Research in Management of Technology and Business Vol. 4 No. 1 (2023) 878–884

RMTB

Homepage: http://publisher.uthm.edu.my/periodicals/index.php/rmtb
e-ISSN : 2773-5044

Production Planning Towards Improving the Productivity Performance in Manufacturing Organization Using Arena Simulation

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DOI: https://doi.org/10.30880/rmtb.2023.04.01.061
Received 31 March 2023; Accepted 30 April 2023; Available online 01 June 2023

Abstract: The objective of this project is to develop a model, simulate and analyse a manufacturing system using ARENA The scope of the study is focused on automotive manufacturer, especially on the automotive parts stamping line. The goal is to provide the best methods to improve the efficiency of workstation processes and to ensure limitations and problems to achieve production targets. Procedure including data collection, model building, simulation, verification, and validation and performance analysis. To improve the understanding of ARENA, a case study was conducted out to make a simple simulation model. Then the model is simulated using the real one stamp production data collected including daily production index, process specifications, parameters, production schedule and machine breakdown. Output from simulations is generated in the form of reports. The report is organized by section which is summed across all replications. The results show that the error percentage of The ARENA model is less than 5% as targeted. This model will be used as a result support system for process improvement investigations by implementing several decisions such as balancing lines and simplifying operations. "What if" analysis is used check the submitted results. Findings confirm the qualitative the behavior of the manufacturing system in response to different decision options.

Keywords: Production planning, Productivity performance, Arena simulation

1. Introduction

Facility layout plays an important role as functional arrangement of different department, machines, equipment, and service in manufacturing organization (Monga & Khurana, 2015). Effective Layout enables the manufacturing system to be more productive and efficient. The good layout system will be

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able to increase the efficiency of the overall production process (Zhenyuan *et al.*, 2011). The layout in an organization is very important because it can increase the productivity in production line which enhances the performance in manufacturing area. It is because the layout that is not created in an efficient and effective way will cause low productivity in production line directly or indirectly.

Scheduling is known to be the process of arranging, controlling, and optimizing workloads in production process or manufacturing process. Scheduling is a useful tool which will be utilized to allocate plant and resources of machine, production planning process and purchase materials. Scheduling is a tool that is wide used in manufacturing and engineering sectors, where it can give major impact on the improvement of performance that increases the productivity. The production scheduling is usually made to maximize the efficiency of the production process in the production line and aims to reduce costs.

Most of the manufacturing organization are facing the challenges in creating a suitable plant layout to reduce the operating cost and improve product delivery speed. Kot and Kovaes (2017), stated that the company must focus on profitability and cost reduction. In order to maximize the profit and effectiveness of production system, an organization should have the ability to produce products or services by minimizing the production cost and should also reduce the time taken in the production process.

The facility layout also can cause problems in manufacturing organization. According to Sandeep and Muralidaran (2014), many layouts are laid out based on the beginning stage of the business and as the business grows it has to adapt to the changes that happens internally and externally, so relocation of facility should be done. The growth of the business influences the certain changes in few aspects. The changes in production volume, changes in production process, technology and products leads to re-locate.

Furthermore, the production scheduling may also cause a lot of problems to a manufacturing organization such as an inefficient production scheduling will lead to waste of industrial resources. According to, certain techniques have been made for flow assessment and flow cartography. But work combining production scheduling and flow remains insufficient. The inefficient production scheduling will increase the production and waste management cost and reduces the image of the company among the customers and shareholders.

The Arena simulation modelling software will used to trace and analyse the existing layout of the manufacturing organization. The arena simulation modelling software is enabled to analyse work process by creating an overview of the movement of a process with more accurate and precise simulation results. The performance and efficient production process is always depending on how well the various machine does, production facilities and amenities of employees are arranged and located in a plant. The properly laid out plant will be able to conduct smooth and fast movement of material, from the stage of raw material to final product. This study aims to identify the problem occur in the production process by using ARENA simulation and implement PPC to improve the productivity of the company.

2. Literature Review

2.1 Factors Affecting Layout

Materials. The productive equipment layout commonly depends on the products characteristics that would be managed at facility, as how does the different parts and materials to work on. The factors that should be consider are size, shape, volume, weight and the physical chemical characteristics, since they influence the material handling processes, storage and manufacturing methods.

Machinery. The process of designing correct layout requires a proper information about the machinery, tools, processes, and necessary equipment and get the understanding of their purpose and how to use in the manufacturing industry. The methods and time studies will be able to improve the processes which have the close link to the plant layout. Material handling. The facility layout will determine by the planner according to the design criterion by considering the information such as machine dimensions, capacities of machines and volumes transferred between all pairs of machines (Zhao and Wallace, 2013). Labour. The production process will be conducted systematically if the labour in an organization is organized in efficient way.

Waiting time. Waiting time have the objective of ensuring the continuous material flow through the facility, waiting time cost should be avoided and avoid delay charges when the process stopped. Auxiliary Service. Supporting the primary production activities at the plant. It is considered waste if the space dedicated to auxiliary service. The management should ensure the indirect cost are always minimized to get efficient services.

The building. If the building has been selected in the beginning, then characteristic of the building will become the constraint for the designing the layout. While the situation will different if the building must be built.

The future changes. The primary objective of the plant layout is to ensure the flexibility. To avoid having inefficient plant layout in short term, it is essential to forecast the future changes. The organization can maintain the flexibility by keeping the original layout as free as possible regarding fixed characteristic, allowing the adjustment to emergencies and variations of the normal process activities.

(a) Internal Factors Affecting Scheduling

Finished goods inventories. Scheduling depends on number of stocks of finished goods is available in an organization. Numerous organization stores, one month's supply of each product, as stock. The scheduling has to be changed if the company's product is fast moving or slow moving. Process intervals. To produce a product the process interval time is important. Different kind of products have different set process intervals. The process interval to produce large size of products needed more time than producing a product in smaller size. Scheduling will vary between each process interval.

Type of machine available. If an organization is using an outdated and not well serviced machine than the scheduling must have provisions if case, there happens breakdowns of machines. The scheduling will become easy and flexible by using modern and computerized machines. Availability of personal. The availability of personnel also affects the scheduling. When an organization hired an inexperienced and untrained workers will affect the time taken to produce a product.

Availability of material the normal scheduling can be done in an organization if the organization is enables to receive regular supply of materials. Manufacturing facilities.

An organization must consider the availability of electrical and water supply to support the production process. The production schedule will be excellent if all the required infrastructure in available in manufacturing. Lastly, Economic production rate (EPR). EPR is the mean of the optimum lot size. That is, in one lot how many items must produce in order to reduce the cost of production. The production cost increases when organization produces more or less than the optimum lot size. Scheduling should be after calculating lot size.

(b) External Factors Affecting Scheduling

Consumer demand. The scheduling depends on the consumer's demand. Sales forecast ease to identify the customer's demand. By this production schedule can be arranged according to the forecast of sales. Still the scheduling must be changed if the actual demand is different from the sales forecast.

Next, consumer delivery dates. This factor should concern very importantly. The production schedule depends on the consumers delivery dates and must assist production of product to be done in fixed date to guarantee the delivery of products in a timely manner to the consumers. Lastly, the scheduling is also. depends on the stock of inventories with dealers and retailers. The production mangers must figure out the number stocks is held by dealers and retailers. In order to do normal-scheduling, the production manager should find out why does the dealers and retailers are keeping their stocks.

2.2 ARENA Simulation

Arena simulation shows the integrated real time animation capability, allowing detailed graphical construction that represents of the system that being modelled. Arena is known as discrete-event simulation product that was concerns the modelling of a system as it evolves over time and represented the changes as a separate event which developed by Rockwell software.

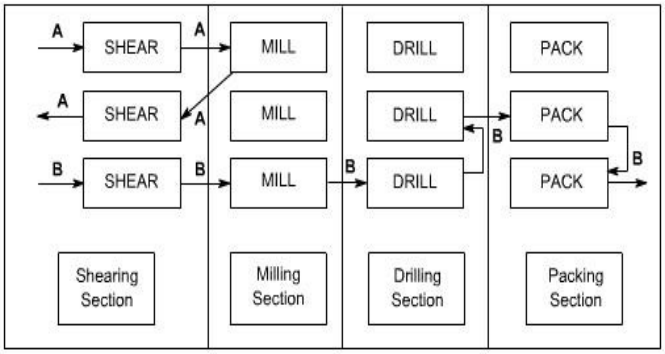

Figure 1: A pictorial representation of process layout (Okpala & Chukwumuanya, 2016)

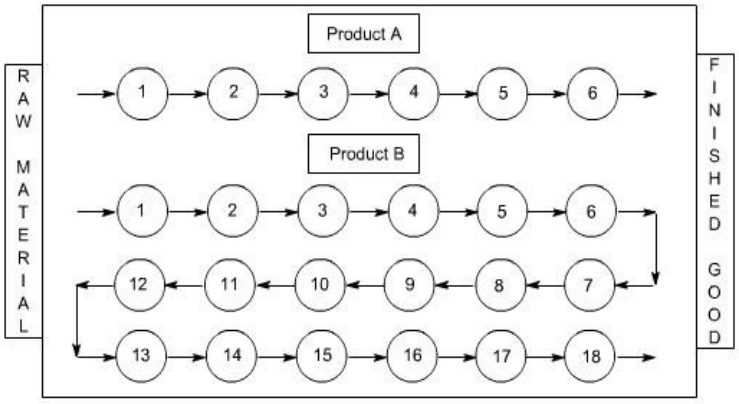

Figure 2: A pictorial representation of product layout (Okpala & Chukwumuanya, 2016)

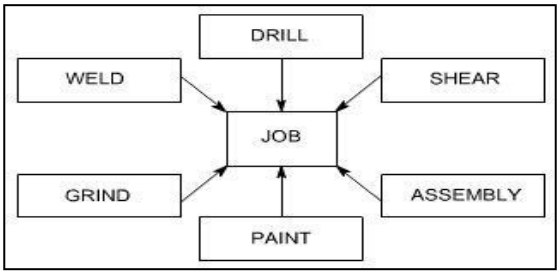

Figure 3: A pictorial representation of fixed position layout (Okpala & Chukwumuanya, 2016)

3. Research Methodology

3.1 Research Design

In this study, the method that are chosen to conduct the study successfully were interviewing, observation, and data collection. The researcher has selected to design facility layout and master production schedule to improve the performance of the selected manufacturing organization, this research influenced by qualitative approach which is aimed to get a deep understanding of the selected organization production environment. The qualitative method will be able to answer the *whys* and *hows* of behaviours of human, experience, and options, that will not be able to collect information from conducting quantitative methods of data collection.

3.2 Data Collection

To conduct the interview, a set of important questions will be prepared earlier and also will ensure questions are easy to understand by the respondents. The questions asked will be open and relevant to the topic. Suitable respondent will be selected based on their knowledge and experience in experience in designing a facility layout and master production schedule.

Observation method enables cover overall view of the manufacturing process in an organization. Observing the production area enables the researcher to gain information and clear view of the production process starting from acquiring raw material to forming product. By having a direct observation, it will enable to avoid wrong information and understand.

Data collection will be done to generate the information and data that are required run the simulation on Arena Simulation software and to make a master production schedule. There are few important data that are need to for Arena simulation and master production schedule such as all the involved process should be listed, distance between the process and identify the size of all the workstation for Arena simulation software and forecast demand, inventory cost, customer order and inventory for master production schedule.

3.3 Data Analysis

The Arena home screen consist of small bar with the name of the model at its stop. The bar is known to be *Arena Bar,* that have general menus and *Arena-specific menus.* Menu bar is a set of *Arena toolbar,* which is able to be displayed and hidden by clicking the right mouse button on the background area of specific toolbars.

The *project bar* lets the user access Arena template panels, where *Arena modules*, *SIMAN blocks*, and *various numerous other objects cohabit*. Template panels can be attached to the project bar by clicking the *Attach button* and *Standard Toolbar*. When the Attach button is clicked, a dialog box pops up on the screen and shows the so-called files corresponding to each temple panel.

Arena standard toolbars contains button the support model building. The important bar is the connect button which supports visual programming which use to connect the Arena modules as well as SIMAN blocks, and the resulting diagram describe the flow of logical control. The *standard toolbar* also provides VCR-styles buttons to run an Arena model in interrupt mode to trace it evolution.

Draw and view bar. The *Draw toolbars* support statistic drawing and colouring of Arena models. The view toolbar assists the user in viewing a model. Its button included *Zoom in*, *Zoom out*, *View all*, and *View Previous.* These function makes it convenient to view large models at various levels of details.

Animated and Transfer bar. The *animated toolbar* is used for animation of Arena model objects during simulations runs. Animated objects include the simulation clock, queues, monitoring windows for variable, dynamic plots, and histogram function. The animated transfer toolbar is used to animate entity transfer activities, including materials handling.

The *Run Interaction toolbar* supports run control functions to monitor simulation run, such as access to SIMAN code and model debugging facilities. It also supports model visualization, such the *Animate Connectors* button that switches on and off entity traffic animation over module connection. Lastly, The *integration toolbar* support data transfer (import and export) to other application. It also permits visual basic programming and design.

4. Discussion

The modeling and simulation process requires a lot of practice to manipulate and fully utilize the ARENA tools and panels Simulink Tools makes it easy for analysts to create models that accurately represent real systems. Some commercial simulation software also provides simulink tools and additional features such as 3D animation, mathematical analysis reports and others. Therefore, it cannot be denied that many large organizations and institutions have used simulation software in a way to improve their systems and increase profits. For this project, the objective of the simulation is to increase the productivity of the manufacturing system by reducing cycle time and eliminating waste, to evaluate the productivity of the manufacturing system and to create an effective spare parts supply schedule to avoid excess inventory.

i) Provide sufficient resources to collect the required data in a timely manner. The study took longer than expected mainly due to the effort required to collect data.

ii) Use the right level of abstraction for the simulation model. Too many details will there is no need to rush the analyst in an extensive effort to collect data and build a model. Too few detailed results in unprepared models required answer.

iii) Spend data collection efforts on critical data elements. Initially build the model with available data. Model training to understand the effects of play factor. Take the time to improve the accuracy of data that has large effect on output.

iv) Focus on key outputs. Simulation models can generate a lot of data. The Key performance metrics for results should be identified first and report the output of the model designed to generate those parameters.

5. Conclusion

This paper will be explaining on how and what will be carried out in this research, the overview of the research background is what is the primary issue discussed, the problems will be identified and solved during the process of research and explained on how the data collects and analyzed using the proposed qualitative methods. Besides, the paper also focuses on how the collected data does will respond to the Arena simulation software and produce result that will be able to provide to solution for the facility layout problems and the collected data regarding the master production also will be focused in order create an effective production schedule to avoid wastage of resources. Nevertheless, this study paper also will specify the impact of production planning that ensures to improve the performance in a manufacturing organization and the provide a fix for the problems in the system.

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