows the parameters taken by inspecting the workplace and processes. It shows the readings of second week of the month.

Total Items (X)	450
Defective Items (Y)	6
Waste Eliminated in KG (M)	34.8kg
Total Waste in KG (N)	36kg
Total Number of Tools (A)	7
Tools Not in Proper Sequence (B)	3
Total Material Required (C)	90kg
Lack of Material (D)	24kg
Total No of Irregular Processes (P)	3
Total Number of Processes (Q)	10
Total Number of Fail Arrangement (I)	18
Total Aspect for Favorable Cond. (J)	60
Total Number of Accident Chances (K)	6
Total Number of Accident Occurs (L)	0.4
Total No of Cleaning Required (E)	12
Total No of Cleaning Not Done (F)	6

Table 5.2: Week 2 readings

5.2.2 Evaluation of Week 3

The following table shows the parameters taken by inspecting the workplace and processes. It shows the readings of third week of the month.

Total Items (X)	450
Defective Items (Y)	6
Waste Eliminated in KG (M)	34.8kg
Total Waste in KG (N)	36kg
Total Number of Tools (A)	7
Tools Not in Proper Sequence (B)	2
Total Material Required (C)	90kg
Lack of Material (D)	30kg
Total No of Irregular Processes (P)	2
Total Number of Processes (Q)	10
Total Number of Fail Arrangement (I)	18
Total Aspect for Favorable Cond. (J)	60
Total Number of Accident Chances (K)	6
Total Number of Accident Occurs (L)	0.2
Total No of Cleaning Required (E)	12
Total No of Cleaning Not Done (F)	6

Table 5.3: Week 3 readings

5.2.3 Evaluation of Week 4

The following table shows the parameters taken by inspecting the workplace and processes. It shows the readings of fourth week of the month.

Total Items (X)	510
Defective Items (Y)	6
Waste Eliminated in KG (M)	35.8kg
Total Waste in KG (N)	40.8kg
Total Number of Tools (A)	7
Tools Not in Proper Sequence (B)	1
Total Material Required (C)	102kg
Lack of Material (D)	12kg
Total No of Irregular Processes (P)	2
Total Number of Processes (Q)	10
Total Number of Fail Arrangement (I)	12
Total Aspect for Favorable Cond. (J)	60
Total Number of Accident Chances (K)	3
Total Number of Accident Occurs (L)	0
Total No of Cleaning Required (E)	12
Total No of Cleaning Not Done (F)	6

Table 5.4: Week 4 readings

5.3 Calculations

5.3.1 Efficiency of week 1 : The following table shows the calculation of the 5S rating system. Each of the 5S techniques were evaluated based on the readings above for week 1.

WEEK 1

5S Rating	Rating parameters	Total Rating
S1 SEIRI RATING	1. Material Availability Rating =0.7 2. Defective goods Rating=1-Y/X=0.988 3. Operating condition Rating=0.8 4. Elimination of Waste Rating=1-M/N=0.034	2.523
S2 SEITON RATING	1. Sequence Rating=1-B/A=0.571 2. Material Arrangement Rating=1-D/C=0.77 3. Tool Arrangement Rating=1-P/Q=0.6	1.948
S3 SEISO RATING	1. Process Path Cleanliness Rating=0.7 2. Working Environment Rating=1-I/J=0.6 3. Safety Rating=1-L/K=0.833 4. Cleaning Consistency Rating=1-F/E=0.5	2.633
S4 SEIKETSU RATING	S4 = (S1+S2+S3)/3	2.368
S5 SHITSUKE RATING	S5 = S1+S2+S3+S4/4	2.368
Efficiency of the system	Efficiency = (S1+S2+S3+S4+S5)*100/25	47.365%

5.3.2 Efficiency of week 2 :The following table shows the calculation of the 5S rating system. Each of the 5S techniques were evaluated based on the readings above for week 2.

WEEK 2

5S Rating	Rating parameters	Total Rating
S1 SEIRI RATING	1. Material Availability Rating =0.8 2. Defective goods Rating=1-Y/X=0.988 3. Operating condition Rating=0.8 4. Elimination of Waste Rating=1-M/N=0.033	2.621
S2 SEITON RATING	1. Sequence Rating=1-B/A=0.571 2. Material Arrangement Rating=1-D/C=0.733 3. Tool Arrangement Rating=1-P/Q=0.7	2.004
S3 SEISO RATING	1. Process Path Cleanliness Rating=0.8 2. Working Environment Rating=1-I/J=0.7 3. Safety Rating=1-L/K=0.933 4. Cleaning Consistency Rating=1-F/E=0.5	2.933
S4 SEIKETSU RATING	S4 = (S1+S2+S3)/3	2.519
S5 SHITSUKE RATING	S5 = S1+S2+S3+S4/4	2.519
Efficiency of the system	Efficiency = (S1+S2+S3+S4+S5)*100/25	50.394%

Each parameter is a representation of 5S techniques and using the rating ,Efficiency can be calculated for the system. The Efficiency can be seen as increasing in weekly fashion, due to workers following the 5S techniques taught to them.

5.3.3 Efficiency of week 3

:The following table shows the calculation of the 5S rating system. Each of the 5S techniques were evaluated based on the readings above for week 3.

WEEK 3

5S Rating	Rating parameters	Total Rating
S1 SEIRI RATING	1. Material Availability Rating =1 2. Defective goods Rating=1-Y/X=0.988 3. Operating condition Rating=1 4. Elimination of Waste Rating=1-M/N=0.033	3.0216
S2 SEITON RATING	1. Sequence Rating=1-B/A=0.714 2. Material Arrangement Rating=1-D/C=0.733 3. Tool Arrangement Rating=1-P/Q=0.7	2.18
S3 SEISO RATING	1. Process Path Cleanliness Rating=0.8 2. Working Environment Rating=1-I/J=0.7 3. Safety Rating=1-L/K=0.933 4. Cleaning Consistency Rating=1-F/E=0.5	2.966
S4 SEIKETSU RATING	S4 = (S1+S2+S3)/3	2.722
S5 SHITSUKE RATING	S5 = S1+S2+S3+S4/4	2.722
Efficiency of the system	Efficiency = (S1+S2+S3+S4+S5)*100/25	54.45%

5.3.4 Efficiency of week 4

:The following table shows the calculation of the 5S rating system. Each of the 5S techniques were evaluated based on the readings above for week 1.

WEEK 4

5S Rating	Rating parameters	Total Rating
S1 SEIRI RATING	5. Material Availability Rating =1 6. Defective goods Rating=1-Y/X=0.988 7. Operating condition Rating=1 8. Elimination of Waste Rating=1-M/N=0.1225	3.1105
S2 SEITON RATING	4. Sequence Rating=1-B/A=0.857 5. Material Arrangement Rating=1-D/C=0.882 6. Tool Arrangement Rating=1-P/Q=0.8	2.5393
S3 SEISO RATING	5. Process Path Cleanliness Rating=1 6. Working Environment Rating=1-I/J=0.8 7. Safety Rating=1-L/K=1 8. Cleaning Consistency Rating=1-F/E=0.5	3.3
S4 SEIKETSU RATING	S4 = (S1+S2+S3)/3	2.983
S5 SHITSUKE RATING	S5 = S1+S2+S3+S4/4	2.983
Efficiency of the system	Efficiency = (S1+S2+S3+S4+S5)*100/25	59.665%

The overall efficiency is increasing in these four weeks and increases from about 47% to anout 59%. This shows the effectiveness and importance of 5S techniques.

Chapter 6

Result and Discussion

The table below shows the efficiency of the system based on 4 different weeks calculated from above.The reading shows that each week has an appreciable increase in efficiency due to implementing and maintaining 5S techniques in the industry. This shows the effectiveness and usefulness of the 5S system. It is also important to understand that the increase in production rate, work flow, space available and waste disposal techniques used above were relatively useful for the industry.

EFFICIENCY OF THE SYSTEM

Week No	Duration	Efficiency
Week 1	28th March 2019- 3rd April 2019	47.365%
Week 2	4th April 2019- 10th April 2019	50.394%
Week 3	12th April 2019- 18th April 2019	54.45%
Week 4	20th April 2019- 26th April 2019	59.665%

Figure 6.1: Efficiency of 5S system

Chapter 7

Conclusion

5S lean manufacturing system is one of the options to reduce non value-added activity (wastes) and improve operational efficiency of the organization. The efficient implementation of 5S technique leads to subsequent improvement in productivity of the manufacturing plant. The 5S improves environmental performance and thus relate primarily in reduction of wastes in manufacturing. It promotes neatness in storage of raw material and finished products. The 5S implementation leads to the improvement of the case company organization in many ways for instance.

(1) Better usage of working area
(2) Work environment improvement
(3) Prevention of tools losing.
(4) Reduction in accidents.
(5) Reduction in accidents.
(6) Reduction in pollution.
(7) Discipline in the employee.
(8) Increasing of awareness and moral of employee.
(9) Improvement in the internal communication.
(10) Improvement in the internal human relation.
(11) Decreasing of mistakes through error proofing.

Chapter 8

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Chapter 9

Paper to be Published

Implementation of 5s on Storage room in a Pipe Fitting industry

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Abstract -

This paper presents the Implementation of 5s on a manufacturing industry which is one of the leading ISO 9001:2008 manufacturer and supplier of world class range of Ferrous / Non Ferrous Tube Fittings, Pipe Fittings, Needle Valves, Manifolds, Thermowells, Flanges, Condensate Pot, Air Header, Mounting Bracket & Piping products. The aim of the implementation of '5S" in the organization is to enhance the productivity, safety, efficiency through effective workplace management. '5S" in simple terms is a Japanese technique consisting of five 'S" terms namely Seiri (sorting), Seiton (set in order), Seiso (shine), Seiketsu (standardize) and Shitsuke (sustain). As importance role of 5S implementation in today's organizations, this study aims to review previous studies about benefits of 5S implementation and its efficiency in organizations. Consequently, 5S can support the objectives of organization to achieve continuous improvement in performance and productivity.

Keywords-5S, Red Tag, Audit, Organizational effectiveness.