Simulation Of Job Shop Scheduling Problem

Katuru Phani Raja Kumar[1], Dr. V Kamala [2], Dr. ACS Kumar[3]
[1*]*Project Manager, IBG Manufacturing, Mahindra Satyam USA/India*

[2]*Professor, Mechanical Engineering TKR College Engg & Technology Meerpet Hyderabad*

[3]*Professor, Mechanical Engineering JNTUH (Rtd) Hyderabad*

Abstract

In a manufacturing system Job Shop Scheduling is an important aspect where the maximum utilization of the resources should be considered. The computer simulation of distinct events is mostly used for manufacturing design, but it is given a slight consideration in production scheduling. The Job Shop Scheduling Problem is solved by using Flexsim simulation software with an objective to optimise the total flow time.

1. Introduction

Scheduling is the process of allocating shared resources over time for competing activities is known as scheduling. It has been the subject of a significant amount of literature in the operations research field. The JSSP is categorised into NP-hard, but it is one of the worst members in the class. An indication of this is given by the fact that one 10x10 problem formulated remained unsolved for over 20 years.Many techniques have been developed by researchers, to solve the JSSP by optimization and approximation based approaches.

Due to maximum consumption of time for determining the solutions, they are limited to small size problems only.

Mathematical optimization of the JSSP were solved with linear or mixed integer programming for formulating the problem accurately.

Besides exhaustive search algorithms based on branch and constraints, several approximation algorithms were developed based on priority rules and active schedule generation [21]. Sophisticated method called shifting bottleneck has been shown to be very successful [30]. Additionally, stochastic approaches such as simulated annealing, Tabu search [15, 26, 32] and genetic algorithms have been recently applied with good success [11,19].

2. Shortest Processing Time Technique

The shortest job are handled first and completed. The shortest processing time (SPT) implies that the next job to be processed is the one that has the least time necessary to complete. The philosophy here is to get the smallest jobs over quickly, which gives a physiological impression that one is being more productive. The problem with this approach is that large jobs, which might be more urgent, are done later. Jobs are sequenced in non decreasing order of processing times.

3. Simulation of JSSP

For analyzing and solving problems that exist in real systems simulation is used as an applied technology. It provides the context for the book by defining what simulation is and the characteristics of the systems in which simulation is applied. The processing systems are used in all areas of manufacturing and mining, as well as service operations transportation, and distribution. Simulation is used to add values to all facets of decision making.

Often the scope of a manufacturing simulation includes one or more production lines. The productions lines are controlled by a schedule to indicate the type of products to be produced, which equipment has to be used, and the order in which production should take place. Simulating this environment requires a large amount of custom coding for all the operating variables. In Flexsim, the production scheduling objects eliminate the need for that custom code, simplifying the process dramatically. For simulation purposes, the production environment is defined as follows: Line: A group of equipment that produces a single output at a time System: One or more lines that are scheduled as a group.

The job shop scheduling problem is simulated using SPT technique. The main objective of simulation is to reduce the idle time of the machine and obtain maximum utilisation from the machines. Flexsim

software was used to optimise the scheduling of the component. The setup time, processing time at each machine, number of components to process and the constraints have been considered from the experimental data for the component.

4. Results and Discussion

For the component the Gantt chart is drawn to analyse the total processing and machine utilisation shown in figure 1. By using the shortest processing time technique the average flow time is in 538.4 hrs. The total utilisation is determined to be 92.91% by using SPT. The total delays from the accumulations of flow time is 78.45hrs

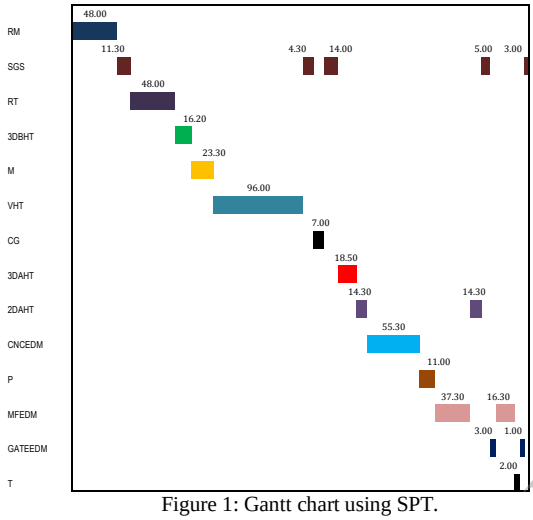

Figure 1: Gantt chart using SPT.

In order to optimise the total processing time of the JSSP, computer simulation is considered. Using Flexsim software the flow of the raw material from the initial stage to the final product output was designed according the job shop arrangement of the processed component. The machines were constrained and the batch of components to be produced was specified at the source. All the jobs were collected at the sink.

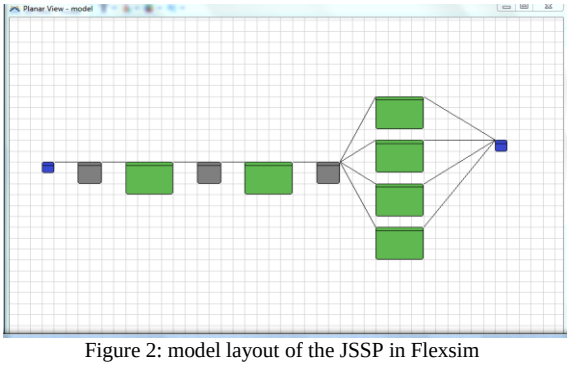

Figure 2: model layout of the JSSP in Flexsim

The state analysis for processing, releasing, setup time, idle time was obtained after simulating the process lay out.

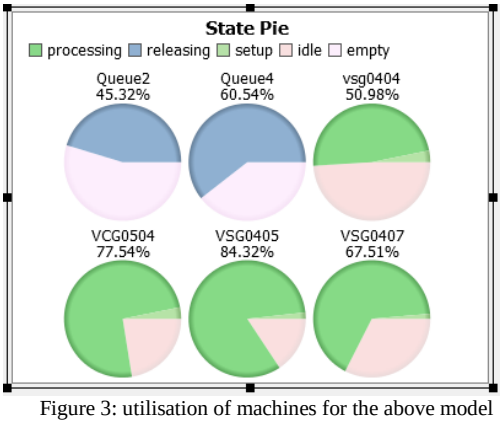

Figure 3: utilisation of machines for the above model

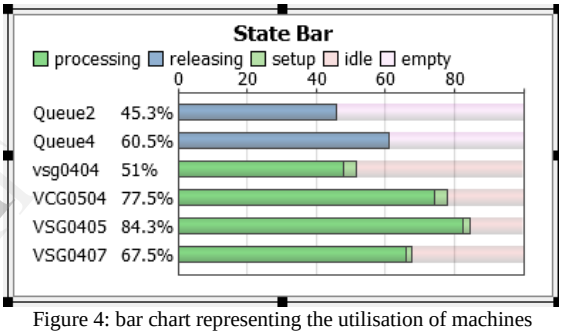

Figure 4: bar chart representing the utilisation of machines

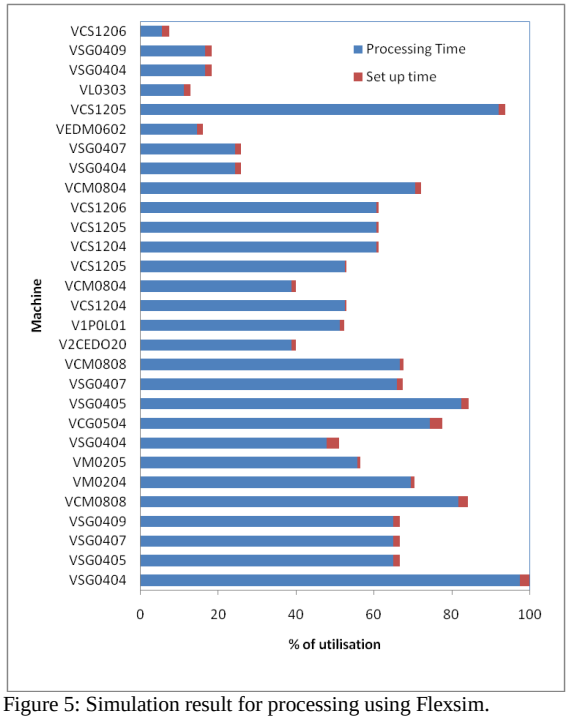

Figure 5: Simulation result for processing using Flexsim.

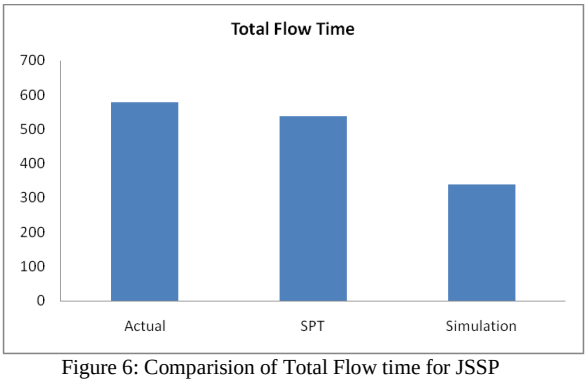

Figure 6: Comparision of Total Flow time for JSSP

The total flow time for the JSSP from the computer simulation was 338.30 hrs. It is observed that the flow time has been decreased by 200.10hrs as shown in figure6.

5. Conclusions

The JSSP has been simulated using Flexsim software. The simulation results optimised the total processing time by 35% of the total processing time determined by the SPT technique. The simulation model reduced the idle time of the machines and increased the utilization of the machines. The computer simulation can be utilised to for Job shop scheduling problems with n jobs and m machines so that maximum utilisation and allocations of the jobs can be optimised.

6. References

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