Shubham Gondey, 2023, 11:6
ISSN (Online): 2348-4098
ISSN (Print): 2395-4752

International Journal of Science, Engineering and Technology

An Open Access Journal

A Review on Development of Production Layout Model to Improve Production Efficiency

M.Tech Scholar Shubham Gondey, Professor Shyam Barode
Department of Mechanical Engineering, BIST, Bhopal

Abstract- With rapid increasing of demand in production, industrial factories 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. Therefore, the way to solve the problem about the production is very important. There are many ways i.e. quality control, total quality management, standard time, plant layout to solve the problems concerning productivity. Companies which currently intend to remain competitive should always seek improvements to achieve excellence in quality through the improvement of its processes and products, and also always target the reduction of production costs by improving production efficiency and rationalization of production resources. Thus, the development of production makes that organizations have to evolve and develop organizational and operational improvements, constantly reviewing procedures and management approach as well as the processes and products in an attempt to tailor them to the needs of market.

Keywords: Development, Production Layout Model, Improvement, Production Efficiency

I. INTRODUCTION

Implementation of lean manufacturing principles and believing in continuous improvement are the tools which help industries to sustain global competition. With the escalation in population, the demand for technology is increased more than ever. This leads to the steady increase in production rates of existing models and even introduction of new product models. These factors often result in “layout modification” of manufacturing industries. Plant layout improves resource utilization and provides means for application of lean tools such as 5S, seven wastes, kanban, Just in Time (JIT), etc. These tools not only contribute in reducing cost but also benefit the organization by improving product quality. This study provides an enhancement in productivity by changing in layout design.

In a reality of global competition, companies have to minimize production costs and increase productivity in order to boost competitiveness. Facility layout design is one of the most important and frequently used efficiency improvement methods for reducing operational costs in a significant manner. Facility layout design deals with optimum location of facilities (workstation, machine, etc.) on the shop floor and optimum material flow between these objects. In this article, the objectives and procedure of layout design along with the calculation method for layout optimization are all introduced.

The study is practice-oriented because the described case study shows how the layout of an assembly plant can be modified to form an ideal re-layout. The research is novel and innovative because the facility layout design and 4 lean methods (takt-time design, line balance, cellular design and one-piece flow) are all combined in order to improve efficiency more significantly, reduce costs and improve more key performance indicators.

II. FACILITY LAYOUT

Companies are constantly aiming for improvements, being cost efficient and meeting customers' expectations (Mathisson-Öjmertz, 1998b). Logistics operations need to be efficient to enable a company's competitiveness in a market with a wide product variety and short response times (Rouwenhorst, et al., 2000). This increases the pressure on manufacturing companies to optimize their production by lowering costs and increasing productivity (Denkena, et al., 2014), where the costs of logistics operations is a part of the overall production costs (Rouwenhorst, et al., 2000). The costs are dependent on inventory and the way material is monitored and managed (Christopher, 2011). Depending on the layout of the facility there will be different costs related to manufacturing, work in progress, productivity and lead times (Drira, et al., 2007). The efficiency of material flow and handling is also affected by the layout of the facility (Aiello, et al., 2002).

A facility layout can, according to Drira et al. (2007) relate to the arrangement and location of a production group or manufacturing cell where production of goods or services are performed. Designing a facility layout is a complex task for two reasons; the constraints of the facility and its necessity to support and ease the materials handling and movement (Mulcahy, 1999). In a manufacturing system there can be different types of layout problems, often related to the location of facilities, for instance machines, in a plant. Finding a suitable location of facilities will increase the efficiency of operations as well as reducing its expenses (Drira, et al., 2007).

The best design of a layout should, according to Drira et al. (2007), be a combination of the most efficient related to the interaction of different facilities, such as production units, and the material handling system. The expenses of the material flow are assumed to be related to the number of times materials are moved, and the distance; increased movement leads to increased expenses (Aiello, et al., 2002). Production units should be placed so that the available space is highly utilized and that the location of machines and production groups should bring as low costs of material handling and slack area as possible in order to be optimized and increase efficiency (Drira, et al., 2007).

The layout should also suit the material handling system and the material flow through and between facilities (Aiello, et al., 2002; Drira, et al., 2007), since the shape of the facility impacts on the efficiency of the movement of material and the materials handling system (Mulcahy, 1999).

In manufacturing, facility layout consists of configuring the plant site with lines, buildings, major facilities, work areas, aisles, and other pertinent features such as department boundaries. While facility layout for services may be similar to that for manufacturing, it also may be somewhat different—as is the case with offices, retailers, and warehouses. Because of its relative permanence, facility layout probably is one of the most crucial elements affecting efficiency. An efficient layout can reduce unnecessary material handling, help to keep costs low, and maintain product flow through the facility.

Firms in the upper left-hand corner of the product-process matrix have a process structure known as a jumbled flow or a disconnected or intermittent line flow. Upper-left firms generally have a process layout. Firms in the lower right-hand corner of the product-process matrix can have a line or continuous flow. Firms in the lower-right part of the matrix generally have a product layout. Other types of layouts include fixed-position, combination, cellular, and certain types of service layouts.

III. ASSEMBLY

Assembly, as described by (Scholl), is a manufacturing process that develops a work-in-progress workpiece into finished product by sequential attachment of parts. Parts are the atomic physical inputs to the assembly process, each of which is typically standardized and interchangeable with other parts of the same type. A subassembly is a collection of parts that are attached to one another, prior to fastening to the workpiece.

The work performed during assembly is portioned into the smallest possible indivisible operations, or tasks, each of which requires an associated task time to complete. The sequence in which tasks are performed may be constrained such that some tasks must be done before another task begins, due to the physical architecture of the workpiece, safety reasons, or other causes. Precedence relationships between two individual tasks are used to codify these constraints, with the task that must come first labeled the predecessor and the later task called the successor.

The set of all binary precedence relationships between task pairs may be represented as a precedence graph, by first drawing each task as a node and then drawing directed arcs pointing away from each predecessor task towards its successor. An example precedence graph is shown in Figure 1.1. The precedence graph must be acyclic, as no task may be considered a predecessor to itself. It is not required for all nodes in the graph to communicate, as disconnected sub graphs indicate that the corresponding tasks are precedence independent from one another. Nor it is required to draw indirect precedence relationships on the graph. For example, in Figure 1.1, task 2 is a predecessor to task 7, but this relationship is implicit by considering the predecessor relationships of task 4.

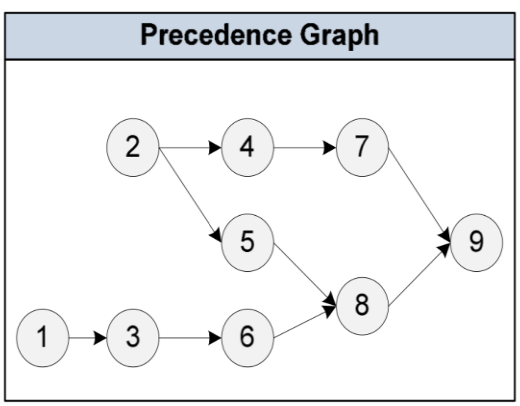

Figure 1: Precedence Graph

Alternatively, precedence relationships may be collected in the form of a precedence matrix. Each task may be arbitrarily assigned an indexing number, 1 to n, where n is the total number of tasks. The rows of the n-x-n matrix index to predecessor tasks and successors are indexed to columns, allowing one matrix element for each possible precedence relationship. The matrix is constructed by placing a 1 in each matrix element for which a precedence relationship exists, and a 0 if not. An example of a precedence matrix is shown in Figure 1.2, containing the same precedence information as in Figure 1.1.

	1	2	3	4	5	6	7	8	9
1	-	0	1	0	0	0	0	0	0
2	0	-	0	1	1	0	0	0	0
3	0	0	-	0	0	1	0	0	0
4	0	0	0	-	0	0	1	0	0
5	0	0	0	0	-	0	0	1	0
6	0	0	0	0	0	-	0	1	0
7	0	0	0	0	0	0	-	0	1
8	0	0	0	0	0	0	0	-	1
9	0	0	0	0	0	0	0	0	-

Figure 2: Precedence Matrix

Note that there are many indirect precedence relationships that are not tracked in the above example precedence graph and precedence matrix. Instead only immediate precedence relationships are shown, i.e. the minimal set of arcs necessary to constrain the acyclic graph. For example, task 1 is a predecessor for tasks 3, 6, 8, and 9, but only the relationship to task 3 is immediate. All indirect precedence relationships may be derived from the set of direct precedence relations, if desired.

IV. LITERATURE REVIEW

Härdig K, (2020) The purpose of this study is to design a suitable layout for a newly started manufacturing company. The company does not have a current production facility as its enterprise development is in the start-up phase. The layout is designed for the future production facility that is under planning. The goal is to design a layout with minimal waste occurrences that benefit a continuous value stream. The study is based on literature and data collections. The literature studies include Lean and production systems as the main field. Relevant data were collected through interviews and study visits at similar manufacturing companies around Värmland. The value stream regarding the company will be described through a visual map. This is done by using value stream mapping as a tool from Lean. Various layouts that are considered to be in alignment with the value stream will be designed and discussed. One of these layouts is chosen as being the most appropriate.

Tarigan U, (2019) The results presented a layout and a value stream map with regard to the company's production process. These were based on a predictable volume of two similar products that were expected to be sold during the first production year. Three scenarios of different production schemes with regard to the presented layout was presented. One production schemed was proved to be the most resource-efficient. This was proved by calculations of machine capacity, the timeframe for production, and customer request. Furthermore, a value stream map of a future workshop and business state was presented. The value stream map provided a comprehensive control over the value stream. However, some data could not be provided. The starting point of this was considered to be unique as there was no current value stream to analyze or judge. Several assumptions, estimations, and simplifications for a future state were, therefore, taken.

Dino, I. G., (2016) This research was conducted at the company that produces bobbins and ream type cigarette paper. Problems that found on the production process is the back and forth (back tracking) movement. Back and forth (back tracking) movement extending the total distance moved by the material and increase the total moment of transfer materials thus reducing the efficiency of the transfer of materials in the production process. The purpose of this study is to give design for the layout of production facilities in the company, so that the expected production produced by the company can reach the targets set by the management company. The method used in this research is the Graph-Based Construction and Travel Chart Method. The results of the analysis of the proposed layout with Graph-Based Construction was selected with a total value that is equal to the moment of transfer of 780 758 m / year. This result is better than the actual layout in the amount of 1,021,038.12 meters / year and the results of the method Travel Alternative Chart I of 826.236,60 meters/year, Alternative II of 1.004.433,56 meters / year, and Alternative III for 828,467.12 meters/year. The design layout of GraphBased Construction material increases the transfer efficiency for 23.53%. With this layout proposal, expected production capacity will be increased along with the shortening of the distance of the displacement that must be passed by the material to be processed.

Horta, M. (2016) The ability of a product company in a competitive market supported by the smooth transfer of material from each of the production department. The layout of the facility is an important element which supports the production of a company. The less effective layout of the facility is resulting the products produced by the company less than the maximum. Therefore, it is necessary to design the layout of the facility every appropriate production department to ensure smooth production. Redesigning the layout of the actions needed to smooth the flow of material in order to increase the production capacity of the company.

Wilson, Lonnie (2010) The importance of efficient methods for developing the production layout has grown tremendously over the last decades and is likely to continue to do so. Although several new technologies and models are developed in the field of layout planning, there are still many areas that lack the attention from specialized research. The aim of this thesis is to develop and test a model for re-layout planning intended for the heavy steel industry. The creation of the model and identification of proper tools was entirely research-based. This means that all parts of the model are previously well established academic approaches. These were chosen so that the final model would be well adapted for the intended environment. The evaluation model was built so that it permitted several parameters to be evaluated against each other. Even though the model was built to consider a tight investment budget, a capacity increase of 7.7% proved to be possible. Furthermore, nearly two hours of operator time could be saved per day and the production bottleneck up-time could be decreased with 1.1% The final model proved to be well applicable for the case company and the final layout solution that was generated showed that improvements were possible.

Krajčovič, M.; Gabalová, G (2020) The paper deals with the issue of the mixed-reality usage in the design of production systems, its changes during expansion, or technological changes in the production, where it is necessary to flexibly and quickly verify the integration of a new machine into the existing layout and eliminate collision situations even before the installation of a physical machine in production. This is realized through Vumark's design methodology, which was verified and applied in the conditions of the production environment of the Innovation and Prototyping Centre in the Faculty of Mechanical Engineering at the Technical University of Kosice.

V. CONCLUSION

Process planning is mainly relevant to generating line balancing set of steps required to approach specified aims, with given constraints, as an attempt to enhance a part of the criteria. Balancing assembly lines becomes one of the most important parts for an industrial manufacturing system that should be supervised carefully. The success of achieving the goal of production is influenced significantly by balancing assembly lines. Since then, many industries and for sure researchers, attempt to find the best methods or techniques to keep the assembly line balanced and then, to make it more efficient. Furthermore, this problem is known as an assembly lines balancing problem.

An assembly line consists of workstations that produce a product as it moves successively from one workstation to the next along the line, which this line could be straight, u-line or parallel until completed. To balance an assembly line, some methods have been originally introduced to increase productivity and efficiency. These objectives are achieved by reducing the amount of required manufacturing time to produce a finished product, by reduction in number of workstations or both of them. This study involved applying the three heuristic algorithms to study the Ginning machine process planning gaining a reduced production time. In this study, Ranked Positional Weight (RPW) was selected to improve the productivity of existing production layout.

REFERENCES

1. Dwijayanti, K., Dawal, S. Z. M., & Aoyama, H. (2010). A Proposed Study on Facility Planning and Design in Manufacturing Process. Proceedings of the International MultiConference of Engineers and Computer Scientists, III(IMECS 2010,Hongkong), 1–6.
2. Razlee, Ahmad & Zubir, Baizura & Che Ani, Mohd Norzaimi & Mohamad Sidik, Mohamad Sabri & Zaki, M. & Faradiana, W. & Helinahani, Noor. (2018). Analysis of Production Layout Model to Improve Production Efficiency. 10.1007/978-3-319-72697-7_31.
3. Rother M, Shook J. Learning to see. Cambridge, Mass.: The Lean Enterprise Institute; 2009.
4. Härdig K, Kämpe P, Söderbom T. Informationsmemorandum [brochure]. Karlstad; 2020
5. Tarigan U, Cahyo F, Tarigan U, Ginting E. Facility Layout Design Through Integration of Lean Manufacturing Method and CORELAP Algorithm in Concrete Factory. IOP Conference Series: Materials Science and Engineering. 2019;(505):1-7.
6. Dino, I. G., 2016 An Evolutionary Approach For 3D Architectural Space Layout Design Exploration, Automation in Construction 69 131–150
7. Horta, M. 2016, Layout Design Modelling For A Real World Just-In-Time Warehouse, Computers & Industrial Engineering 101 1–9.
8. Wilson, Lonnie (2010) How to Implement Lean Manufacturing. GBR: McGraw-Hill
9. Balakrishnan, Jaydeep, Jacobs, Robert F and Venkataramanan, Munirpallam A (2003) Solutions for the constrained dynamic facility layout problem. European Journal of Operational Research. Vol 57, Iss 2, pp 280-286
10. Chien, Te-King (2004) An Empirical Study of Facility Layout Using a Modified SLP Procedure. Journal of Manufacturing Technology Management Vol 15, Iss 6, pp 455-465.
11. Krajčovič, M.; Gabalová, G.; Furmannová, B. Augmented Reality and Its Use in Industrial Engineering, 1st ed.; EDIS: Žilina, Slovakia, 2020; p. 223.

12. ADES, C. (2011) Investimento no setor de construção civil. Estado de São Paulo, São Paulo
13. PERGHER, I.; et al. (2012) Discussão teórica sobre o conceito de perdas do Sistema Toyota de Produção: inserindo a lógica do ganho da Teoria das Restrições. Gestão & Produção, v. 18, n. 4, p. 673-686.
14. RAMOS, M.; Eidt, A. (2015) A filosofia Kaizen no processo produtivo da empresa Construblocos Scherer.
15. CORRÊA, Henrique L.; CORRÊA, Carlos Alberto. Administração de Produção e Operações: Manufatura e Serviços - Uma Abordagem Estratégica. São Paulo: Atlas, 2007.
16. Ali Naqvi, S. A., Fahad, M., Atir, M., Zubair, M., & Shehzad, M. M. (2016). Productivity improvement of a manufacturing facility using systematic layout planning. Cogent Engineering, 3(1).
17. W. Wiyaratn, and A. Watanapa, "Improvement PlantLayout Using Systematic Layout Planning (SLP) for Increased Productivity" World Academy of Science,Engineering and Technology 48 2010.