A REVIEW OF OPTIMIZATION OF PROCESS LAYOUT WITH THE HELP OF ANALYTICAL FORM AND SIMULATING TECHNIQUES

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Abstract- To reduce industrial process time Optimization techniques are useful for modern industries. As it depend on the industry what method should be applied to it.
Facility layout design involves a systematic physical arrangement of different departments, work stations, machines, equipment's, storage areas and common areas in a manufacturing industry. In today's competitive global environment, the optimum facility layout has become an effective tool in cost reduction by enhancing the productivity. It has become very essential to have a well-organized plant layout for all available resources in an optimum manner to achieve the maximum returns from the capacity of facilities. To achieve the optimization objectives a lot of techniques are developed by many researchers in the domain area.

Keywords: - Facilities Layout; Layout Design; Simulation; Redesign facility layout; Material flow.

I. INTRODUCTION

Optimizing facility layout is an important problem for modern manufacturing systems and it plays a key role for designing the process and material flow. Manufacturing facilities design is the company's physical assets to promote the efficient use of resources such as worker, material, equipment, time and cost. Facilities design includes plant location, process flow, plant layout and material handling systems. Only the proper process flow of layout can ensure the smooth and rapid movement of material, from the first stage of material until the end of process. Optimizing the flow layout also can reduce the wastes or non-value added activities in the production lines and improve the overall effectiveness in the production. **[1]**

In manufacturing industry, **there are two main problems** that need to be considering for the facility layout (Sahin et al., 2009). **[1]**

- The first one is the quantitative approach aiming at minimizing the total material handling cost between workstations based on a distance function.
- Secondly is the approach aiming at minimizing the non-value added activities.

Material handling and process flow have close relationship in production. Material handling accounts for a significant portion of the total production cost. Workers and materials have to travel long distances in the course of the manufacturing process; this leads to loss of time and energy and nothing is added to the value of the product. Through effective plant layout analysis and design, much material handling operations can be reduced or eliminated. The choice of material handling methods and equipment is an integral part of the plant layout design. Furthermore, by optimizing the process flow, it will maximize the closeness between the workstations and effectively reduce the cross flow cause by workers in the production lines.

II. PLANT LAYOUT

Plant layout refers to the arrangement of physical facilities such as machines, equipment, tools, furniture etc. in such a manner so as to have quickest flow of material at the lowest cost and with the least amount of handling in processing the product from the receipt of raw material to the delivery of the final product. **[2]**

- "Plant layout is the arrangement of machines, work areas and service areas within a factory". —**George R. Terry**
- "Plant layout involves the development of physical relationship among building, equipment and production operations, which will enable the manufacturing process to be carried on efficiently". —**Morris E. Hurley**
- "Any arrangement of machines and facilities is layout". —**F.G. Moore**
- "Plant layout can be defined as a technique of locating machines, processes and plant services within the factory so as to achieve the greatest possible output of high quality at the lowest possible total cost of manufacturing". —**Sprigal and Lansburg**
- "Plant layout ideally involves the allocation of space and the arrangement of equipment in such a manner that overall operations cost can be minimized."— **J. Lundy [3]**

There are mainly three types of plant layout: **[2]**

- Product layout
- Process or functional layout
- Combined or Group layout
- Fixed position or location layout

2.1 Characteristics of Good Plant Layout

- Proper and efficient utilization of available floor space
- Transportation of work from one point to another point without any delay
- Proper utilization of production capacity.
- Reduced material handling costs
- Utilize labor efficiently

- Reduced accidents
- Provide for volume and product flexibility
- Provide ease of supervision and control
- Provide for employee safety and health
- Allow easy maintenance of machines and plant.
- Improve productivity

2.2 Importance of Plant Layout

The basic objective of the plant layout is to develop a facility layout that should be functionally better for the industry and cost savings. For functionally better industries the placing of necessary departments such as the operating and recovery rooms should be close together and keeping apart those departments which should not be together. Overall the Facility Layout includes the features of a layout which may not be immediately quantifiable, such as facilitating communication and improving staff safety.

III. PLANT LAYOUT OBJECTIVES

Generally the typical plant layout should possess the following objectives:

- Economic demands such as investments in equipment and material handling cost are to be minimized.
- Requirement of product design and volume is to be satisfied.
- Requisite of process equipment and capacity such as minimize overall production time; maintain flexibility of arrangement and operations are to be justified.
- Different types of material handling equipment are to be facilitated in the manufacturing process.
- The quality of work life provided for employee convenience, safety and comfort; facilitate the organizational structure must be the basic priority.
- Requirement of building and site constraints such as utilizing existing space most effectively.

IV. FACTORS AFFECTING THE PLANT LAYOUT

The following factors should be considered while designing the layout. **[4]**

1. **Nature of the product:** The nature of the product to be manufactured has a significant influence on plant layout. Small and light products can be moved from one machine to another with minimum effort and time and therefore line layout would be more suitable. Stationary layout would be suitable for heavy and bulky products. In case of production of large variety of non-standardized products, process layout is ideal.
2. **Production volume:** Line layout should be preferred if standardized commodities are manufactured on a large scale. Functional layout is suitable if production is based on customers' orders. It is better suited for low volume job production.
3. **Location of the site:** The topology and size of the site influences the choice of a particular layout. The idea is to maximize the utilization of space. Layout should also suit the factory building. The positioning of elevators, stairways, parking lots and storage points also influence the layout.
4. **Type of machines:** Stationary layout is preferable if machines are heavy and emit more noise. Such heavy machinery can be fitted on the floor. Adequate space should be provided for the location of machines and also there should be sufficient space between them to avoid accidents.
5. **Climate**: Temperature, illumination, ventilation should be considered while deciding on the type of layout. The above factors should be considered in order to improve the health and welfare of employees.
6. **Service facilities**: The layout should provide for the comforts and welfare of the employees. It should have adequate provision for rest rooms, drinking water, and lavatory. There should be sufficient space for free movement of workers.
7. **Safety of employees**: While deciding on a particular type of layout, the safety of employees should be given importance. The layout should provide for obstruction free floors, non-slippery floors, protection against dangerous fumes, excess heat, strong odors Etc.
8. **Type of production**: Layout plans differ according to the type of production. In case of job orders, production of non-standardized products are undertaken and therefore functional or process outlet is suitable. Line layout would be suitable when there is mass production of standardized goods.
9. **Type of process**: In the case of intermittent type of production (bi-cycle manufacturing, electronics), functional layout is suitable. For synthetic type of Production (cement and automobile industries), line layout is preferable.
10. **Management policies**: Policies of the management relating to type of product, quality, scale of production, level of plant integration, type of production, possibility of future expansion etc., influence the type of layout to be adopted.

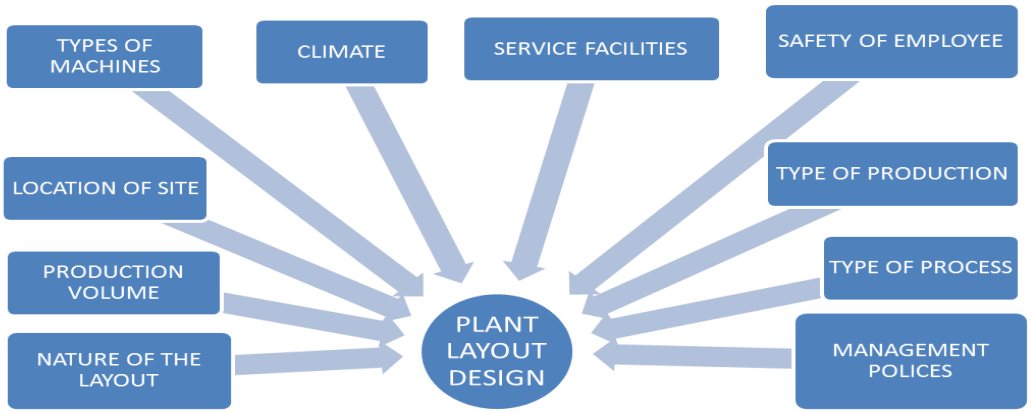

Figure number 1: -Factors affecting the layout

V. TOOLS AND TECHNIQUES USED FOR INDUSTRIAL LAYOUT PLANNING

1. ANALYTICAL METHODS

The six tools and techniques used for layout planning/plant layout are as follows:

- Operation process charts
- Flow process charts
- Process flow diagram
- Machine date cards
- Templates
- Scale models.

2. SIMULATING TECHNIQUES

Due to the high complexity of plant lay-out analyses and optimizations, considering the high stochastic nature of the main variables (e.g. the process and set-up times, market demand, queuing, downtimes, and so on) as well as the unit requirements to have feasible solutions, it becomes easy to understand the inadequacy of traditional methodologies and approaches. Among the computerized approaches to plant lay-out study the most important are as follows- **[1]**

- **CORELAP-**Computerized Relationship Layout Planning

CORELAP constructs layouts by locating rectangular shaped departments; the relationship chart provides the basis for the order in which departments are placed.

The input requirements of CORELAP consist of:

1. Relationship chart with weights for depts.
2. Number and area of departments

- **ALDEP-** Automated Layout Design Program

ALDEP is basically construction algorithm, but it can also be used to evaluate two layouts. It uses basic data on facilities and builds a layout successively placing the layout using relationship information between the departments.

CRAFT-Computerized Relative Allocation of Facilities Technique

Computerized Relative Allocation of Facilities Technique (CRAFT) is a tool that used to help improve the existing layout of the facilities. The facility is improved by swapping two or more departments to help arrange the facility to an optimal floor plan.

- **ARENA-**

Arena is discrete event simulation and automation software developed by Systems Modeling and acquired by Rockwell Automation in 2000. It uses the SIMAN processor and simulation language.

- **Autodesk Factory Design Suite**

The Product Design Collection to conceptualize, plan, and validate manufacturing facilities for optimized workflows and equipment placement.

- **Flexsim-**

FlexSim is a discrete event simulation software package developed by FlexSim Software Products, Inc. The FlexSim product family currently includes the general purpose FlexSim product and FlexSim Healthcare (FlexSim HC).

VI. RESEARCH METHODOLOGY

The research objective is to reduce the maintenance lead time and WIP in order to increase the working rate in so that customer time is being fulfilled.

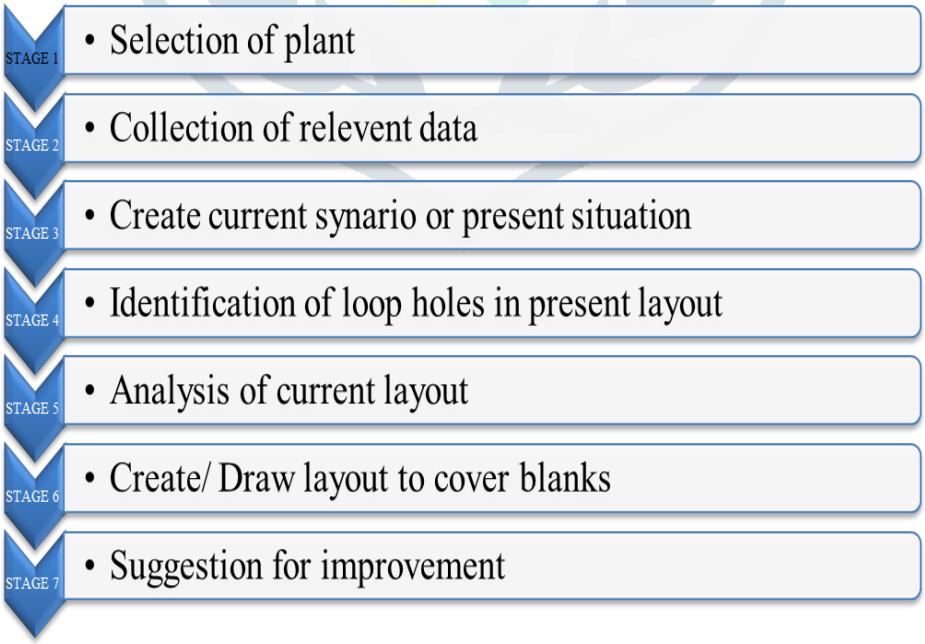

Figure number 2:- Methodology Steps for Implementing new plant layout

VII. CONCLUSION

In this work, we have presented an analytical methods and simulation techniques for the access of a maintenance unit. The computational complexity, however, is considerably better in the software. This software would make the model much closer to real values.

With that we can conclude that optimization of process layout is one of the key factors for rapid growing industry; as we see now a day's space utilization places an important role in any industry.

VIII. FUTURE SCOPE OF THE STUDY

I would plan a simulation model for modeling in a diesel electric locomotive maintenance unit and analyze shop floor management. With the transitioning Flexsim I would be able to overcome the excessive time for automation and layout design. Hence, for future scope if the professional edition of Flexsim would be used then there might be options for changing or reshuffling the existing layout of the unit to achieve 80 to 90 percent of shop floor utilization.

Therefore, the core and add-on approach to simulation will be used for new controls software and new interface requirements for shop floor management. These changes could include intelligent shop floor management controls and work rule scheduling methodologies. The main thing, I expect is to compare the different things for simplifying the techniques by using the advanced techniques and different methodologies. Further some more following improvements can be implemented.

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