PRODUCTIVITY IMPROVEMENT IN PLANT BY USING SYSTEMATIC LAYOUT PLANNING (SLP) - A CASE STUDY OF MEDIUM SCALE INDUSTRY

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Abstract

In the present work, the layout design is an important task when a manufacturing system is constructed, or expanded. The objective of this research is to study the existing plant layout of manufacturing unit and improve it using systematic layout planning theory (SLP) for better plant area utilization and increased productivity In this paper we highlighted some problems faced by one medium scale Auto Ancillary company. The layout of the firm was the main concern regarding the operations conducted and material flow in the assembly line. Company focuses mainly to improve the productivity of plant. We use systematic layout planning (SLP) approach to improve existing layout of the company. The detailed study of the plant layout such as operation process chart, flow of material and activity relationship chart has been investigated. Final layout was selected by installation of new machine with effective utilization of area to improve productivity.

Keywords-*Plant layout, Systematic Layout Planning, Flow analysis, Activity relationship chart*

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1. INTRODUCTION

Plant layout is the best and an optimum arrangement of operating equipment, personnel, storage space, material handling equipment and other services to facilitate the design of product. Plant layout embraces the physical arrangement of industrial facilities. This arrangement either installed or in plan, includes the spaces needed for material movement, storage, laborers, and all other related activities or services. A good layout is one which allows material flow rapidly and directly for processing. This reduces transport handling and other costs per unit, space requirement are minimized and idle machine and idle man time reduces.

A key concern for any manufacturing company is the ability to produce a variety of high quality products by reducing manufacturing time and cost. In given auto ancillary company the main task is improvement in productivity by changing the Plant Layout. So the task was to improve the Plant Layout which will best suits to their part family. Existing plant layout is improved by applying SLP methodology. New plant layout improves the process flow through the plant, and help to increase space in plant.

The Company was having problems with some old machines regarding their maintenance quality issues and space utilization. So Company wanted to install the new machines. They purchased SWAGING, WELDING SPM,SHOT FILLING,PIPE BENDING, SHOT REMOVING,WELDING-2, DRILL (10 mm). At present company is having process layout, to increase the productivity. of it is required to shift from process to product layout.

1.1 Objective of Company

1. Installation of new machines.
2. Proper utilization of floor space.
3. Layout improvement for Disco assembly line for productivity improvement.
4. Layout improvement for Pipe A and Pipe PD assembly line.

1.2 Company Introduces New Machines

- Inlet pipe Swaging Machine
- Inlet pipe mouth piece Welding Machine
- Shot filling and Ramming Machine
- Pipe Bending Machine
- Shot Removing Machine
- Pipe Welding for Stopper Ring
- Gauge Inspection Fixture
- Leakage Testing SPM
- Hole Drilling Machine

Company wanted to shift the Machines

- Cutting Machine
- Drilling (Ø 3 mm) Machine
- Grinder Machine

- Pneumatic Grinder Machine

2. PROCEDURE FOR SYSTEMATIC LAYOUT PLANNING

The **systematic layout planning** (SLP) is a tool used to arrange a workplace in a plant by locating two areas with high frequency and logical relationships close to each other. The process permits the quickest material flow in processing the product at the lowest cost and least amount of handling.

Systematic Layout Planning is an organized way to layout planning. It involves of procedures, based on conventions for identifying, rating, and visualizing the elements involved in planning a layout.

The detailed procedure for SLP is shown in the figure1.

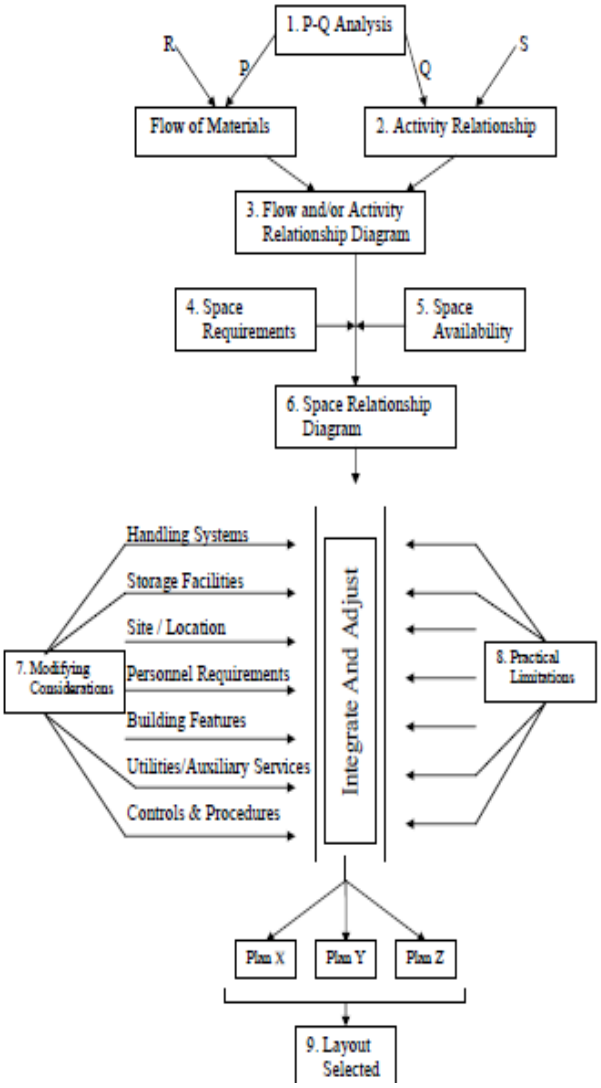

Fig 1 SLP Procedure Block Diagram

3. SLP APPLICATION IN COMPANY

3.1 P-Q Analysis

P-Q Analysis is process of identifying various products in comparison with the quantities of each product.

This analysis gives information of

1. Grouping of the various products, materials, or items involved.
2. Get information about the quantity of each group, or each product or variety within each group.

The product quantity analysis for the company under study is given in the table below

Table 1 P-Q Table

SR NO	PRODUCT	QUANTITY/DAY
1	Silencer pipe A	225
2	Silencer pipe pd	600
3	Silencer pipe Disco	400
4	Silencer Honda	350

From this table we prepare P-Q chart. This chart/curve reveals the product varieties that are produced at assembly line as per requirement

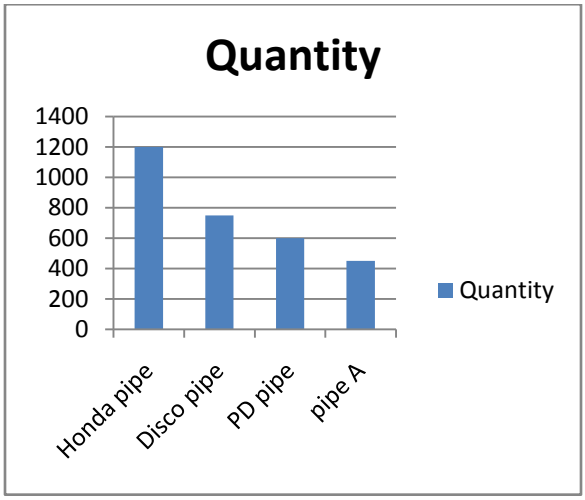

Fig 2 P-Q analysis chart

3.2 Flow Analysis

The next step in the SLP is to analyze the flow of material. In most of the cases sequence of operations forms the basis for the flow analysis. The process chart in its various forms is the most useful for analyzing the material movement within the layout. (3).Multiple-product process chart is one of the best techniques. When there are number of product uses combined processes. Table 2 Shows multi product process chart for the Pipe A and Pipe PD products of company. Operations are

indicated by a slant line joining them with the preceding operation. Form this chart; the layout can be seen already taking shape. Using the operation number at the very left for identification.

Table 2 Multi Product Process Chart

No.	Operation	silencer pipe A Assembly	silencer Pipe PD Assewmbly
E1	Connector weld	1	1
E2	Leakage	2	2
E3	Inner & Outer pipe weld	3	3
E4	Push ramming	4	4
E5	Shot filling	5	5
E6	CNC bending	6	6
E7	Shot removal	7	7
E8.B	Leakage		8
E9.B	Gauge		9
E10.B	FG		10
E8.A	Cutting of pipe	8	
E9.A	Grinding	9	
E10.A	Bush inserting	10	
E11.A	Drill on pipe	11	
E12.A	Gauge inspection	12	
E13.A	Welding of bush & bending pipe	13	
E14.A	Leakage	14	
E15.A	FG	15	

3.3 From-to Chart

From-To Chart shows quantitative data on material flow by recording distance and frequency of movement between different pairs of departments and assembly line. From-To Chart are useful to determine degree of closeness necessary between different departments and assembly line for material interaction. (2) The efforts are made in layout design to place these departments having more material movement close to each other to minimize material handling.

From-To Chart for all parts of family is shown in table3.

Table 3 From –To Chart of Pipe A and Pipe PD Assembly line

FORM \ TO	connector welding(E1)	leakage (E2)	inner & outer pipe weld(E3)	ram pushing(E4)	shot filling(E5)	cnc bending(E6)	shot removing(E7)	leakage (E8.B)	gauge(E9.B)	FG(E10.B)	cutting of pipe(E8.A)	grinding(E9.A)	bush inserting(E10.A)	drilling(E11.A)	gauge(E12.A)	welding of bush & pipe(E13.A)	leakage (E14.A)	FG(E15.A)	Total
connector welding(E1)	0	8.3																	8.3
leakage (E2)		0	2																2
inner & outer pipe weld(E3)			0	14															14
ram pushing(E4)				0	4														4
shot filling(E5)					0	4													4
cnc bending(E6)						0	78												78
shot removing(E7)							0	4											4
leakage (E8.B)								0	6										6
gauge(E9.B)									0	2									2
FG(E10.B)										0	6.3								6.3
cutting of pipe(E8.A)											0	3							3
grinding(E9.A)												0	1						1
bush inserting(E10.A)													0	1					1
drilling(E11.A)														0	4				4
gauge(E12.A)															0	4			4
welding of bush & pipe(E13.A)																0	10		10
leakage (E14.A)																	0	5	5
FG(E15.A)																		0	0
Total		8.3	2	14	4	4	78	4	6	2	6.3	3	1	1	4	4	10	5	156

Table 4. From –To of Disco Assembly Line

FORM \ TO	Shot filling (D1)	CNC bending (D2)	Shot removal (D3)	Gauge (D4)	FG	TOTAL
Shot filling (D1)	0	9				9
CNC bending (D2)		0	80			80
Shot removal (D3)			0	4		4
Gauge (D4)				0	4	4
FG					0	0
Total		9	80	4	4	97

Table 5.from –To Honda Assembly Line

FORM \ TO	cutting of pipe(H2)	drill(H3)	grinder(H4)	pnumatic grinder(5)	FG(H6)	TOTAL
cutting of pipe(H2)	0	5.25				5.25
drill(H3)		0	6			6
grinder(H4)			0	4		4
pnumatic grinder(5)				0	4	4
FG(H6)					0	0
Total		5.25	6	4	4	19.3

4. ACTIVITY RELATIONSHIP CHART (REL CHART)

Flow analysis tends to relate various activities on some quantitative basis. Some qualitative aspects of layout design are also important, such as ease of supervision, connivance, contact etc. The activity relationship chart (REL chart) is helpful to facilitate the consideration of qualitative factors. It involves developing a relationship chart showing the degree of importance of having each department located adjacent to every other department. Table4 shows the six level rating used in REL chart.

To identify the relative importance of having one department near to other department we interviewed the workers and supervisors.Table5 shows the reasons for locating one department near to other department.

Table 6 Reasons for Closeness

Code	Reason
1	Flow of Material
2	Ease of supervision
3	Convenience
4	Production Control
5	Contact

According to the study of the manufacturing process, of the various parts it was found that the distance for moving materials is most significant factor in determining department closeness, considering other qualitative factors we prepare REL Chart as shown in Table 7.

Table 7 activity relationship chart

Description	1	2	3	4	5	6	7
office	0						
tool room	A(2)	0					
raw material area	U(3)	O(5)	0				
pipe A and PD assembly	U(4)	U(4)	U(4)	0			
disco assembly(D)	U(4)	U(4)	U(4)	A(5)	0		
honda assembly(H)	U(4)	U(4)	A(3)	A(1)	A(1)	0	
finish good storage	U(2)	A(3)	I(4)	I(1)	I(1)	I(1)	0

Table 8 Relation between the Department

Department	area(sq ft)	Total working area (sq ft)
Office	352	352
Toolroom	192	192
Finish storage	156	156
Pipe A and PD assembly(E)	156	432
Disco pipe assembly(D)	97	197
honda pipe assembly (H)	19	65
Raw material	768	1152

4.1 The Flow of Material

Raw materials were carried out with long distance and that means waste in time and energy resulting in high cost.

4.2 Utility of the Area

The area was not used to the full potential because old machine and remaining material were still there in the working area resulting in unless area of the plant.

4.3 Material Handling Equipment

Material handling equipment of the raw material was not good enough that is to say trolley was used to move in one direction and pathway was not flexible enough due to untidy arrangement of the things.

4.4 Storage of Finish Good Material

Storage area for finish good material was 156 square feet. the plant at the present time could contain only finish good material .after improvement it had more space to install new assembly line.

4.5 Analysis Factory Layout on SLP

According to study of manufacturing process, it was found that long distance could be reduced for moving material from assembly line and the problem about unless area could be solved .the way to improve plant to apply SLP method to make the flow continually by arranging the important sequence of the manufacturing. Then the relationship of each activity in closeness area was considered to make the relationship of activity.

4.6 Proposed Layout

The important sequence of each activity was rearranged from the most important one to least important one. Based on modifying plant layout were deployed .the original plant layouts represent a while modified plant layout represent B.

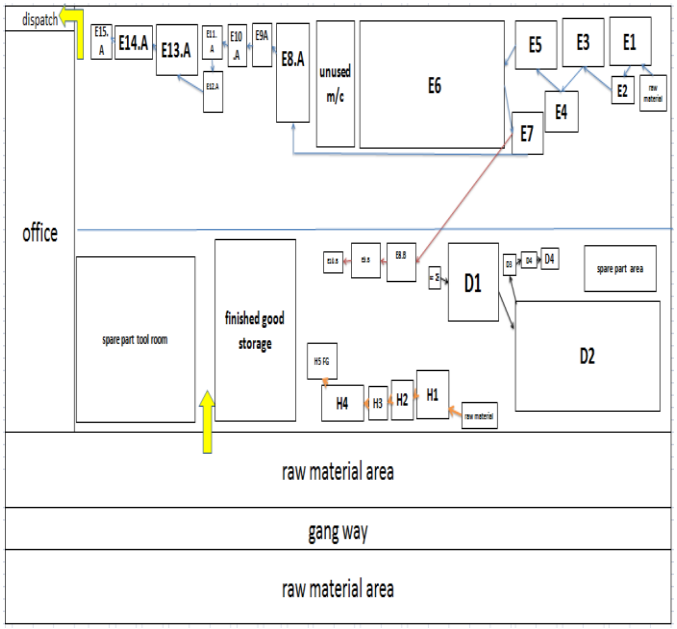

Fig 3 A .original plant layout

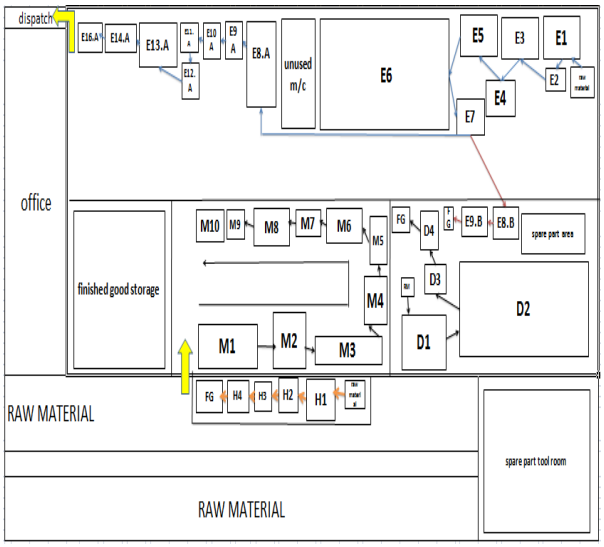

Fig 4 B Proposed layout

Table 9 New machine specification

Operation	Area (sq ft)
Inlet pipe swaging	18.27
Inlet pipe mouth piece weld	20.25
Inlet pipe shot filling and raming	25.08
Pipe bending	16
Shot removing	7.7
Pipe welding for stopper ring	7.7
Gauge inspection	3.43
Leakage testing SPM	10.3
Hole drilling	2.57
Pipe rework and finishing	10.3

According to analysis of plant and work flow it was found that finish good material area was 156 square feet and new all new machine area was 121.6 square feet. spare part tool room area was 192 square feet , it was shifted to raw material department the area of raw material was 1152 square feet. Finish good material area shifted to tool room without affecting the excess area, the Honda assembly line shifted to raw material area, and Mahindra silencer assembly line shifted to finish good area.

5. CONCLUSIONS

By applying SLP to the plant of company we have get the following results obtained,

- Installation of new machines helps to improve the productivity.
- The company's demand of space utilization has been thoroughly justified in the project work.

- We are successful to minimize the material handling time, labour cost, transportation cost for some operations
- Greatly Reduction in Material Handling.

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