**A PROJECT REPORT**

**ON**

# "PRODUCTIVITY ENHANCEMENT USING SYSTEMATIC LAYOUT PLANNING AND MONITORING 5S STRATEGIES"

**Submitted to**

## UNIVERSITY OF MUMBAI

**In Partial Fullfilment of the Requirement for the Award of**

**BACHELOR'S DEGREE IN**
**MECHANICAL ENGINEERING**
**BY**


| | |
|---|---|
| **SAYYED AMMAR** | **15ME38** |
| **MAPKAR SARFARAZ** | **15ME28** |
| **THAKUR UZAIR** | **15ME59** |
| **BELAL AHMED** | **15ME07** |


**UNDER THE GUIDANCE OF**
**PROF. AFAQ AHMED**


**DEPARTMENT OF MECHANICAL ENGINEERING**
**Anjuman-I-Islam's Kalsekar Technical Campus**
**SCHOOL OF ENGINEERING & TECHNOLOGY**
Plot No. 2 3, Sector - 16, Near Thana Naka,
Khandagaon, New Panvel - 410206


**2018-2019**

**AFFILIATED TO**

## UNIVERSITY OF MUMBAI

**A PROJECT II REPORT**
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# CERTIFICATE

This is certify that the project entitled

## "PRODUCTIVITY ENHANCEMENT USING SYSTEMATIC LAYOUT PLANNING AND MONITORING 5S STRATEGIES"

submitted by

| | |
|---|---|
| **SAYYED AMMAR** | **15ME38** |
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| **BELAL AHMED** | **15ME07** |

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.

**Date: / /**

**(Prof. AFAQ AHMED)**
**Project Supervisor**

**(Prof. RIZWAN SHAIKH)**
**Project Coordinator**

**(Prof. ZAKIR ANSARI)**
**HOD, Mechanical Department**

**(DR. ABDUL RAZAK HONNUTAGI)**
**Director**

**External Examiner**

# Acknowledgements

I would like to take the opportunity to express my sincere thanks to my guide **Afaq Ahmed**, Assistant Professor, Department of Mechanical Engineering, AIKTC, School of Engineering, Panvel for his invaluable support and guidance throughout my project research work. Without his kind guidance & support this was not possible.

I am grateful to him for his timely feedback which helped me track and schedule the process effectively. His time, ideas and encouragement that he gave is help me to complete my project efficiently.

We would like to express deepest appreciation towards **DR. ABDUL RAZAK HONNUTAGI**, Director, AIKTC, Navi Mumbai, **Prof. ZAKIR ANSARI**, Head of Department of Mechanical Engineering and **Prof. RIZWAN SHAIKH**, Project Coordinator whose invaluable guidance supported us in completing this project.

At last we must express our sincere heartfelt gratitude to all the staff members of Mechanical Engineering Department who helped me directly or indirectly during this course of work.

SAYYED AMMAR
MAPKAR SARFARAZ
THAKUR UZAIR
BELAL AHMED

# Project I Approval for Bachelor of Engineering

This project entitled ***Ïproductivity enhancement using systematic layout planning and monitoring 5S strategies¨*** by ***Sayyed Ammar, Mapkar Sarfaraz, Thakur Uzair, Belal Ahmed*** 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

Small scale industries play an important role in the Indian economy. After agriculture, it has emerged as a powerful tool in providing relatively large employment. The objective of this thesis is to improve the productivity of a company using systematic layout planning and to increase organizational performance by monitoring 5S strategies in a forging company named as **Magmachino forge Pvt. Ltd.** located in Thane-Maharashtra, which is popular in manufacturing and exporting precision machined components. The major problems faced by the company is a poor utilization of space, poor material handling, and poor time management, due to lack of following the principles of 5S and effective plant layout. There is a real need for empirical studies in the field of the new management system and their impact on a company.

In this report, we provide a detail definition of 5S and plant layout; and listed efficient utilization of resources, manufacturing and maintenance ease, enhanced productivity, effective utilization of space, material and time, as well as the increase in efficiency and overall cost. In this report an alternate layout is proposed using activity relationship chart which involves transferring the departments which have high interrelationship close to each other and flow of material, But this does not help in tackling the problems faced by the company due to which we have monitored and implemented 5S technique as it plays an important role in continuous improvement in today's organization. Surveying method is used for data collection which is done by distributing a questionnaire among the workers and owner. The result shows after implementation of 5S it improves organizational performance in day to day working environment and proposing layout results in smooth material flow, efficient utilization of floor area and increase in the area which can be used for more products simultaneously. The final evaluation results show after applying 5S and plant layout strategies, it improves the overall efficiency of the company and cost per manufacturing of a product piece.

**Keywords:** Organizational performance, Utilization, surveying.

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# Chapter 1

# Introduction

In these chapter we have discuss the introduction and exposure of the company named as Magmachino forge pvt.ltd. In this part , the briefing of the goals, objectives, problem statement and scope is discussed in the below topics.

## 1.1 Introduction

In the 21st century business world, companies are exposed to continuous challenges. One of it is to equip organizations with the ability to compete in a global marketplace. Schonberg states that world class performance is dedicated to serving the customer. Thus, to keep track of performance, organizations must develop measures of performance. The current trend in the industry, which is experiencing very competitive era like many others is striving hard to reduce manufacturing costs, improve quality and customer satisfaction. Materials handling equipment and the facilities it operates can contribute to as much as 70 percent of the total cost of the manufactured product. Facilities layout design is part of facilities planning. It is the arrangement of work space which, in general terms smoothest way to access facilities that have strong interactions. The main concern with the plant facility layout planning is to reduce the cost of materials handling as poor materials handling can generate business problems. The best material handling is no handling. Subsequently, a good layout will enable the manufacture of the product economically in the required volume and variety. Other objectives can be stated as effective utilization of manpower, space and infrastructure, as well as providing overall wellbeing and morale of the work. Today s manufacturing industry is facing problems that have been growing and complexity over the last several years. As a result, there is an immediate need for procedures or techniques in solving various problems encountered in today's manufacturing arena without extended shutdown's or expensive modifications (Clark,1996). Based on the above facts, it is obvious that layout optimization 5S is crucial to any facility planning. If not tackled in the early phases, it can generate logistics implications for the company involved.

## 1.2 Project Scope

To study the existing plant layout and implement 5S techniques to suggest some improvements at Magmachino ltd. to reduce overall forging cost and improve working environment.

## 1.3 Problem statement

Magmachino forge Pvt. Ltd. located in Thane which is a forging company finishes the cast product . The company suffers from poor utilization of space, lack of time management, poor material handling and safety precautions. The travelling of material from one station to other stations take a lots of time, also company have implemented 5S principles but it is not in proper sustained along with sort and set in order. This cause high travelling time for the operator and poor working environment which effects in job's efficiency.

## 1.4 Project Goals and Objectives

### 1.4.1 Goals

The project goal was to achieving a desired performance outcome from the new layout and getting a improved efficiency of the workstation. And also to put on some 5s technique to improve the overall efficiency at a specific time of 4 weeks by employing a specific amount of resourceful knowledge from the company. In the end to get the company overall efficiency enhance with better working conditions and comfortable working environment.

### 1.4.2 Objectives

1. To have most effective and optimum utilization of available floor space
2. To develop a new plant layout.
3. To study and identify problems at work area.
4. To provide better quality product at lesser cost to consumers.
5. To measure the improvement after implementing 5S

## 1.5 Introduction to Company

Magmachino Forge Pvt. Ltd. is a small scale company which is ISO 9001-2000 certified engaged in manufacturing and exporting precision components. The unit is established in 1989 by **Pramod Apte sir** since then it enjoys the confidence and goodwill of many customer. There are quite few reputed manufacturers who are daily customers of the company, company have good relation with their customers and manufacturers along with high satisfaction of their product. Company forge the casting material provided by manufacturers based on the CAD design provided to them. Highly tech CNC and VMC are used to forge the product in microns level. Company have 6-7 workers per shift which includes manager, supervisor and working staff and there are 2 to 3 shifts according to conditions . Innovative and superior quality product is manufactured in company based on demands and product delivered within deadlines. Owner of the company is very friendly and supportive and guided us throughout my project research work. His time, ideas and encouragement help me to complete my project efficiently.

## 1.6 Conclusion

In the beginning of this chapter an overview of the company is explained that there are some improvements necessary. The objectives are also defined to be linked to be linked to the deliverable in the case study. The boundary of this project is also defined based on the statement of problem. Some justification and scope of conducting this case study and its importance is discussed.

# Chapter 2

# Literature Survey

## 2.1 Improvement in plant layout using systematic plant layout (SLP) for increasing productivity. (Pramod P. Shewal, Manmath S. Shete, Prof. DR. S. M. Sane)

The objective of this research is to study plant layout of compressor manufacturing based on the systematic layout planning pattern theory (SLP) for increased productivity. In this case study, amount of equipment and tools in compressor production are studied. The detailed study of the plant layout such as operation process chart, flow of material and activity relationship chart has been investigated. The new plant layout has been designed and compared with the present plant layout. The SLP method showed that new plant layout significantly decrease the distance of material flow from stores until dispatch.

According to the analysis of the workflow, it was found that the distance from the moving out of the stores to machining, assembly and to keeping at dispatch was 320 m., reduced to 143 m or reduced by 176 m. As for the c-shaft in the new plant layout, the distance for moving materials is 82 m, reduced from 106 m. or reduced by 24 m. As for the flywheel in the new plant layout, the distance for moving materials is 67 m, reduced from 172 m. or reduced by 105 m. Finally, rearrange layout decreased flow of material, resulting in reduction in waste and increased production.

## 2.2 Improvement in Layout Design using SLP of a small size manufacturing unit: A case study (Chandra Shekhar Tak, Mr.Lalit Yadav)

The paper presents an application of the SLP (System Layout Planning) method for establishing, in an efficient manner, the layout of a productive enterprise. A case study is described in the paper, referring to a factory designated for manufacturing steel almirah. The phases of the SLP method application are described in the paper

together with the presentation of one particular product given as example. The optimal solution of the productive system's layout is selected by analysing three possible identified alternatives.

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## 2.3 Optimization of Plant Layout Using SLP Method (Shubham Barnwal, Prasad Dharmadhikari)

In this paper, ongoing engine reconditioning process layout of an automobile industry are studied and a new layout is developed based on the systematic layout planning pattern theory to reduce engine reconditioning cost and increase productivity Since it is an automobile assembly plant, the company has both processes as well as product layouts. The number of equipment and travelling area of material in engine reconditioning have been analysed. The detailed study of the plant layout such as operation process chart, activity relationship chart and the relationship between equipment and area has been investigated. The new plant layout has been designed and compared with existing plant layout. The new plant layout shows that the distance and overall cost of material flow from stores to dispatch area are significantly decreased. The implementation of proposed model will help in the overall improvement of production performance of the engine reconditioning unit of the corporation.

The proposed model based on SLP is found to be effective in solving the above-mentioned problems. The production rate increased by 28 percent, the production time per bus came down by 3.34 percent and total distance travelled by material came down by 14 percent. In this paper per unit cost and distance are considered to improve existing layout but there are many other parameters to analyse the layout that may be worker number, the area required, equipment required. Due to Lack of opportunity and practical limitations above two parameters are used in our calculation. The problem of existing layout is the large comparative distance between

several departments that's forced to travel a long distance and impedes the smooth material flow and leads to higher cost. In our proposed layout, the position of various departments is altered with various others based on activity relationship chart. It is expected that this proposed model will mostly be preferable while setting up a new plant implementation and will help in the overall improvement of production performance of the engine reconditioning unit of MSRTC.

## 2.4 Planning for a Gas Manufacturing Plant (Chui Wing Cheong Chu Lap Keung)

This case study is regarding facilities planning carried out in a manufacturing plant, named Hong Kong Oxygen. Oxygen supply in tanks is the main products of this company. Plant relocation is needed due to new town planning scheme, by the Hong Kong government. The new town ship will be a residential area replacing the area of this plant. Some of the objectives of this relocation are also better safety could be achieved in the new plant; considerable profit could be derived by redeveloping the existing piece of land into a residential and commercial area. There are 3 locations whereby the company needs to select the lowest transportation cost among 3 locations to minimize delivery cost. After the selection of the strategic location, Systematic Layout Planning is used to develop block plans based on the data input, activity relationship diagrams, activity relationships charts. The best solution is this case study utilized computer aided planning (CORELAP), which is a construction type of layout program, to generate layout alternatives, to generate a new layout from the activity relationship diagram, space requirements and shape. The best layout is selected based on the most favourable compromise among a list of competing criteria. The layout alternative which has the highest score of competing criteria is selected. Results are relocation of new plant to new location, Tseung Kwan, which has minimum transportation cost. The best layout selected has the most compromising among the competing criteria in terms of economy of material handling, safety, ease of supervision, room for expansion, flow of material and convenience. The limitations however, are it did not publish the quantitative improvements as it only uses the ratings. No actual data of performance measures indicators. The reader will not have a clear idea on the improvements before and after re-layout.

## 2.5 Review on Implementation of 5S in Various Organization (Vipulkumar C. Patel,Dr.Hemant Thakkar)

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. The 5S methodology permits to analyze the processes running on the workplace and establishment of 5S sustaining well organized, clean, high effective and high quality workplace. Research clearly show, that very essential is training of workers about the 5S rules. 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.

5S is a technique originated from Japan and it was first developed by Hiroyuki Hirano. It include five words Seiri, Seiton, Seiso, Seiketsu and Shitsuke, which means Sort, Set in order, Shine, Standardize and Sustain respectively. The 5S technique is included within Kaizen which means change for the better. It allows the enhancement of efficiency and productivity. The 5S technique is a structured program to systematically achieve total organization cleanliness, and standardization in the workplace. The benefit of 5S technique is improvement in productivity, quality, health and safety [1, 6, 7, 12]. Term of 5S given as: SEIRI(sort): the removal of all unwanted, unnecessary, and unrelated materials in the workplace. SEITON(set in order): This step consists of putting everything in an assigned place so that it can be accessed or retrieved quickly as well as returned in that same place quickly. SEISO(shine/clean): It is consists of cleaning up the workplace and giving it a 'shine'. SEIKETSU(standardize): It defining the standards by which personnel must measure and maintain cleanliness. SHITSUKE(sustain): This last step is about 'Discipline.' It maintain orderliness and to practice the first 4 S as a way of life the introduction of the paper should explain the nature of the problem, previous work, purpose, and the contribution of the paper. The contents of each section may be provided to understand easily about the paper.

## 2.6 Conclusions

In this chapter, the literature review of facilities planning and types of layout is discussed. Apart from that, some review on previous trends of layout improvement methodology is reported, followed by systematic planning layout (SLP) methodology. From the review of the literature indicated in the above section, it can be concluded that there have been numerous research activities in the area of layout design. There also have been a number of algorithms developed. Existing literature for a layout design problem often fall unto two major categories as algorithmic and procedural approaches Algorithmic approaches usually simplify both design constraints and objectives in order to reach a surrogate objective function which solution can then be obtained (Peters and Yang 1997; Cardarelli and Pelagagge,1995; Geiger et al,1997). These approaches usually involve quantitative input data. Their design solutions are easier to be evaluated by comparing their objectives functions.

The output from algorithmic approaches often need further modifications in order to satisfy detailed design requirements such as departmental shapes, utilities supply, material handling system, ergonomics concerns, work in process storage, space utilization, etc. Advance training in mathematical modelling techniques are often pre-requisites for a designer to use algorithmic approaches. Accordingly, many companies hesitate to adopt algorithmic approaches as their design methodologies.

Procedural approaches can incorporate both qualitative and quantitative objectives in the design process (Padilli et al,1997; Apple ,1997; Muther 1973) For these approaches, the design process is divided into several steps that are then solved sequentially. The success of a procedural approach implementation is dependent on the generation of quality design alternatives that are often from the output of an experienced designer.

Systematic Layout Planning (SLP) is a procedural layout design approach. The process involved in performing SLP is relatively straight forward; however, it is a proven tool in providing layout design guidelines in practice in the past few decades. This case study proposes to use Muther‘’s systematic layout planning (SLP) (Muther 1973) as the infrastructure to solve an electronic layout problem.

# Chapter 3

# Theory and Problem Identification

## 3.1 Introduction

In this chapter we have discuss in detail about the plant layout and 5S principles. In further topic we have discuss the identification of area to implement 5S and systematic layout planning.

## 3.2 Philosophy of 5S

5S is a workplace organization method that uses a list of five Japanese words: seiri , seiton , seisō , 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 a dialogue about standardization, which builds understanding among employees of how they should do the work.The 5S Method is a standardized process that when properly implemented creates and maintains an organized, safe, clean and efficient workplace. Improved visual controls are implemented as part of 5S to make any process non-conformance's obvious and easily detectable. 5S is often one element of a larger Lean initiative and promotes continuous improvement.


### 3.2.1 Seiri or Sort

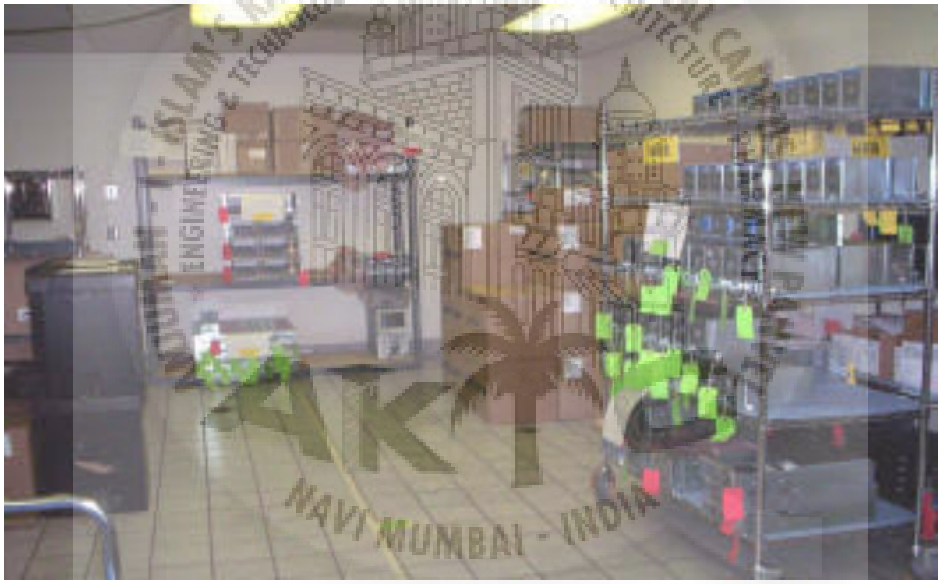


**Figure 3.1: SORT**

The first step in 5S is sorting. During sorting the team should go through all items in the work area including any tools, supplies, bulk storage parts, etc. The 5S team leader should review and evaluate every item with the group. This will help to identify which items are essential for getting the job done effectively and efficiently. If the item is essential for everyday operations it should be tagged and cataloged. If the item is not essential, determine how often it is used in the performance of work in that area. If it is a bulk item, decide the proper amount to be kept in the area and move the remaining quantity to storage. Excess inventory is one form of waste and should be eliminated during the 5S activities.

### 3.2.2 Seiton or Set in order


in order.jpeg

**Figure 3.2: SET IN ORDER**

Designate a place for all items that remain in the work area. Put all items in their designated location. An often referenced quote is "A place for everything and everything in its place". During the straighten step, look for ways to reduce or eliminate waste. One form of waste in a process is unnecessary operator motion or movement. Therefore, frequently used tools and supplies should be stored in the immediate work area close to the operator. One effective method commonly used to avoid wasted time searching for the correct tool is constructing shadow boards for all essential tools. Items that are not used as often should be stored based on their frequency of use. All parts bins should be properly labeled. The label should include part number, part description, storage location and the recommended min / max quantities. A properly straightened work area allows the operator to quickly review and verify that they have everything they need to successfully perform their task at hand.

### 3.2.3 Seiso or Shine


**Figure 3.3: SHINE**

The next step is to clean everything in the area and remove any trash. To be effective we must keep the area and any related equipment clean. Dirty process equipment can actually increase the potential for process variability and lead to equipment failure. Lost time due to equipment failure is considered waste and non-value-added time. A dirty area can also contribute to safety issues that have the potential to cause a worker to be injured. Operators should clean their areas at the end of each shift. By doing this they will likely notice anything out of the ordinary such as oil or lubricant leaks, worn lift cables, burnt out bulbs, dirty sensors, etc. The purpose is to reduce waste and improve operator safety and efficiency

### 3.2.4 Seiketsu or Standardize

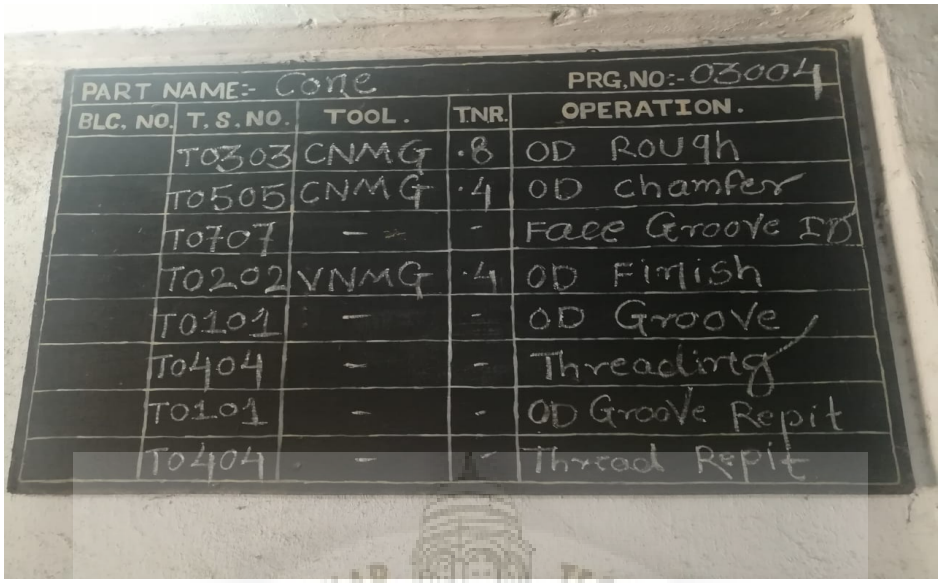



**Figure 3.4: STANDARDIZE**

The fourth step has been called the most important step in the 5S Process. In this step we must develop the standards for the 5S system. They will be the standards by which the previous 5S steps are measured and maintained. In this step, work instructions, checklists, standard work and other documentation are developed. Without work instructions or standard work, operators tend to gradually just do things their own way instead of what was determined by the team. The use of visual management is very valuable in this phase. Color coding and standard colors for the surroundings are sometimes used. Photos of the area in the standard 5S configuration are often posted for easier identification of non-conformance's. The operators are trained to detect non-conforming conditions and correct them immediately. Schedules should also be developed for regular maintenance activities in each area.

### 3.2.5 Shitsuke or Sustain


**Figure 3.5: SUSTAIN**

This step in the 5S Process can sometimes become the most challenging of all the five steps. Sustaining is the continuation of the Sort, Straighten, Shine and Standardize steps. It is the most important step in that it addresses the need to perform 5S on a consistent and systematic basis. During this step a standard audit system is usually developed and implemented. The goal of the sustain step is to ingrain the 5S process into the company culture. The company must strive to make 5S a way of life so the benefits gained through the exercise can be maintained. 5S is not a one-time exercise. Following the 5S Process must become a habit.

# 5S EVALUATION - PRODUCTION

Magmachino Forge Pvt. Ltd.

| SORT - Proper arrangements | SCORE | | | | | |
|---|---|---|---|---|---|---|
| | 5 | 4 | 3 | 2 | 1 | Total |
| 1. Does the inventory include any unneeded material or parts? | | | | | | 3 |
| 2. Are there any unused machines or equipments around? | | | | | | 2 |
| 3. Are there any unused jigs, tools, dies or similar items ? | | | | | | 3 |
| 4. Have unneeded items been marked? | | | | | | 2 |
| 5. Do workers follow unneeded standards? | | | | | | 3 |
| | | | | | SORT | 13 |

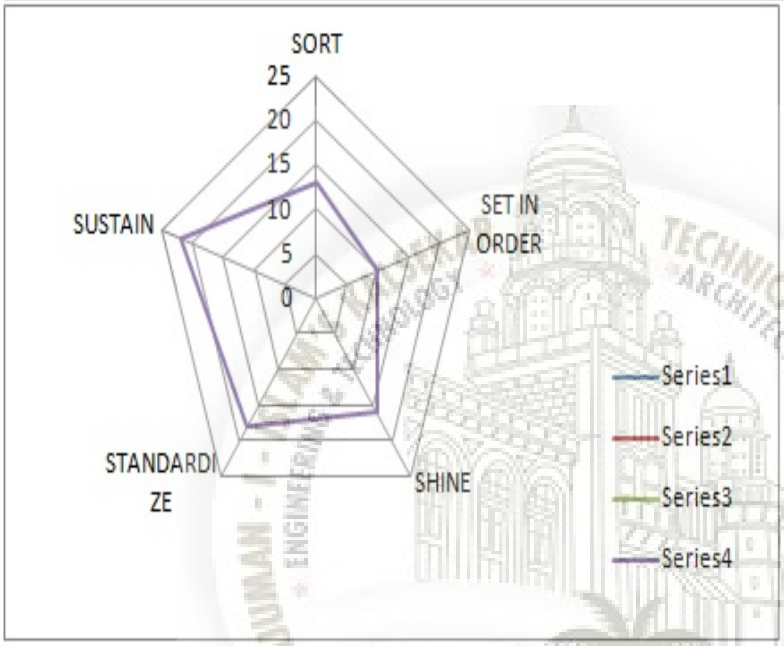
| SET IN ORDER - Orderliness | SCORE | | | | | |
|---|---|---|---|---|---|---|
| | 5 | 4 | 3 | 2 | 1 | Total |
| 1. Are shelves and storages are marked with indicator and addresses? | | | | | | 2 |
| 2. Do the shelves have signboard showing item to go? | | | | | | 2 |
| 3. Are the maximum and minimum quantity indicated? | | | | | | 2 |
| 4. Are markers used to indicate storage areas? | | | | | | 2 |
| 5. Are tools and gauges arranged properly? | | | | | | 2 |
| | | | | | SET IN ORDER | 10 |

| SHINE - Cleanliness | SCORE | | | | | |
|---|---|---|---|---|---|---|
| | 5 | 4 | 3 | 2 | 1 | Total |
| 1. Are floors kept shiny and clean? | | | | | | 3 |
| 2. Are machines covered with shavings and oils? | | | | | | 4 |
| 3. Do operators clean their machines while checking them? | | | | | | 3 |
| 4. Have specific cleaning task assigned to operater? | | | | | | 2 |
| 5. Has cleanliness becomes a habit? | | | | | | 4 |
| | | | | | SHINE | 16 |

| STANDARDIZE - Keep under Standards | SCORE | | | | | |
|---|---|---|---|---|---|---|
| | 5 | 4 | 3 | 2 | 1 | Total |
| 1. Is the room ventilated well enough to clear heavy dust and odors? | | | | | | 4 |
| 2. Is the angle and intensity of light is proper for work? | | | | | | 4 |
| 3. Are workers wearing dirty or oil stained clothes? | | | | | | 4 |
| 4. Have improvements been made to prevent things from dirty? | | | | | | 4 |
| 5. Are the first three 5S being maintained? | | | | | | 2 |
| | | | | | STANDARDIZE | 18 |

**Figure 3.6: Before implementation of 5S**

| SUSTAIN - Discipline | SCORE | | | | | |
|---|---|---|---|---|---|---|
| | 5 | 4 | 3 | 2 | 1 | Total |
| 1. Do workers have uniforms? | | | | | | 5 |
| 2. Do people verbally acknowledge each other when they meet? | | | | | | 4 |
| 3. Are people punctual about their breaktime? | | | | | | 4 |
| 4. Do workers reviews rules and regulations? | | | | | | 4 |
| 5. Do people obey rules and regulations? | | | | | | 5 |
| SUSTAIN | | | | | | 22 |




Graph - RADAR CHART

| | |
|---|---|
| SORT | 13 |
| SET IN ORDER | 10 |
| SHINE | 16 |
| STANDARDIZE | 18 |
| SUSTAIN | 22 |
| Total | 79 |

**Figure 3.7: Before implementation of 5S**

## 3.3 Plant layout

Systematic layout planning is the tool used to adjust the desired machines at work-place in such a way that it will minimize material handling throughout different workstations and enhance productivity. Increasing global competition with demand of product is increasing and resources are limited. The industry should produce a product with standard quality which meets customer demand. The impotence to get production process right in workplace leads to delay, excessive inventory, inefficiency, quality of product, high cost etc. hence the need of referring to technique which helps in making right functional plant layout of an organization .The different techniques can be used to improve productivity like TQM , QC, control chart, plant layout etc. Systematic layout planning could be tool to improve productivity in industry by reduction in cost with proper workflow. The research paper presents

solving of industrial problem using systematic layout planning in which flow of product (pump impeller) from raw material to dispatch has been studied and existing layout is made. While Designing new plant layout, following entities need to be considered like parts, process, fixed position layout etc. The propose layout is made with help of activity relationship chart. The string diagram is used for measuring the travel distance by product through different workplaces .it has been measured in both existing and proposed layout. The travelling distance and Cost of material handling between workstations is compared in both cases and it has been concluded at the end that efficiency has been improved in proposed layout.

## 3.4 Systematic layout planning

In 1973 Richard Muther proposed the Systematic Layout Planning (SLP) method that formalizes the whole layout process as a pattern of procedures through which each layout project passes. The design of process is being treated step wise starting from the generation of alternatives, evaluation, selection, and implementation. It has been wisely used since its introduction which has proven to work well in many situations, Overall there are 11 stages required to complete an SLP.

1. Gather input data
2. Identify flow of material.
3. Identify relationships between activities and resources.
4. Create string diagram.
5. Determine space requirement.
6. Quantify space availability.
7. Create a space relationship diagram.
8. Identify modifying considerations.
9. Apply practical limitations.
10. Developing layout alternatives.
11. Evaluation of final design.

some stages are shown in methodology chapter.

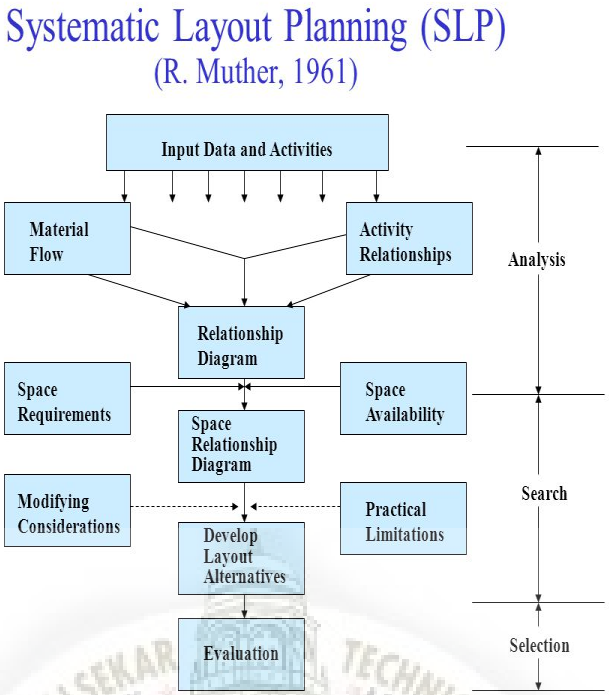



**Figure 3.8: Flow chart of SLP**

### 3.4.1 Input Data and Activities

The input variables for every SLP and P, Q, R, S and T. P (Product), material or service that will be processed. Q (Quantity), is the volume each item to be processed. R (Routing), is the path an item travels to be processed. S (Services), refers to services required to complete this processing and T (Time), refers to the overall time required to complete processing should be scrutinized in order to assure the validness of the input data at the design stage.

### 3.4.2 Flow of material analysis

All material flows from the whole production line are aggregated into a from to-chart that represents the flow intensity among different departments. The analysis of material flow involved determining the most effective sequence of work and material. An effective flow means that the materials move progressively through the process and should always advance without excessive detours. In traditional manufacturing applications, the flow is determined from either the product or the process.

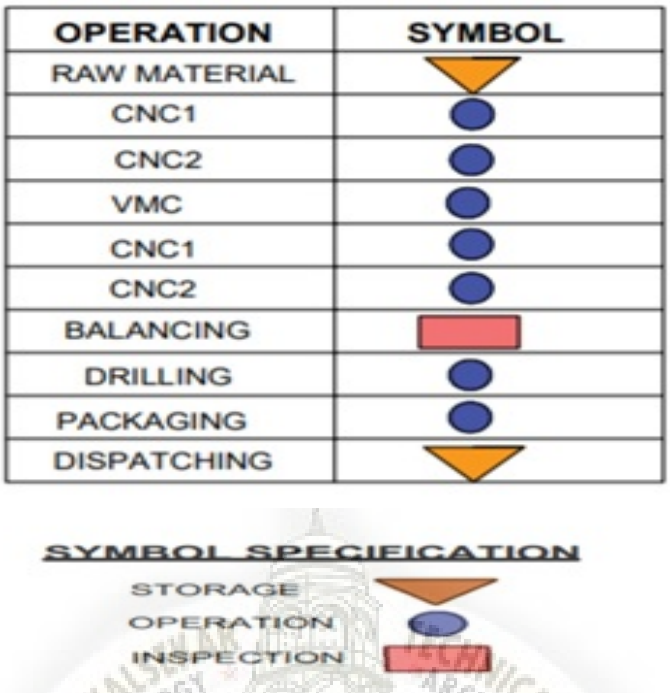



**Figure 3.9: Flow of material**

### 3.4.3 Activity Relationship Diagram

The step of activity relationships performs qualitative analysis towards the closeness relationship decision between activities and resources. The results will be displayed into an activity relationship chart. The relationship chart displays which entities are related to others and it also rates the importance of the closeness between them. These ratings make the relationship chart one of the most effective tools for layout planning and are the best way of planning the arrangement of facilities. The activity relationship chart itself is a record keeping tool to organize data into a usable form. With this data and Activity Relationship Diagram was generated where proximity and relationship are visually evident. 1. Stabilizer-1, 2. Stabilizer-2, 3. Tool rack-1, 4. Tool rack-2, 5. CNC-1, 6. CNC-2, 7. VMC, 8. Drilling, 9. Cutter, 10. Storage area-1, 11. Storage area-2(raw material), 12. Storage area -3(scrap), 13. Static balancing (inspection), 14. Desk, 15. Compressor -1, 16. Compressor-2, 17. Compressor-3(useless), 18. Hacksaw (useless), 19. Packaging area.

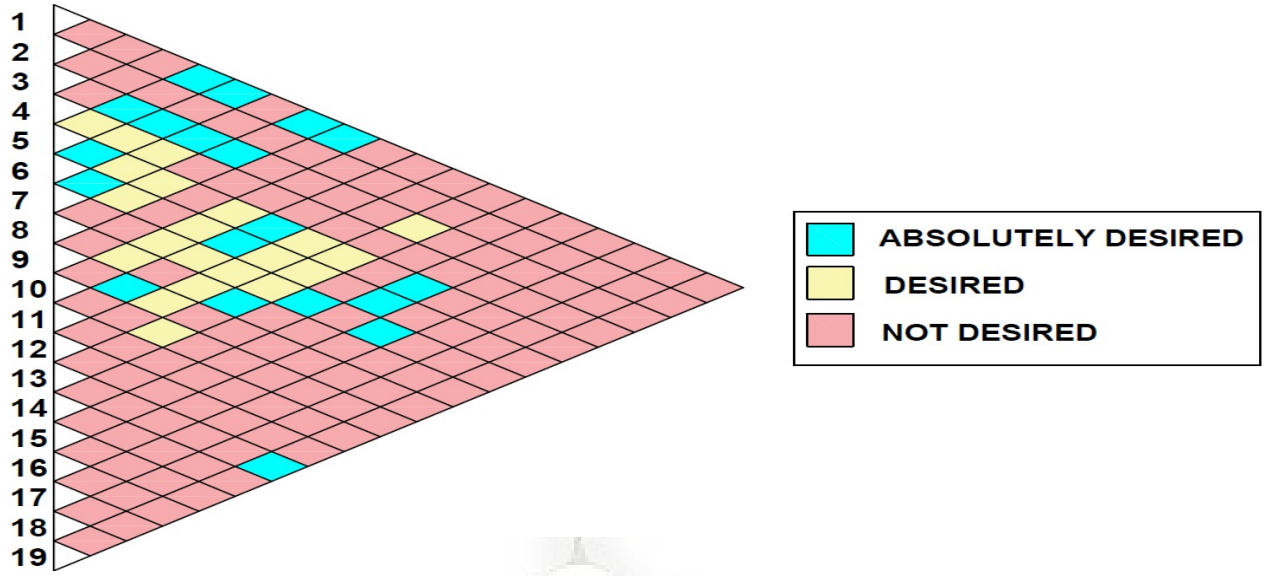



**Figure 3.10: Activity Relationship Diagram**

### 3.4.4 Existing Plantlayout

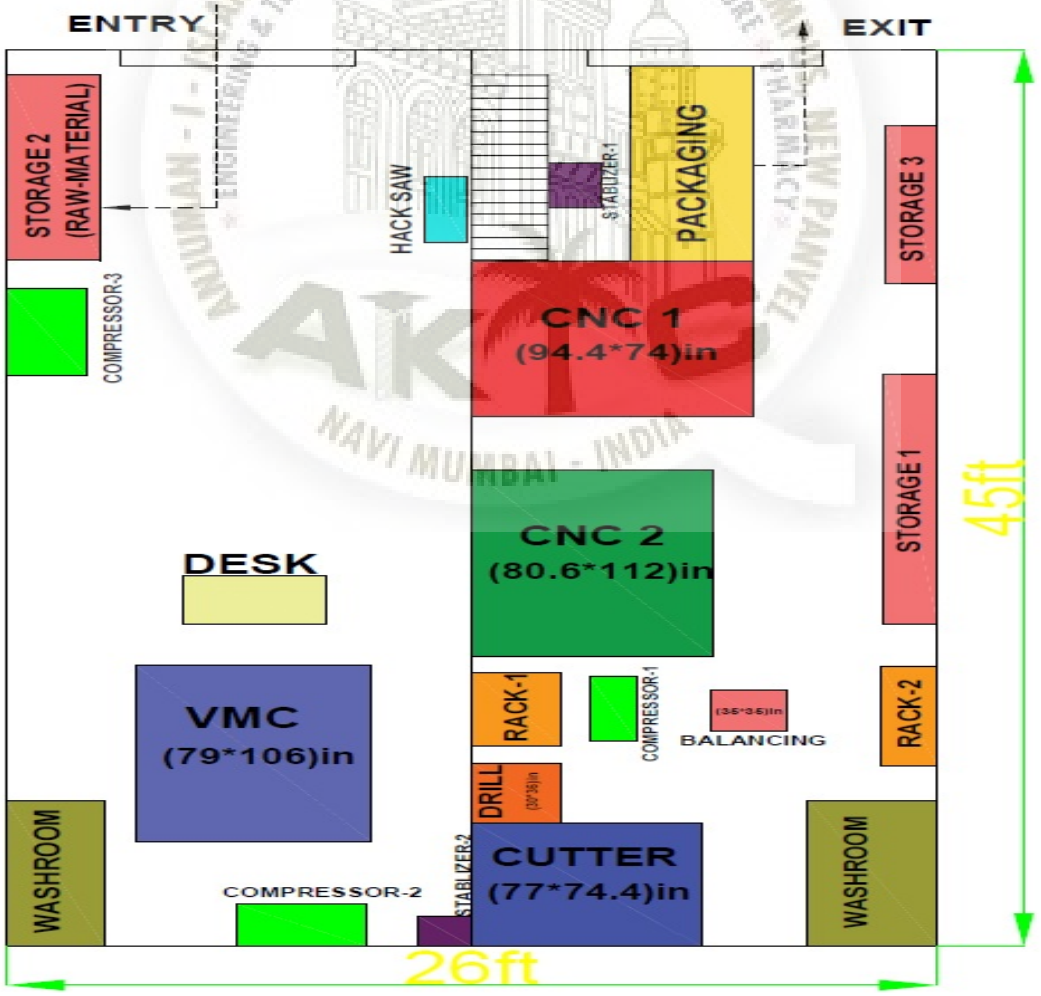



**Figure 3.11: Existing Plantlayout**

### 3.4.5 Space Requirement

Now that relationships have been identified, special requirements must be analysed and then applied to a spatial relationship diagram. The information to be included in terms of amount of space, equipment and operational improvements for each activity has to be determined. Cost per foot of the job is also calculated as it is provided by the owner of company.

| Column1 | Column2 | Column3 | Column4 |
|---|---|---|---|
| From | To | Distance (ft) | Unit Cost (rs) |
| raw material | cnc 1 | 32.1 | 235.29 |
| cnc 1 | cnc 2 | 2.667 | 19.54 |
| cnc 2 | vmc | 75.51 | 553.48 |
| vmc | cnc 1 | 65.01 | 476.52 |
| cnc 1 | cnc2 | 2.667 | 19.05 |
| cnc 2 | static balancing | 2.68 | 19.64 |
| drilling | packaging | 4.18 | 30.63 |
| packaging | dispatch | 31.86 | 233.53 |
| | Total | 216.674 | 1587.68 |

**Figure 3.12: Distance travel by job and cost per foot.**

### 3.4.6 Space Available

During this step, a square footage is assigned to each activity. The space assigned to each activity is predicated previously in the space requirements step. The total available space at the plant is reviewed. The area is divided at first approach to estimate the space required for each department. When performing the detailed layout, it is required to have more accurate shapes adjusted to the reality. The total available area of the company is 1170 sq.ft.

### 3.4.7 Modifying Constraints

These are additional constraints for the department during the initial stages of the new layout design. It is in terms of space requirement or department personnel needs.

### 3.4.8 Practical Limitation

Practical limitation can be in terms of budget or space.

## 3.5 Conclusion

In these chapter we have given a detail information regarding the 5s philosophy and systematic layout planning. We have identified the problems and find a method how to overcome the problem. This research help the company to increase in its profit there by economically divided the work among the employees.

# Chapter 4

# Methodology

## 4.1 Methodology of 5S

5S is analyzed with the help of ”Visual Inspection Scoring System” and ”5S Rating System”.

### 4.1.1 Visual Inspection Method

In these method we give scoring to any 5S question according to the visual conditions, If the Inspection fulfill all the demand then we give the highest scoring i.e. ’5’.If the inspection is good but not fulfilling all the demands then we give ’4’.If the inspection is average then we give ’3’, If the inspection is missing 75percent of criteria then we give ’2’, and If the inspection gives worst result then we have to score it as ’1’. Initial inspection reading is provided by the company and after applying 5S we have given the score according to the conditions.After implementation and inspecting result is obtained in the form of Radar chart.

# 5S EVALUATION - PRODUCTION

A HIGH SCORE IS DESIRABLE

| SORT - Proper arrangements | SCORE | | | | | |
|---|---|---|---|---|---|---|
| | 5 | 4 | 3 | 2 | 1 | Total |
| 1. Does the inventory include any unneeded material or parts? | | | | | | 4 |
| 2. Are there any unused machines or equipments around? | | | | | | 4 |
| 3. Are there any unused jigs,tools,dies or similar items ? | | | | | | 3 |
| 4. Have unneeded items been marked? | | | | | | 4 |
| 5. Do workers follow unneeded standards? | | | | | | 3 |
| | | | | | SORT | 18 |

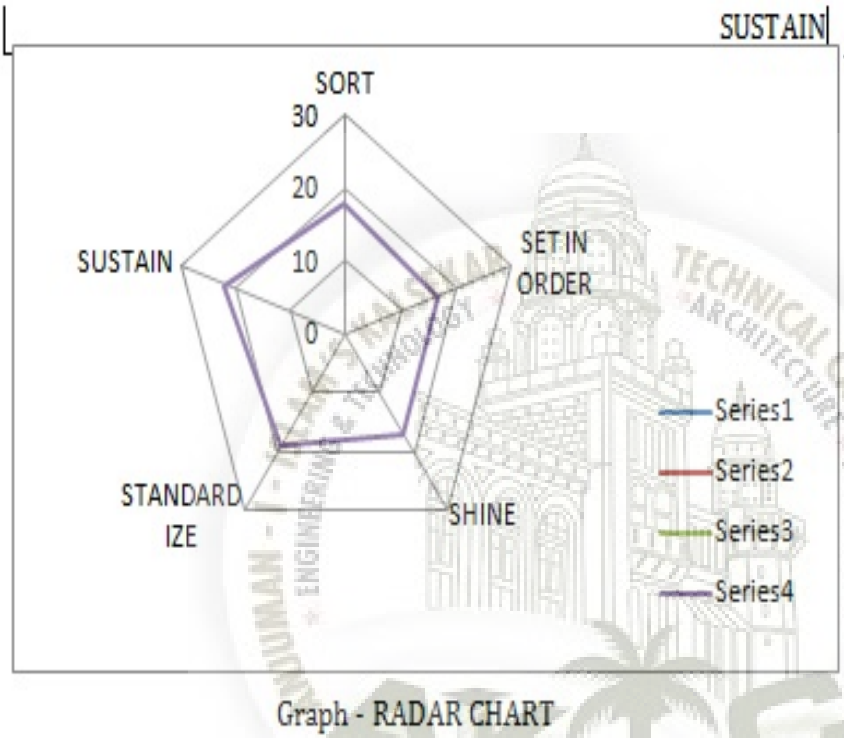
| SET IN ORDER - Orderliness | SCORE | | | | | |
|---|---|---|---|---|---|---|
| | 5 | 4 | 3 | 2 | 1 | Total |
| 1. Are shelves and storages are marked with indicator and addresses? | | | | | | 4 |
| 2. Do the shelves have signboard showing item to go? | | | | | | 4 |
| 3. Are the maximum and minimum quantity indicated? | | | | | | 2 |
| 4. Are markers used to indicate storage areas? | | | | | | 4 |
| 5. Are tools and gauges arranged properly? | | | | | | 3 |
| | | | | SET IN ORDER | | 17 |

| SHINE - Cleanliness | SCORE | | | | | |
|---|---|---|---|---|---|---|
| | 5 | 4 | 3 | 2 | 1 | Total |
| 1. Are floors kept shiny and clean? | | | | | | 3 |
| 2. Are machines covered with shavings and oils? | | | | | | 4 |
| 3. Do operators clean their machines while checking them? | | | | | | 3 |
| 4. Have specific cleaning task assigned to operator? | | | | | | 3 |
| 5. Has cleanliness becomes a habit? | | | | | | 4 |
| | | | | | SHINE | 17 |

| STANDARDIZE - Keep under Standards | SCORE | | | | | |
|---|---|---|---|---|---|---|
| | 5 | 4 | 3 | 2 | 1 | Total |
| 1. Is the room ventilated well enough to clear heavy dust and odors? | | | | | | 4 |
| 2. Is the angle and intensity of light is proper for work? | | | | | | 4 |
| 3. Are workers wearing dirty or oil stained clothes? | | | | | | 4 |
| 4. Have improvements been made to prevent things from dirty? | | | | | | 4 |
| 5. Are the first three 5S being maintained? | | | | | | 3 |
| | | | | | STANDARDIZE | 19 |

**Figure 4.1: After implement**

| SUSTAIN - Discipline | SCORE | | | | | |
|---|---|---|---|---|---|---|
| | 5 | 4 | 3 | 2 | 1 | Total |
| 1. Do workers have uniforms? | | | | | | 5 |
| 2. Do people verbally acknowledge each other when they meet? | | | | | | 4 |
| 3. Are people punctual about their break time? | | | | | | 4 |
| 4. Do workers reviews rules and regulations? | | | | | | 4 |
| 5. Do people obey rules and regulations? | | | | | | 5 |
| | | | | | | 22 |




Graph - RADAR CHART

| | |
|---|---|
| SORT | 18 |
| SET IN ORDER | 17 |
| SHINE | 17 |
| STANDARDIZE | 19 |
| SUSTAIN | 22 |
| Total | 93 |

**Figure 4.2: After implement**

### 4.1.2 5S Rating System

We have evaluated our result after monitoring 5S in terms of weeks. The result obtained were calculated in terms efficiency and we can see after 4 weeks the efficiency is improved thereby improving working environment.

**WEEK 1**

| Column1 | Column2 | Column3 | Column4 |
|---|---|---|---|
| Total items (X) | 88 | **S1 SEIRI RATING** | |
| Defective items (Y) | 24 | 1.Material availibility rating | 1 |
| Waste eliminated in kg (M) | 14 | 2.Defective goods rating=(1-Y/X) | 0.7272727 |
| Total waste in kg (N) | 24 | 3.Operating condition rating | 1 |
| Total number of tools (A) | 100 | 4.Elimination of waste rating=(1-M/N) | 0.4166667 |
| Tools not in proper sequence (B) | 25 | ***TOTAL RATING*** | ***3.1439394*** |
| Total material required (C) | 88 | **S2 SEITON RATING** | |
| Lack of material (D) | 0 | 1.Sequence rating=(1-B/A) | 0.75 |
| Total number of irregular processes (P) | 0 | 2.Material arrangement rating =(1-D/C) | 1 |
| Total number of processes (Q) | 8 | 3.Tool arrangemnet rating=(1-P/Q) | 1 |
| Total number of fail arrangement (I) | 0 | ***TOTAL RATING*** | ***2.75*** |
| Total aspect of favorable condition (J) | 8 | **S3 SEISO RATING** | |
| Total number of accident chances (K) | 0.2 | 1.Process path cleanliness rating | 1 |
| Total number of accidents occurs (L) | 0 | 2.Working environment rating=(1-I/J) | 1 |
| Total number of cleaning required (E) | 1 | 3.Safety rating =(1-L/K) | 1 |
| Total number of cleaning not done (F) | 0.4 | 4.Cleaning consistency rating=(1-F/E) | 0.6 |
| | | ***TOTAL RATING*** | ***3.6*** |
| | | | |
| | | **S4 SEIKETSU RATING** | |
| | | S4=(S1+S2+S3)/3 | ***3.1646465*** |
| **EFFICINCY OF 5S SYSTEM** | | | |
| | | **S5 SHITSUKE RATING** | |
| efficiency=(S1+S2+S3+S4+S5)*100/25 (%) | ***63.2929293*** | S5=(S1+S2+S3+S4)/4 | ***3.1646465*** |

**Figure 4.3: Week 1**

After 1 week the Efficiency obtained is 63.29 percent.

**WEEK 2**

| Column1 | Column2 | Column3 | Column4 |
|---|---|---|---|
| Total items (X) | 88 | **S1 SEIRI RATING** | |
| Defective items (Y) | 15 | 1.Material availibility rating | 1 |
| Waste eliminated in kg (M) | 7 | 2.Defective goods rating=(1-Y/X) | 0.8295455 |
| Total waste in kg (N) | 15 | 3.Operating condition rating | 1 |
| Total number of tools (A) | 100 | 4.Elimination of waste rating=(1-M/N) | 0.5333333 |
| Tools not in proper sequence (B) | 14 | ***TOTAL RATING*** | ***3.3628788*** |
| Total material required (C) | 88 | **S2 SEITON RATING** | |
| Lack of material (D) | 0 | 1.Sequence rating=(1-B/A) | 0.86 |
| Total number of irregular processes (P) | 0 | 2.Material arrangement rating =(1-D/C) | 1 |
| Total number of processes (Q) | 8 | 3.Tool arrangemnet rating=(1-P/Q) | 1 |
| Total number of fail arrangement (I) | 0 | ***TOTAL RATING*** | ***2.86*** |
| Total aspect of favorable condition (J) | 8 | **S3 SEISO RATING** | |
| Total number of accident chances (K) | 0.2 | 1.Process path cleanliness rating | 1 |
| Total number of accidents occurs (L) | 0 | 2.Working environment rating=(1-I/J) | 1 |
| Total number of cleaning required (E) | 1 | 3.Safety rating =(1-L/K) | 1 |
| Total number of cleaning not done (F) | 0.3 | 4.Cleaning consistency rating=(1-F/E) | 0.7 |
| | | ***TOTAL RATING*** | ***3.7*** |
| | | | |
| | | **S4 SEIKETSU RATING** | |
| | | S4=(S1+S2+S3)/3 | ***3.3076263*** |
| **EFFICINCY OF 5S SYSTEM** | | | |
| | | **S5 SHITSUKE RATING** | |
| efficiency=(S1+S2+S3+S4+S5)*100/25 (%) | ***66.1525253*** | S5=(S1+S2+S3+S4)/4 | ***3.3076263*** |

**Figure 4.4: Week 2**

After 2 week the Efficiency obtained is 66.15 percent.

**WEEK 3**

| Column1 | Column2 | Column3 | Column4 |
|---|---|---|---|
| Total items (X) | 88 | **S1 SEIRI RATING** | |
| Defective items (Y) | 14 | 1.Material availibility rating | 1 |
| Waste eliminated in kg (M) | 5 | 2.Defective goods rating=(1-Y/X) | 0.8409091 |
| Total waste in kg (N) | 14 | 3.Operating condition rating | 1 |
| Total number of tools (A) | 100 | 4.Elimination of waste rating=(1-M/N) | 0.6428571 |
| Tools not in proper sequence (B) | 8 | ***TOTAL RATING*** | ***3.4837662*** |
| Total material required (C) | 88 | **S2 SEITON RATING** | |
| Lack of material (D) | 0 | 1.Sequence rating=(1-B/A) | 0.92 |
| Total number of irregular processes (P) | 0 | 2.Material arrangement rating =(1-D/C) | 1 |
| Total number of processes (Q) | 8 | 3.Tool arrangemnet rating=(1-P/Q) | 1 |
| Total number of fail arrangement (I) | 0 | ***TOTAL RATING*** | ***2.92*** |
| Total aspect of favorable condition (J) | 8 | **S3 SEISO RATING** | |
| Total number of accident chances (K) | 0.2 | 1.Process path cleanliness rating | 1 |
| Total number of accidents occurs (L) | 0 | 2.Working environment rating=(1-I/J) | 1 |
| Total number of cleaning required (E) | 1 | 3.Safety rating =(1-L/K) | 1 |
| Total number of cleaning not done (F) | 0.3 | 4.Cleaning consistency rating=(1-F/E) | 0.7 |
| | | ***TOTAL RATING*** | ***3.7*** |
| | | | |
| | | **S4 SEIKETSU RATING** | |
| | | S4=(S1+S2+S3)/3 | ***3.3679221*** |
| **EFFICINCY OF 5S SYSTEM** | | | |
| | | **S5 SHITSUKE RATING** | |
| efficiency=(S1+S2+S3+S4+S5)*100/25 (%) | ***67.3584416*** | S5=(S1+S2+S3+S4)/4 | ***3.3679221*** |

**Figure 4.5: Week 3**

After 3 week the Efficiency obtained is 67.35 percent.

**WEEK 4**

| Column1 | Column2 | Column3 | Column4 |
|---|---|---|---|
| Total items (X) | 88 | **S1 SEIRI RATING** | |
| Defective items (Y) | 5 | 1.Material availibility rating | 1 |
| Waste eliminated in kg (M) | 1 | 2.Defective goods rating=(1-Y/X) | 0.9431818 |
| Total waste in kg (N) | 5 | 3.Operating condition rating | 1 |
| Total number of tools (A) | 100 | 4.Elimination of waste rating=(1-M/N) | 0.8 |
| Tools not in proper sequence (B) | 0 | ***TOTAL RATING*** | ***3.7431818*** |
| Total material required (C) | 88 | **S2 SEITON RATING** | |
| Lack of material (D) | 0 | 1.Sequence rating=(1-B/A) | 1 |
| Total number of irregular processes (P) | 0 | 2.Material arrangement rating =(1-D/C) | 1 |
| Total number of processes (Q) | 8 | 3.Tool arrangemnet rating=(1-P/Q) | 1 |
| Total number of fail arrangement (I) | 0 | ***TOTAL RATING*** | ***3*** |
| Total aspect of favorable condition (J) | 8 | **S3 SEISO RATING** | |
| Total number of accident chances (K) | 0.2 | 1.Process path cleanliness rating | 1 |
| Total number of accidents occurs (L) | 0 | 2.Working environment rating=(1-I/J) | 1 |
| Total number of cleaning required (E) | 1 | 3.Safety rating =(1-L/K) | 1 |
| Total number of cleaning not done (F) | 0.2 | 4.Cleaning consistency rating=(1-F/E) | 0.8 |
| | | ***TOTAL RATING*** | ***3.8*** |
| | | | |
| | | **S4 SEIKETSU RATING** | |
| | | S4=(S1+S2+S3)/3 | ***3.5143939*** |
| **EFFICINCY OF 5S SYSTEM** | | | |
| | | **S5 SHITSUKE RATING** | |
| efficiency=(S1+S2+S3+S4+S5)*100/25 (%) | ***70.2878788*** | S5=(S1+S2+S3+S4)/4 | ***3.5143939*** |

**Figure 4.6: Week 4**

After 4 week the Efficiency obtained is 70.28 percent.

Conclusion

We can see after implementing these two methods the efficiency of working environment increased and also the sustainability is well adopted by the employee of the Company. Radar Chart of visual inspection shows the weak areas of 5S is optimized and efficiency is improved in the 4 weeks after analyzing the 5S Rating System.

## 4.2 Methodology of Plant Layout

After detail study of the manufacturing process, it was found that the distance travel by the raw material needs to be reduced and it is done by applying systematic layout planning. The relative importance of having one department near another is displayed in relationship chart. "Robert Muther" developed the REL chart. The relationship diagrams recognize the need for exploring relationship rather than calculating exact flow and cost. Here we are using similar technique in which three different colours are used to indicate the closeness desired between machines and other resources. Since, it is small scale company we are listing all resources. After making activity relationship chart the proposed layout is made. Activity Relationship Chart after studying is shown on page no.19.

### 4.2.1 Proposed Layout

The new layout is based on activity relationship chart, where by altering position of different machines and resources we are reducing total travel distance by material throughout workplace also we are proposing the door between the two sections.

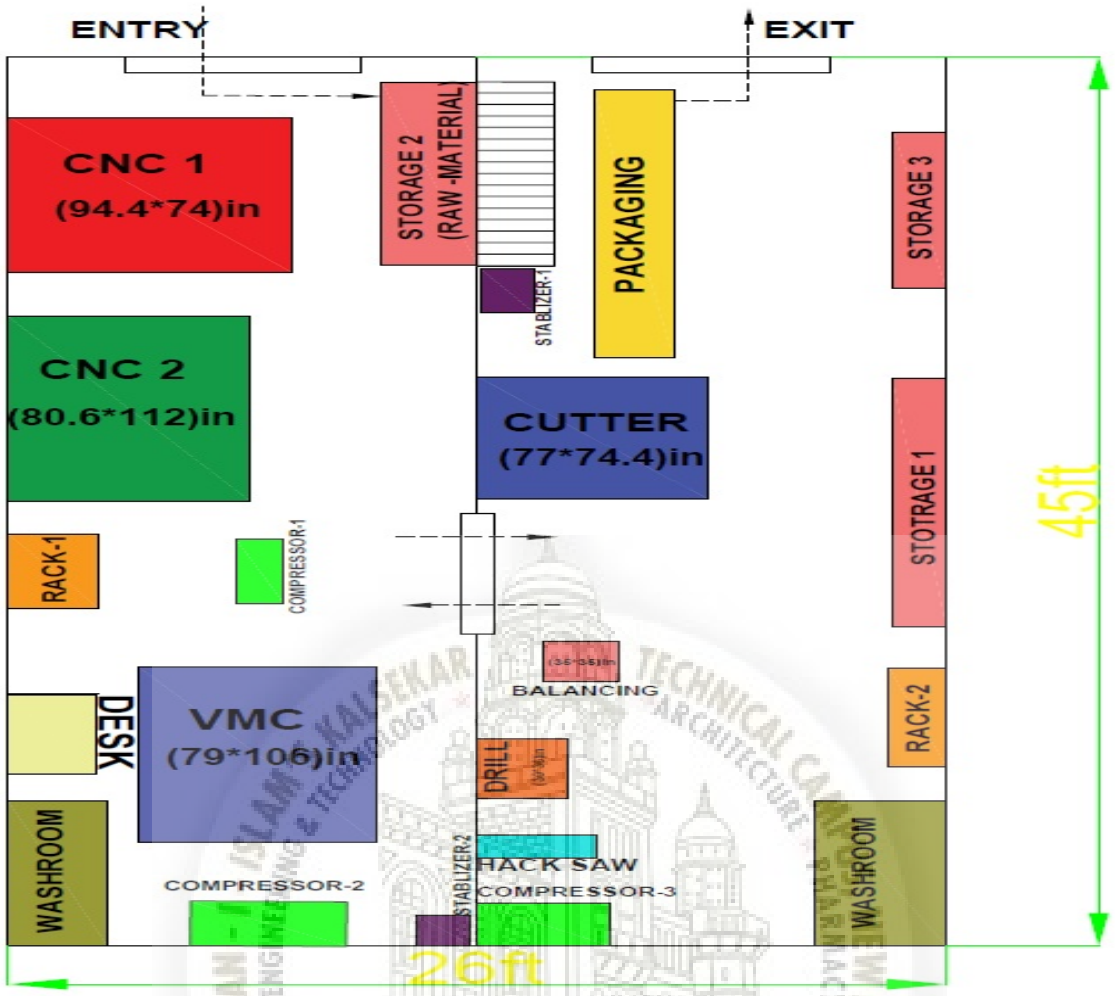



**Figure 4.7: Proposed Layout**

| Column1 | Column2 | Column3 | Column4 |
|---|---|---|---|
| **From** | **To** | **Distance (ft)** | **Unit Cost (rs)** |
| raw material | cnc 1 | 2.88 | 21.1104 |
| cnc 1 | cnc 2 | 2.667 | 19.54 |
| cnc 2 | vmc | 10.08 | 73.88 |
| vmc | cnc 1 | 22.08 | 161.84 |
| cnc 1 | cnc2 | 2.667 | 19.54 |
| cnc 2 | static balancing | 17.22 | 126.22 |
| drilling | packaging | 4.187 | 30.69 |
| packaging | dispatch | 31.86 | 233.53 |
| | **Total** | 93.641 | 686.3504 |

**Figure 4.8: Distance and Cost**

### 4.2.2 Conclusion

After analyzing the existing layout the overall distance and cost of handling the material is 216.67 ft and Rs.1587.68 for existing layout while it is reduced to 93.641 ft and Rs. 686.3504 for the proposed layout. The total handling cost can be reduced by 56.8 percent according to the layout which is proposed. It is due to reduction in total distance travel by the material throughout work place. Thus After applying Systematic Layout Method Overall Cost is reduced upto 56 percent which is very profitable for the company

# Chapter 5

# Implementation

## 5.1 Implementation of 5S

### 5.1.1 Sort


**Figure 5.1: Sorting of Gauges**

We have sorted the Gauges by making a board and hanged in front of the worker so they can easily opt for any gauge, Before gauges are difficult to find due to dimensions are not present. We have sorted out all gauges according to the dimensions.

### 5.1.2 Set in Order

in order.jpeg


**Figure 5.2: Tool board**

In set in order we provide a tool board along with image imprint on it so that they can easily place without any wastage of time.

### 5.1.3 Shine


**Figure 5.3: Shine1**


**Figure 5.4: Shine2**

In shining we have cleaned , discarded unwanted material, place in order all the tools and jigs, which not only looks good in presentable but also it create more space to perform different operation.

### 5.1.4 Standardize

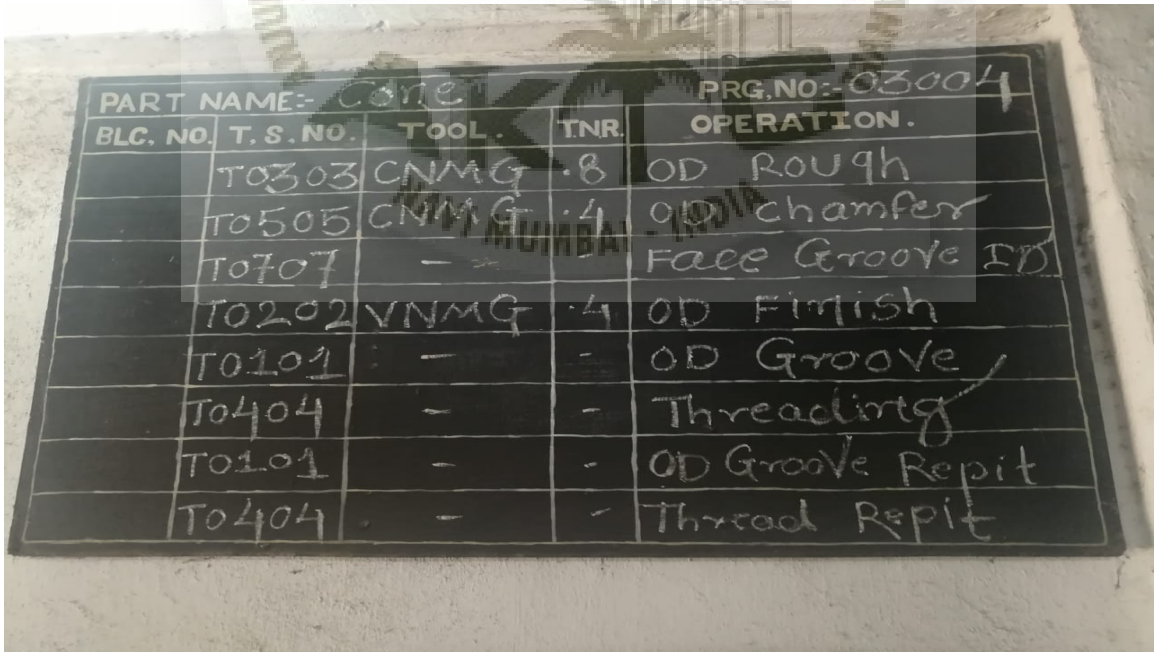



**Figure 5.5: operation table**

In Standardize we have provided a board which shows todays task,how many jobs are inline, how many tools need to be required, machines and operation. Which is

very handy and worker can easily perform looking to their daily task.

### 5.1.5 Sustain


**Figure 5.6: Activity table**

As far As sustainability is concerned it is the most difficult operation in implementing 5S ,workers are need to inform and create habit of sustaining all the things because as time passes workers get tired and lazy in sustaining ,like putting the tool in its original position, performing operations consistently etc. so we have provided an encouraging banners near their workstations and Employee of the month certificate which provide more competition among the worker and indirectly profit to the company.We have also provided the activity table which help easy to understand next step.

## 5.2 Implementation of Plant layout

The Proposed layout is well optimized creating extra space for different operation and also owner can used to install new CNC machine to increase the productivity and also we have suggested the extra space can be used to put on rent . Owner of the company will implement this layout when the workload is reduced and surely will gain more profit from our project.

# Chapter 6

# Evaluation and Result

## 6.1 5S

Time analysis or Time comparison is play an important role in a company or industry to improve working and productivity efficiency. Time analysis nothing but comparison of operation time means how much time take by the process, manufacturing of product, searching of tools and materials, etc., In our filter Company we have implement 5S, we have work on each stages of 5S and we recorded all data and compare it with before implementation of 5S data we have improve it after implementation of 5S, that comparison shown in below table.

| **Sr no.** | **weeks** | **Efficiency** |
|---|---|---|
| 1. | Week 1 | 63.29 |
| 2. | Week 2 | 66.15 |
| 3. | Week 3 | 67.35 |
| 4. | Week 4 | 70.28 |

One of the major problem in the company is jobs get delayed in dispatching due to lack of favorable conditions.After looking above table we can say that after monitoring 5S there is a good amount of improvisation in a company which can any how provide ease in day to day manufacturing processes. Time for every job to forge is improved and gives more accurate and finished product as per the customer demand.

## 6.2 Plant Layout

### 6.2.1 Existing plant layout

1. Distance travel by the job = 216.674 ft
2. Total Unit Cost per feet = Rs.1587.68

### 6.2.2 Proposed plant layout

1. Distance travel by the job = 93.64 ft
2. Total Unit Cost per feet = Rs.686.35

### 6.2.3 Efficiency

1. Efficiency= 1 - ((93.64/216.674)*100)=56.79 percent
2. Total Cost of job = Rs. 8000
3. Current cost of job excluding forging = 8000 - 1587.68 = Rs.6412.32
4. Optimized Cost= 6412.32 + 686.35= Rs. 7098.67.
5. Cost saved per job = 8000 - 7098.67 = Rs. 901.33

Hence we can see we have saved Rs. 901.33 by providing new layout to the company .The new layout is 56.79 percent efficient.

# Chapter 7

# Conclusion and Future Scope

## 7.1 Conclusion

The optimized plant layout is obtained with the application of SLP technique and Better working environment is obtained by monitoring 5S principles. This report focuses on the optimization of capacity, productivity and Overall cost thus taking into consideration the sequence of the operation to be followed and space requirements, the capacity of plant is increased. Hence it has reduced the overall cycle time into more than half. Previously it was required to travel 216 ft to complete a cycle, now in optimized layout it require to travel just 93.64 ft to complete the cycle. Hence it reduces the unnecessary material travel distance and reduces the idol time. Monitoring 5S increase high precisioned product, less overall waste, friendly environment, less fatigue to employees and reduced chances of job halts at stations.

## 7.2 Future Scope

The future development can be carried out by integrating CNC with process so that the efficiency of operation can be improved and the accuracy of product will get improved. Further improvement can be done by implementing new type storage system of raw materials like multi- stage rack it will reduce the area required for storing raw material hence increasing the area of work. We have suggested to owner that the area that is left empty can be utilize to either put on rent or install a new CNC machine to take different jabs simultaneously.

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# Achievements

1. Paper to be published: Efficiency enhancement using systematic layout planning to reduce overall travelling cost ,Prof. Afaq ahmed,Mapkar Sarfaraz,Uzair Thakur,Sayyed Ammar,Belal Ahmed, International Journal of Engineering Research and Technology (IJERT), Volume8,issue.5,May 2019(`http://WWW.IJERT.com`)