Problems of manufacturing industries

CHAPTER I

INTRODUCTION

1. 1. Background of the problem

Today s manufacturing industry is facing problems that have been growing in size and complexity over the last several years. As a result, there is an immediate need for procedures or techniques in solving various problems encountered in today s manufacturing arena without extended shutdown s or expensive modifications (Clark , 1996). Materials handling equipment and the facilities it operates can contribute to as much as 70 percent of the total cost of the manufactured product (Tompkins et al, 1996).

Facilities layout design is part of facilities planning (Tompkins et al, 1996). It is the arrangement of work space which, in general terms smoothes the way to access facilities that have strong interactions. The main concern with the plant facility layout planning is to reduce the cost of materials handling as poor materials handling can generate business problems. To stay competitive in today's market a company must reduce costs by planning for the future

Material handling cost is a indirect costs and every company wants to reduce this indirect cost and it constitutes a major part of indirect costs in a facility Therefore even small improvements in material handling costs makes a large reduction in total indirect costs. The cost of material flow is a function of the distance the material is moved between divisions called departments in a manufacturing facility. To reduce material handling costs, it is essential to have an optimal arrangement of departments to minimize the total distance traveled

Tompkins (1982) estimated that between 20% and 50% of operating expenses in manufacturing can be attributed to facility planning and material handling. Thus any cost saving in this area can contribute to the overall efficiency of the production system. Due to its wide range of applicability, the facility layout problem will continue to be the subject of research for many years to come. Graph theory and computerized software of facility layout is a powerful tool that allows experimentation with various manufacturing techniques and layout without actual implementation.

Based on the above facts, it is obvious that layout optimization and improvement are two tasks that are crucial to any facility planning and layout study.

1. 2 Statement of problem

JPM Automobiles ltd is an automobile component manufacturing company located in Gurgaon Haryana. The problem area in that company is the departments are not located to according to manufacturing process; processes which have high interdependency are not located close to each other. This cause distance travelled by the material is high from one department to another department which result high material handling cost. Which affect the overall efficiency of the company.

In response to the above problems, the need for facilities layout optimization is needed. This dissertation proposes to use Systematic Layout Planning (SLP) as to improve the facility layout of the company by graph theory and BLOCKPLAN software to improve the company performance. The company

performance improvements are in terms of productivity increase, reduction in travelling cost and reduction in travelling distance.

1. 3 Objectives

The problem area in that company is of higher material handling, in-process inventory, poor interdependency of department and inflexibility etc. due to its improper layout. Based on the above fact the objectives of the study are:

- To conduct a detailed literature review of the facility layout problems.
- To analyze the existing layout of the company and conduct cost analysis of the existing layout.
- To propose improvements in the existing layout by graph theory and BLOCKPLAN software.
- To conduct cost analysis of the existing and proposed layouts.
- Compare cost analysis of the existing and proposed layout by graph theory and BLOCKPLAN software

1. 3 Concept of Facilities Planning and Plant Layout

A facility planning is a complex and broad subject that covers several disciplines. It involves civil, electrical, industrial and mechanical engineers, as well as architects, consultants, managers and urban planners. Facilities planning can be divided into two components: facilities location and facilities design. Facilities location is about placement of the facility on a specific plot of land with respect to customers, suppliers and other facilities. Facilities design consists of the facility systems design, the layout design and the handling systems design. The facility systems consist of the structural systems, the environmental systems, the lighting/electrical systems and safety systems. The layout consists of all equipment, machinery and

furnishings within the building structure. The handling system consists of the mechanisms needed to satisfy the required facility interactions for a manufacturing plant, the facilities layout, also called plant layout, consists of the production areas, production related or support areas and personnel areas within the building. Facilities' planning has become a critical component for companies to keep up with the current market trends in the last few years. In the past facilities planning was primarily considered to be a science. In today's competitive global marketplace, facilities' planning has become a strategy, (Tompkins et al, 2003).

1. 4 Facility Layout

In any plant, there are large numbers of finite geometric areas i. e. production, machine foundation area, space for inventory, design, production control and supervision are arranged on the floor space of the building. The problem of arranging these areas in an effective manner is the facility layout problem

Francis et al (2006) define, facility layout as a technique of locating machines, processes and plant services within the plant, so as to achieve the right quantity and quality of product at the lowest possible cost of manufacturing.

The facility layout problem is concerned with an arrangement of physical facilities, such as departments or machines, in certain areas to reduce a company's indirect costs. It has been estimated (Savsar 1991) that between 20 and 50% of the total operating expenses within manufacturing are attributed to material handling, which is directly related to facility layout. A

poorly conceived layout can result in congestion and prohibitive material handling costs; and, on the other hand, an effective layout can provide an environment for efficient production. Since indirect costs are the largest portion of a company's total operating cost, the objective of a facilities layout problem is to minimize both interdepartmental flows and the rearrangement costs of changing layouts between time periods. These costs are a function of the amount of material flow and the distance the material is to be moved.

The main objective of the facility layout problem is to minimize overall cost, which is directly related to material flow between departments. Generally material flow is represented by the product of the amount of material and the distance the material is moved. The distance traveled is estimated using rectilinear distance between centroids of the departments . Constraints ensure departments do not overlap and departments are of proper size. Many computer algorithms have been developed for designing layouts, mainly for the layout of departments within factories.

1. 5 Types of facilities layout

There are four types of plant layout from the point of view of manufacturing

1. 5. 1 Product layout

Product layout is based on the processing sequence of part being produced on the line. Parts follow a fixed path through the production resources. In product layout, materials flow from one workstation to next adjacent workstation directly. This type of plant layout is useful when the production process is organized in a continuous manner.

Advantages of product layout

1. Simple, smooth logical flow lines result due to fixes sequence of operation.
2. Small work in process inventories due to work from one process is fed directly into the next.
3. Low cost of material handling, due to straight and short route and absence of backtracking.
4. Total production time per unit is short.
5. Since the machines are located so as to minimize distances between consecutive operations, material handling is reduced.
6. Little skill is usually required by operators at the production line; hence, training is simple, short, and inexpensive.
7. Simple production planning control systems are possible.
8. Less space is occupied by work in transit and for temporary storage

Disadvantages of product layout

1. Whenever breakdown of one machine stops the entire line in the presence of enough manpower.
2. Lack of process flexibility, since the layout is determined by the product, a change in product design may require major alternations in the layout.
3. Lack of flexibility in timing, as the product cannot flow through the line faster then the slowest task can be accomplished unless that task is performed at several stations.
4. Supervision is general, rather than specialized.
5. Comparatively high investment is required, as identical machines (a few not fully utilized) are sometimes distributed along the line.

6. Worker fatigue as workers may become bored by the endless repetition of simple tasks.

Process layout

Process layout is also called job shop layout in which the layout for a process department is obtained by grouping of machines according to function of machine centers. Orders for individual products are routed through the various machine centers to obtain the required processing. This type of plant layout is useful when the production process is organized in batches. Machines are general purpose, within their general function area, so that a wide variety of products can be handled.

Advantages of process layout

1. A high degree of flexibility exists relative to equipment or manpower allocation for specific tasks.
2. Smaller investment in equipment as duplication is not necessary unless volume is large.
3. The diversity of tasks offers a more interesting and satisfying occupation for the operator.
4. Supervisors for each department become highly, knowledgeable about their functions.
5. Better utilization of machines can result in fewer machines used

Disadvantages of process layout

1. Lack of process efficiency as back tracking and long movements may occur in the handling of materials.
2. Lack of efficiency in timing as workers must wait between tasks.
3. Complications of production planning and control

4. Workers must have broad skills and must be paid higher wages than assembly line workers.
5. Comparatively large amounts of in process inventory as space and capital are tied up by work in process.
6. Lowered productivity as each job requires different setups and operator training.

Fixed position layout

Fixed position layout is generally associated with large, bulky product such as assembly of ship building, aircraft etc. In Fixed position layout workstation are brought to the material. Fixed position layout is shown in fig. 1. 3

Advantages of fixed position layout

1. Material movement is reduced, minimizes damage or cost of moving.
2. Promotes job enlargement by allowing individuals or teams to perform the whole job.
3. Continuity of operations and responsibility results from team. This reduces the problems of re-planning and instructing people each time a new type of activity is to begin.
4. Highly flexible; can accommodate changes in product design, product mix, and product volume.
5. Independence of production centers allowing scheduling to achieve minimum total production time.

Disadvantages of fixed position layout

1. Increased movement of personnel and equipment may be expensive. The necessary combination of skills may be difficult to find and high pay levels may be necessary.

2. Equipment duplication may occur.
3. Higher skill requirements for personnel as they are involved in more operations.
4. General supervision required.
5. Cumbersome and costly positioning of material and machinery.
6. Low equipment utilization as equipment may be left at a location where it will be needed again in a few days rather than moved to another location where it would be productive.

Product family layout / Cellular Layout

The layout for a product family is based on the grouping of parts to form product family. Groupings are determined by the operations needed to perform work for a set of similar items or part families that require similar processing. A part family is a set of parts that require similar machinery, tooling, machine operations and jig or fixtures. The parts within the family normally go from raw material to finished parts within a single cell.

Advantages of cellular Layout

1. Reduced in process inventory
2. Increase operator expertise
3. Improved human relations, job enlargement tend to occur.
4. Supports the use of general purpose equipment
5. Increased machine utilization.

Disadvantages of cellular layout

1. General supervision required.
2. Higher skills level required of employees than for product layout.
3. Reduced shop flexibility

4. Depends on balanced material flow between product layout and process layout, otherwise buffers and work in process storage are required.
5. Lower machine utilization than for process layout

1. 5 Layout Design Methods and Computer Packages

It is highly desirable that the optimum plant layout be designed. Unfortunately, the magnitude of the problem is so great that true system optimization is beyond current capabilities. The approach normally taken in solving the plant layout problem is to try to find a satisfactory solution. Previously, facilities layout problems were solved primarily by using iconic models. Then analytical approaches were developed.

In general, plant layout problems can be solved by any of the following approaches:

- Exact mathematical procedures.
- Heuristics.
- Optimal.
- Graph theory.

A number of different procedures have been developed to aid the facilities planner in designing layouts.

These procedures can be classified into two main categories: construction type and improvement type. Construction type layout methods basically involve developing a new layout from scratch. Improvement procedures generate layout alternatives based on an existing layout.

Based on the above two procedures, many algorithmic approaches have been developed. Some of them are Systematic Layout Planning (SLP) procedure, graph-based construction method, programming, network, Tabu search, simulated annealing and genetic algorithm. Based on these approaches, many computer-aided layout routines have been developed. Some of them are CRAFT, COFAD, CORELAP, ALDEP, PLANET, MULTIPLE, BLOCPLAN

1. 6 Methodology of dissertation

This dissertation is to be completed in 3rd and 4th semesters of my M. Tech duration of four semesters. The methodology for this dissertation is stated in Figure 1. 1

The dissertation report is divided into seven chapters as shown in figure 1. 3. The current chapter gives an introduction of Facilities Planning and Plant Layout, Layout Design Methods and Computer Packages. In this chapter is also introducing Background of the problem, Statement of problem, Objectives of the dissertation

Chapter 2 provides detailed literature review which would be done throughout the 3rd semester.

This chapter covers the different type of facility layout problems and layout design method and commercial software available for solution of facility layout problems.

Chapter 3 introduces the details of Systematic Layout Planning (SLP) for generation of layout alternatives.

Chapter 4 covers the company background. It covers the company profile, Organization structure of the company, products, esteemed customer and its manufacturing process and its policies.

Chapter 5 presents the case study in which existing layout is analyzed and new layout is proposed by GRAPH theory and BLOCKPLAN software and also provides a detailed cost analysis of existing layout and proposed layout.

Chapter 6 contains conclusion and future scope.