DEVELOPMENT OF SIMULATION-BASED SYSTEM FOR PRODUCTION PLANNING

***Shijath T. A., **Anilkumar V.J.**

**Lecturer, Mechanical Engineering Govt. Polytechnic College, Kalamassery-Kerala*
***Lecturer, Mechanical Engineering Govt. Polytechnic College, Muttom-Kerala*

ABSTRACT

Models that can take into consideration the intricacy and unpredictability inherent in manufacturing processes are necessary for production planning. The capacity of a model to generate production plans that are resistant to system disturbances and realistic enough to be implemented in practice is a more crucial need than the ideal identification of a globally optimal plan. Here, we introduce a simulation-based optimization technique that supports production planning decision-making by using DES and a GA as a methodology. While taking into account system limitations and the uncertainty resulting from variances in manufacturing lead times, production line failures, and maintenance service times, the model seeks to minimize the total of projected backorders and inventory costs.The model may generate workable production plans that accurately take into account the inherent unpredictability of the underlying manufacturing system, according to preliminary results for a real-world scenario.

KEYWORDS: *Simulation based System; Production Planning; Simulation System*

INTRODUCTION

Manufacturing planning is a complicated technical challenge that calls for a mix of computer-based simulation techniques, internet technologies, and theoretical methods, among other things. The Internet of Things, the Cloud, and Industry are radically altering the globe. According to the new manufacturing paradigm (4.0), factories of the future will have more adaptable structures that will enable them to manufacture highly personalized goods in smaller quantities, at a cheaper cost, and with a higher level of quality before the deadline. It is only feasible to buck such a broad trend if the factory layout and processing flow are appropriately planned and swiftly adjusted. [1]

One manufacturing technique that accurately depicts the reality of operations and processes in a model is simulation. The model considers the factors and situations on the ground and reflects what actually occurs. It is a really helpful tool for scheduling and product planning. Managers undertake scheduling, which involves allocating resources, identifying procedures, and estimating various aspects that are involved in the procedures, such as expenses.

This is very important in project management since it provides the manager with information about the upcoming project and serves as a prediction tool. Product planning, on the other hand, is the process of allocating limited resources to manufacturing tasks in order to fulfil business goals.

Meeting demand and ensuring client satisfaction are part of this. Generally speaking, this is an optimization problem for a business since it describes a procedure in which a manager must decide whether to simultaneously minimize expenses and maximize earnings. This study investigates the potential of using simulation to address scheduling and production planning issues in various businesses.

Simulation models of different forms of production flow

All of the essential functional and technological components of the production system were represented in the simulation models for the Smart Factory lab. In addition to technical components that guarantee the models run correctly, objects that depict the essential components of the production process (such as an order list) have been put into place. These components include objects that visualize the model's execution as well as tables that list the parameters and outcomes of its operation.

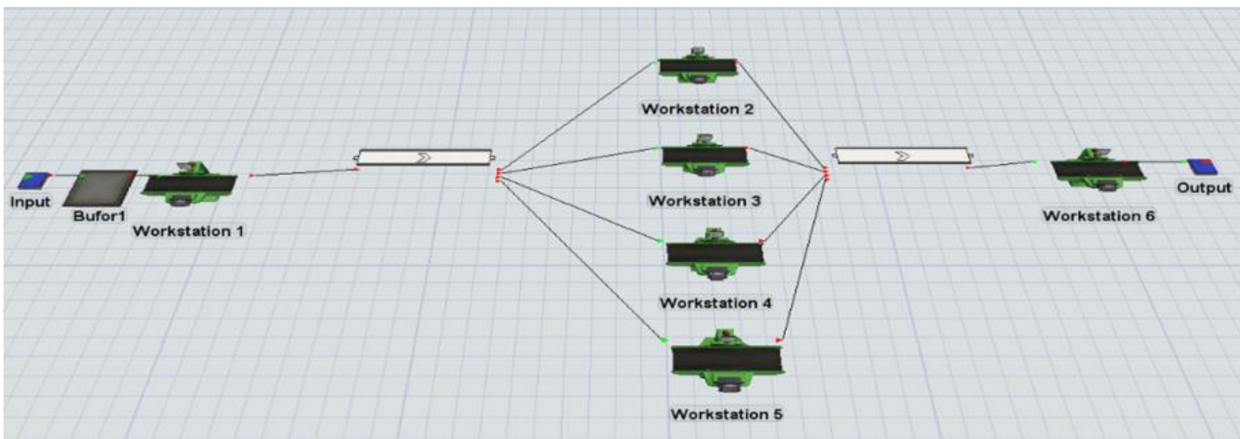

Figure 1: Schemes of variants of forms of organization of the flow of production

Figure 1 illustrates how the simulation model is visualized for one of the variations in the flow's organizational structure. The parameters listed in the "parameters" table dictate how the simulation model operates. Both the model's basic parameters and the specific parameters for every product are included in this table. An appropriate table of the "orders" object is used in the model to represent the list of production orders. Each row in this table represents a single order and includes the following information: the product name, order size, and execution sequence.Graphs updated during the model operation, output tables, and messages in the simulator console window all show the outcomes of the model process.[2]

Production Planning

Production planning is the process by which a manufacturing or service company aims to satisfy consumer needs by applying and using resources in an effective and efficient manner. Production planning is a useful technique for identifying the best answers to managerial issues.

It can be used for staff planning, determining how many lots to create in a given amount of time, allocating additional work time, and efficiently sequencing production runs. Since this is an optimization problem, it can be solved using a variety of tools. This is influenced by the size of the company in question, the type of manufacturing, and the degree of technology. Complex computer software, simulation, and linear programming are a few examples of optimization solution methodologies.

Graves (1999) also notes that particular aspects of the product and manufacturing processes, such as production time, must be taken into consideration when using a particular technique. This influences how specific techniques are used. Simulation is a widely used technique. This is due to the potential to test the model and utilize the results to determine which model best suits the organization.

It is comparatively simpler to utilize in some circumstances than others. Furthermore, it is highly adaptable and commendable that these models may be successfully tested. This is the most commonly used strategy in production planning. An organization must determine its goals and compile a summary of its resources, restrictions, and restraints. This is incorporated into a model that simulates the real-world scenario.

Linear programming is another approach to production-planning problems that is frequently used in many organizations. Although it has numerous assumptions, it is nearly identical to simulation. [3][4]

REVIEW OF LITERATURE

In today's competitive market, a manufacturing company's primary mission is to address the needs of certain consumer segments in order to optimize profitability and survive, among other things. This calls for a methodical approach to production system management. Accordingly, the two most crucial pillars of a production system are thought to be manufacturing support systems and production facilities [5][6].

Putnik & Silva (1995) assert that factories built to manufacture multiple items are technically less efficient than those focused on producing a single product, when performance is at its peak. This idea serves as the foundation for the development of One Product Integrated Manufacturing (OPIM), an organizational approach for manufacturing systems that optimizes the production of a specific product. In comparison to other manufacturing systems, it is a relatively new concept that looks at some traits of extended, agile, and virtual businesses in an effort to increase productivity and efficiency. [7]

Based on enhanced virtual interactions between users and machines, Mujber et al. (2004) highlighted the possibility of using virtual reality to improve industrial processes and operation management. Even if previous research has clearly contributed to a deeper theoretical understanding, these review-oriented works lack the nuances and details needed to direct practical implementation. [8]

A hierarchical method for determining production rates and preventive and corrective maintenance programs was given by Kouedeu et al. (2014a). Their goal was to reduce the discounted total cost of a system that produces a single product in a single machine that is prone to random failures and get worse as the number of failures increases.In order to minimize inventory and shortage costs over an infinite time horizon, Kouedeu et al. (2014b) developed stochastic dynamic programming equations to determine production rates for a single product manufactured by two machines, one with production-dependent failure rates and the other with constant failure rates.In a closely related work, Kouedeu et al. (2014c) used the same methodology as Kouedeu et al. (2014b) to set production rates for a manufacturing and re-manufacturing machine that manufacture a single product in order to minimize the discounted overall cost. [9][10][11]

Liu et al. (2013) also examined the evolution and use of simulation in manufacturing, including the benefits, drawbacks, and potential advancements of different simulation technologies. They remained, nevertheless, at the theoretical level. They haven't also identified a methodical way to use simulation to reimagine the manufacturing process. [12]

In 2018, Woo and Oh did research on creating an environment from the viewpoint of the user and developed a modeling and simulation-based methodology for digital shipyard development. These studies provided the necessary data, modeling techniques, and logic for result analysis along with a set of procedures needed for shipbuilding simulation. These earlier works applied simulation approaches to optimization methodology in an effort to enhance planning and prediction capabilities. [13]

Woo, Song, and Shin used DES simulation as a representative simulation study of yard logistics, a difficult problem in shipyards. One of the problems with yard logistics for Daewoo Shipbuilding & Marine Engineering is the construction of an additional assembly factory. This was done to determine the impact of logistics. The DES simulation's outcomes were used in the study to address the shipyard's real production problems. However, because to the time-consuming nature of computation logistics transportation, its ongoing use was restricted. In order to address these issues, Jeong, Lee, and Woo carried out a DES simulation study to examine shipbuilding yard logistics with an emphasis on enhancing simulation computation performance. [14]

OBJECTIVES

1. Study of Developing simulation-based system for production planning.
2. Analysis of simulation-based system.
3. To examine the simulation-based production planning.

RESEARCH METHODOLOGY

Determining the problem, implementing modeling and simulation to solve the problem, and assessing the solution constitute the fundamental methodology for this study. The fact that this study is a component of larger, more thorough research on production planning and control must be underlined. Therefore, this article does not include the procedures and equipment needed to complete the first stage.

RESULT AND DISCUSSION

Figure 2 shows how the cam's output changes throughout the course of the 12-hour simulation. When each pallet with a total of six cams is completed, the output is considered a single set. As a result, the output is six times the real cam output.[15]

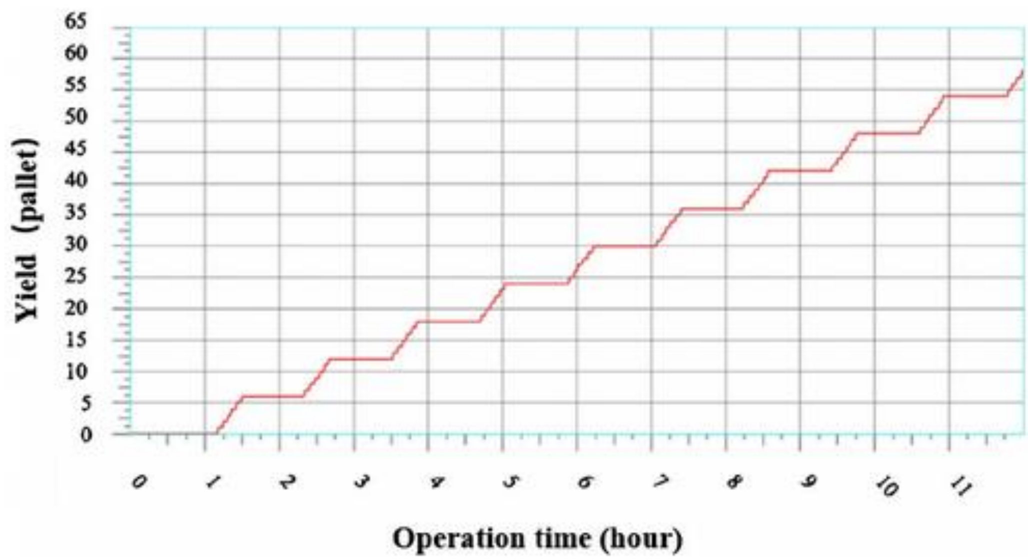

Figure 2: the output of the cams

A quick evaluation of the five developed techniques is presented in Figure 3. Following five replications, it examines the average production statistics associated with each technique and draws conclusions. The first of these conclusions discusses the most notable tactic (strategy 4) and makes reference to the potential for increasing each strategy's impact. The graph indicates that any of the employed tactics will have a beneficial effect on the system for the identical entry values. With a production increase of 5% and 28% for the rolls of knit and damask textiles, respectively, strategy 3 is the most noticeable when compared to strategies 1, 2, and 3.

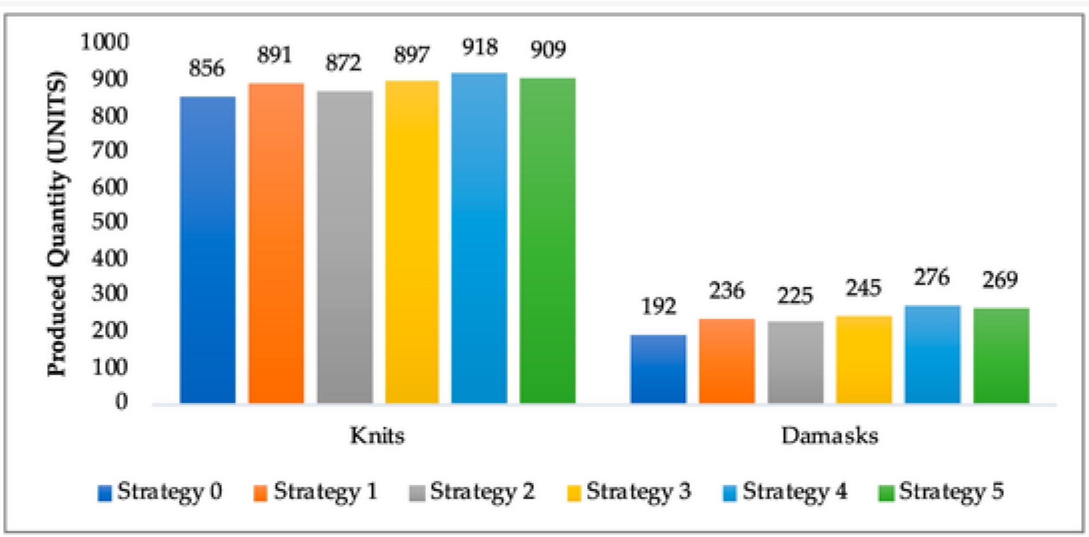

Figure 3: Comparison between the control strategies

The optimization or improvement of routing times between operations, as well as other processes that can be improved further, such as in the knit production area, are also given more attention. With an increase of 8% in knit rolls and 44% in damask rolls, the first crossover strategy outperforms the other two (strategies 4 and 5). The ultimate goal is to prioritize tasks according to the kind of article in order to reduce bottlenecks at the finishing area entry and to improve routing and process time reduction, which will guarantee increased production system speed overall.The model was experimented with in order to get the most practical result that took into account the least amount of work and money needed to put the improvement into practice. [16]

Analysis of Planning and simulation

To confirm the viability of the suggested model, exploratory simulations were run. Five scenarios with varying norm values were simulated. To avoid impeding the release of orders, the first scenario takes into account a huge norm value, which represents the infinite norm. Scenario 2 = 8, Scenario 3 = 16, Scenario 4 = 24, and Scenario 5 = 32 were the norm values for the remaining scenarios.

One hundred replications were conducted, each with a simulation time of 6,000 units of time (specified in the modeling as seconds) and a warm-up time of 3,000 units of time. Similar WLC experiments frequently employ these parameters to lessen variation (Land, 2006). A home PC running Microsoft® Windows 10 with an Intel i7 processor and 6GB of RAM was used to run the simulation.

The simulation took into account the traditional WLC model, which states that orders are always categorized based on the scheduled release date and that returning orders from the loop (list of unreleased orders) have no priority. Furthermore, it is only released to the shop floor if the total workload of the machines plus the time needed to process orders does not above the predetermined standard.

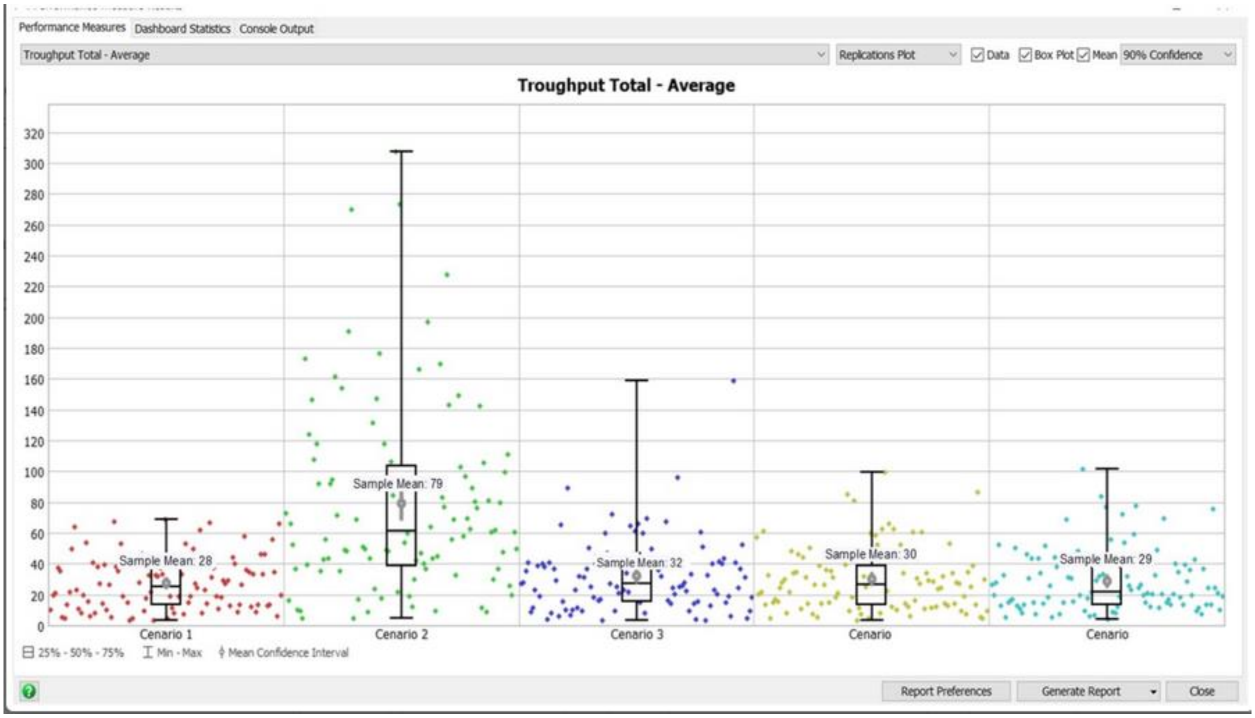

Figure 4: Simulation result throughput time

The first scenario's throughput time figures were contrasted with those of the other scenarios.

In contrast to the first situation, which has an unlimited norm (average of 27 time units), the mean total throughput time (Figure 8) on a very tight norm, as in the second scenario (norm of 8), is significantly higher (average of 79 time units). The mean total throughput time in scenarios 3, 4, and 5 was 32, 30, and 29 units of time, respectively. [17]

CONCLUSION

A fundamental aspect of production systems that enables fulfilling customer demands in the creation of bespoke goods is production flexibility. The findings of a study on the impact of production flow organization on production order implementation are presented in this article.

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