"Enhancement of Productivity through Analysis & Modification of Existing Plant Layout at a Manufacturing Firm"

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Abstract: *With increasing demand in production, industrial factories must need to increase their potentials in production and effectiveness to compete in markets. Therefore, the way to solve the problem relating to the production is very important. This study of plant layout is done in B. Shankara Sales Organization, Agra which is a piston and piston ring manufacturing company of two and three wheeler vehicle. Throughout the study, the aim is to proposed new layout to this company to increase their productivity. In each workstation the processing time is different and the longest time consumption is workstation will be identified as a bottleneck workstation. The time is taken by stopwatch of each and every machine in the cell. In this study, application of Computer Aided tools is introduced which in this study is ARENA software. The related inputs are going to be simulated with this software. The goal of the thesis is to seek the best layout in terms of increasing productivity rate hence proposed to the company*.

KEYWORDS: *Plant layout, Line Balancing and ARENA software.*

I. INTRODUCTION

Production System

To operate effectively, a manufacturing firm must have systems that allow it to efficiently accomplish its type of production. Production system is a collection of people, equipment, and procedures, organized to accomplish the manufacturing operations of a company or other organization. Fig 1.1 represents the production system which consists of facilities and manufacturing support systems Production systems can be divided into two categories:

- Production facilities/ plant layout.
- Manufacturing Support System.

1. Production Facilities/Plant Layout: This refers to the physical equipment and their arrangement in the factory.

2. Manufacturing Support Systems: Manufacturing support systems are the procedures used by the company to manage production and solve the technical and logistics problems encountered in ordering materials, moving work through factory, and ensuring that products meet quality requirements.

Plant Layout

Plant layout is the optimum arrangement of man, machine, equipment, and materials. And it also showing the space allocated for material movement storage and activities from the conflict of raw materials to the shipping of the finished goods for an overall economy and efficiency of production. Fig.1 represents a simple plant layout.

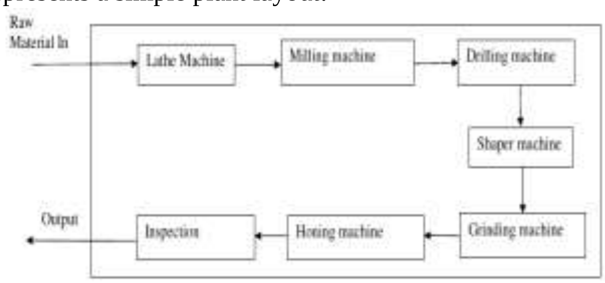


Figure 1 plant layout

Line Balancing

The term line balancing is associated with the schedule of production line jobs that balance the work load of each work station so that each of the worker on the production line has to carry out more or less equal amount of work. The output of line is dictated by the largest station time which becomes invariably cycle time of the line. The first step is to divide the whole work into elements and list them sequentially along with the time required to complete the element and group the tasks/elements, which have to be performed into balanced work assignments. This process of grouping the tasks/elements is known as line balancing. (Murthy 2006).

II. METHODOLOGY

In an assembly line the product units move with a constant transportation speed through the consecutive stations. The total work content to be performed by the production system has been split up into economical indivisible work elements which are called tasks. Among the set of tasks there exist technological precedence relations. The set of tasks to be performed in the same station is called an operation or a station load. The time to perform an operation is restricted by the cycle time.

The assembly line balancing problem consists in allocating the tasks to the stations subject to the technological precedence relations, the cycle time restriction of the stations and the indivisibility of the tasks. (Amen 1998).

The objective of assembly line balancing is usually is to minimize the number of stations in a line, minimize the total idle time of the total capacity provided by the sum of the stations of the line. Therefore, this is called time-oriented assembly line balancing.

2.1 Methods for balancing assembly lines:

1. Heuristic Layout Technique.
2. Simulation Layout Technique.

2.1.1 Heuristic Layout Technique:

1. Largest Candidate Rule.
2. Kilbridge and Wester Method.
3. Ranked Positioned Weights Method.

2.1.2 Simulating Layout Technique

A number of computerized layout programs have been developed since the 1970s to help devise good process layouts. Of these, the most widely applied Programs are

1. Arena.
2. Tecnomatix plant simulation.
3. Witness.
4. Factory Simulation.
5. Autodesk Factory Design Suite.
6. Simul8.

2.2 ARENA

Arena is a simulation environment consisting of module templates, built around SIMAN language constructs and other facilities, and augmented by a visual front end.

With Arena, you can:

- **Model** your processes to define, document, and communicate.
- **Simulate** the future performance of your system to understand complex relationships and identify opportunities for improvement.
- **Visualize** your operations with dynamic animation graphics.
- **Analyze** how your system will perform in its "as-is" configuration and under a myriad of possible "to-be" alternatives so that you can confidently choose the best way to run your business. (Altiok 2007).

III. ANALYSIS OF EXISTING DATA OF COMPANY & PROPOSED LAYOUT TO IMPROVED PRODUCTIVITY

Companies have 3 manufacturing cell and each manufacturing cell have sub production line, each perform a particular specific work. Here each manufacturing cell take input from sub production line These manufacturing cell are following:-

- Casting of piston.
- Finishing of piston cell.
- Packing of piston and ring.

3.1 Layout of Piston Finishing Cell

This layout shows that arrangement of manufacturing machines in sequence. It has eleven main machines. All of these machines process in way of sequencing, This way of sequence grinding, lathe-1, lathe-2, lathe-3, lathe-4, lathe-5, lathe-6, lathe-7, boring machine, lathe-8, Reaming machine. First of all grinding machine operator takes input in the form of casting piston, after that perform operation and transfer to next machine operator, this way of sequence to be continue end of the cycle and after the end of cycle we get finished piston as output. The sequence of machine layout is shown in fig. 2.

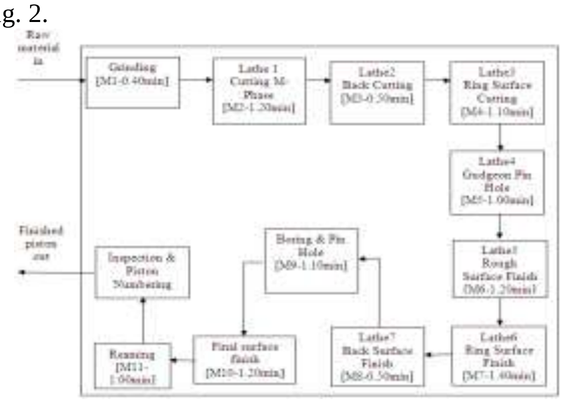
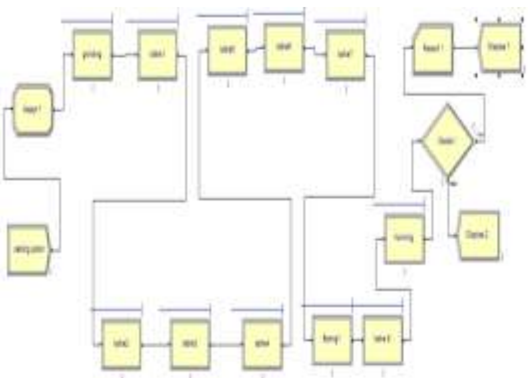


FIG. 2: Layout & Process of Sub Production Line

3.2 The Present Layout Model of Piston Cell of Company on ARENA

THE PRESENT LAYOUT OF THE COMPANY IS SHOWN IN FIG. 3



3.3 THE MODIFIED PROPOSED LAYOUT MODELS OF PISTON CELL OF COMPANY ON ARENA

PROPOSED CASE-I:

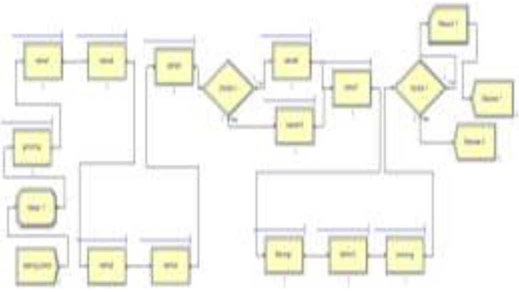


FIG. 4: THE PROPOSED LAYOUT-I OF PISTON CELL OF COMPANY IN ARENA SOFTWARE

PROPOSED CASE-II:

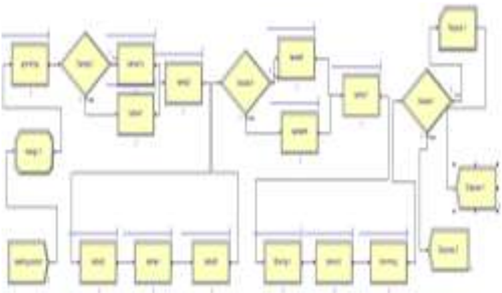


FIG. 5: THE PROPOSED LAYOUT-II OF PISTON CELL OF COMPANY IN ARENA SOFTWARE

PROPOSED CASE-III:

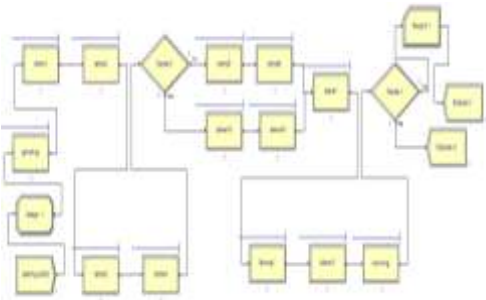


FIG. 6: THE PROPOSED LAYOUT-III OF PISTON CELL OF COMPANY IN ARENA SOFTWARE

PROPOSED CASE-IV:

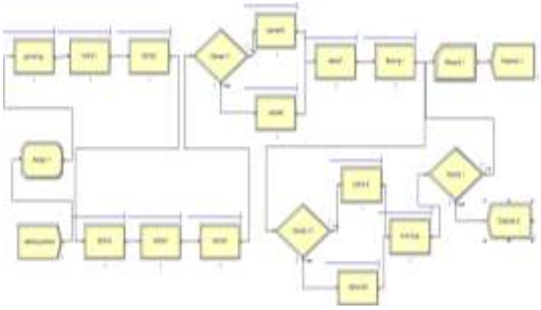


FIG.7: THE PROPOSED LAYOUT-IV OF PISTON CELL OF COMPANY IN ARENA SOFTWARE

IV. COMPARISON OF ANALYSIS

TABLE 4.1 SHOWS THE COMPARISON OF PROPOSED LAYOUT WITH BASIC LAYOUT

S. No	Cases Name	Machines Added to Basic model in parallel	Total Production	Selected Pistons	Rejected Pistons	% Efficiency
1	Current Case	No Machine added	307	276	31	84.86%
2	Best Case-1	Lathe m/c-6	358	325	33	90.78%
3	Best Case-2	Lathe m/c-1 & Lathe	358	326	32	91.06%
4	Best Case-3	Lathe m/c-5 &Lathe m/c-6	359	327	32	91.08%

Fig. 8 shows the graph of the result, shows the graph of Total Production, graph of Selected Piston & the graph of Rejected Pistons, & also shows the Simulation Results with Utilization of Machines in Different Cases

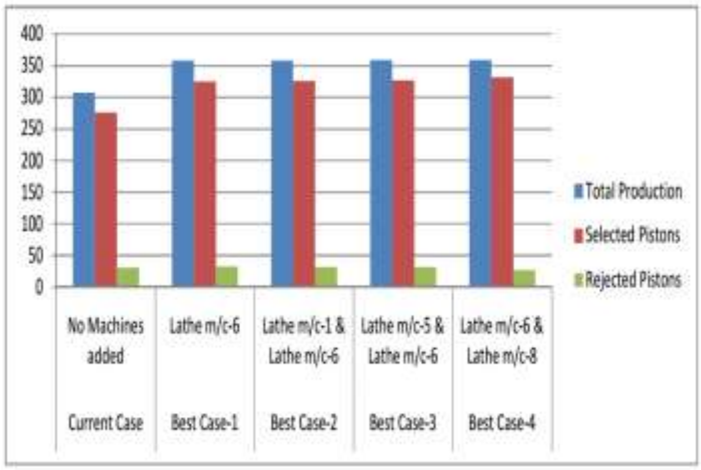


Fig.8: Graphical representation of production rejection & selection of piston per cycle.

V. RESULTS

Results After this simulation of existing data process in arena is carried out. Result of Arena in Different Cases are generated and analysed. Concluding different cases of the case arena results are compared. The best result is then applied to the manufacturing cell of the company as shown in fig.

1. Total Number of Pistons Produced in a Particular Shift Increases From:

276 to 325 on increasing Lathe 6 in parallel. 276 to 326 on increasing Lathe 1 & Lathe 6 in parallel. 276 to 327 on increasing Lathe 5 & Lathe 6 in parallel. 276 to 332 on increasing Lathe 6 & Lathe 8 in parallel.

2. Total Production Efficiency in a Particular Shift Increases from:

12.25% on increasing Lathe 6 in parallel. 12.5% on increasing Lathe 1 & Lathe 6 in parallel. 12.75% on increasing Lathe 5 & Lathe 6 in parallel. 14% on increasing Lathe 6 & Lathe 8 in parallel.

Result 1,

Suggested experimental process number –I (Lathe 6 increased)

Number of pieces out – 325 Nos.

Efficiency – 81.25%

Result 2,

Suggested experimental process number –I (Lathe 1 & Lathe 6 increased)

Number of pieces out – 326 Nos.

Efficiency – 81.5%

Result 3,

Suggested experimental process number –I (Lathe 5 & Lathe 6 increased) Number of pieces out – 327 Nos.

Efficiency – 81.75%

Result 4,

Suggested experimental process number –I (Lathe 6 & Lathe 8 increased) Number of pieces out – 332 Nos.

Efficiency – 83%

VI. Conclusions

Conclusions out of all suggestion the best option was case-4 the company will implement this option to improve the productivity as on adding two machine (Lathe 1 & Lathe 6) makes increase in production of 14%.

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