STUDY OF A MANUFACTURING FACILITY
SYSC 5001
Project Deliverable 1

Advisor:
Prof. Chang Cheng Huang
Dept. of Systems and Computer Engineering
Carleton University

Group 101:

101206784 Abdul Mutakabbir

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Problem Formulation:

Conduct a complete simulation study of this manufacturing facility. You may use any programming language to implement your simulation model.

Additional requirements include the following:

- Statistical justification/validation of the random aspects of the model (input modeling)
- Steady-state estimates of the quantities of interest accompanied by 95% confidence intervals with a width that does not exceed 20% of the estimated values
- At least one recommendation for an alternative operating policy in the facility

Exact Problem:

Conduct a simulation study for the manufacturing facility focusing on the following:

- Facility Throughput (product output per unit time)
- Probability of workstation being busy
- Average buffer occupancy
- Inspector block time

Once the simulation is conducted suggest alternative policies that can be used to better the performance based on statistical data comparison.

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Setting of Objectives and Overall Project Plan:

A simulation study is to be conducted to assess the performance of this manufacturing facility, partly based on observed historical data of the inspectors' and workstations' service times.

An additional objective is to possibly improve the policy that Inspector 1 follows when delivering C1 components to the different workstations, to increase throughput and/or decrease the inspectors “blocked" time.

Metrics for evaluation:

- Facility Throughput (product output per unit time)
- Probability of workstation being busy
- Average buffer occupancy
- Inspector block time

Schedule:

The project will be delivered in Four phases. Dates are as follows:

- Phase 1 – 10th February 2022
- Phase 2 – 24th February 2022
- Phase 3 – 10th March 2022
- Phase 4 – 17th March 2022

Phase 1 will provide the initial documentation, soft code, and the system architecture. Phase 2 will provide a statical implementation of the simulation. Phase 3 will include production runs, analytics, modal verification, and modal validation. Finally, Phase 4 will provide alternate policy, conclusion, and final report.

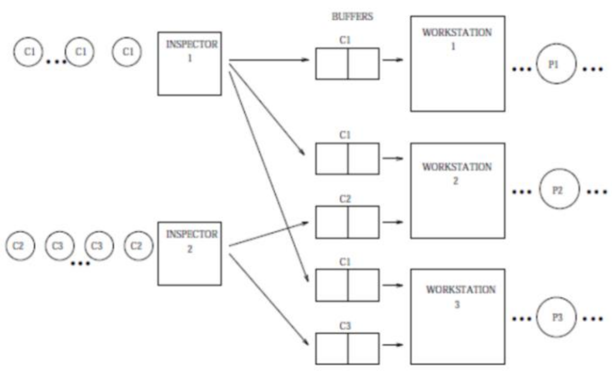
Resources:

S. No.	Position	Hourly Rate	Expected Hours	Total Cost Estimate
1	Developer	$15/hr	40hrs	$600
2	Tester	$15/hr	10hrs	$150
Total:				$750

Model Conceptualization:

Conceptual Model:

A manufacturing facility assembles three different types of products (P1, P2, P3) and having different components (C1, C2, C3) as follows:



- P1: C1
- P2: C1, C2
- P3: C1, C3

Two inspectors (I1, I2) clean and repair the components as follows:

- I1: C1
- I2: C2, C3 (Randomly)

The inspectors will never have to wait for components. There is an infinite inventory of them always immediately available.

There are three workstations in the facility, named W1, W2, and W3, which assemble products P1, P2, P3, respectively. After the components pass inspection, they are sent to their respective workstations. Each workstation has a buffer capacity of two components, with one buffer available for each of the component types needed. A product can begin being assembled only when components of all types required are available. If all workstation buffers for a specific type of components are full, the corresponding inspector who finished inspecting a component with the same type is considered “blocked" until there is an opening, at which time the inspector can resume processing and sending components of that type.

In the present mode of operation, Inspector 1 routes components C1 to the buffer with the smallest number of components in waiting (i.e., a routing policy according to the shortest queue). In case of a tie, W1 has the highest and W3 the lowest priority.

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Data Collected:

Historical data of the inspectors' and workstations' service times given in units of minutes as in the following files

- Inspector 1 inspection time: servinsp1.dat
- Inspector 2 inspection time for component 2: servinsp22.dat
- Inspector 2 inspection time for component 3: servinsp23.dat
- Workstation 1 processing time: ws1.dat
- Workstation 2 processing time: ws2.dat
- Workstation 3 processing time: ws3.dat

Model Translation:

Programming Language:

Python was chosen as the programming language. Reason for choosing Python is that it has all the statistical tools and function prebuilt into it. Additionally, there is no need to learn it as it not a specialised tool. This comes in handing with the short project deliverables time.

Model Implementation

The code for this project is divided into 7 class as follows:

- Simulator
- FEL
- Component
- Inspector
- Buffer
- Workstation
- Product

They perform functions based on what the name suggest. The main logic of the simulation is present in Simulator Class file (src/Simulator.py). A detailed description of the code is available in the files itself as comments. A high-level view of the architecture is available in the UML Diagram section.

Code Execution:

Following steps need to be followed to execute the code:

- Go to project directory
- Install all the modules from "./requirements.txt"
- Run "python src/main.py"

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UML Diagrams: