A PROJECT REPORT

ON

" IMPLEMENTATION OF 5S AND SPL AT HITESH MECHANICAL PVT.LTD "

Submitted to

UNIVERSITY OF MUMBAI

In Partial Fulfilment of the Requirement for the Award of

BACHELOR'S DEGREE IN
MECHANICAL ENGINEERING

BY

SHAIKH MOHAMMAD AFTAB	15ME102
KHAN ABDURRASHEED	15ME80
BARANWAL PRINCE	15ME66
ANSARI USAMA	15ME64

UNDER THE GUIDANCE OF
PROF. ALTAMASH GHAZI

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
ON

"IMPLEMENTATION OF 5S AND SPL AT HITESH MECHANICAL PVT.LTD"

Submitted to
UNIVERSITY OF MUMBAI

In Partial Fulfilment of the Requirement for the Award of

BACHELOR'S DEGREE IN MECHANICAL ENGINEERING

BY

SHAIKH MOHAMMAD AFTAB	15ME102
KHAN ABDURRASHEED	15ME80
BARANWAL PRINCE	15ME66
ANSARI USAMA	15ME64

UNDER THE GUIDANCE OF
PROF. ALTAMASH GHAZI

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

Anjuman-I-Islam's Kalsekar Technical Campus

Department of Mechanical Engineering

SCHOOL OF ENGINEERING & TECHNOLOGY

Plot No. 2 & 3, Sector - 16, Near Thana Naka,

Khandagaon, New Panvel - 410206

CERTIFICATE

This is certify that the project entitled

"IMPLEMENTATION OF 5S AND SPL AT HITESH MECHANICAL PVT.LTD"

submitted by

SHAIKH MOHAMMAD AFTAB	**15ME102**
KHAN ABDURRASHEED	**15ME80**
BARANWAL PRINCE	**15ME66**
ANSARI USAMA	**15ME64**

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. ALTAMASH GHAZI)
Project Supervisor

(Prof. RIZWAN SHAIKH)
Project Coordinator

(Prof. ZAKIR ANSARI)
HOD, Mechanical Department

DR. ABDUL RAZAK HONNUTAGI
Director

External Examiner

Acknowledgements

After the completion of this work, we would like to give our sincere thanks to all those who helped us to reach our goal. It's a great pleasure and moment of immense satisfaction for us to express my profound gratitude to our guide **PROF. ALTAMASH GHAZI**, 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.

We take this opportunity to give sincere thanks to **Mr.MUKESH. R.GUPTA** Owner and **Mr.HITESH GUPTA** Technical Engineer at **HITESH MECHANICAL PVT LTD, MUMBAI,** for all the help rendered during the course of this work and their support, motivation, guidance and appreciation

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 Computer Engineering Department who helped me directly or indirectly during this course of work.

SHAIKH MOHAMMAD AFTAB
KHAN ABDURRASHEED
BARANWAL PRINCE
ANSARI USAMA

Project I Approval for Bachelor of Engineering

This project entitled ***" IMPLEMENTATION OF 5S AND SPL (SYSTEMATIC PLANT LAYOUT) AT HITESH MECHANICAL PVT.LTD "*** by *SHAIKH MOHD AFTAB (15ME102), KHAN ABDURRASHEED (15ME80), BARANWAL PRINCE (15ME66), ANSARI USAMA (15ME64)* 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.

Student Name
Roll Number:

ABSTRACT

The objective of this thesis is to improve the facility layout of manufacturing firm using Systematic Plant Layout (SPL) or Systematic Layout Planning (SLP) and implementation of 5S. This project is conducted at **HITESH MECHANICAL PVT. LTD, RABALE** where various pressure vessels, agitated vessels, chemical reactors, chimneys, feed gas preheater, galvanizing tank, etc. like products are manufacturing company located at New Mumbai. The major problem faced by this firm is inventory control, scrap management, store management, poor utilization of space, poor material handling. There is high flow intensity between the departments which have high interrelationship. This leads to high travelling time which increases the travelling cost which in turn decreases the overall productivity of the company.

An alternative layout is proposed by using the steps in Systematic Plant Layout, which is the systematic way of generating layout alternatives. The proposed layout involves optimizing the departments which have high interrelationship and close to each other. The proposed alternative layout is further evaluated by using Pugh matrix. The layout is chosen based on the performance measures which have the most significant improvements in the facility. Later after implementing the modified layout 5S is also implemented simultaneously based on the steps as discussed in this thesis to manage the facility.

Keywords: Systematic plant layout, algorithms, material flow, CRAFT, CORELAP, from-to chart, activity relationship chart, fabrication, Pugh matrix, 5S, lean manufacturing, quality, waste.

Contents

List of Figures

List of Tables

Chapter 1

Introduction

With the evolution in the technology, advance technologies, new methods and machines are being developed to increase the productivity. To meet the consumer demands and to survive in this highly competitive market, for that it is necessary to have a proper system to maintain the market position. Any production industries should be ready to adopt and evolve so that they can commercially viable. Thus, the facility layout or the plant layout plays an important role as it is the base foundation of any industry, and continuing that this study is based on the methods and approach to design a small-scale industry to get the maximum benefits using available resources at their disposal. As small-scale industry largely depends upon its ability to innovate, improve operational efficiency and increase its productivity to compete and maintain its position in the market using all the resources at their disposal. As said for the industry to be economically more viable it is important that it is well organized take care of the materials available in the inventory and most important optimize the resources in the facility.

In the current scenario the manufacturing industry is facing problems that have been growing and becoming more complexity over the last several years. As a result, there's a direct would like for procedures or techniques in determination varied issues encountered in today's producing arena while not extended shutdown's or expensive modifications (Clark,1996). Based on the above facts, it is obvious that layout optimization and 5S is crucial to any facility planning. If not tackled within the early phases, it will generate supply implications for the corporate concerned.[21]

5S is typically a Japanese composition of five words, those are seiri (organization), seiton (neatness), seiso (cleaning), seiketsu (standardization), shitsuke (discipline). It is a management system platform which can be used along with total productivity maintenance [3]. The employment of 5S results in standardization and discipline at workplace. Japan is the torch bearer of the said management system of 5S. It was initiated in the manufacturing sector and extended to the other industries and service sectors.[23]

1.1 Problem Definition

Hitesh Mechanical Pvt Ltd, New Mumbai a fabrication company located at MIDC RABALE. The products in this facility are manufactured by going through various processes like marking, cutting, fitting, welding, etc. The plant suffers from poor material handling and material storage systems. All the process is done at different locations in the facility which causes the improper work, sometimes unsafe working environment and increased in material traveling time. Hitesh mechanical Pvt Ltd., New Mumbai is a fabrication company located at MIDC RABALE. Due to the multiple products being produced with variable nature, size and application along with different and variable manufacturing process at the same, the facility seems to be unorganized in many ways, not proper record of maintenance systems are in place, and due to the variable in material requirement, every time it is costs the company with higher material handling and improper inventory records adds on the material and labour costs pulling down the profitability. Increase in the wastage of inventory area makes material handling difficult. The figure shown below represents the initial scenario of the facility.

Figure 1.1: Improper management and placement

Figure 1.2: Improper waste management

Figure 1.3: Improver Inventory management

1.2 Proposed System

In response to the above problems the facility layout needs to be optimize to achieve the manufacturing goals of the company. This project proposes to use systematic plant layout (SPL) and 5S system is identified as proper solution to many

problems at hand. The implementation and reorganization of each section systematically with proper data maintenance of available stocks may prove game changer for increasing the production.[22]

1.3 Objective of the study

- To study the current material flow pattern and relation between departments of the overall plant layout.
- To develop the alternative plant layout.
- To propose an appropriate and better material storage system.
- To propose an appropriate scrap storage system.
- To implement the 5S system among the employees and in the industry.
- To measure the improvements after implementing 5S system.
- To increase the overall efficiency and effectiveness of the facility.

1.4 Scope of the study

In this thesis, the case study is limited to increase the storage area, scrap area and manage the total facility of Hitesh Mechanical Pvt Ltd. This work focusses on improving the facility layout design and the basic structural relationship. The layout of the production using is the process-oriented layout. The systematic plant layout (SPL) methodology will be utilized in this case study as part of the strategy to portrait the relationship between each department to generate improved alternate layout.

1.5 Significance of study

An approach from Muther (1973), Systematic Layout Planning (SLP) is used as the improvement method. It uses a graphical illustration and builds up a proximity matrix that represents the closeness of every facility. Flowcharts can also be developed showing quantitative relationships. From the above proximity matrix, a trial and error process can be used to generate the layout.[21]

1.6 5S Strategy

5S is a strategy for attaining workplace organization and cleanliness, and it will improve quality, productivity and more than any other lean manufacturing improvement. Fishbone diagram shows various phases of 5S methodology. In each phase

we have describe the problem by using these phases we have solved the store management and inventory problems.

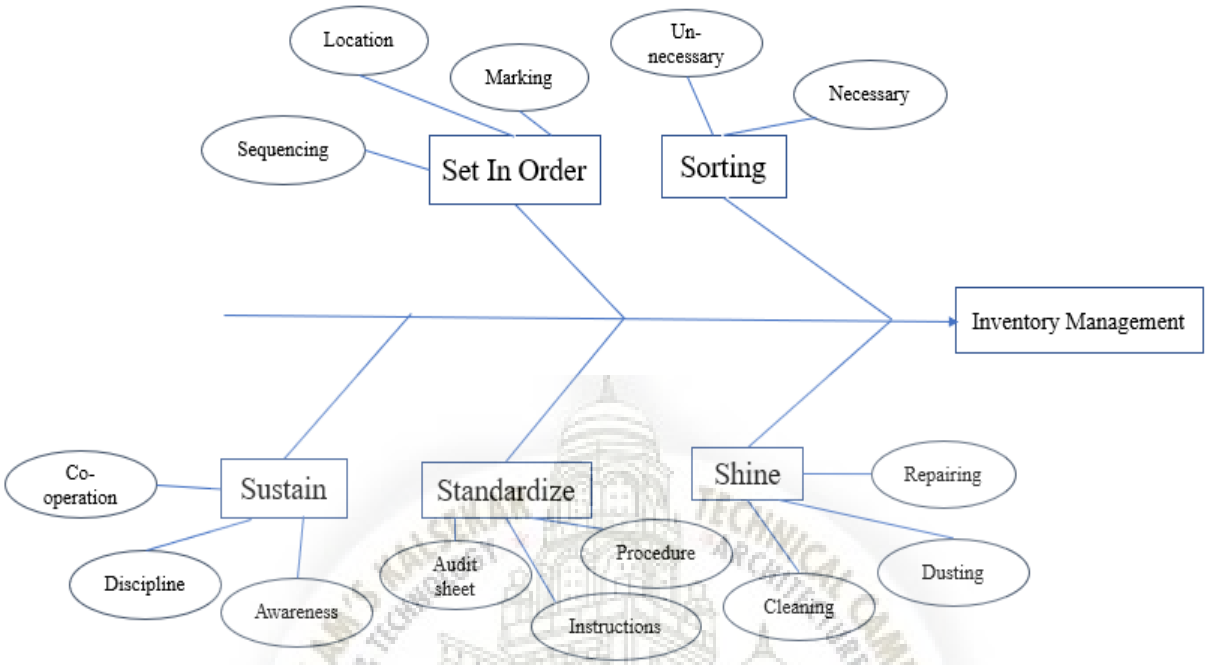

Figure 1.4: Fishbone Diagram

1.7 Company Background

1.7.1 Introduction:

Hitesh Mechanical Pvt Ltd is a leading fabrication company established in 1995. They are well known as a leading manufacturer of high-quality Reactor, Storage Tank, Heat Exchanger, Condenser, Presser-vessels, Chemical Plant Machinery, Steel Plant Machinery, Air Pre-Heater, Hot Air tube bundle, Galvanising Tank, Structurers, etc. The products are manufactured by going through various processes. The highest qualities of raw material and cutting-edge techniques have been utilized in the manufacturing process to ensure the quality. Raw material has been procured from some of the genuine vendors of the market.

1.7.2 Plant layout of the company:

The figure shows the dimensional plant layout. In this the constraints areas are clearly mentioned by hatching lines.

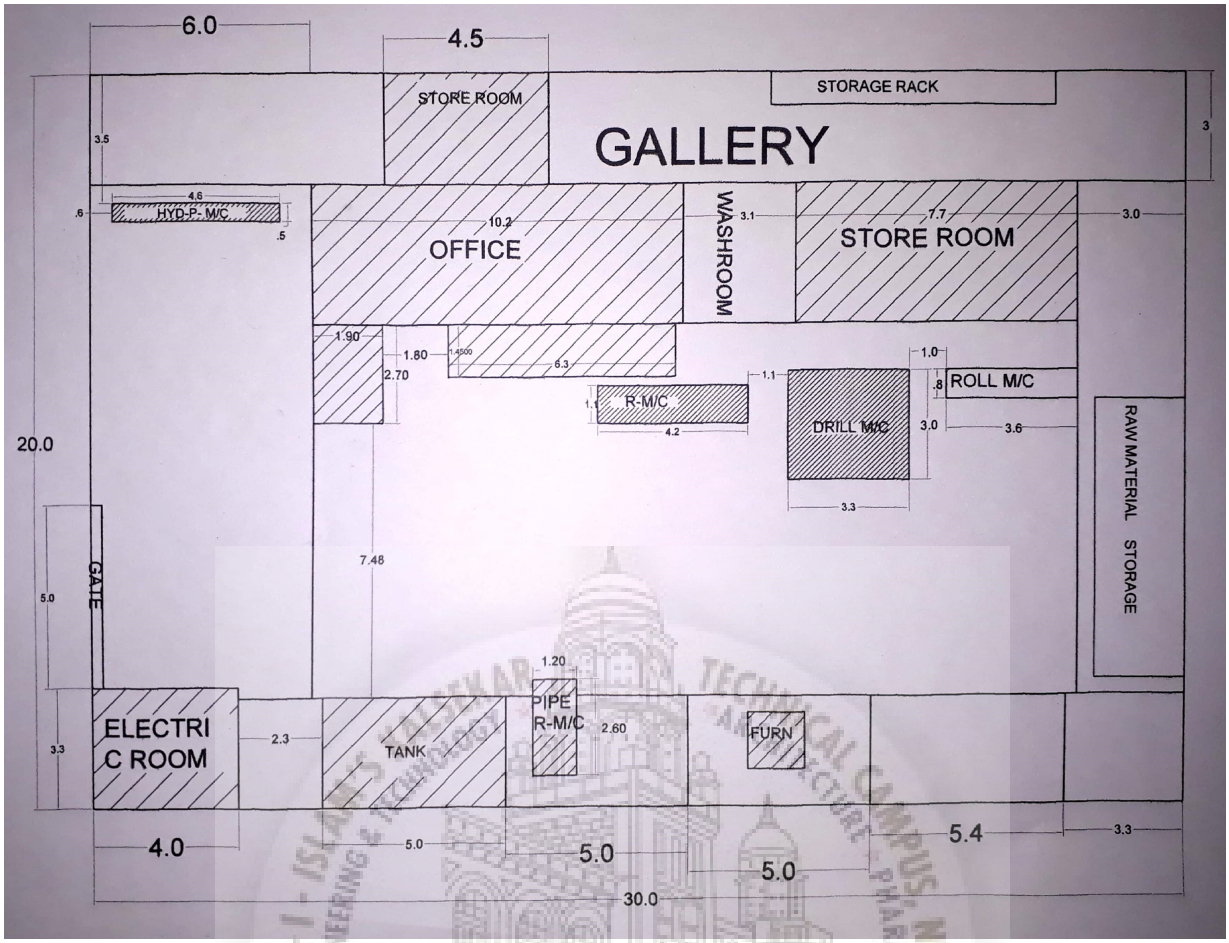

Figure 1.5: Initial Company Layout

1.8 Conclusion

In the starting of this chapter, a summary of facility layout designing and its importance to existing corporations is mention to any enhance the importance for victimisation it because the main principle for this project. The objectives are outlined on be connected to the deliverables during this case study. Some justifications of conducting this case study and its importance is additionally mentioned.

Chapter 2

Literature Review

2.1 Introduction:

This chapter in the thesis discuss about the different literature review and different methods to identify the process for Systematic Plant Layout and 5S system can be implemented.

2.2 Literature Survey:

Sr.No	Title and Author	Methodology	Findings	Applicable or Not and Reason
1	A literature review of facility planning and plant layouts - M.H Kulkarni, S.G. Bhatwedekar, H.M. Thakur	This study consists of method and approach to design a better plant layout.	This paper contains the overflow and the basic SPL and different types of layouts.	YES - This paper helps us to understand the meaning of plant layout with the help of other literature surveys mention in the paper.
2	Adopting the lean methodology by improving the plant layout in the foundries – Praveen Tandon, Dr. Ajay Tiwari and Shashikant Tamrakar	In this study they have explain the method that by using with the help of flow chart of foundry and the steps required for the implementation of SPL can obtain lean manufacturing.	This paper consists of method to reduce the production cost and improve the quality of the product, suitable methodology is to be adopted.	YES - We can use flow charts for our study.

3	Comparative study of CRAFT and QAP techniques applied to redesign of layout for cub board manufacturing –G. Bharathi, G. Ambrish	This paper consists of simulation based on CRAFT and QAP technique.	This paper presents results of the competitive study of CRAFT and QAP technique applied to redesign the layout for cub-board manufacturing process.	YES - Use the method explained in the paper and try to optimize our design.
4	Plant layout optimization of oven manufacturing unit using CORELAP algorithm - M. Rajesh, N V R Naidu, P. Naveen Kumar	Layout design by using CORELAP Algorithm	This paper consists of the implementation of SLP in oven manufacturing industry using CORELAP	YES -We can use the algorithm mention in the paper
5	Design and development of simulation model for plant layout- Mahesh R. Korde, Dr. A. R. Sahu, Achal Shahare	This study consists of method and approach to design a better plant layout with the help of simulation.	In this paper the work was to investigate the possible improvements in the blanking plant layout which manufactures automotive parts.	YES - In this the complete steps is provided to design an SPL but not considering the last step i.e. the use of simulation.
6	Design and improvement of plant layout – Ram D. Vaidya and Prashant N. Shende	This study proposes to adopt load distance score method for development of plant layout.	In this paper a layout design is explain, propose and verify by load distance score method.	YES - We can use load distance score method to check the layout efficiency.

7	Effective improvements of a plant layout using Pugh matrix approach – Sushil Dange, Shyam Sundar Luha, Prabhu Kurtakoti	This case study shows the effective use of Pugh matrix for the development of plant layout and its benefits.	This research paper is aiming to study and improve and current plant layout of the ANSA technologies and generate three effective plant layouts which are evaluated through Pugh matrix approach.	YES - We can use the following tips and techniques like String diagram, Flow process diagram, Material process chart, Outline process chart, etc.
8	Design of Plant Layout Having Passages and Inner Structural Wall Using Particle Swarm Optimization - Shiv Ranjan Kumar	Facility layout problems (FLPs) concerning space layout optimization have been investigated in depth by researchers in many fields, such as industrial engineering, management science, and architecture with the help of various algorithms.	In this thesis various algorithms like CRAFT, ALDEP, CORELAP, FRAT, COFAD, FLAC, DISCON and SHAPE, etc.	YES – We can study and implement the algorithm best fitted for our purpose.
9	Implementation of 5s in a small-scale industry: A case study -R. S. Agrahari, P.A. Dangle, K. V. Chandrate	In this paper 5S method and implementation methods is explain for lean manufacturing.	This paper consists of implementation of 5s in industries and provide lean manufacturing	YES - Red tag is explained and guidelines is explained for implementation of 5S.
10	Implementation of plant layout using 5s technique: An industrial case study - Dinesh B. Shinde, Prashant N. Shende	This research paper consists of both methods and improvements of 5S and SPL.	In this paper a 5S system and SPL is implemented and tested.	YES - Firstly a SPL is made using process chart and other method is made and 5s system is implemented

11	Review of 5S technique - Prof. Saad Shaikh, Ansari Noor Alam, Khan Naseem Ahmed, Sawant Ishtiyak, Sayyed Ziaul Hasan	Review of 5S system with the help of other literature surveys.	This paper explains the overview of 5S system.	YES - 5S methodology and its benefit is explained in this paper
12	Review on implementation of 5S methodology in service sector - Ravi Chourasia, Dr. Archanan Nema	In this paper 5S techniques and its improvement and implementation steps are being discuss.	The aim of the paper is to review the implementation of 5s methodology as one of the tools of lean management in service sector.	YES - In this paper 5S is explained in and this can be used as reference.
13	A review on 5S implementation in Industrial and business organization - Arash Ghodrati, Norzima Zulkifili	The paper has given the review in the implementation on 5S.	The research shows that 5S is an effective tool for improvement of organizational performance regardless of its size, type, it's production or its service.	YES - In this method is explained and used-Sampling method.
14	The use of 5S is in Healthcare services: A literature review -Fanny Y. F. Young	In this paper the befits of 5S in Healthcare services is discussed.	The aim of this paper is to review the use of 5S in Healthcare Services.	YES - In this paper the six-sigma method is explained in detailed and this can be used for reference.

15	Layout design for Low capacity manufacturing Line - A case study Flippo De Carlo.	Empirical type of format	In the present work, the results of a fashion manufacturing line relay out were compared by analyzing the current situation with the solutions provided by a homemade company design, both through a systematic layout planning approach and a lean reengineering activity.	YES – Steps of implementing SLP can be used to understand the SLP in a detail.
16	Using Simulation for Facility Design: A Case Study	A discrete event simulation model was developed and used to estimate the storage area required for a proposed overseas textile manufacturing facility.	In this paper it was found that the simulation was able to achieve this because of its ability to both store attribute values and to show queuing levels at an individual product level.	NO – This is one of the useful methods but it requires simulation software and knowledge to use the simulation.
17	A methodology for solving the unequal area facility layout problem using distance and shape-based measures R. Logendran.	A mixed binary nonlinear programming model is formulated	In addition to the distance measure, the impact of geometry or the shape of the departments is quantified in the formulation of the model.	YES – We can use this study for our reference for solving the unequal area facility layout.

18	An alternative multiple attribute decision making methodology for solving optimal facility layout design selection problems K.D. Maniya.	The proposed methodology is based on Preference selection index (PSI).	In the proposed methodology appropriate facility design is selected for a given application. Two different types of facility layout design selection problems are examined to demonstrate, validate and to check the reliability of proposed methodology. It is concluded that FLP design selection methodology based on PSI method is simple, logical and more appropriate.	YES – We can study and try to adopt some methods for our study and layout development.
19	An Empirical Comparison of Tabu Search, Simulated Annealing, and Genetic Algorithms for Facilities Location Problems.	Compare the relative performance of Tabu Search (TS), Simulated Annealing (SA), and Genetic Algorithms (GA) on various Facilities Location Problems (FLP).	The results indicate that TS shows very good performance in most cases. The performance of SA and GA are more partial to problem type and the criterion used. Thus, in general it may conclude that TS should be tried first to the extent that it always yields as good or better results and is easy to develop and implement.	YES – We can use this for our reference.

20	Genetic Algorithms for Integrating Cell Formation with Machine Layout and Scheduling.	Proposed a new approach to concurrently make the cell formation (CF), group layout (GL) and group scheduling (GS) decisions for a successful Cellular manufacturing (CM). A conceptual framework and mathematical model, which integrates these decisions, are proposed.	The result of this study indicates that: The concurrent approach often found better solutions than the sequential one. With the proposed heuristic operators, the hierarchical genetic algorithm (HGA) procedure performed better than without them. A hierarchical genetic algorithm (HGA) is developed to solve the integrated cell design problem. Two heuristic operators are proposed to enhance its computational performance.	YES – But we first need to understand all the genetic algorithm but as our system is simple, we will not use this method.

Table 2.1: Table of Literature surveys

2.3 Review of Literature Survey:

1. M.H Kulkarni, S.G. Bhatwedekar, H.M. Thakur [1] have explained the importance of facility planning and plant layout and it planning and also the different stages of the layout planning which consists of plant location, structure, layout and system handling. A Muther's Systematic Layout Planning (SPL) is discussed in this paper with the layout configuration and the position.

2. Praveen Tandon, Dr. Ajay Tiwari and Shashikant Tamrakar [2] have proposed that by improving the plant layout one can adopt the lean manufacturing and with the help of flow chart of foundry and the steps required for the implementation of SPL. They have explained the way one can adopt the system for their industry and how to use and arrange the areas and the section in the facility to maximize utilization of available resources

3. G. Bharathi and G. Ambrish [3] has proposed the use of Algorithm or the techniques namely SPL, CRAFT and QAP in this they have try to apply this method to redesign the layout of the cub-board manufacturing by applying the concept and with the simulation they were able to reduce the total material handling cost significantly.

4. M. Rajesh, N V R Naidu, P. Naveen Kumar [4] have proposed the plant layout optimization by using CORELAP Algorithm. For this study they have try to apply this method in oven manufacturing. By using activity relationship diagram and Total Closeness Rating (TCR) they have proposed different layouts and calculated the layout score for each individual layout and they had considered the layout having the highest score and by applying that they were able to minimize the total surplus area by 8.83%.

5. R. S. Agrahari [9], P. A. Dangle, K.V. Chandratre, have proposed the method and implementation 5S system in the industries. They have explained the different stages of 5S, its steps and methods that one can implement this method and organize the systems and procedures in the industry.

6. Dinesh B. Shinde [10], Prashant N. Shende have explained the implementation of 5S in the plant considering the plant layout of a small-scale industries, they have found that 5S technique has improved the visibility of problem condition, reduced wastage of material, improved safety, etc. also it helps the culture to develop a new sense of discipline and order that carries over in activities among the management and employees.

7. Prof. Saad Shaikh [11] and co-authors in their paper, have reviewed the 5S technique and explained the methods of implementation. During their study they found that this method is very useful and beneficial in industrial organization and by implanting it industries can improve the quality, production rate and the overall performance of the plant along with improvement in balance sheet

8. Ravi Chourasia [12], Dr. Archana Nema in this paper they have reviewed the implementation of the 5S methodology as one of the tools of lean manufacturing. They have reviewed and studied various papers and explain the 5S and they concluded that the use of 5S in an organization provides a safe environment.

2.4 Conclusion:

In this chapter, the literature review of facilities planning and types of layout is discussed. As a part from that, some review on previous trends of layout improvement methodology is reported, followed by systematic layout planning (SLP) methodology. From the study of the above literature survey, 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 –

1. 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 style solutions area unit easier to be evaluated by comparison 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.
2. 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.[21]

Systematic Plant layout (SPL) or Systematic Layout Planning (SLP) is a procedural layout design approach. The process involved in performing SPL 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.[21]

Chapter 3

Problem Identification

3.1 Introduction:

This chapter in the thesis discuss about the methods to identify the area where Systematic Plant Layout to be implemented. Process flow diagram, from-to-chart, flow of material and Activity relationship diagram and some methods will be used to determine the relationships and best optimization methods for the departments.

3.2 Layout modification technique and use of suitable algorithm:

3.2.1 Flow of material:

All the materials flow from the whole production line are to be formulated into a from-to chart that indicates the material flow pattern and frequency among different departments or sections of plant. The analysis of material flow involves determining the most effective sequence of work and material. The flow of material is shown below represents initial material flow in the facility.

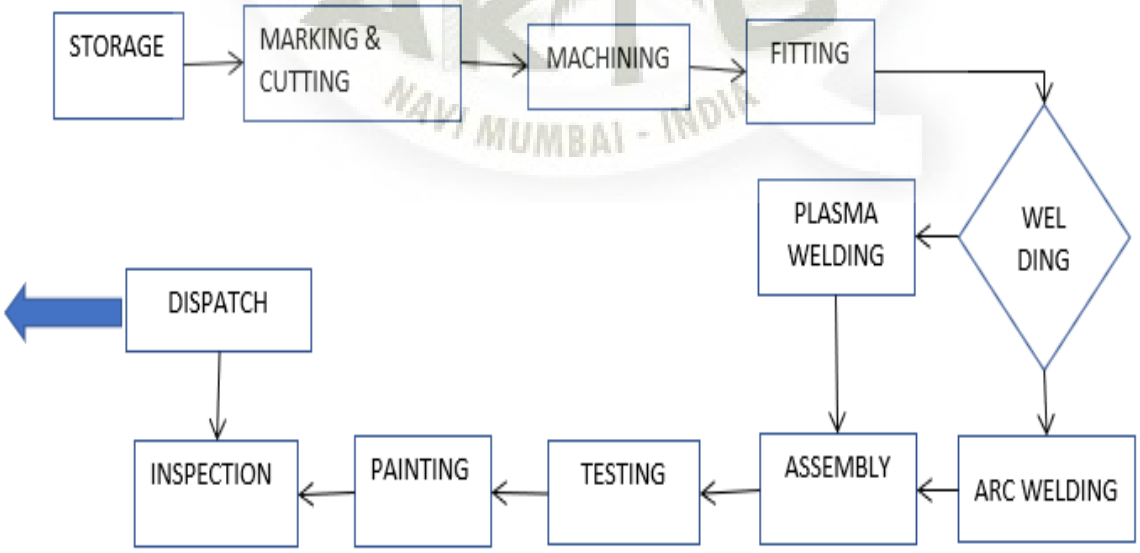

Figure 3.1: Flow of materials

3.2.2 Process flow chart:

This chart uses to record the process required for the product to make from the initial raw material to final product in the compact manner. The chart is set out the sequence of the flow of the process for different products in appropriate manner. For example, for certain product to be manufactured in the industry this steps or procedure is been followed to compete it in an efficient and productive way.

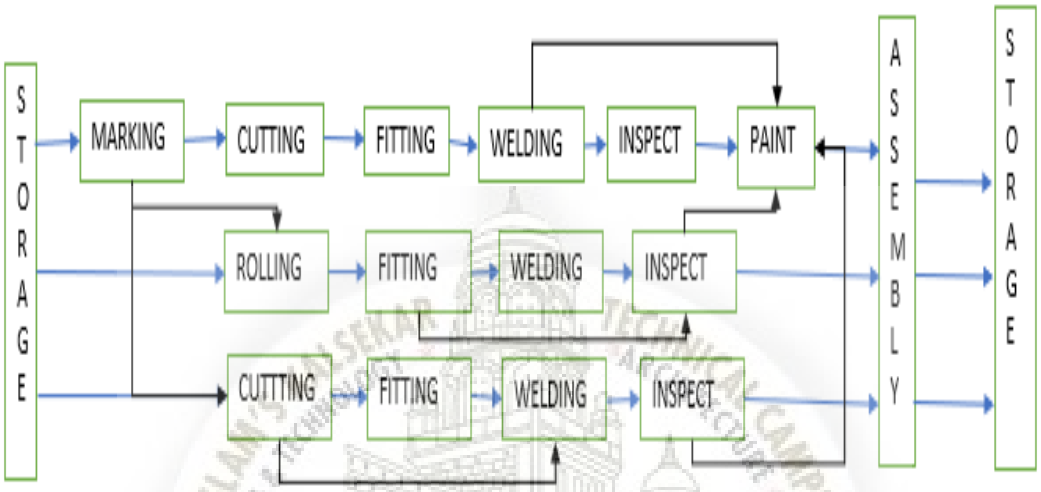

Figure 3.2: Process flow chart

3.2.3 From-to chart:

This chart represents the flow intensity between each process. The more the flow intensity, the more important the relationship between each process. From this chart, we can see that which process have the high intensity due to both products have the same process as shown in the chart. For example, the relation the storage and the marking area and should the department should be kept close to each other or not. In the figure shown below the relationship of the departments in the industry is shown and it is taken by considering the requirement of the departments for completing or making the products.

DEPT.	STORAGE	MARKING	CUTTING	MACHINING	FITTING	WELDING	TESTING	PAINTING	DISPATCH	OFFICE	INVENTORY	SCRAP
STORAGE		A	O	U	U	U	U	U	U	U	U	X
MARKING			I	A	U	U	U	U	X	U	I	I
CUTTING				I	U	U	U	U	U	X	X	U
MACHINING					I	I	U	I	U	X	I	U
FITTING							A	O	U	U	E	U
WELDING							A	I	U	U	U	U
TESTING								I	U	X	O	U
PAINTING									A	X	E	U
DISPATCH										U	U	U
OFFICE											X	X
INVENTORY												U
SCRAP												U

Figure 3.3: From-to chart

3.2.4 Conclusion:

From the analysis, From-To-Chart, it is obvious that the layout of the products is a major contribution to the high cost and the high cross-over quantity. This is further justified by the from-to- chart where significant flow intensity occurs within processes which are currently located far apart.
We conclude the following problems in the company:

- Improper utilization of workspace area.
- Poor placement of machining equipment.
- Problem in material handling causing unnecessary increase production time.
- Several injuries of labors due to improper precautionary measures.

Therefore, in the following chapter, systematic layout planning will be used as a methodology to define, analyses and synthesize the current problem faced by the company.

Chapter 4

Methodology

4.1 Introduction:

In this chapter, the Systematic Layout Planning methodology is analysed in detail for different layout alternatives generations. Basically, the SLP methodology literature has a total of 11 steps. First is input data, followed by flow of materials, activity relationships, relationship diagram, space requirements, space available, space relationship diagram, modifying constraints, practical limitation, developing layout alternatives and lastly evaluation.[21]

4.2 Systematic Plant Layout:

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 stepwise starting from the generation of alternatives, evaluation, selection and implementation. It has been wide used since its introduction that has well-tried to figure well in several things. Overall there are 11 stages required to complete an SLP which is shown in the figure below.[16][21]

1. Gather input data
2. Identify flow of material/information
3. Identify relationships between activities and resources.
4. Create a relationship diagram.
5. Determine space requirements
6. Quantify space availability
7. Create a space relationship diagram
8. Identify modifying considerations
9. Apply practical limitation

10. Developing layout alternatives
11. Evaluation of final design

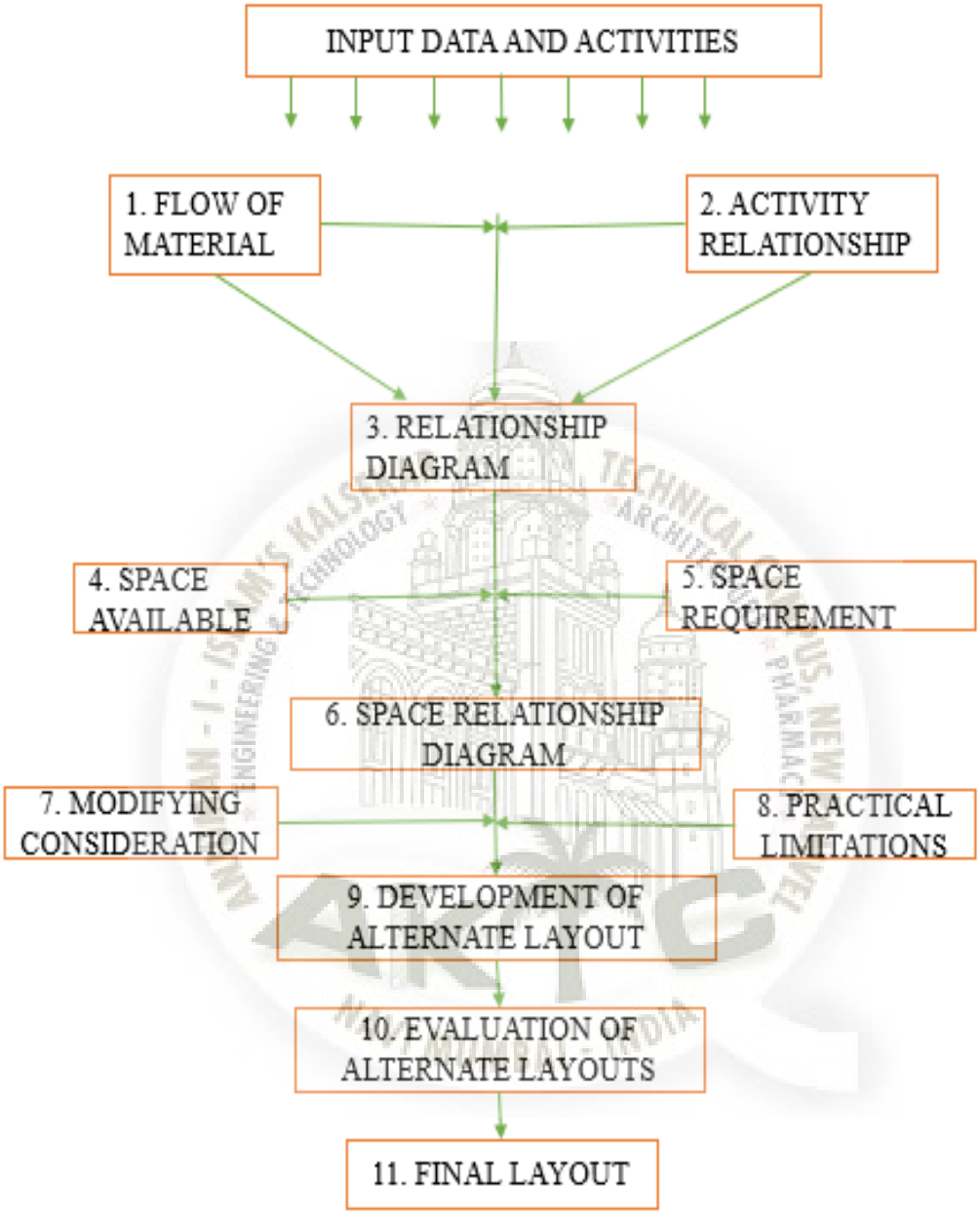

Figure 4.1: Procedure of Systematic layout Planning

4.3 Steps to solve the problem:

"Optimization of Plant layout"

The methodology is summarized in graph format during which is made originally from Richard Muther and simplified by the subsequent researchers like Gómez. The general procedures are consisted by 3 elements that are analysis, search and choice.

the primary section of the SLP methodology involves using a from – to matrix to clarify Associate in Nursing division material flow. so as to undertake and do that, a unit of activity regarding material handling ought to be determined foremost. So, the merchandise with totally different characteristics is also homogenized and comparisons unit of measurement doable. Then the REL chart which implies the connection diagram ought to be created. This chart collects the qualitative information of proximity ratios that comes with a set of letters (A, E, I, O, U, X). They replicate but necessary is for a pair of work units to be adjacent at intervals the ultimate layout (ranging from A which suggests absolutely necessary through to X that shows not fascinating. The following step is layout analysis which has availableness and needs.

Space availableness consists concerning the particular facility layout wherever the various work units ought to be placed. Space area needs area unit specialise in the mandatory production parameters like workers, equipment's, tools from a theoretical analysis. Comparison and combination of layout availability and wishes can give the actual area to be appointed to each unit. As a results of study technique, the area relationship diagram is emerged supported the on top of area analysis. when the area relationship diagram is formed up, the styles need to transform or modify the previous design to a bigger or lesser extent. Therefore, sure factors that might have an impact on the following implementation of the layout got to be taken into thought.

These factors embrace various aspects like natural light-weight inside the power, roof heights, the position of electricity points and doors, and also the inclusion of aisles for workers, material and instrumentation movements and then on. in addition, the sensible limitations and modifications that are researched in step seven and eight are extremely obsessed with the empirical ability data and also the subjectiveness of the one that is chargeable for the layout.

In the end, again it is dependent on the design person's experience and opinions to determine how the new information or sources affect the modified layout of the different sections.[21]

4.3.1 Step 1: Input Data and Activities:

The input variables for every SPL 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 legality of the input file at the look stage.

4.3.2 Step 2: Flow of Materials 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 implies that the materials move increasingly through the method and will continuously advance while not excessive detours. In traditional manufacturing applications, the flow is determined from either the product or the process. Figure is shown above i.e.of Flow of materials.[22]

4.3.3 Step 3: Activity Relationship Diagram:

The step of activity relationships performs analysis towards the closeness relationship call between activities and resources. 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 could be a record keeping tool to arrange knowledge into a usable type. With this knowledge and Activity Relationship Diagram was generated wherever proximity and relationship area unit visually evident.

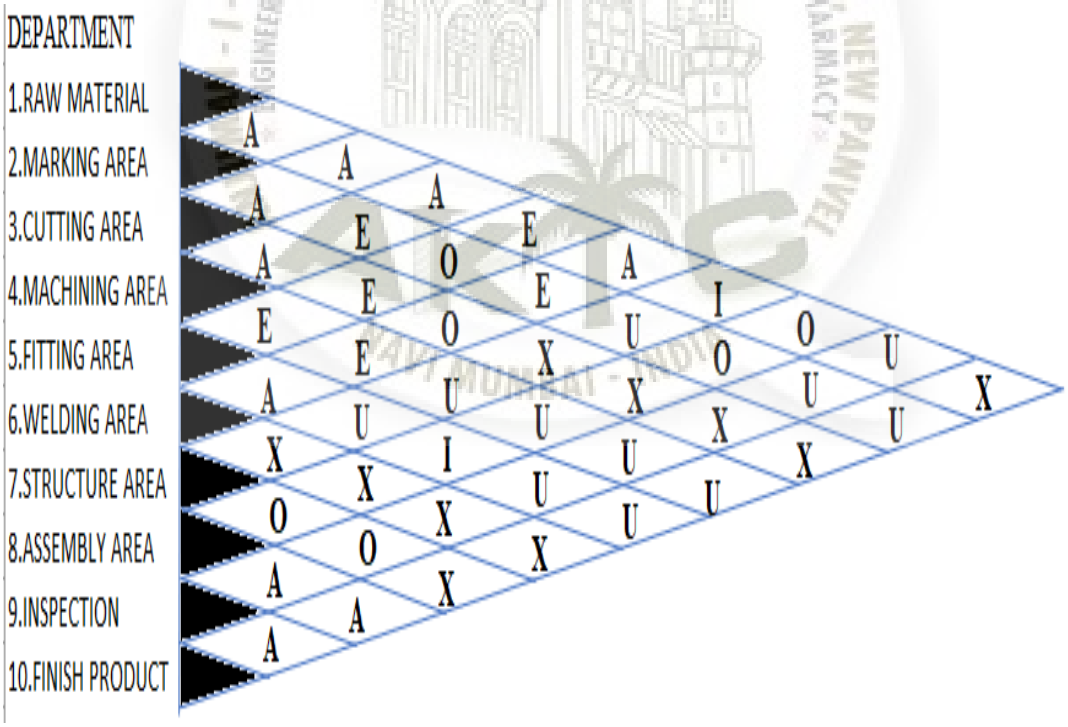

Figure 4.2: Activity relationship diagram

4.4 Step 4: Use of Algorithm

4.4.1 CRAFT Algorithm:

Computerized Related Allocation of Facility Layout Technique were developed by Armour and Buffa in 1963. It is supported the exchange of position of departments This requires input data such as -

1. Initial layout plan
2. Data on material flow
3. Data on cost incurred
4. Number of fixed departments and their location

The consideration in CRAFT is to check exchange of locations for those departments, which either are at the same location or have a common border and its mostly interchanges the departments which are adjacent to each other. So, because of the constraints in our facility we cannot use this algorithm.[3][8]

4.4.2 CORELAP Algorithm:

Computerized Relationship Layout Planning given by Lee and Moore in (1967). It converts qualitative input data into quantitative data and uses this information to determine the facility to enter the layout. It constructs a layout for the facility by calculating the Total Closeness Rating (TCR) for each department. TCR is the sum of the numbers assigned or allotted to the closeness relationships between the departments or activities (A=6, E=5, I=4, O=3, U=2, X=1) where A means Absolute necessary, E means Essential, I means Important, O means Ordinary, U means Unimportant and X means Extremely unimportant between the departments.[4] [8][22]

CORELAP Methodology–

- For department give Total Closeness Rating (TCR) as –
- TCR= (6xA + 5xE+4xI +3xO +2xU +1xX) = (6x4 + 5x1 + 4x1 + 3x1 + 2x1 + 1x1) =39
- The department having higher TCR should be identified and to be placed in the layout, here we identified it as Department “1”.
- Next the Activity relationship diagram is used to find the other departments with the higher activity relationships with the department already fixed. If there is a similar department, then select that department with the highest TCR.
- Repeating all the above steps till all the departments is being assigned.

- After assigning all the departments we have to calculate the layout score and that is determined by using the relationship weights as given below –
- A=243; E=81; I=27; O=9; U=3; X=0
- Layout score = sum of (department number x Relationship weights factor).
- For example: for layout A, Total Layout score = (10x243+1x27+1x81+1x9+2x1+0x0) =2549

											6	5	4	3	2	1	TCR
-	1	2	3	4	5	6	7	8	9	10	A	E	I	O	U	X	
1	-	A	A	A	E	A	I	O	U	X	4	1	1	1	1	1	39
2	E	-	A	E	O	E	U	O	U	U	1	3	0	2	3	0	33
3	A	A	-	A	E	O	X	X	X	X	3	1	0	1	0	4	30
4	A	E	A	-	E	E	U	U	U	U	2	3	0	0	4	0	35
5	E	O	E	E	-	A	U	I	U	U	1	3	1	1	3	0	34
6	A	E	O	E	A	-	X	X	X	X	2	2	0	1	0	4	29
7	I	U	X	X	U	U	-	O	O	X	0	0	1	2	3	3	19
8	O	O	X	U	I	X	O	-	A	A	2	0	1	3	1	2	29
9	U	U	X	U	U	X	O	A	-	A	2	0	0	1	2	4	29
10	X	U	X	U	U	X	X	A	A	-	2	0	0	0	3	4	22

Figure 4.3: Calculation of Total Closeness Rating (TCR)

4.5 Step 5: Create Existing Layout:

Existing layout is shown above in Fig.- i.e. Company Layout.

4.6 Step 6: Space Available:

During this step, a square footage is assigned to each activity. The space assigned to every activity is based antecedently within the space needs step. The total on the market space at the plant is reviewed. The area is split initially approach to estimate the space needed for every 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 600sq.mtr.

4.7 Step 7: Space Relationship Diagram:

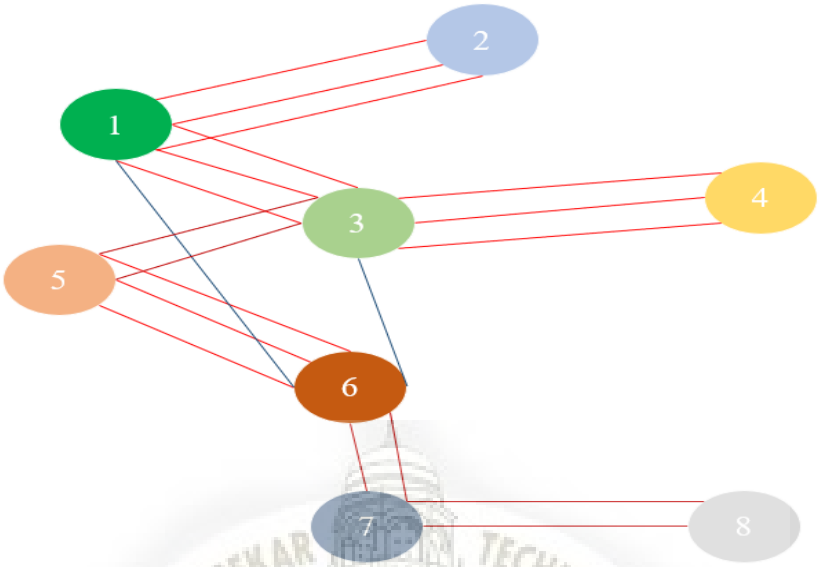

Figure 4.4: Space Relationship Diagram

Adds division size data into the connection diagram from step four. At this point, the space requirements are applied to the space available. The purpose of the space relationship diagram is to combine established spatial constraints with the activity relationship.

4.8 Step 8: Modifying Constraints:

These square measure further constraints for the department throughout the initial stages of the new layout style.
It is in terms of space demand or department personnel desires.

4.9 Step 9: Practical Limitations:

Practical limitations are often in terms of budget or space.

4.10 Step 10: Develop the Layout Alternatives:

This step involves development of layout alternatives as style candidates. These initial designs were created using the requirements and constraints described before. This is a layout of facility using blocks of space. The block plan is developed by using the space available information and the relationship chart that have been previously developed. With this information, blocks

of space are developed and positioned according to their relationships defined in the relationship chart. The pros and cons of each layout are compared as each layout had good traits that are combined into a final block plan layout. Usually these designs are brought to the management for further inputs and comments.[21]

Design of the layout from the above steps-

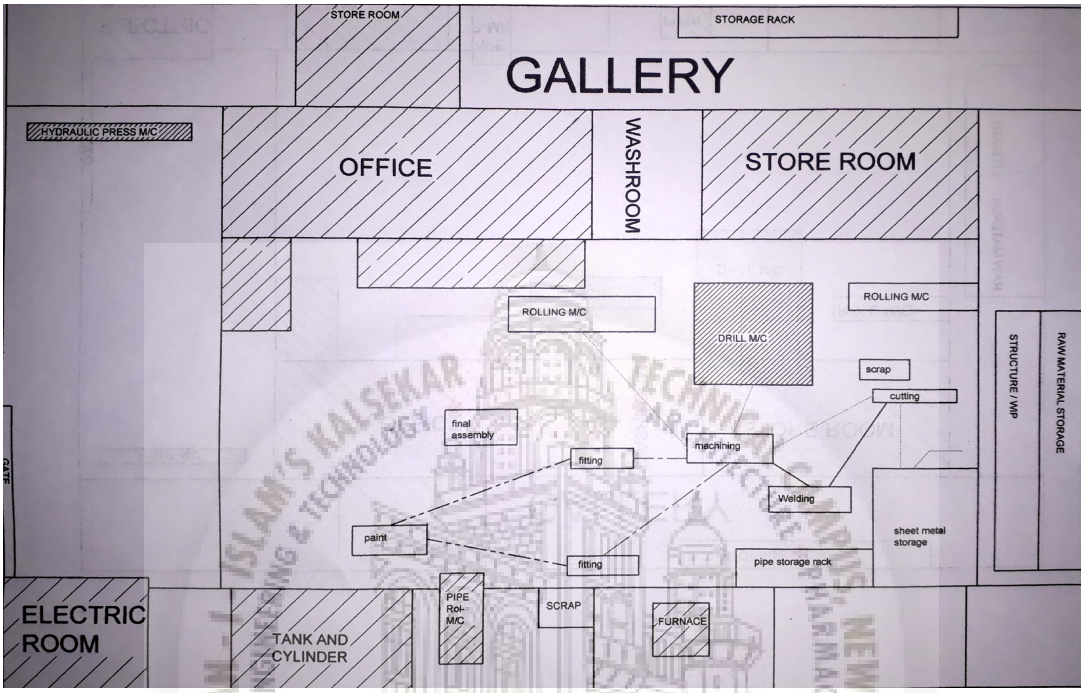

Figure 4.5: Concept layout A

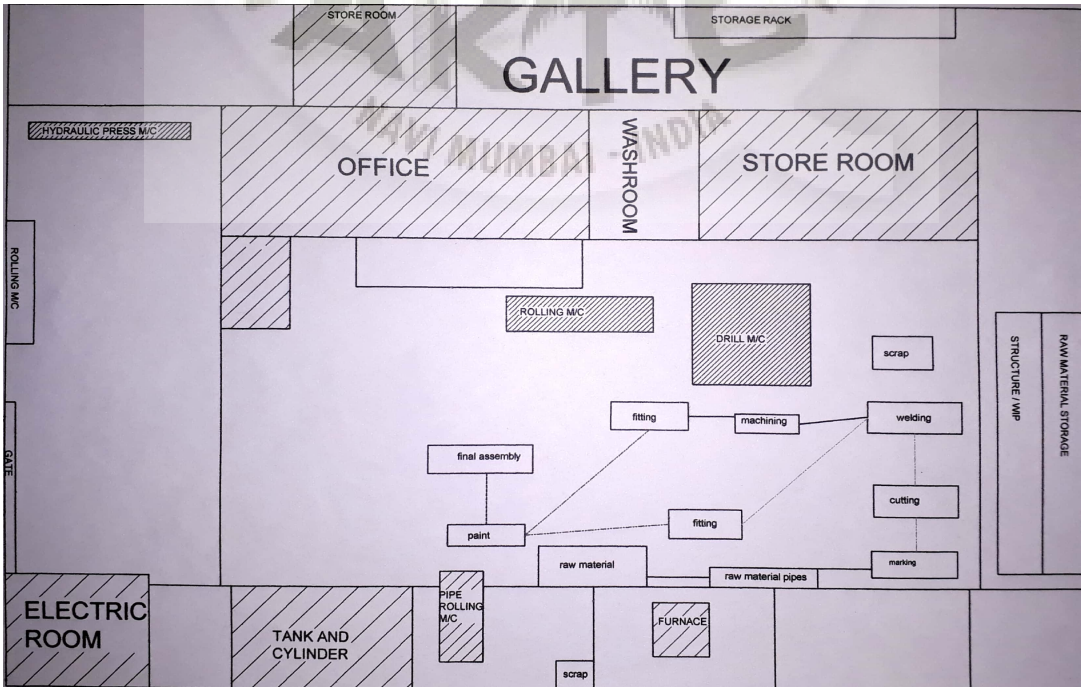

Figure 4.6: Concept layout B

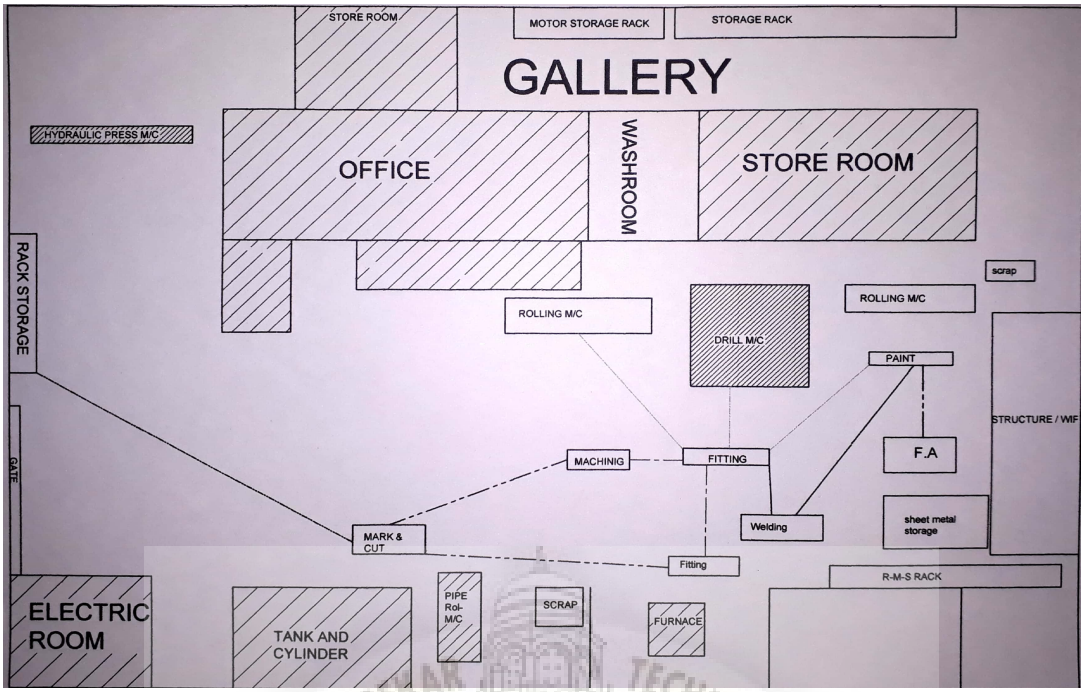

Figure 4.7: Concept layout C

4.11 Step 11: Evaluation:

Chooses the ultimate style from the planning candidates. Once a final block established layout has been no appointive.

4.12 Implementation of 5S:

The name 5s refers to a set of five terms borrowed from Japanese, all beginning with the letter "S" when transliterated. The equivalent terms in English conjointly begin with an S.
In essence, these 5 terms represent the 5 steps toward operational and method excellence.

- **Sort:** Separate needed tools, materials, and instructions from those that are not needed. Remove everything that's not necessary from the work space.
- **Store:** type and organize all tools, equipment, files, data, material, and resources for fast, easy location, and use. Label all storage locations, tools, and equipment.
- **Shine:** Set new standards for cleanliness. Clean and remove all trash, grease, and dirt. Everything should be clean, tidy, and showing neatness place in its acceptable place. Cleanliness provides a secure geographical point and makes potential issues noticeable, e.g., instrumentation leaks, loose components, missing guards, loose paperwork, or materials.

– **Standardize:** Interact with the manpower to consistently perform steps one, two, and three on top of daily, to maintain the workplace in perfect condition as a standard process. Establish schedules and set expectations for adherence.
– **Sustain:** Build 5S a part of your culture, and incorporate it into the company philosophy.

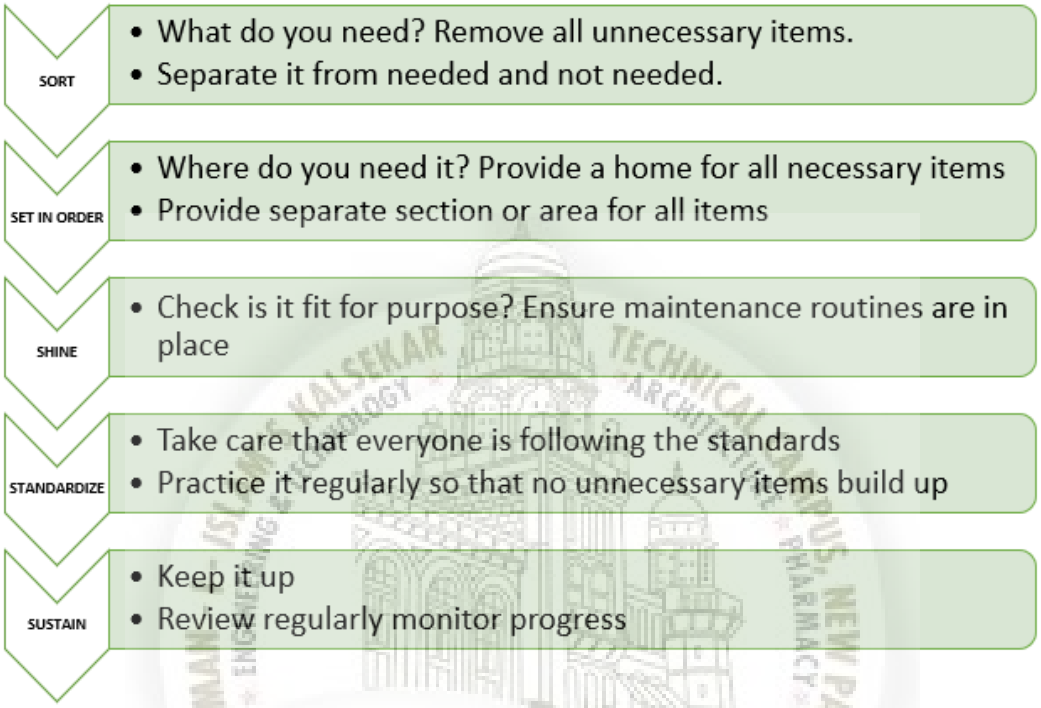

Figure 4.8: 5S system

DETERMINATION OF THE SEQUENCE OF THE DEPARTMENT:

"Finalization of the Layout"

After applying the above steps and brainstorming we have created some alternate layouts as mentioned above and the layout is presented to the selecting authorities and after the selection one layout is being finalized.The proposed layout Concept "C" is being selected based on its less material traveling time, having a good material storage location and also because of the arrangement of process which increase the speed of the production by reducing the idle time of the process.

4.13 Conclusion

After implementation of the layout 'C' it is found that the working area is increase by 20% and the storage area for raw material is increased by 35%

and also the travelling time of material is reduced significantly as everything is arranged in order so it is simple to move the material during storage and process.

Chapter 5

Systematic Plant Layout (SPL)

5.1 Introduction:

In this chapter, a top view of Facilities Layout developing with, sorts of layout, Systematic developing with, methodology and simulation are mentioned. this will offer a short-lived outline on the tools and techniques used for this case study.

5.2 Plant Layout:

Plant layout arising with includes selections with reference to the physical allocation of the economic activity centres throughout a facility. Associate in Nursing economic activity centre is any entity occupying space. The plant layout method starts at Associate in Nursing mixture level, taking under consideration the various departments. As before long because the details square measure analysed, completely different problems arise and also the original configuration perhaps modified through a feedback thirteen method. Most layouts square measure designed properly for the initial conditions of the business, though as long because the company grows and has tailored to internal and external changes, a re-layout is important. Symptoms that permit USA to discover the requirement for a relay out. [21]
Congestion and unhealthy utilization of area.

- Excessive stock in method at the power
- Long distances within the work flow method
- Simultaneous bottle necks and workstations with idle time
- Qualified employees concluding too several easy operations
- Labor anxiety and discomfort.
- Accidents at the power.
- Difficulty in dominant operations and personne.

5.3 Facility Layout Planning:

A facility layout is an appointment of everything required for production of products or delivery of services. A facility is Associate in Nursing entity that facilitates the performance of any job. it should be a machine, a piece centre, a producing cell, a shop, a department, a warehouse, etc. (Heragu,1997). It means that coming up with for the locations of all machines, utilities, worker workstations, client service areas, material hold, aisles, restrooms, lunchrooms, internal walls, offices and pc rooms this can be for the flow patterns of materials and other people around, into and at intervals buildings. The layout style typically depends on the merchandise selection and also the production volumes. Four kinds of organization square measure said, specifically mounted product layout, method layout, product layout and cellular layout (Dilworth,1996).[21][25]

5.3.1 Factors affecting Facility Layout Planning

The final answer for a Plant Layout needs to take under consideration a balance among the characteristics and concerns of all factors moving plant layout, so as to induce the maximum advantages.
The factors moving plant layout are often classified into five main categories:

1. Materials
2. Machinery
3. Labour
4. Material Handling
5. Waiting Time

Material:

The layout of the merchandiseive instrumentation can depend upon the characteristics of the product to be managed at the ability, likewise because the completely different elements and materials to figure on. Main factors to be considered: size, shape, volume, weight, and therefore the physical-chemical characteristics, since they influence the producing ways and storage and material handling processes. The sequence and order of the operations can have an effect on plant layout likewise, taking under consideration the range and amount to supply.

Machinery:

Having data regarding the processes, machinery, tools and necessary instrumentation, likewise as their use and necessities is crucial to style an accurate layout. The methods and time studies to improve the processes are closely linked to 16 the plant layout. Regarding machinery, the type, total accessible for every sort, likewise as sort and number of tools and instrumentation needs to be thought-about. It is essential likewise to grasp regarding area needed, shape, height, weight, amount and sort of staff needed, risks for the personnel, requirements of auxiliary services, etc.

Labour:

Labour needs to be organized within the production method (direct labour, superintendence and auxiliary services). Environment considerations: employee's safety, lightweight conditions, ventilation, temperature, noise, etc. Process considerations: personnel qualifications, flexibility, number of workers required at a given time as well as the type of work to be performed by them.

Material Handling:

Material handling does not add value to the product; it is just waste. Objective: Minimize material handling likewise as combining with alternative operations once attainable, eliminating reserve and expensive movements.

Waiting time:

Continuous Material Flow through the ability, avoiding the value of waiting time and demurrages that happen once the flow stops. On the opposite hand, the material waiting to flow through the facility not always represents a cost to avoid. As stock generally provides safety to guard production, up client service, allowing more economic batches, etc. It is necessary then to consider space for the required stock at the facility when designing the layout. Resting time to cool down or heating up.[21]

5.3.2 Importance of Plant Layout:

Plant layout are often varied and may considerably impact the general effectiveness of production systems. Since 1955, just about eight p.c of the gross national product (GNP) has been spent annually on new facilities, and it is generally accepted that effective facilities planning can reduce material handling

cost by at least 10 to 30 percent (Tompkins,1996). The magnitude of the investment within the new facilities annually renders the criticality to the plant layout generations operate. The main objectives of the plant layout function are to 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 for the overall well being and morale of the worker. [21]

5.4 Traditional Types of Facilities Layout:

Traditionally 4 types of layout are considered appropriate for a manufacturing facility:

1. Process (Job Shop)
2. Layout Product (Flow Shop)
3. Layout mounted Position
4. Group technology Layout

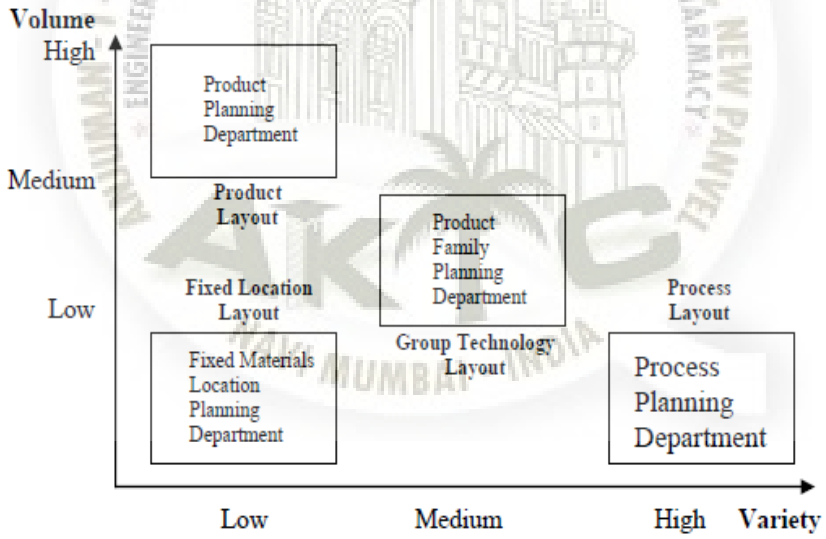

Figure 5.1: Types of Layout

5.5 Process (Job Shop) Layout

In the job look layout, machines are classified in step with operate to machine centres. Orders for individual product arrouted through the various machine centres to induce the specified method. Designed to facilitate process things or providing services that gift a spread of process necessity. The layout includes departments or different useful groupings within which similar types of activities are performed.

this sort of plant layout is helpful once the assembly method is organized in batches. Personnel and instrumentation to perform identical operate are allotted within the same space. the various things need to move from one space to a different one, consistent with the sequence of operations antecedently established. The variability of product can result in diversity of flows through the ability. Variations within the production volumes from one amount to ensuing one (short amount of time) might result in modifications within the factory-made quantities yet because the sorts of product to be created. [21]

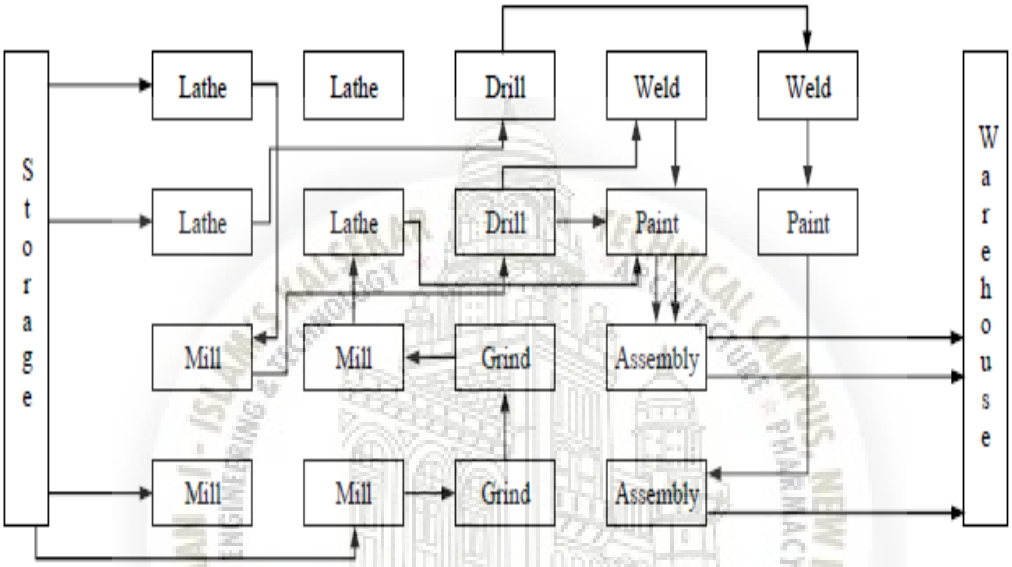

Figure 5.2: Process Layout

5.5.1 Advantages of Process Layout

1. A high degree of flexibility exists relative to equipment or manpower allocation for specific tasks.
2. Smaller investment in equipment as duplication is not necessary unless volume is large.
3. The diversity of tasks offers a more interesting and satisfying occupation for the operator.
4. Supervisors for each department become highly, knowledgeable about their functions.

5.5.2 Disadvantages of Process Layout

1. Lack of process efficiency as back tracking and long movements may occur in the handling of materials.

2. Lack of efficiency in timing as workers must wait between tasks.
3. Complications of production planning and control.
4. Workers must have broad skills and must be paid higher wages than assembly line workers.
5. Comparatively large amounts of in process inventory as space and capital are tied up by work in process.
6. Lowered productivity as each job requires different setups and operator training.

5.6 Product (Flow Shop) Layout

Here the merchandise (or products) follows a set path through the assembly resources. The resources are organized to attenuate the fabric movement. this sort of plant layout is helpful once the assembly method is organized in an exceedingly continuous or repetitive method. Continuous flow: The correct operations flow is reached through the layout design and equipment and machinery specifications.

Repetitive flow (assembly line): The correct operations flow will be based in a line balancing exercise, in order to avoid problems generated by bottle necks. The plant layout is going to be based mostly in allocating a machine as shut as attainable to ensuing one in line, within the correct sequence to manufacture the merchandise. employment is split into a series of standardized tasks, allowing specialization of each labour and instrumentation. attributable to the high volume of production, the machines on the road is designed with a high level of mounted automation, with little or no labour. Operations are organized within the sequence needed to form the merchandise. [19]

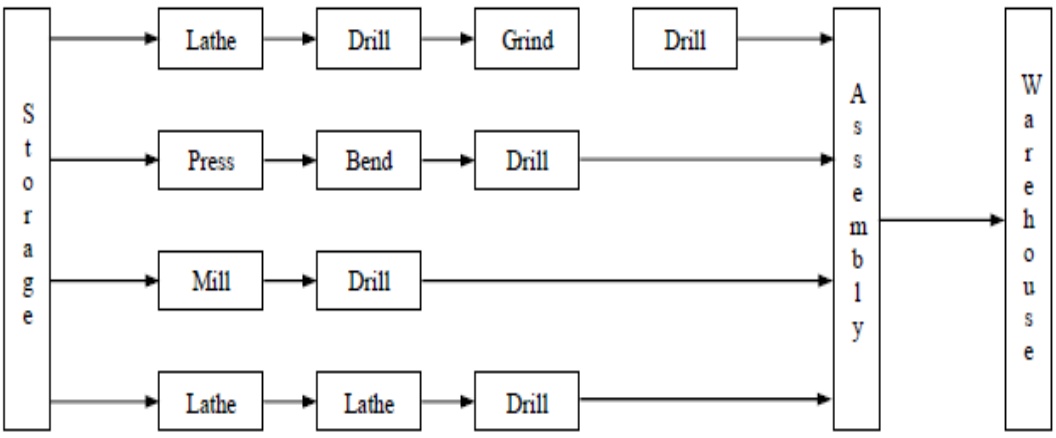

Figure 5.3: Product Layout

5.6.1 Advantages of Product Layout

1. Since the layout corresponds to the sequence of operations, smooth and logical flow lines result.
2. Since the work from one process is fed directly into the next, small in-process inventories result.
3. Total production time per unit is short.
4. Since the machines are located so as to minimize distances between consecutive operations.
5. Simple production planning control systems are possible.
6. Less space is occupied by work in transit and for temporary storage

5.6.2 Disadvantages of Product Layout

1. A breakdown of one machine or absence of enough operators to staff all work stations may stop the entire line.
2. Lack of process flexibility, since the layout is determined by the product, a change in product design may require major alternations in the layout.
3. Lack of flexibility in timing, as the product cannot flow through the line faster than the slowest task can be accomplished unless that task is performed at several stations.

5.7 Fixed Position Layout

For tasks on large objects such as the manufacture of an electrical generator, the construction of a building, or the repair of a large airplane, the machines implementing the operation must come to the product, rather than the product moving to the machine. In fixed position layouts, the item being worked on remains stationary and workers, materials and equipment are moved as needed. Fixed positions layouts are used in large construction projects (buildings, power plants and dams), shipbuilding and production of large aircraft and space mission rockets. Fixed position is widely used for farming, firefighting, road building, home building, re modelling and repair and drilling for oil. [21]

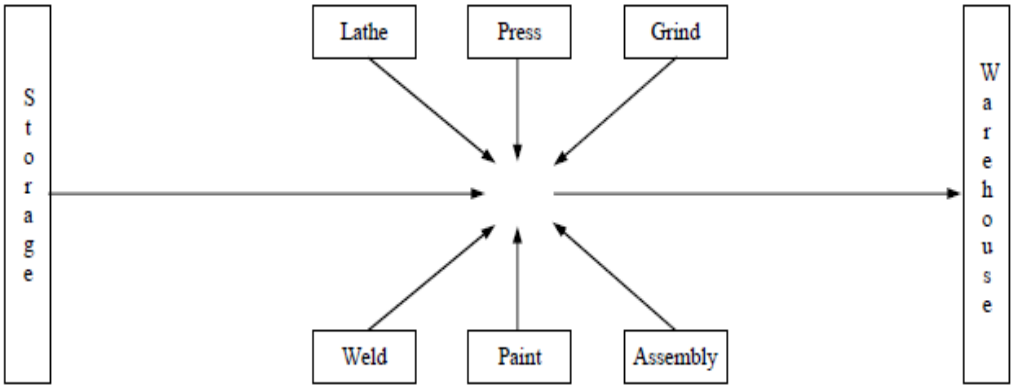

Figure 5.4: Fixed Position Layout

5.7.1 Advantages of Fixed Position Layout

1. Material movement is reduced, minimizes damage or cost of moving.
2. Promotes job enlargement by allowing individuals or teams to perform the whole job.
3. This reduces the problems of re-planning and instructing people each time a new type of activity is to begin.
4. Highly flexible; can accommodate changes in product design, product mix, and product volume.

5.7.2 Disadvantages of Fixed Position Layout

1. Increased movement of personnel and equipment may be expensive.
2. The necessary combination of skills may be difficult to find and high pay levels may be necessary.
3. Equipment duplication may occur. Higher skill requirements for personnel as they are involved in more operations.
4. Cumbersome and costly positioning of material and machinery.

5.8 Group Technology Layout / Cellular Layout

Group technology us the technique of identifying and bringing together related or similar parts in a production process in order to utilize the inherent economy of flow production methods. V.B Solaja, 24 Institute of Machine Tools, Belgrade, Yugoslavia. Group technology is also called cellular layout. Cellular layout is a type of layout in which machines are grouped into what is referred to as a cell. Groupings

are determined by the operations needed to perform work for a set of similar items or part families that require similar processing. It is the physical division of the manufacturing facilities into production cells. Each cell is designed to produce a part family. A part family is a set of parts that require similar machinery, tooling, machine operations and jig or fixtures. The parts within the family normally go from raw material to finished parts within a single cell. [21]

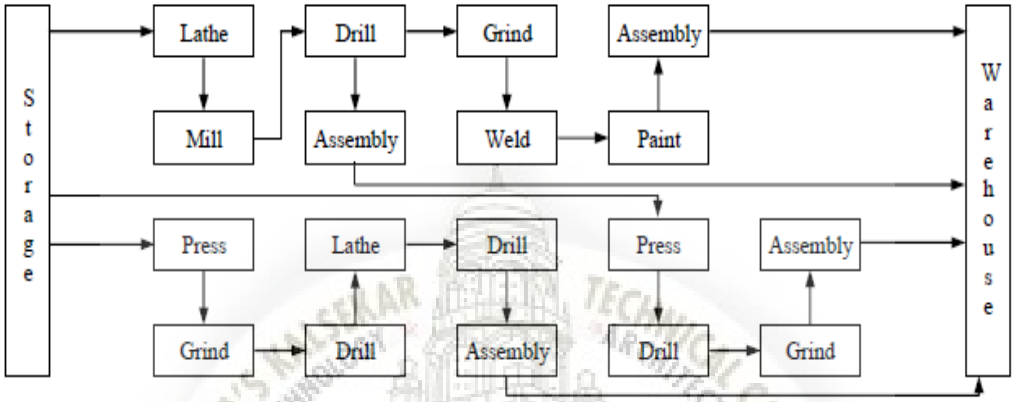

Figure 5.5: Group Technology Layout

5.8.1 Advantages of Cellular Layout

1. Reduced material handling
2. Reduced set up time
3. Reduced tooling
4. Reduced in process inventory
5. Increase operator expertise
6. Improved human relations, job enlargement tend to occur.
7. Supports the use of general purpose equipment

5.8.2 Disadvantages of Cellular Layout

1. General supervision required.
2. Higher skills level required of employees than for product layout.
3. Reduced shop flexibility
4. Depends on balanced material flow between product layout and process layout, other wise buffers and work in process storage are required.

5. Lower machine utilization than for process layout
6. Extended job flow times.

Chapter 6

5S Implementation

6.1 Introduction of 5S:

5S at the start supported the Japanese acronyms of seiri (organization), seiton (neatness), seiso (cleaning), seiketsu (standardization) and shitsuke (discipline), is employed as a platform for developing, an integrated management system by the parallel use of total productive maintenance (TPM) Bamber (2000). Osada (1991) refers to 5S because the 5 keys to a complete quality atmosphere. 5S could be a system to cut back waste and optimize productivity and quality through maintaining an orderly geographic point and mistreatment visual cues to attain additional consistent operational results. The apply of 5S aims to infix the values of organization, neatness, cleaning, standardization and discipline into the workplace basically in its existing configuration, and it is typically the first lean method implemented by firm. Kobayashi (2008) make a distinction between 5S as a philosophy or way and 5Sas a technique or tool by comparing the frameworks provided by Osada (1991) and Hirano (1995) respectively. From their study, they conclude that 5S tends to be recognized as a philosophy in Japan, but in the other hand it is likely to be considered as a technique or tool within the UK and United State of America. Osada (1991) views 5S as a strategy for organizational development, learning and change, whereas Hirano (1995) considers 5S to be an industrial formula that differentiates a company from its competitors. A common definition of 5S within the West is housework (Becker, 2001; Chin and Pun, 2002; Ahmed and Hassan, 2003; Eckhardt, 2001). In the West both 5S and TPM are sometimes 9 disregarded or at least underutilized (Douglas, 2002). A framework of applying 5S within a business (as appose to a personal philosophy of way of life) was first formalized in the early 1980s by Takashi Osada (Ho et al., 1995). The apply of 5S aims to infix the values of organization, neatness, cleaning, standardization and discipline into the workplace (Osada, 1991). In Japan the 5S apply was initiated within the producing sector so extended to alternative industries and services sector. The Toyota Production System provides a well-known example of 5S principles in practice, the early versions were based on 3-S this, became 4-S (Ohno, 1988)

6.2 History of 5S:

5S was developed in Japan.It was initial detected of mutually of the techniques that enabled what was then termed 'Just in Time Manufacturing'. The Massachusetts Institute of Technology's 45- year study into the long run of the car within the late 80's known that the term was inappropriate since the Japanese success was built upon much more than elements incoming solely at the time of demand. John Krafcik, an investigator on the project, ascribed Lean to the collective techniques being used in Japanese automobile manufacturing; it reflected the focus on waste in all its forms that was central to the Japanese approach. Minimized inventory was only one aspect of performance levels in companies such as Toyota and in itself only arose from progress in fields such as quality assurance and Andon boards to highlight problems for immediate action. 5S was developed by Hiroyuki Hirano among his overall approach to production systems. Many Western managers viewing the approach for the primary time found the expertise one among enlightenment. They had maybe forever illustrious the role of housework among optimized producing performance and had forever illustrious the weather of best apply. However, Hirano provided a structure for improvement programs. He seen a series of identifiable steps, every building on its forerunner. Western managers, as an example, had always recognized the need to decide upon locations for materials and tools and upon flow of work through a work area; central to this (but maybe implicit) is that the principle that things not essential to the method ought to be removed – keep elsewhere or eliminated utterly.

6.3 Philosophy of 5S:

6.3.1 Introduction:

5S is a manufacturing management technique to organize work place. These are five Japanese techniques (5S) which standardizes the process to improve the work in the manufacturing facility. The implementation of 5S is divided in to five different steps and that is discuss below:

1. **SEIRI / SORT:**

   Seiri or sorting is initialization of implementation in 5S, it includes categorical sorting of the required items depending upon their importance. The systematic removal of unnecessary items, work pieces from the shop floor improves and optimizes the workplace management.
   The necessary and unnecessary items are available in the work area should be sorted and classified. The benefit of sorting is that the identification of the materials, tools, equipment and necessary items become much easier. It helps to

maintain the workplace clean and well-organized inventory with improved retrieval efficiency of the workplace reducing the material handling costs.

Steps for performing Sorting –

- Firstly, we trained the workers/ supervisors to make a list of all necessary things and not necessary things which are causing the mixing of the resources.
- All unnecessary parts of items on work floor were brought back to its previously destined position.
- We asked the tools and machine parts should be paced in its own places.
- Checked for once, weather all necessary things sorted in their own place.
- Classification of all tools was done in consultation with supervisor.

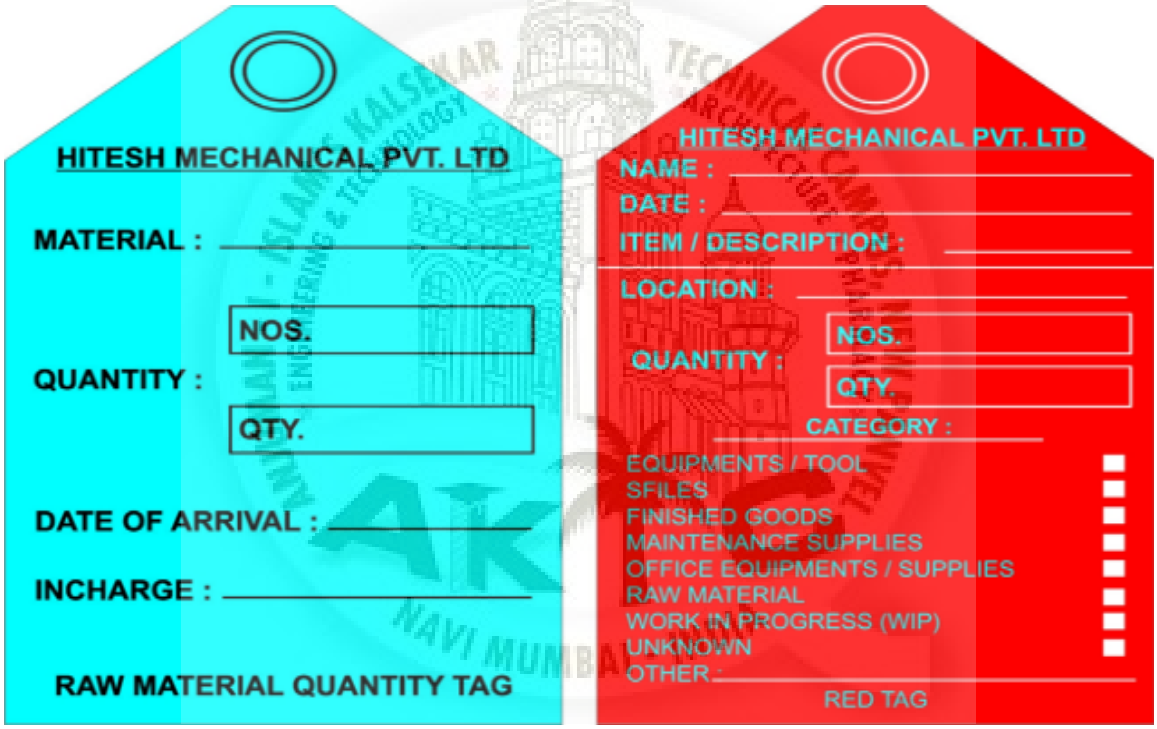

Figure 6.1: Tags

Benefits of Seiri:

- Improve the processing in the work place.
- Reduction in the cost.
- Solves the problem of Stock of item.
- Problem of losing tools eliminated.
- Better Work area.

2. **SEITON / SET IN ORDER / STRAIGHTEN:**

After sort the second step in 5S is seiton or set in order. After sorting the remaining items are to be arranged in efficient manner through the use of ergonomics principle and making sure that every item should be at proper place and none is left out. Proper signage of the workplace and inventory is also very important. E.g. Marking the area by sign boards helps to identify the areas of storage of materials and other useful items and use of labelling to identify the materials, tools, scrap, spare parts and documents and if possible, arranged that systematically for easiest and most efficient and hierarchical access. The benefits are the it increases the effectiveness, efficiency of the production and reduces the time required for seeking the items. It improves the safety.

Steps for setting the items in order–

- Firstly, we decided the positions where the items supposed to be placed, by doing discussions with staff and supervisors.
- Then segregated all tools on the basis of regular uses like drill bits, measuring tape, Vernier caliper, measurement and machining tools etc.
- Put all the important items in an accessible position based on their importance and frequency of use. Small tools should be easily accessible

Figure 6.2: Before and after implementation of seiton

Benefits of Seiton:

- Increases the efficiency of the production.
- Effectiveness increases.

- Time required for finding the items, tools or material are reduced.
- Improves the safety.

3. **SEISO / SHINE:**

Seiso is the third step in 5S. Seiso or shine is the careful cleaning of the machinery, tools, area, tables, floor and other equipment. The damages or faults will be identified such as oil leaks, etc using this technique. In this aesthetic view is taken into consideration. The benefits of this step are that it increases the efficiency of machines, finds the error in the working area, maintains the cleanliness in the facility. We intended to apply the principal at Hitesh Mechanical Pvt. Ltd.

Steps for shine–

- We checked roughly everything and clear all major sources of unnecessary things.
- We called to clean all the machine on a regular or at least on the weekly basis.
- We proposed to clean the work floor prior to the starting of the next process.

Figure 6.3: Before and after implementation of seiso

Benefits of Seiso:

- Cleans the workplace.

- Increases the efficiency of machines.
- Maintains the cleanness in the industry.
- Finds the errors in the workplace.

4. **SEIKETSU / STANDARDIZE:**

Standardization is to assure that we have prevailing ways of working across the departments or facilities. Through standardization uniformity in working and product quality can be achieved. The benefits of this method that it increases the safety of industry and helps in reducing the pollution created by the industry.

Steps for standardizing–

- Made an audit sheet or checklist to ensure the cleanness
- Tried to inculcate the habit to Maintain habit to check the progress in the cleanness among the employees. Management had given strict instruction about cleanness to the whole staff.

Figure 6.4: Marking separate area for every item and departments

Benefits of Seiketsu:

- Increases the safety of industry.
- Reduction in the pollution created by industry.

5. **SHITSUKE / SUSTAIN:**

Final and the last step of 5S is Shitsuke or sustain, ensuring the continuity in implementation of previous four stages of 5S. Maintain the facility clean, carry out the audits, etc. and we tried to make sure that the 5S become the culture of the business and everyone is responsible and accountable. And made sure that the exercise of the 5S is executed or audit is done once a month. The Benefits of this is that it had increased the awareness among the staff and reduced the chances of mistake.

Steps for sustain–

- The manager or the in charge of the industry was asked to take the responsibility to held a program for 5S rule.
- And take care that the staff should understand and practice those rules.

Sr.No.	CATEGORY	ITEM	RATING LEVEL					REMARK
			0	1	2	3	4	
1	SORT (Organization)	1. Distinguish between what is needed and what is not.						
		2. Unneeded equipment, tools, etc.						
		3. Items are present in corners.						
		4. Unneeded inventory, supplies, arts or material present.						
		5. Safety hazards (Water, machines, oils, etc.)						
2	SET IN ORDER (Orderliness)	1. A place for everything and everything in its place.						
		2. Correct places for items that are obvious.						
		3. Items are not in their place.						
		4. Workstation, equipment location is not indicated.						
3	SHINE (Cleanliness)	1. Cleaning and looking ways to keep it clean and organized.						
		2. Equipment is not kept clean and free of dirt, oil and grease.						
		3. Cleaning materials are not easily accessible.						
		4. Lines, labels, signs are not clean and unbroken.						
		5. Other cleaning problems of any kind are present.						
4	STANDARDIZE (Adherence)	1. Maintain and monitor the first three categories.						
		2. Necessity information is not visible.						
		3. All standards are not known and visible.						
		4. Checklists doesn't for cleaning and maintenance jobs.						
		5. All quantities and limits are not easily recognizable.						
5	SUSTAIN (Self-discipline)	1. Stick to the rules.						
		2. Number of times that personal belongings are not neatly stored.						
		3. Number of times job aids are not available or up-to-date.						
		4. Number of times, last week, daily5S inspections not performed.						
6	Overall 5S Efficiency	Considering all the 5S						

Figure 6.5: 5S Technique checklist

The figure shown above is a tabular form of checklist to verify the 5S status in the facility at certain interval. The rank from 0 to 4 shows the condition about the particular query as mentioned in the items list.

Benefits of Shitsuke:

- Increases the awareness among the staffs.
- Reduces mistake resulting by staffs.
- Improves relations between the staffs.

Chapter 7

Evaluation of Results

7.1 Evaluation of Systematic Plant Layout (SPL) and 5S:

The Pugh Method is invented by Stuart Pugh, and it is a qualitative technique used to rank the different layout parameters basically it is a method for making decision based on design. The Pugh Matrix (PM) is a type of Matrix Diagram that allows for the comparison of a number of design candidates leading ultimately to which best meets a set of criteria. The Pugh Matrix is easy to use and relies upon a series of pair-wise comparisons between design candidates against the number of criteria or requirements. And it also has the ability to handle a large number of decision criteria.

CONCEPT SELECTION MATRIX (Pugh Matrix)				
Selection Criteria	Concepts / Proposed Layout			
	Initial Layout	Layout A	Layout B	Layout C
1. Available of storage space	0	+	+	+
2.Space available for easy movement	0	+	+	+
3.Scrap management	0	+	+	+
4.Material handling easiness	0	-	-	+
5.Safety measurements	0	0	0	+
6.Minimum material travelling	0	0	+	+
7. Proper processing area	0	+	+	+
8.Cost	0	-	-	+
9.Total + 's	0	4	5	8
10.Total – 's	0	-2	-2	0
11.Total 0 's	7	2	1	0
12. Net score	7	4	4	8
13. Rank obtained	2	3	4	1
14. Continue with the layout				

Figure 7.1: Pugh matrix approach for concept selection

The following are the steps for these method-

1. Firstly, define the selection criteria which can be used for comparing the generated design from the initial.
2. Select the initial or reference concept, against which all other concepts are to be rated and ranked.
3. The rating is assigned as better as (+) positive, some as (0) zero and worse as (–) negative in each cell rate each component and finally calculate the net score and make your decision as shown below.[7]

7.2 Concept Selection:

Concept selection is the activity in which various concepts are analyzed and sequentially eliminated to identify the most promising concept. It is a decision-making matrix. This technique was developed by Stuart Pugh (PM) in 1980s and infrequently referred to as Pugh construct choice.[7]
For the analysis of plant layout style, the subsequent criteria area unit thought of the following

1. Availability of space between each inspection table
2. Minimum material handling
3. Ease of material handling
4. Work in process
5. Gangway width
6. Maintenance
7. Safety
8. Cost

7.3 Conclusion of evaluation:

By using the Pugh matrix, we have evaluated our results after implementing the SPL and selected the best possible layout design and implemented in the industry.

Chapter 8

Conclusion and Future Scope

8.1 Results:

8.1.1 By implementing the new layout in the facility-

After implementation of the layout 'C' it is found that the working area is increase by 20% and the storage area for raw material is increased by 35% and also the travelling time of material is reduced significantly as everything is arranged in order so it is simple to move the material during storage and process. The figure shown below represents the before and after result and improvement is the facility.

Figure 8.1: Before and after implementation of SPL and 5S

8.1.2 By applying the 5S system in the facility-

After studying and implementation of this 5S methods in this industry we have able to achieve the following benefits which are as follows:

- Material travelling time is reduced by 15%.

- Efficiency of the work is increased by 20%.
- Time is reduced by 25% for finding the necessary tools and materials due to orderly arrangement.

8.2 Conclusion

From the study and implementation of Systematic Plant Layout and 5S system in the facility we have seen the following improvements mention above. The SPL helps us to increase the working area, decreases the material travelling and handling time and provide a proper position for each individual item. 5S help us to maintain the systematic arrangement of our inventory and also help to implement certain rules and regulation related to health and work in the industries.

8.3 Future Scope

- The future development can be carried out by increasing the number of machines so that more productivity, accuracy and efficiency of the product can be achieve.
- Making sure that the rules and guidance is practice in the industries.
- And repairing the old available machine can also increase the productivity and it will be beneficial economically

References

[1] *A literature review of facility planning and plant layouts*; M.H Kulkarni, S.G. Bhatwedekar, H.M. Thakur,International Journal of Engineering Sciences & Research Technology, March 2018

[2] *Adopting the lean methodology by improving the plant layout in the foundries*; Praveen Tandon, Dr. Ajay Tiwari and Shashikant Tamrakar,International Journal of Modern Engineering Research – Volume.5, Issue.6, May 2015

[3] *Comparative studies of CRAFT and QAP techniques applied to redesigning of layout for cub-board manufacturing*; G. Bharathi, G. Ambrish,International Journal of Informative & futuristic Research – Volume.2, issue.11, July 2015

[4] *Plant layout optimization of oven manufacturing unit using CORELAP algorithm*; M. Rajesh, N V R Naidu, P. Naveen Kumar,International Journal of Research in Engineering and Technology – Volume.5, Issue.16, Sep 2016

[5] *Design and development of simulation model for plant layout*; Mahesh R. Korde, Dr. A. R. Sahu, Achal Shahare,International Journal of Science Technology & Engineering – Volume.3, Issue.9, March 2017

[6] *Design and improvement of Plant layout*; Ram D. Vaidya and Prashant N. Shende,International Journal on Theoretical and Applied Research in Mechanical Engineering – Volume.1, Issue.2, 2012

[7] *Effective improvement of a plant layout using Pugh Matrix Approach*; Sushil Dange, Shyam Sundar Luha, Prabhu Kurtakoti,International Research Journal of Engineering and technology– Volume.5, Issue.6, June 2018

[8] *Design of Plant Layout Having Passages and Inner Structural Wall Using Particle Swarm Optimization*; Shiv Ranjan Kumar,Master of Technology Thesis, Department of Mechanical Engineering, NIT Rourkela 2017

[9] *Implementation of 5S methodology in the small-scale industry: A case study*; R. S. Agrahari, P.A. Dangle, K. V. Chandrate,International Journal of Scientific & Technology Research – Volume 4, Issue 4, April 2015

[10] *Improvement of Plant Layout by using 5S technique – An industrial case study*; Dinesh B. Shinde, Prashant N. Shende, International Journal of Modern Engineering Research – Volume 4, Issue 2, February 2014

[11] *Review on 5S technique*; Prof. Saad Shaikh, Ansari Noor Alam, Khan Naseem Ahmed, Sawant Ishtiyak, Sayyed Ziaul Hasan, International journal of Science, Engineering and Technology Research – Volume 4, Issue 4, April 2015

[12] *Review on implementation of 5S methodology in the service sector*; Ravi Chourasia, Dr. Archanan Nema,International Research Journal of Engineering and Technology – Volume 3, Issue 4, April 2016

[13] *The impact of 5S on industrial organization's performance*; Arash Ghodrati, Norzima Zulkifili, International Journal of Business and Management Invention – Volume 2 Issue 3, March 2013

[14] *The use of 5S in Healthcare service*; Fanny Y. F. Young, International Journal of Business and Social Science – Volume 5, No. 10(1), September 2014

[15] *Efficiency improvement of a plant layout*; Vivekanand S Gogi, Rohith D, Shashi Kiran K, Suhail M Shaikh, International Journal of Innovative Research in Science, Engineering and Technology - Vol. 3, Issue 4, April 2014

[16] *Optimization of plant layout using slp method*; Shubham Barnwal, Prasad Dharmadhikari, International Journal of Innovative Research in Science, Engineering and Technology - Vol. 5, Issue 3, March 2016

[17] *Improvement in plant layout using Systematic Layout Planning (SLP) for increased productivity*; Pramod P. Shewale, Manmath S. Shete, Prof. DR. S. M. Sane, International Journal of Advanced Engineering Research and Studies

[18] *A literature review on efficient plant layout design*; Sanjeev B. Naik,International Journal of Industrial Engineering Research and Development (IJIERD) - Volume 7, Issue 2, May-August 2016

[19] *Improvement in layout design using SLP of a small size manufacturing unit: a case study*; Chandra Shekhar Tak, Mr.Lalit Yadav, IOSR Journal of Engineering (IOSRJEN) - Volume 2, Issue 10, October 2012

[20] *5S use in manufacturing plants contextual factors and impact on operating performance*;Bayo. A.M, Pintado A.B., and Cerio J M.D ,International Journal of Quality & Reliability Management, 27 (2), pp.217 – 230, 2010.

[21] *Facility layout improvements using Systematic Layout Planning (SPL) and Arena*; Chee Ailing,University of Malaysia – May 2009

[22] *Implementation of Systematic Plant Layout (SPL) at Hitesh Mechanical Pvt. Ltd.*; Shaikh Mohd Aftab, Khan Abdurrasheed, Prince Baranwal, Ansari Usama, Ghazi Altamash,Journal of Emerging Technologies and Innovative Research (JETIR) - Volume 6, Issue 2, February 2019

[23] *Study and Implementation of 5S at Hitesh Mechanical Pvt. Ltd.*; Shaikh Mohd Aftab, Khan Abdurrasheed, Prince Baranwal, Ansari Usama, Ghazi Altamash,Journal of Emerging Technologies and Innovative Research (JETIR) - Volume 6, Issue 2, February 2019

[24] *Overall Productivity Improvement in Casting Industry by Using Various Industrial Engineering Techniques*; Mayank Dev Singh, Swati Singh, Derasari Keyur, Soni Saumil, Patel Niki, Panchal Harshal, International Journal of Innovative Research in Science, Engineering and Technology (IJIRSET) - Volume 4, Issue 1, January 2015

[25] *Facility Layout Planning: A Review*; Rohit Monga, Varinder Khurana, International Journal of Innovative Research in Science, Engineering and Technology (IJIRSET) - Volume 4, Issue 3, March 2015

[26] *Allocating Facilities with CRAFT*; E. S. Buffa, G.C. Armour, and T.E. Vollman, Harvard Business Review, Vol. 42, No. 2, March-April, 1964

Achievements

1. Publications

   (a) *Implementation of Systematic Plant Layout (SPL) at Hitesh Mechanical Pvt. Ltd.*; Shaikh Mohd Aftab, Khan Abdurrasheed, Prince Baranwal, Ansari Usama, Ghazi Altamash, Journal of Emerging Technologies and Innovative Research (JETIR),February 2019, Volume 6, Issue(http://www.jetir.org/view?paper=JETIR1902250)

   (b) *Study and Implementation of 5S at Hitesh Mechanical Pvt. Ltd.*; Shaikh Mohd Aftab, Khan Abdurrasheed, Prince Baranwal, Ansari Usama, Ghazi Altamash, Journal of Emerging Technologies and Innovative Research (JETIR), February 2019, Volume 6, Issue 2 (http://www.jetir.org/view?paper=JETIR1902251)