Layout Planning in a Pump Manufacturing Industry Using ARENA

Manivel Muralidaran V, Sandeep D

Abstract— Plant layout study helps much in improvement in the existing layout. The production efficiency depends on how well the various production facilities, employee's amenities and, machines are located in a plant. Most layouts are designed properly for the initial conditions of the business, although as long as the company grows and has to be adapted to internal and external change, a re-layout is necessary. There should be an optimum relationship among the output, floor area and manufacturing process. This study is based on the analysis of existing layout in a Pump manufacturing industry. The arrangement of machines is to be simulated using the software and efficiency of each machine has to be analyzed. The layout design generally depends on the product's variety and production volumes. The objective of factory simulation that will be developed in this project is to analyze the factory layout of manufacturing system. An attempt is to be made to simulate the existing layout of the industry using the ARENA software. The aim of this project is to find out most efficient arrangement of machines in the machine shop that will improve the efficiency of workflow in the shop floor allowing workers and equipment being more productive. This paper tries to illustrate how the plant layout problem can be solved using simulation technique. It also helps to modify the plant layout so as to improve the efficiency.

Index Terms— ARENA, Facilities, Layout, Process Flow, Queue, Resource, Simulation.

1 Introduction

A plant layout study is an engineering study used to analyze different physical configurations for any manufacturing facility/plant. Plant layout planning includes decisions regarding the physical allocation of the economic activity centers in a facility. An economic activity center is any entity occupying space. Most layouts are designed properly for the initial conditions of the business, although as long as the company grows and has to be adapted to internal and external change, a re-layout is necessary. The main objective of this project is to find out the most efficient arrangement of machines in the machine shop to reduce the non-value added time.

2 Literature Survey

From the literature survey it was found the ARENA modeling system is a flexible and powerful tool that allows analysts to create animated simulation models that accurately represent virtually any system. The aim of this project is to find out most efficient arrangement of machines in the machine shop that will improve the efficiency of workflow in the shop floor allowing workers and equipment being more productive.

Bobby John et al., (2013), made an attempt to simulate the factory layout using the software ARENA (student's version). Utilization of each machine is calculated. The efficiency of production depends on how well the various machines; production facilities and employee's amenities are located in a plant. Only the properly laid out plant can ensure the smooth and rapid movement of material, from the raw material stage to the end product stage. They use the software ARENA (student version) for the simulation purpose. A simulation study was under taken to find out the efficiencies of the machines in the industry. The main aim is to find out most efficient arrangement of machines in the machine shop. By the simulation we can see the individual movements from one machine to other. This paper tries to illustrate how the plant lay out problem can be solved using simulation technique. It also helps to think how the efficiency can be improved. Extensive interviews and discussions are conducted with engineers and top management of industry to get the clear idea of layout of plant. A step wise analysis procedure is followed to reduce the complexity. The production efficiency depends on how well the various production facilities, employee's amenities and, machines are located in a plant. Only the properly laid out plant can ensure the smooth and rapid movement of material, from the raw material stage to the end product stage. Plant layout study helps much in improvement in the existing layout.

3 Problem Definition

The problem identified in the factory includes the following:

- The productivity has been reduced due to improper shop floor layout.
- Improper positioning of the machines in the shop floor with regard to the sequence of the operations.
- Raw materials and finished products are randomly stored without any proper allocation of space.
- Some backward movement in the flow of material is observed.

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- Improper material handling design for the movement of raw material to finished products.

4 METHODOLOGY

Step1: Data collection.
Step2: Design and analyse the existing Layout.
Step3: Simulate using ARENA.
Step4: Search for alternative layout and evaluate it.
Step5: Select the appropriate layout that would minimize the drawbacks of existing layout.

5 COMPANY DETAILS

The Industry was established in 1989 and has been manufacturing Pumps & motors for more than 24 years of market presenceand have been well accepted by its customers in India. The significance of the organization lies in the supply of high quality motors and pumps at affordable costs to its customers. The objective of the the company is working itself for the welfare of the society by providing them with high quality products at affordable cost. The production capacity of the plant is 2500 nos. per month. Due to constrain in the market at present they are doing about 1500 nos. per month. The above figure is based on single shift and if it is necessary a second shift can be arranged with the capacity to manufacture the same quantity of pumps. Skilled and semi – skilled persons are freely available in the area and procuring of necessary items such as casting, shafting bearing etc., are also at ease. Apart from the any Customers Special Requirements and enquiry they will meet to committed time and schedule.

6 DATA COLLECTION

6.1 Takt Time

No. of Operators = 9 operators
Working shift per day = 1
Available time per shift = 480 minutes
Tea break per shift = 2 * 10 minutes
= 20 minutes
Lunch break per shift = 60 minutes
Down time per shift = 0
Net working time per shift = [available time-(breaks + break down)]
= 480-80
= 400 minutes
Customer demand per day = 60 Pumps/day.
Takt time = (Available production time/
Total daily quantity required)
= 400/60
Takt time = 6.67 minutes

The Takt time required to meet the customer demand is calculated & found to be 6.67 minutes.

6.2 No. of Operators Needed

Total cycle time = 75 min
No. of Operators Needed (Calculated Value)
= (Total cycle time / Takt time)
= (75/6.67) = 11.245
= 12 (approx)

6.3 Present Manufacturing Case Study

The cycle time and number of operators for every machine are noted and tabulated in Table 1 and the existing layout is given in figure 1.

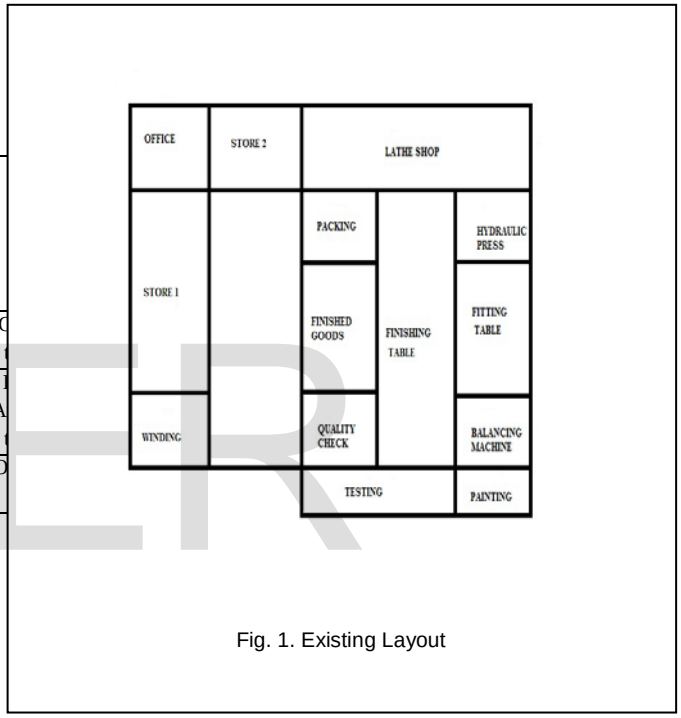

Fig. 1. Existing Layout

7 SIMULATION RESULT

The material flow in the shop floor is simulated using ARENA

software.

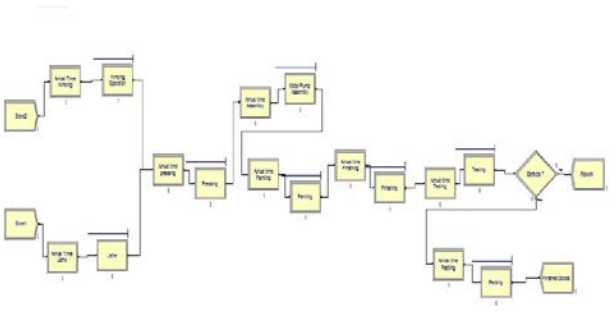

Fig. 2. Simulation Model

The simulation results obtained from the ARENA are as follows:

Resource

Usage

Scheduled Utilization	Value
Hydraulic Press	0.1610
Lathe Operations	0.7046
Manual Assembly	0.9663
Manual operator	0.8052
Manual Winding	0.9260
Packing Machine	0.1476
Sprayer	0.2818
Testing Machine	0.4026

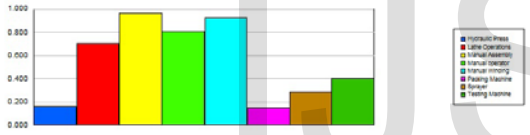

Fig. 3. Resource Utilization (Graphical Representation)

Queue

Time

Waiting Time	Average	Half Width	Minimum Value	Maximum Value
Finishing.Queue	0.00	(Insufficient)	0.00	0.00
Lathe.Queue	482.22	(Insufficient)	0.00	965.92
Motor Pump Assembly.Queue	113.85	(Insufficient)	0.00	219.60
Packing.Queue	0.00	(Insufficient)	0.00	0.00
Painting.Queue	0.00	(Insufficient)	0.00	0.00
Pressing.Queue	0.07416667	(Insufficient)	0.00	1.9000
Testing.Queue	0.00	(Insufficient)	0.00	0.00
Winding Operation.Queue	644.00	(Insufficient)	0.00	1287.10

Other

Number Waiting	Average	Half Width	Minimum Value	Maximum Value
Finishing.Queue	0.00	(Insufficient)	0.00	0.00
Lathe.Queue	19.4150	(Insufficient)	0.00	56.0000
Motor Pump Assembly.Queue	9.1677	(Insufficient)	0.00	19.0000
Packing.Queue	0.00	(Insufficient)	0.00	0.00
Painting.Queue	0.00	(Insufficient)	0.00	0.00
Pressing.Queue	0.00597215	(Insufficient)	0.00	1.0000
Testing.Queue	0.00	(Insufficient)	0.00	0.00
Winding Operation.Queue	25.9526	(Insufficient)	0.00	56.0000

Fig. 4. Queue Length and Waiting Time

8 Result and Suggestions

From the simulation result, it is clear that the queue length is found more in lathe and winding operation and also waiting time for each component is found more in lathe and winding operation. The utilization of all the resources is given in Fig. 3. From the result the utilization of Assembly section is found to be 96.63%.

The following suggestions have be made to improve the utilization of the machines and to reduce the queue length

- The queue length and waiting time of the component can be reduced by adding facilities in winding and in lathe shop.
- From the data collection, the number of operators is 9. But the required number of operators needed (through calculation using Takt time) is 12. Therefore the operators can be appointed in either lathe shop or in winding section.
- There should be a change in the layout to improve the utilization.
- Introduction of multi skilled employees can help the organization to improve.
- There should be a maximum usage of existing facilities.
- CNC machines can be introduced in the organization to reduce the queue length in lathe operations.

9 Conclusion

This paper delivers the evidence of valid advantage when the above given suggestions are applied in the industry. The proposed suggestions will overcome the drawbacks of the existing layout and thus the productivity can be improved. These suggestions will be very useful for the industry to avoid the problems in existing layout.

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