

Simulation-based Decentralized Task Assignment for a Manufacturing Facility

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ABSTRACT – The importance of production task assignment when it comes to provider manufacturing modes cannot be overstated, as it allows for the provision of a just-in-time supply of manufacturing services to clients. This study investigates a crucial aspect for optimizing a production schedule in a manufacturing facility. Discrete Event Simulation (DES) technique was used to imitate real-time information about activities and services, may be utilized to establish more efficient task assignment rules for the tasks and services under consideration. The results show that the system performance could be optimized by using appropriate technique.

1. INTRODUCTION

Most of the time, the tasks assignment is conducted based on centralized approach where task scheduler will match tasks to the most suitable machine. As more researches found [1][2], it became clear that centralized task assignment approach alone may not be able to achieve optimized productivity within timely manner. Furthermore, the advancement of computing technologies allows decentralized approach to be applied in solving task assignment problem. Decentralized task assignment is a loose reference to the system that enable the task assignment to be decided by more than one entity within the system [1][3]. At times, this could accommodate the dynamic demand of an integrated sector.

Researches on task assignment methods are focused mainly to cut idle times, speed up production processes, and to lower costs by optimizing operating processes for the production systems [4]. The objective of production task assignment machines is to locate a pattern of machine work to increase a range of principles without breaching any of the shortcomings.

Simulation is a study that simulates or imitates a structure of real life. The imitation of a system without time or a dynamic simulation may be a static simulation, like a real system in time. The simulation can be categorized into a physical simulation. The word simulation is called dynamic machine software simulation in this project. Simulation is examined in several ways like a computer simulation which through its evolution replicates a structure. The programs can be broken down into discreet and ongoing versions [5]. The conditions of such structural elements continue to change over time in a continuous model. Previously, it is quite difficult to simulate a decentralized task

assignment due to the technological restriction. However, as the computing technology advances, the study is becoming more feasible.

2. METHODOLOGY

The proposed work flow to establish the optimization model is illustrated in Figure 1. As the study is conducted in a manufacturing facility, series of discussions were conducted before the simulation was developed. Decision on product groups, selection of important parameters and stock levels are among the important decisions made during the discussion.

Two types of dispatching rules used in this study are:

- First In First Out (FIFO)
- Last In First Out (LIFO)

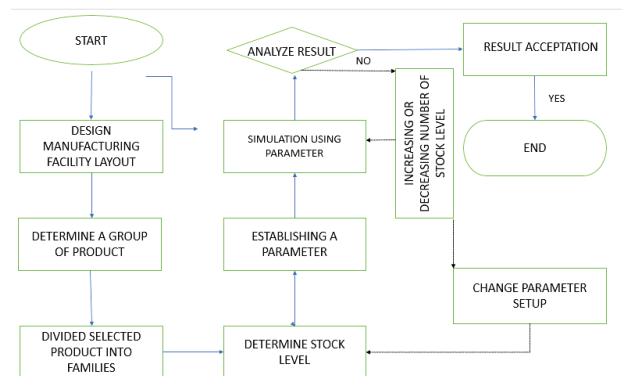


Figure 1 Research workflow

The configuration of the factory, depicted in Figure 2, is based on the actual layout that is employed in the facility where gears are made. Each of the workstations will be responsible for the transformation of raw materials into finished items. The critical process is delivered into the material throughout the material's transformation into a final product at each of the stations along the way. The aim of this study is to increase machine utilization as the current utilization is about 50%.

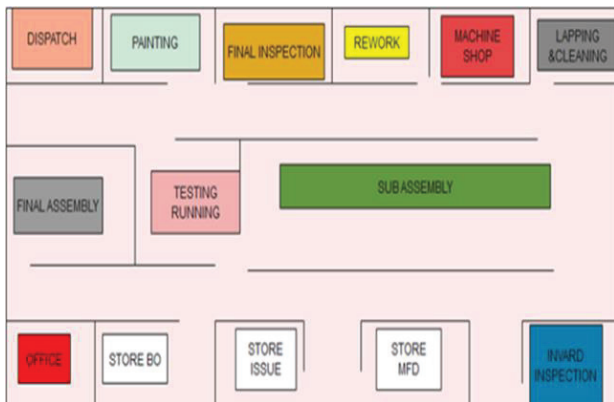


Figure 2 Manufacturing layout

3. RESULTS AND DISCUSSION

Anylogic 8.5.2 simulation software was selected as the simulation software due to the reason that it is capable to model the required system. The multi-method approach based on discrete event simulation (DES) and multi-agent systems (MAS) was used to build a simulation model for this application. The resource and job populations of agents are portrayed as resources and jobs, respectively, in the production scheduling model. The resources indicate the entities that oversee the processing of the finished product. Jobs are the things that are subjected to machining to be transformed into completed goods after the technical cycle. Operation and transitions are two extra populations that are required for the Job Shop system to function properly: they are contained within each job agent. Figure 3 shows the developed

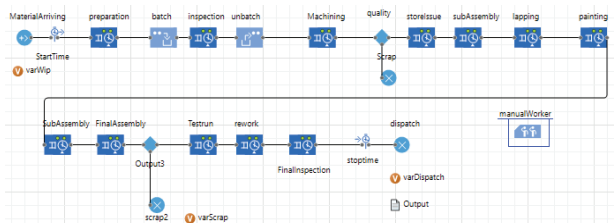


Figure 3 Manufacturing layout

As illustrated in Figure 4, the throughput unit for the LIFO dispatching rule that we simulate, we classified the throughput unit by 5 and received a cycle time of 528.37 for this simulation. Furthermore, we find that the number of units for throughput is 3, and the cycle time is 482.98 for the FIFO simulation. We can see from the data that comes from the simulation that the larger the unit of throughput for the product, the greater the number of cycles required to complete the product cycle. Even though both phrases explain how long it takes a manufacturing process to complete, cycle time refers to the amount of time it takes to complete each stage in the manufacturing process.

4. CONCLUSIONS

It is necessary to conduct extensive research on the theory and task assignment method for this final year project, which will be completed across two semesters.

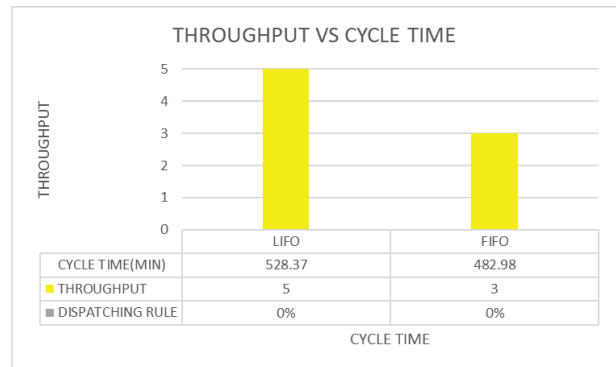


Figure 4 Throughput and cycle time

The research on identifying the important task assignment aspects within a production system is completed before the implementation of decentralized machine task assignment. The choice of the dispatching rule, in conjunction with the use of the machines, can be characterized as an important element in task assignment. It has been established in the company that the dispatching rule is FIFO, and it has been established in this project simulation that the dispatching rules are FIFO and LIFO. Meanwhile, equipment utilization has increased from 50% to 80%, representing a significant increase over the previous year.

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