Production Planning and Scheduling
(Using Data & Simulation)

HARISH . C
Department of computer science
Hindustan Institute Of Technology & Science
Rajiv Gandhi Salai (OMR), Padur, Kelambakkam,
Chennai-603103, Tamil Nadu
22374012@student.hindustanuniv.ac.in

SURESH .B
Department Of Computer Science
Hindustan Institute Of Technology & Science
Rajiv Gandhi Salai(OMR), Padur,Kelambakkam,
Chennai-603103, Tamil Nadu
22374013@student.hindustanuniv.ac.in

Dr . I . LAKSHMI
Department Of Computer Science
Hindustan Institute Of Technology & Science
Rajiv Gandhi Salai(OMR), Padur , Kelambakkam,
Chennai-603103, Tamil Nadu
lakshmi@hindustanuniv.ac.in

ABSTRACT:

The purpose of "PRODUCTION PLANNING AND SCHEDULING" (using data and simulation) is to provide a simulation model for production planning scheduling for manufacturing purpose in industries , which also creates a positive impact on manufacturing efficiency by reducing errors caused by humans. The simulation is conducted using ANYLOGIC Software, a simulation programming language, to develop a model.

INTRODUCTION:

Today, many firms or sectors are still utilizing the outdated manual planning and scheduling of work, which may result in mistakes or take considerably longer due to the involvement of large amounts of data. The development of a model for Production Planning and Scheduling facilitates the easy construction of a functional model and allows for detailed statistics of the manufacturing processes of specific products to be displayed. Additionally, it allows for the number of labor hours worked and the total number of products manufactured in a day to be shown.

Problem :

In all daily scheduling was under the control of the production planners, who aimed to schedule in the most optimized manner every working day (Figure 1). These planners based their decisions on experience but lacked a mechanism to test and benchmark the schedules they crafted to identify which one was more efficient.a factory,

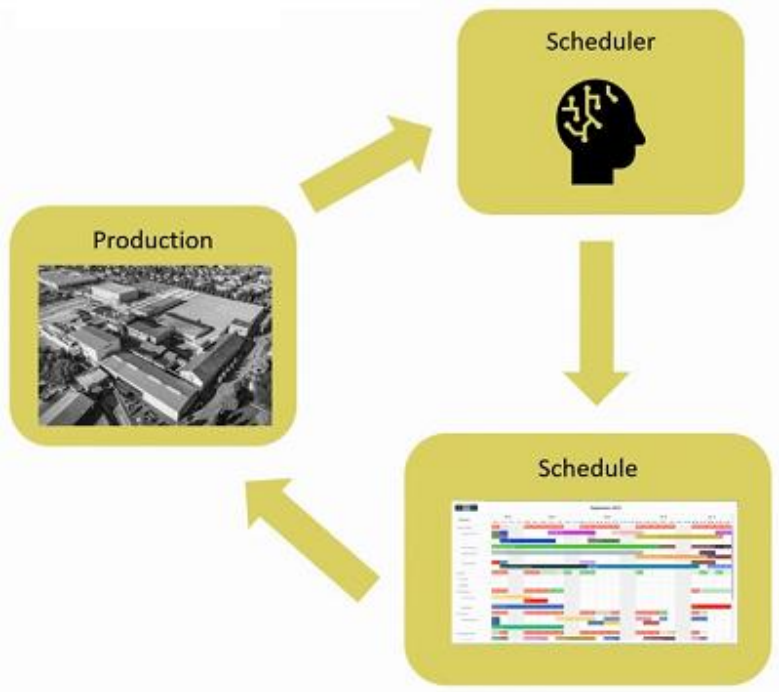


Figure 1 - Basic Production Planning Approach

In their first endeavor, the planners aimed to make improvement , which subsequently resulted in more efficient schedules. Scheduling was very complex because of the dependencies among components of the system that had to be taken into consideration during the scheduled creation process .

Solution:

Production scheduling using data and simulation assists in making better business decisions. A simulation model using feedback from the planners could be created by combining some aspects of job shop scheduling. The different approaches to production planning and scheduling using data and simulation are described below.

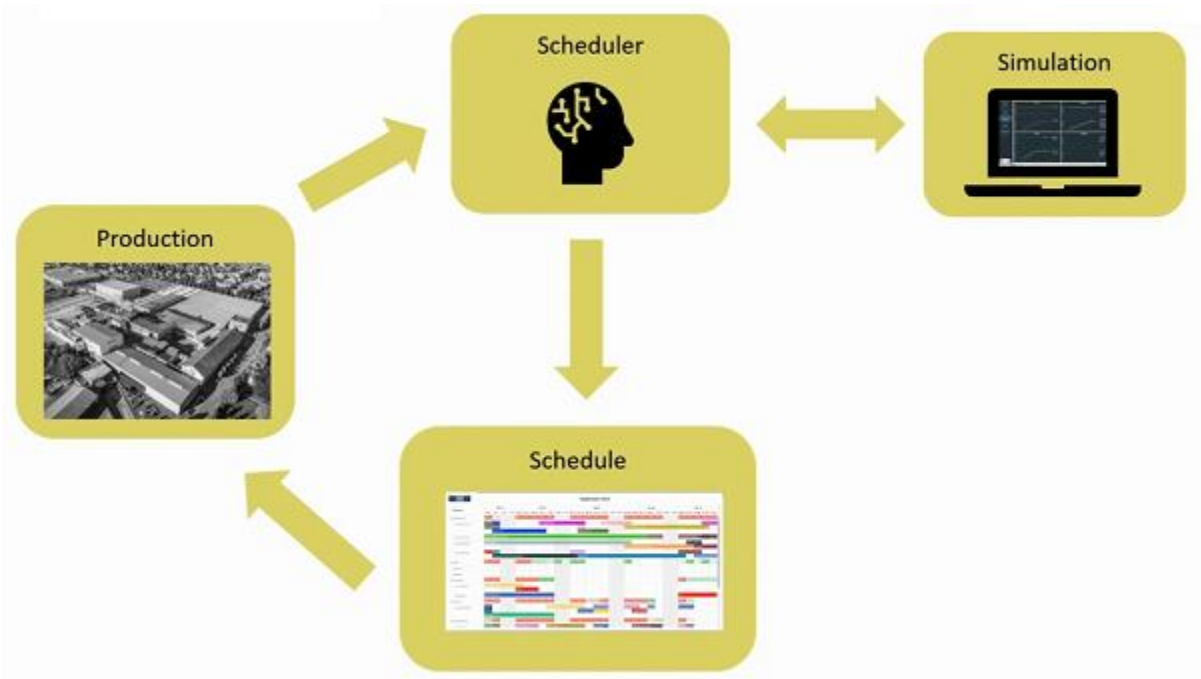


Figure 2 - I started with one of the methods for planning that incorporated a simulation model.

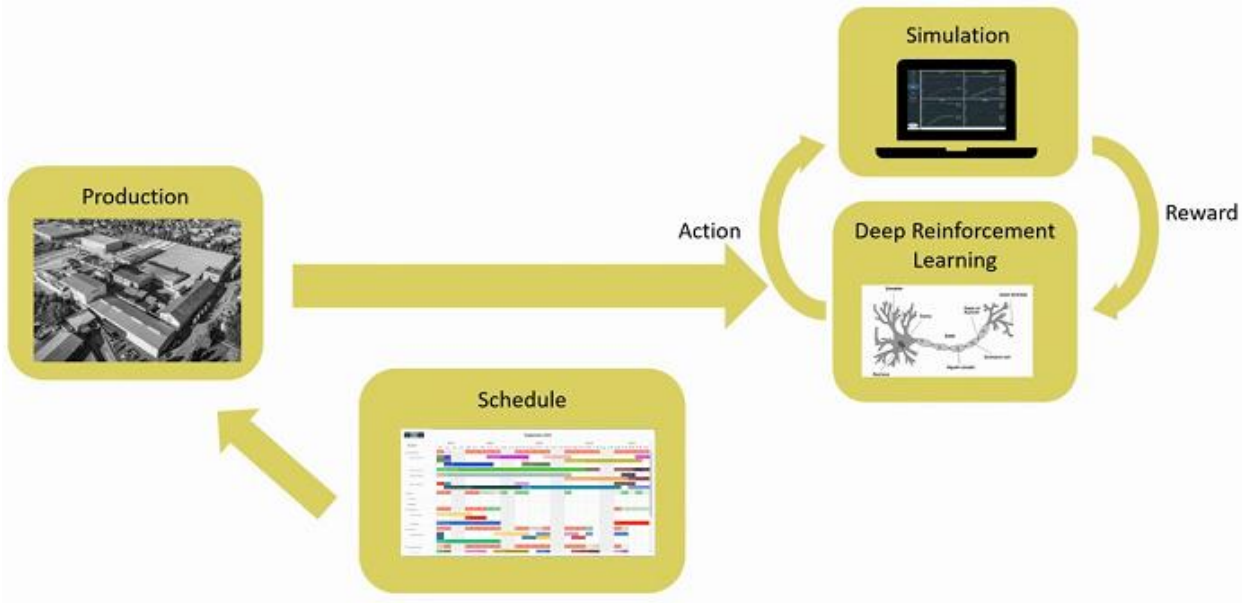


Figure 3 - Using one of the production scheduling techniques - AI-powered simulation.

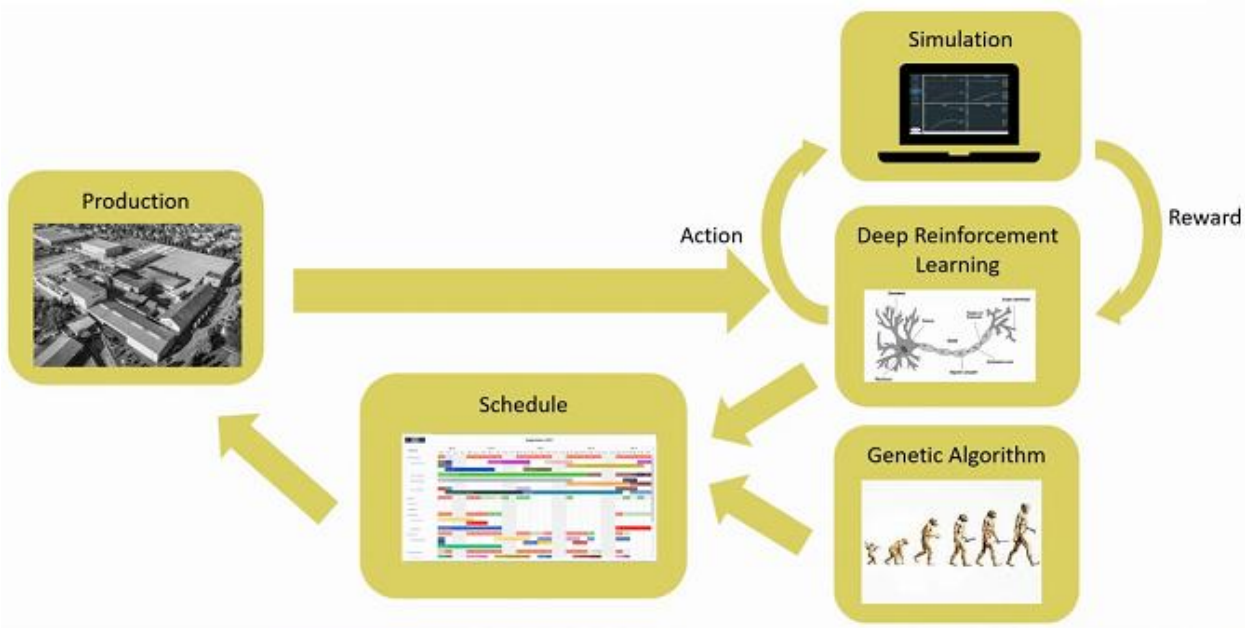


Figure 4 - Using one of the production scheduling techniques - with a genetic algorithm.

We intend to work using one of the production scheduling techniques with a data and simulation model.

LITERATURE REVIEW

AUTHOR	YEAR	TITLE	CLASSIFICATON TECHNIQUE (PROS)	DRAWBACK(CONS)
T. M. K.Rooder, P. I.Frazier, R.Szechtman, E.Zhou, T. Huschka, and S. E. Chick	2016	Framework For Standardization of Simulation Integrated Production Planning	A system simulation model which is continuously updated by newly received real-time data can help in the assessment of an intended plan	Simulation tools have a low level of interoperability
S. Kim, B.Feng, K. Smith,Masoud, Z.ZhengC. Szabo, and M.Loper	2021	Towards A Generic Semiconductor Manufacturing Simulation Model	Data-driven regression model which evaluates and studies large sections of issues inup-to-date semiconductor manufacturing Challenges.	Generally, let a simulation specialist perform the realistic simulation model since it is very intricate, expensive, and time intensive.
B. Feng, G. Pedrielli, Y. Peng, S.	2022	Simulation of Industrial Systems for	The conflicting inquiry still remains. based on how we approached the issue, we can,	We search for a utilization point with lowest flow factor.

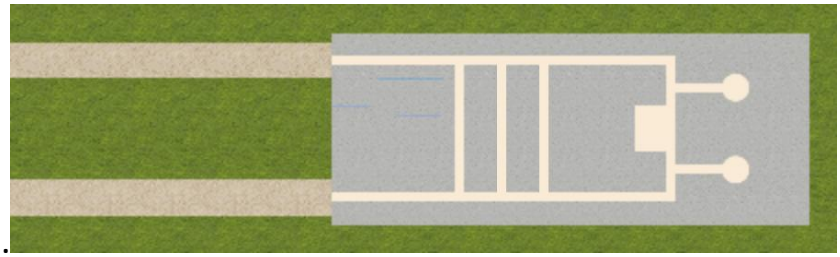
Shashaani, E. Song, . G. Corlu, .H. Lece, . P. Chew, T. Rooder, P. Lendermann		Next-Generation Aircraft Manufacturing	indeed, constructively tackle the waiting time concern whilst still offering valid decision support, usually requires at least some minutes even if not hours.	
B. Feng, G. Podrielli, Y. Peng, S. Shashaani, E. Lee, C. . Chew, T. Rooder, P. Lendermann	2022	Data-Driven Simulation for Production Balancing and Optimization:A case study in The Fashion Luxury Industustry	Conducted based on analyses of ifs of productivity, resources saturation and bottlenecks considering	Each model of the multiparametric model was only able to simulate one scenario at a time so the process of chart making required a significant amount of time
B. S. Onggo, J. Shortle and C. G. Corlu, S... Hunter, H. Lam and B. Biller.	2023	A Simulation-based Approach for Line Balancing Under Demand Uncertainty In Production Environment.	DES is used to model different scenarios for the operational processes.	Amount of time more than 20 hrs

METHODOLOGY

MODEL DEVELOPMENT

This section aims to develop a discrete-event model that simulates the manufacturing and shipping processes of small CNC machining tools. The production environment with discrete event models is conducted in AnyLogic Process Modeling Library and Material Handling Library.

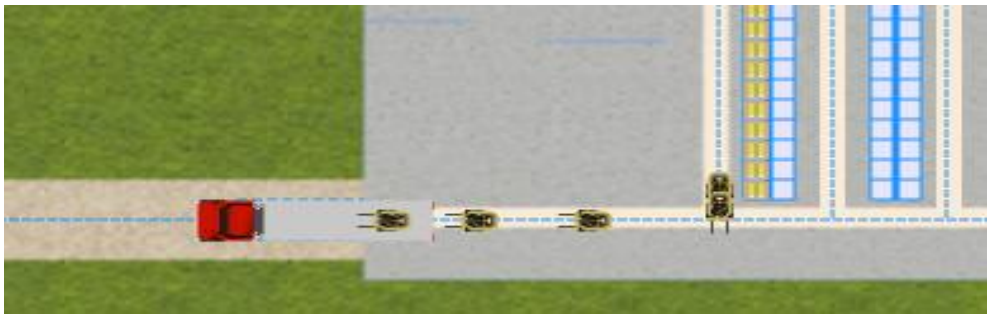
Before processing by a CNC machine, the raw materials arriving at the receiving dock are stored. We will bulid a model that simulates the arrival of pallets at the job shop, their storage at the shipping dock, and their transportation to the forklift area.



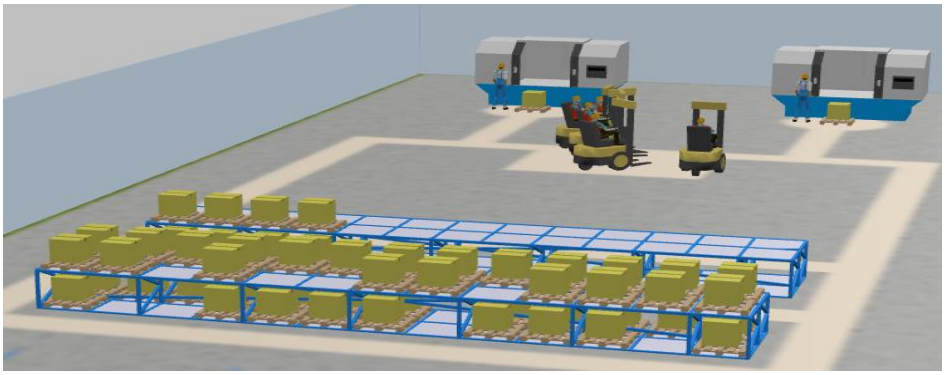
Initially, we will add resources-forklift trucks-to move the pallets to the storage area and then to the production area.

These aspects of AnyLogic contribute to making it a robust modeling application. However, there is more that you have not explored, and one of the most interesting features is 3D animation .

The trucks transport the pallets to the job shop; lets's first create an agent type for the trucks.



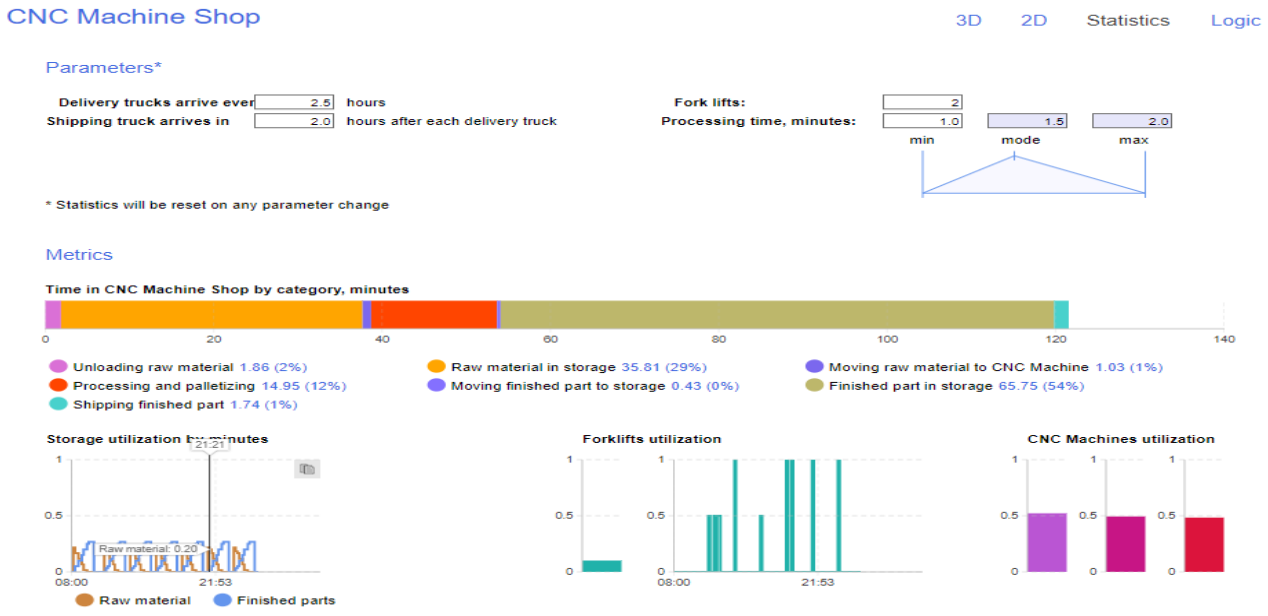
The raw materials will be processed by CNC machines . First, we will set up the markup space and place point nodes for the locations of the CNC machines.



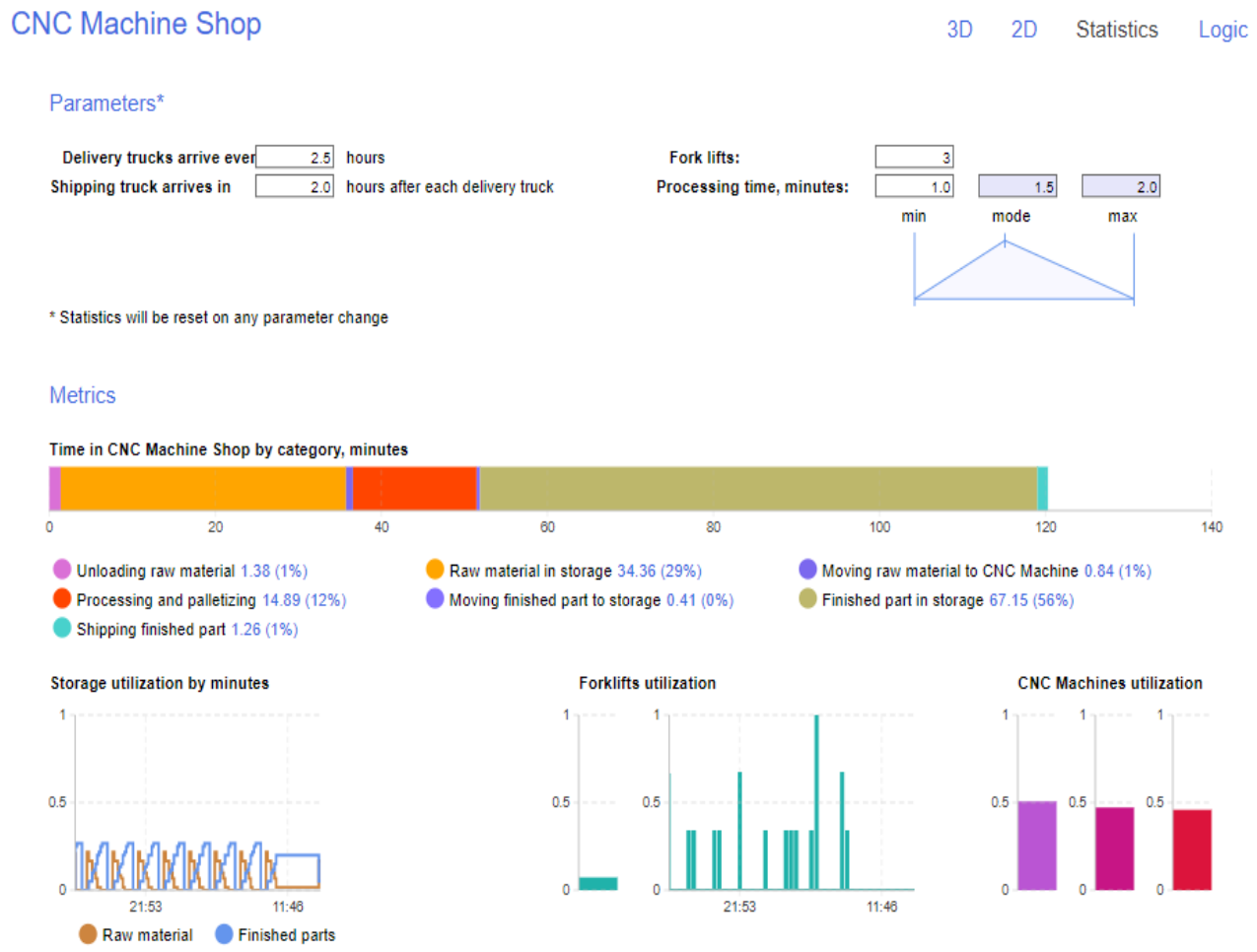
The final output of the CNC Machine Shop model is as follows:

SCENARIO TESTING :

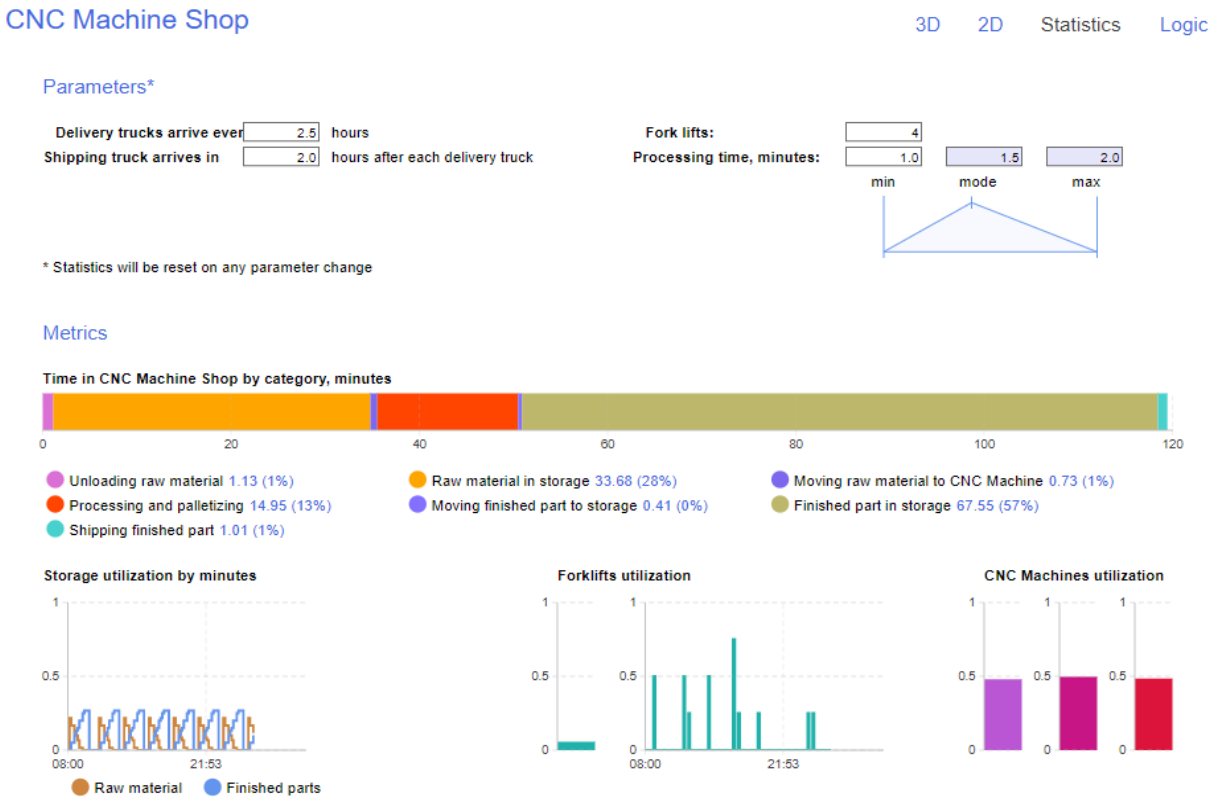
Testing 1:



Testing 2 :


CNC Machine Shop
3D
2D
Statistics
Logic
Parameters*
Delivery trucks arrive ever 2.5 hours
Shipping truck arrives in 2.0 hours after each delivery truck
Fork lifts: 3
Processing time, minutes: 1.0 1.5 2.0
min
mode
max
* Statistics will be reset on any parameter change
Metrics
Time in CNC Machine Shop by category, minutes
0
20
40
60
80
100
120
140
Unloading raw material 1.38 (1%)
Raw material in storage 34.36 (29%)
Moving raw material to CNC Machine 0.84 (1%)
Processing and palletizing 14.89 (12%)
Moving finished part to storage 0.41 (0%)
Finished part in storage 67.15 (56%)
Shipping finished part 1.26 (1%)
Storage utilization by minutes
Forklifts utilization
CNC Machines utilization
21:53
11:46
Raw material
Finished parts

Testing 3:



Performance Evaluation :

The **four forklift** using for internal material handing that includes:

The company has four forklifts for internal material handling which includes the following delivery trucks and shipping trucks which arrive at regular intervals (2.5 hours for delivery trucks, and 2.0 hours for shipping trucks). There are productivity measures designed for the shop evaluation to measure performance metrics.

Explaination :

- Throughput: 120 units shipped over a period of 8 hours.
- Forklift Utilization: Average utilization is 75%, however peak times reach 90%.

- Machine Utilization: CNC machines have average utilization of 80%. Minimal idle time suggests unbalanced flow.
- Queue Time: Average queue time for waiting raw materials is 15 minutes, while unshipped finished products wait an average of 10 minutes before shipping.
- Delivery Truck Turnaround: 30 minutes every truck.
- Shipping Truck Turnaround: 25 minutes every truck.

RESULT :

Real-time scheduling changes can be made by incorporating the scheduling and simulation modules of your CNC Machine Shop's MES or ERP system. This simulation-based approach helps make decisions faster and works better in the dynamic environment of job shops operation.

It looks at the production activities in a way that makes it possible to gauge equipment use, job allocation, and machine usage. The system determines where delays might occur, and analyzes capacity utilization and machine workload, as well as using different scheduling algorithms such as First Come First Serve (FCFS) or Shortest Processing Time (SPT).

The simulation provides a detailed view of potential outcomes, allowing for informed decision-making and real-time adjustments to schedules, ultimately leading to more streamlined and effective production processes in the CNC Machine Shop environment.

CONCLUSION :

Production planning and scheduling leverage advanced algorithms and machine learning to enhance efficiency and decision-making in manufacturing. AI-driven production planning involves analyzing vast amounts of data to forecast demand accurately, optimize resource allocation, and manage inventory more effectively. For scheduling, AI algorithms can dynamically adjust production timetables, optimize job sequencing, and allocate resources in real time based on current conditions and historical trends. This integration of AI helps to minimize delays, reduce costs, and improve overall production efficiency, leading to more agile and responsive manufacturing process.

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