Industrial Layout And Material Handling Improvement

Sudarshan T A
Assistant Professor, Dept of Mechanical Engineering
New Horizon College of Engineering, Bangalore-560103

Abstract- *The paper focuses mainly on layout and material handling improvement methods. Increasing global competition has evolved a manufacturing environment which gleans vast product configuration, reduced lead times, and increased standards of quality and competitive costs. In parallel with a rising trend toward globalization, these manufacturing facilities must be designed to cater for new challenges to survive and grow in the marketplace. Plant layout is the arrangement of desired machinery and equipment of a plant in a way which will permit the easiest flow of materials, at the lesser cost with minimum handling, in processing the product from the raw materials to the dispatched of the finished product. The research paper presents solving an industrial problem using the principle of string diagram and simulation software.*

Keywords- Layout, String diagram

I. INTRODUCTION

When discussion starts about plant layout usually, papers link it with planning an entirely new plant starting from the scratch. Layouts are designed for new plants and this is not the case always. Problems are there which necessitate the improvement and revision of existing layouts also. There are many reasons which make management to think to redesign the existing layouts. For example Expansion of capacity, Shrinkage of output, Change in product design, Replacement of equipment, Entire department moved to new location, Poor work environment, Frequent accidents, To reduce material handling costs. To reduce other costs here in this project we are focusing on the requirement of facility layout planning, in order to reduce the material handling cost and reduce the travel time and distance covered by the product before it gets in to the final product.

Types of Plant layout

A .Product or Line Layout:

Product or Line Layout is the arrangement of machines in a line (not always straight) or a sequence in which they would be used in the process of manufacture of the product. This type of layout is most appropriate in case of continuous type of industries where raw materials is fed at one end and taken out as finished product at the other end. For each type of product a separate line of production will have to be maintained.

This type of layout is most suitable in case of metal extraction industry, chemical industry, soap manufacturing industry, sugar industry and electric industry. It should be noted that this method is most suitable in case of mass production industries.

According to Shubin and Madeheim, product layout is suitable where:

(i) Large quantity of standardized products are produced;
(ii) The standardized products are to be processed repetitively or continuously on the given production facilities;
(iii) There must be sufficient volume of goods processed to keep the production line actively occupied,
(iv)There should be greater interchange ability of the parts; and
(v) to maintain good equipment balance each work station must employ machines or equipment's of approximately equal capacities. Similarly to maintain good lab or balance, each work station must require an equal amount of work to be performed.

B. Functional or Process Layout:

It is just the reverse of product layout. There is a functional division of work under this method. For example, lathes are fixed in one department and welding activities are carried in another department of the factory. The salient features of this type of layout are based on Frederick W. Taylor's concept of 'functional organization'.

This method is generally adopted for producing different varieties of unlike products. This is particularly adopted tor job order industries like engineering, ship building and printing etc. The following diagram shows that raw material travels through various process or departments from lathes passing through mills, grinders, drills, welding, inspection, finishing, and assembly and to finished product.

Material Handling

Material handling technology is becoming the most important criteria to all type of the productive and non productive businesses operating in today's competitive society. So material handling equipment selection is an important function of a material handling system. Use of proper material handling equipment can enhance the production process, and improves system flexibility . Today's dynamic and global competition in the market due to the rapid growth in technology shortened product life cycle and high quality product expectation by the customers at lowest price makes the concerns more competitive at national and international level . To overcome these difficulties importance of material handling equipments cannot be ignored. In this modern era of technology, availability of wide range of material handling equipment options, selection of material handling equipment is a complex and tedious task for the decision maker. Therefore, MHE selection problem can be considered as multiple criteria decision making (MCDM) problem.

II. OBJECTIVES

The problem genesis led to the formulation of the following objectives:

1. To study the current flow pattern and relation of overall plant layout and develop a newplant layout.
2. Relocating the workstations for simpler flow and reduction in check points.
3. To improve the efficiency of the plant layout using simulation.
4. Minimize waiting time between straitening and grinding the beam.
5. Minimum material handling and related travelling cost.
6. Minimizing travelling distance in material flow.
7. Minimizing total time in process.
8. No backtracking moves.
9. Standard material flow pattern.
10. Better utilization of available space.

III. LAYOUT IMPROVEMENT

Pair wise Exchange Method:

- The pairwise exchange method is animprovement-type layout algorithm.

Although it can be used with both an adjacency-based and distance-based objective, it is often used with the latter.

- The pairwise exchange method simply states that for each iteration, all feasible exchanges in the locations of department pairs are evaluated one at a time, and the pair that results in the largest reduction in total cost is selected.
- Evaluating each exchange one at a time means that when departments i and j are exchanged and the layout cost is computed.

EXISTING PLANT LAYOUT:

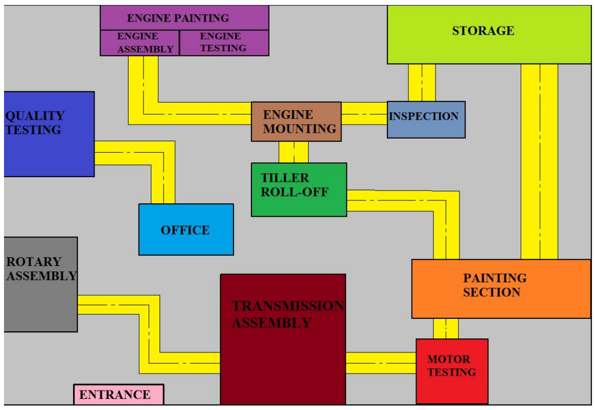


Fig.1.Existing Plant Layout

EXISTING PLANT LAYOUT CALCULATION

Efficiency of current plant layout

$$= \frac{\text{prescribed travel length by DGCA}}{\text{current travel length}} \times 100 = \frac{1900}{2720} \times 100$$

Efficiency of current plant layout = 69.85%

PROPOSED PLANT LAYOUT

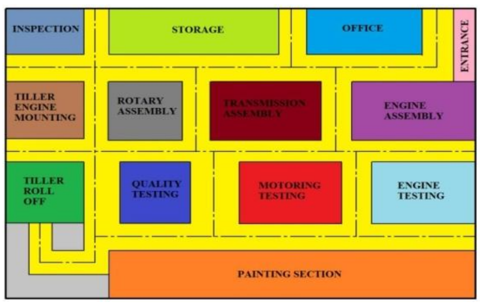


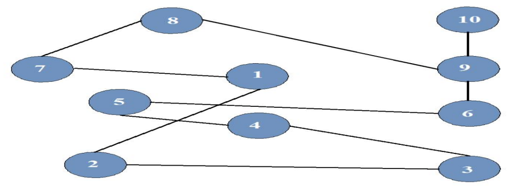
Fig.2 Proposed Plant Layout

Efficiency of current plant layout

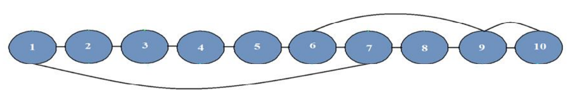
$$= \frac{\text{prescribed travel length by DGCA}}{\text{current travel length}} \times 100 = \frac{1900}{2000} \times 100$$

Efficiency of current plant layout = 95%

SEQUENCE FLOW OF EXISTING PLANT LAYOUT



PERFORMANCE MEASURE OF MATERIAL FLOW SEQUENCE OF EXISTING LAYOUT

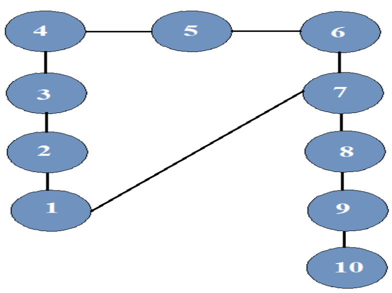


Total moves	In-sequence Moves	Backtracking Moves	Bypassing Moves
09	06	01	02

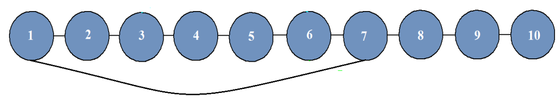
PARAMETER	EXISTING LAYOUT	PROPOSED LAYOUT
DISTANCE MOVED PER UNIT PRODUCED (METER)	672.08	362.71

- % of in-sequence moves = 6/9 = 0.66%
- % of bypassing moves = 2/9 = 0.22%
- % of backtracking moves = 1/9 = 0.11%

SEQUENCE FLOW OF PROPOSED PLANT LAYOUT



PERFORMANCE MEASURE OF MATERIAL FLOW SEQUENCE OF PROPOSED LAYOUT



Total moves	In-sequence Moves	Backtracking Moves	Bypassing Moves
09	08	01	0

- % of in-sequence moves = 8/9 = 0.88%
- % of backtracking moves = 1/9 = 0.1%
- % of bypassing moves = 0/9 = 0%

REDUCTION IN TRANSPORTATION LENGTH CALCULATION

$$\text{Percentage reduction in transportation length} = \frac{\text{difference in material movement}}{\text{current material movement}} \times 100$$

$$\text{Percentage reduction in transportation length} = \frac{362.71}{672.08} \times 100$$

$$\text{Percentage reduction in transportation length} = 53.96\%$$

DISTANCE TRAVELLED MEASUREMENTS

Comparison of results

PARAMETER	**PRESCRIBED BY DGCA(DIRECTOR GENERAL OF CIVIL AVIATION)**	**EXISTING LAYOUT**	**PROPOSED LAYOUT**
SIMULATION EFFICIE	80.24%	69.85%	95%

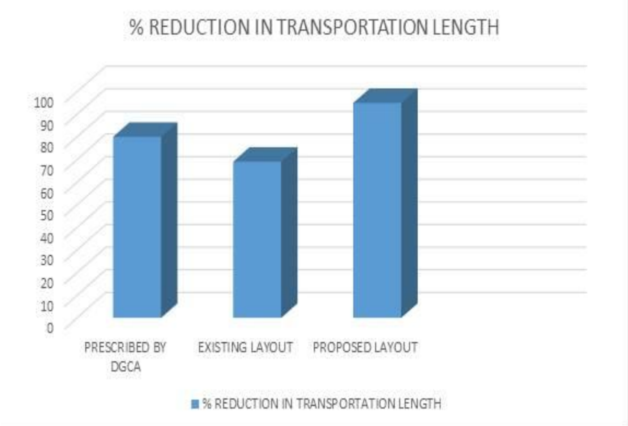


Chart.1

IV. TIME MOTION STUDY

TIME MOTION STUDY OF ENGINE ASSEMBLY IN EXISTING PLANT LAYOUT USING ANOVA DATA ANALY

WORK STATION	AVG. TIME TAKEN	NO OF TRAILS
1	13.64	10
2	13.64	10
3	13.64	10
4	13.64	10
5	13.64	10
6	13.64	10
7	13.64	10
SUB1	7.14	10
SUB2	7.14	10
SUB3	9.78	10
SUB4	8.04	10
PACKING	10.71	10
PRESS	9.78	10
MTG1	11.54	10
MTG2	11.54	10
MTG3	11.54	10

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Column 1	16	136	8.5	22.66667
Column 2	16	182.69	11.41813	5.899096

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	68.12363	1	68.12363	4.7696	0.036919	4.170877
Within Groups	428.4864	30	14.28288			
Total	496.6101	31				

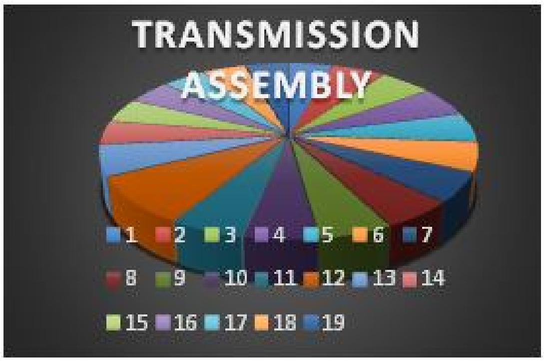


Chart.3

	Count	*Sum*		*Variance*
Column 1	19	190	10	31.66667
Column 2	19	202.34	10.64947	4.164505

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	4.007253	1	4.007253	0.223674	0.63911	4.113165
Within Groups	644.9611	36	17.91559			
Total	648.9683	37				

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Column 1	19	190	10	31.66667
Column 2	19	175.96	9.261053	4.570154

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	5.187411	1	5.187411	0.286306	0.595887	4.113165
Within Groups	652.2628	36	18.11841			
Total	657.4502	37				

V. CONCLUSION

Over the past three months we have been working on the betterment of layout planning and material handling improvement and trying to reduce the problems faced because of the existing plant layout and material handling techniques in order to meet the current production requirements of VST TILLERS AND TRACTORS PVT LIMITED. We studied and measured all the parameters of existing plant layout and material handling techniques which are currently in practice. We tried improving the existing plant layout by PAIRWISE EXCHANGE method and material handling techniques by total productive mantainance (TPM).

The efficiency of proposed plant layout standards set, which is the result of our project ensures reduction in travel length of the parts in the layout, without any compromise in the quality. Also environmentally speaking, this reduces the time consumption thereby automatically increasing the production.

The improvement done on the plant layout and material handling techniques,will have a positive impact on all the departments of VST TILLERS AND TRACTORS PVT LIMITED, both economically and environmentally.

REFERENCES

[1] Thinklink (2014). “Plant Layout and Material Handling” [Online] http://www.thinklink-scs.com/index.php?option=com_content&view=article&id=29&Itemid=36 [Accessed 28 May 2015]
[2] Kumar, A. (2013) “Plant Layout and its Objectives”[Online]http://www.slideshare.net/anupamkr/plant-layout-its-objectives [Accessed 30 May 2015]
[3] Singh, M. (2012) “Innovative Practices in Facility Layout Planning” International Journal of Marketing, Financial Services & Management Research www.indianresearchjournals.com
[4] Hiroyuki, H. (1998). “JIT Factory Revolution: A Pictorial Guide to Factory Design of the Future” Productivity Press, Massachussets, USA
[5] Levinson, W. and Rerick, R. (2002). “Lean Enterprise: A Synergistic Approach to Minimizing Waste” ASQ Quality Press, Milwaukee, USA
[6] Ghosh, T. and Dan, P. (2012). “Modeling of Optimal Design of Manufacturing Cell Layout Considering Material Flow and Closeness Rating Factors” Proceedings of 4th International & 25th AIMTDR Conference, December 2012 http://arxiv.org/ftp/arxiv/papers/1212/1212.5095.pdf