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SYSTEMATIC LAYOUT PLANNING: AN EFFECTIVE TOOL FOR MINIMIZING WORK FLOW IN A MANUFACTURING FACILITY; DESK REVIEW

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Abstract: *Facility layout plays a key role for the manufacturing system design process and it is an important problem solving toll for modern manufacturing systems. Currently manufacturing firms need to have a proper facility layout design to have a competitive and flexible production system which can fit with their productive strategy.Improving plant layout helps to eliminate obstructions in material flow and thus obtain maximum productivity. It is obvious that a good layout design leads to reduced production cost, and increased productivity by minimum work flow. For this interesting objective,manufacturing companies have to use different kind of tools. This article tries to review various scientific literaturesand finds works as to how systematic layout planning can be used as an effective tool to minimize work-flow and improve work place safety in a manufacturing facility.*

Key words: *- Plant layout, systematic layout planning, work-flow, manufacturing facility.*

Introduction

One of the main goals of a manufacturing system is the maximization of its productivity which depends upon several factors, such as the kind and the complexity of the product made, the quality of the raw materials, the complexity of the manufacturing process and the arrangement of the workstations constituting the production process [1]. Due to rapid increasing of demand in production, industrial facilities need to increase their potentials in production and effectiveness to compete against their market rivals. At the same time, the production process needs to be equipped with the ability to have lower cost with higher effectiveness [3].Facility layout is one factor in the sphere of both efficiency and improvement of productivity. It may be initiated while whether at the start of the business, when there is a need of moving to a new location or during purchasing of new machinery and/ or during new product development, generally could be either improvement or construction type layout design.

However, designing a facility layout problems along with even at the early stage of the product and process design phase minimize the difficulty encountered during production time.It is obvious that a perfect facility layout design leads to reduced production cost, and increased productivity by minimum work flow. However to achieve this manufacturing facilities need to use various layout design tools.This article tries to review one of the most effective tools of facility layout, systematic layout planning.

Objectives

The general objective of this paper is to review available scientificliterature on systematic layout planning as an effective tool for minimizing work-flow in a manufacturing facility. Specifically, it aims to assess the views of various authors on the effectiveness of systematic layout planning for optimal manufacturing industry facilities design in view of work-flow improvement and workplace safety.

Methodology

This paper is based on an extensiveliterature surveyon the effectiveness of systematic layout planning. It critically examines research findings, case study reports, scientific journals related to facility layout optimization methods, tools, techniques, with special focus on manufacturing work flow and workplace safety. Local and international scientific research experiences,

official research reports, and the author's own experience were reviewed to assess theoretical gaps and to identify future research directions. Many researchers have examined the link between facility layout and productivity. As a result this paper tries to show the application of the systematic layout planning in the area of facility layout design for effective and productive arrangement of facilities and crews. Basic aspects of the method that could be examined critically during the development process were discussed in detail. The essential tools for systematic layout planning including relationship diagrams, from –to chats and relative importance relationship chars were examined to validate the review results.

Results and Discussion

Plant layout or most commonly known facilities layout is the arrangement of desired machinery and equipment of a plant in a way which will permit the easiest flow of materials and operators, at the lesser cost with minimum handling, in processing the product from the raw materials to the dispatched of the finished product [10].

The findings of various research results on different case manufacturing firms showed that the long distance traveled by materials and people could be reduced if appropriate decisions are made to determine the placement of departments, working groups within the departments, workstations, machines, and stock-holding points within a production facility. This can be evidenced by different scientific research works that show the high cost of improper layout.Shewale[2]found that effective plant layout is one way to reduce the cost of manufacturing and increase productivity in addition to that it increase good work flow in production route. It was also further stated that the best way to improve the plant was to apply systematic layout planning (SLP) method to make the work flow continually by arranging the important sequence of the manufacturing and solving the problem of congestion.

Rajshekhar et al. pointed out that SLP, which was developed by RechardMutherin 1961,employs a systematic an organized approach to facilities' layout planning (FLP) andit utilizes a graphic and a schematic analysis for an input-output resources flow[9]. Though SLP has limitations when the problem size increases, the basic and relevant steps it comprises today are: analysis, search and selection that have great significance in both manufacturing processes and giant stores that carry wide range of merchandise or the hypermarkets but with light developments.

Yujie et al. studied the general plane of long yards using SLP which the best layout showed the good workflow and practical significance [4]. The basic industrial layout planning is applied to SLP method in which showed step-by-step of plant design from input data and activities to evaluation of plant layout. This method provides the new plant layout that improves the process flow through the plant, and help to increase space in industries [3].According to these researchers efficient facility layout means to arrange the physical equipment within a workshop to help the facility work in a productive way and it has been shown that the negative impact of improper plant layout on the manufacturing process is tremendous.

The basic elements of any layout planning are PQRST; Product, Quantity, Routing, Supporting service and Time [9], with slight difference in meaning in the material handling of production goods and hypermarket, which can be seen as service.

Procedures of SLP

For an effective SLP analysis, some useful procedures are considered. The most important of them [11] are:

1. Collection of data: at this stage, important data for SLP like the number of machineries and/or equipment need to be collected were collected in terms of the direction of raw materials and finished products;
2. Measuring of the area of operation units:
3. Studying of the overall process of production of products: here the process should be studied using operation process charts and flow of material;
4. Analyzing of the current problem of the current layout: this analysis enables experts to
5. Developing alternative layouts: new layouts with better space utilization and art of arrangements of operation units that give preferred sequences that shortens the distance travelled by operators, materials and work-in-process are developed at this stage.

The general procedure of SLP is presented in the figure below:

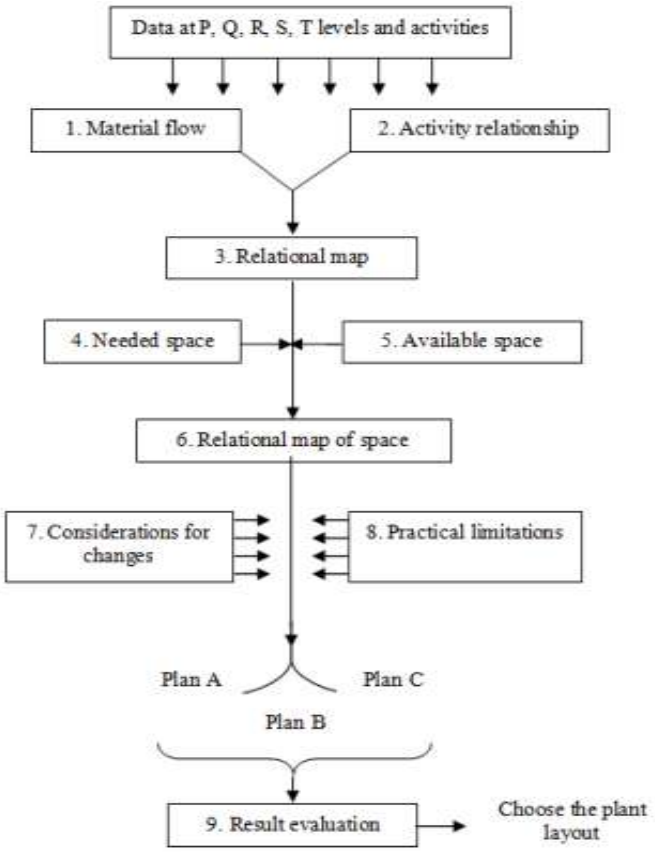

Fig: Procedures of SLP [11]

Diagram/Charts/Maps Important for SLP

From-To chart:is a routing planning chart, it consists of a matrix. The operations are written down the left hand side of the form and across the top. The vertical sequence of machines is the form side of the matrix. The horizontal sequence of machines of machines is the "to" matrix. Everything moves from some place to some place. Each time a move is required, a weighted value is placed in that coordinate[13].

To / From	A	B	C	D	E	F	G	H
A								
B								
C								
D								
E								
F								
G								
H								

Fig: From-To Chart (adopted from [14])

Activity Relationship Diagram:a diagram that shows the relationship of every department, office, or service area with every other department and area. It helps to organize departments that need to be close to each other in relevance of importance[23].

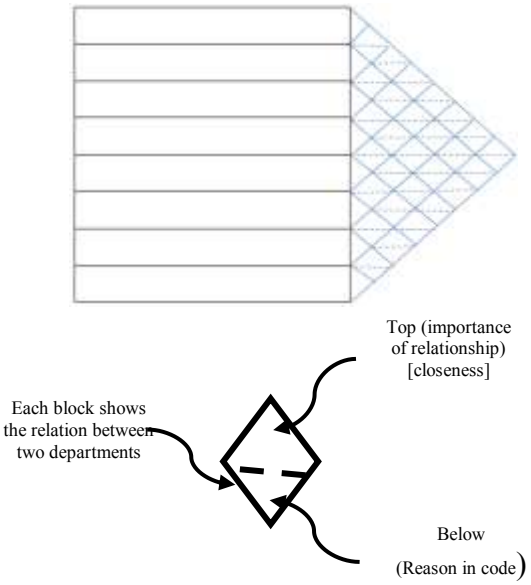

Fig: Activity relationship diagram (adopted from [14] and [15])

Closeness codes/value table

Code	Closeness
A	Absolutely necessary
E	Especially important
I	Important
O	Ordinary important
U	Unimportant
X	Undesirable

Value of reason

Value	Reasons
1	Reason 1
2	Reason 2
3	Reason 3
4	Reason 4
…	…
n	Reason n

Flow Diagram: a diagram that shows the path travelled by each part number from the start of the process to the fabrication of each part at subassembly to packaging at warehouse than shipping. These paths are drawn on a layout of the plant. The flow diagram will point out problems with such factors such as cross traffic, backtracking, and distance travelled[24].

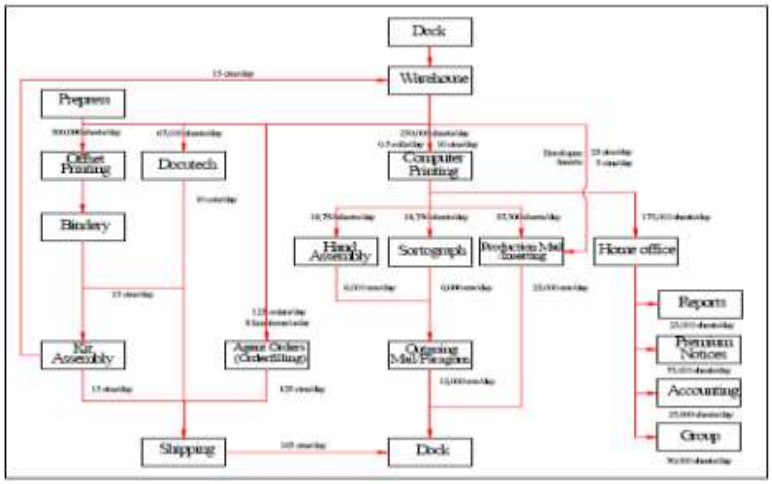

Fig: Flow diagram (chart) [22]

Relationship Diagram:

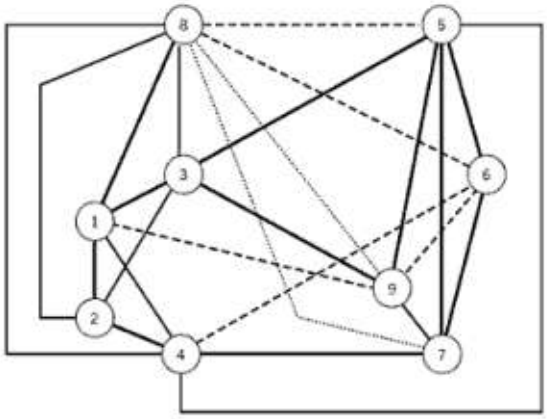

Fig: Relationship diagram [22]

Space Relationship Diagram:

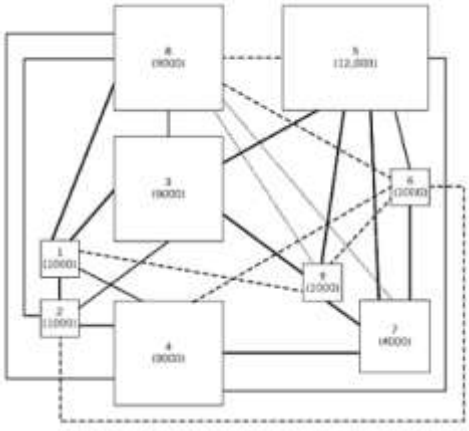

Fig: Space relationship diagram [22]

Art of the state of SLP

In addition to production plant layout, SLP also solves the problem of logistics of companies through rearrangement being integrated with SHA (System Handling Analysis) [19].SLP was used by Yasir and Mohamed in an armor Malaysian company to solve a line balancing problem through an alternative layout [21]. According to ShubhamBarnwal and Prasad Dharmadhikari, the facility layout design's proper analysisis able to improve the performance of production line such as bottleneck rate decrease, material handling cost minimization, reduction of idle time, a raise in the efficiency and utilization of labor, equipment and space. The systematic layout planning (SLP) methodthat shows step-wise plant design from input data and activities to evaluation of plant layout.SLPis believed to come up with a new plant layout that improves the product flow throughout the plant. Studies addresses these problems by designing a product layout with the principles of systematic layout planning for enhanced productivity and higher product outputs at the scheduled time or at a shorter cycle time[16].By applying SLP to design an optimized plant Layout,Orville Sutari and SathishRao Uwere able to reduce the wastes resulted from the motion and transportation of the products, therefore, increasing the productivity [18].For Md. RiyadHossain, Md. KamruzzamanRasel&SubrataTalapatra too, the implementation of SLP for layout improvement can save up to 38.75% of material handling cost. These all show that using the SLP, is very important today to improve plant layout and material handling so as companies can save more resources and hence rise up their profits[17].

Conclusion

Unquestionably, selection of optimal layout design method is a very crucial step in a layout design. In fact each available method has its own pros and cons. It is found that there is no method which can be best solution to the entire layout problem by itself. SLPalso does not completely satisfy all sorts of layout design problems. However, asclearly indicated in this paper, systematic layout planning is an important tool to improve facility design problems.

Research Limitations/Implications

This paper is not based on a specific problem and is totally dependent on previous research works and generalizations. However, an optimal plant layout design needs to include environmental and health indicators, employees' idea in its design consideration and should lend itself to promotional activities to customers. Therefore, it provides organizations only a way to devise and refine adequate criteria to select systematic layout planning as a tool to minimize work flow and workplace safety in a manufacturing set up.

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