Micron NUS-ISE Business Analytics Case Competition 2022 Question

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1. Introduction

Digital technologies such as Smart Devices, Internet of Things (IOT) and Artificial Intelligence (AI) are changing the world we live in from the way we connect with each other, how we make purchases, and even how we commute. Data is the new currency, and it is all around us, in our connected devices, machines, and gadgets. It's captured in data centers, stored in the cloud, and surging through networks. 2.5 quintillion (10^{18}) bytes of data are stored, shared, and streamed per day. And memory chips are the key enablers in moving, processing, collecting, storing, and sharing data, empowering many of the cutting-edge digital devices we use today and the technologies that are changing our life.

Micron is a world leader in innovative memory solutions that transform how the world uses information to enrich life. Backed by 43 years of technology leadership, Micron offers the industry's broadest and most cutting-edge technologies including DRAM, NAND and NOR memory, enabling disruptive trends in key market segments like mobile, data center, client, consumer, industrial, graphics, automotive, and networking. Micron has operations throughout Asia, Europe and the United States, with more than 40,000 team members collaborating with one another. Singapore is home to Micron's largest manufacturing footprint with three fabrication facilities and a technology center supporting innovation across the company. Micron continues to expand its presence here, serving as the base of worldwide operations.

Applications of Micron Memory Chips

2. Background

According to World Semiconductor Trade Statistics, the Worldwide Semiconductor Market is estimated to have grown by 25.6% in 2021, with Memory chips having the largest outsized growth at 34.6%. This rally is expected to continue, with a year-on-year growth rate of 8.8% projected for 2022.

Evidently, the semiconductor market has seen an explosion in demand over the past two years, through the Covid-19 pandemic. With the sudden transition to work-from-home arrangements, there was a surge in demand for the key enablers of this move – PCs, smartphones, and cloud computing capabilities, of which semiconductors are a critical component.

Chipmakers have been scrambling to keep up since, which has led to the ongoing global semiconductor shortage. Lead times for chip orders remain long at an average of 21.9 weeks, compared to the pre-pandemic average of 4 to 8 weeks. The impacts of this shortage have propagated downstream, with the production of goods ranging from gaming consoles to automobiles being delayed. With demand projected to continue to grow and the worldwide shortage of chips showing minimal signs of abating well into 2022, the market is ripe for major semiconductor players to increase their production capabilities.

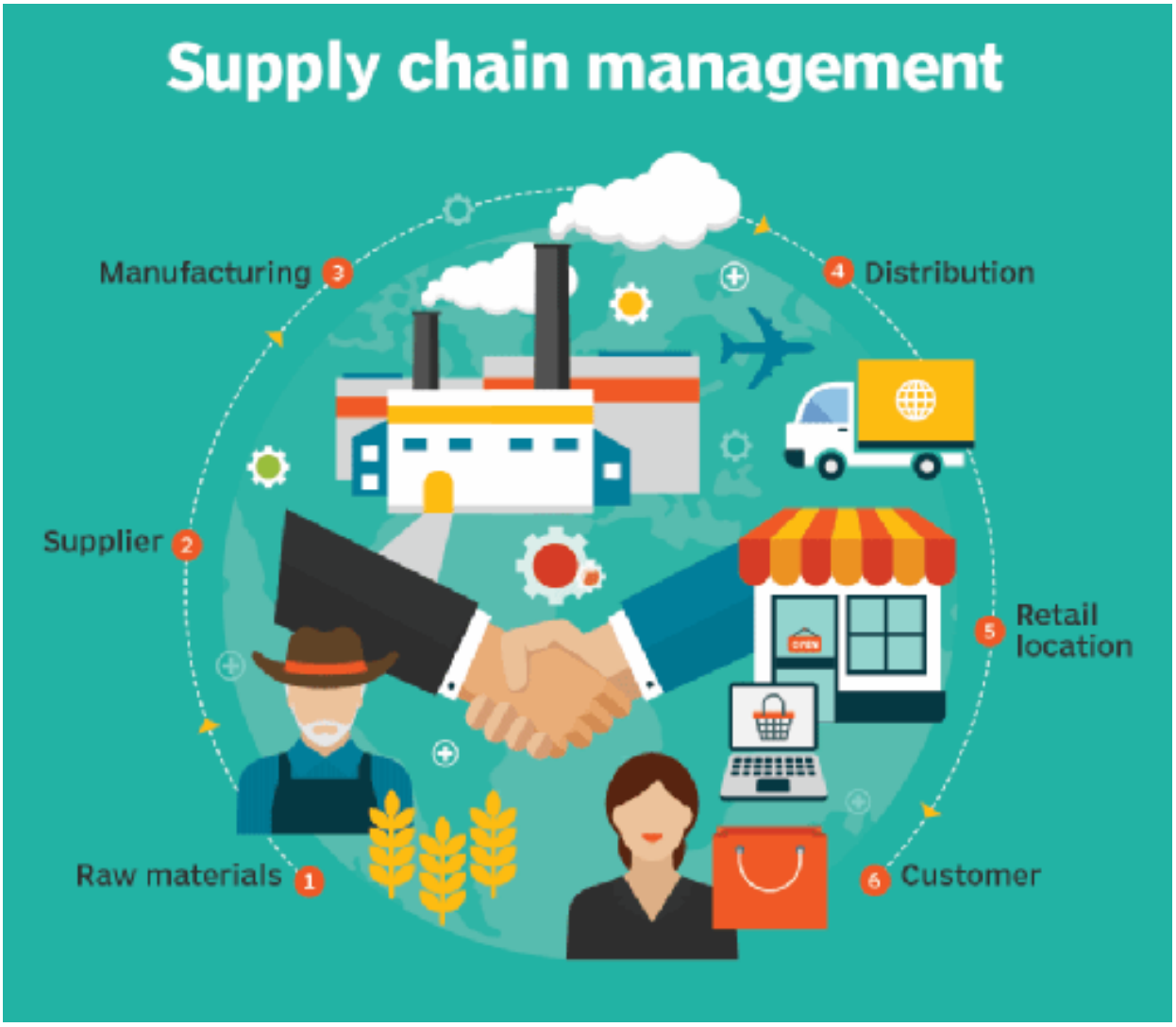
Micron, as one of world's largest suppliers of DRAM and NAND memory chips, has identified this as a perfect business opportunity to further ramp up production. Amidst this shortage, Micron has already delivered strong returns and is seeking to continue capitalizing on this wave. In this Business Analytics Case Competition, we will explore some of the drivers behind the semiconductor shortage and take a deeper dive into part of the considerations and factors that go on behind enabling increasing production output.

3. Disclosure

In this challenge, all figures and numbers used are strictly arbitrary and have no reference to Micron Technology, Inc.

4. Challenge

4.1 Question 1



Source: https://searcherp.techtarget.com/definition/supply-chain-management-SCM

With reference to the figure above, describe Micron's role in today's chip shortage situation and how Micron has been impacted in no more than 800 words.

4.2 Question 2

Your challenge for Question 4.2 involves writing a report addressing tasks 4.2.1, 4.2.2 and 4.2.3. Your report should include a description of your method and assumptions made in the model formulation. There can be many ways to approach this problem and you can use different approaches to answer with proper justifications. You may use Excel, Programming script or any other relevant software to obtain solutions to the problem. Please consider other any other interesting factors and/or scenarios in your analysis that you feel might be important in guiding your leadership team.

Limit the report to a maximum of 20 single sided A4 pages, excluding cover page, references, and appendices (if any). The **font size** used should be **12** with **1.5 line spacing** and pages should be numbered. For task 4.2, do fill in the necessary answers that you obtained in the excel sheet named “Answer Sheet” provided in the Zip folder.

4.2.1 Task 1

<refer to Excel – Historical Demand>

In Micron, the leadership team places a strong emphasis on the importance of demand forecasting, to be able to react to cyclical and rising demands from electronics such as smartphones and the proliferation of applications like the Internet of Things, cloud computing and Artificial Intelligence.

As the newly appointed Industrial Engineer, you are tasked to formulate a forecasting model for future demand over the next 2 years, starting from work week 2022-01. You may assume there are 52 weeks every year. However, the information provided to you is only limited to historical data. Do select an appropriate statistical model in your analysis and justify it accordingly.

4.2.2 Task 2

<refer to Excel – Product Flow and Workstations>

As an Industrial Engineer, it is also your responsibility to ensure that Micron has sufficient capability to meet the forecasted demand. Based on the result of your model in Task 1, derive the number of machines required to support the forecasted demand.

Below are some of the terms and formulas as a guide for your capacity planning:

Attribute	Definition
Utilization	Proportion of time which the machine is utilized to carry out manufacturing processes.
Load size	The number of wafers per chamber that can be loaded into a machine for the manufacturing step defined.
Raw Processing Time (RPT)	The time taken for a machine to complete the defined manufacturing step in minutes.
RPT basis	The number of batches a machine can process at any point of time which is determined by the number of chambers a machine has.
Chamber count	Number of chambers in a machine. 1 Chamber can process 1 batch at a time.
Machine availability	The proportion of time available for the machine to carry out manufacturing activities/processes.
Machine capability	The capability of a machine to produce an output for a specific time. It is often expressed as a function of utilization, raw processing time and load size.

$$Machine\ Utilization\ per\ Week(Min) = Time\ in\ a\ Week(\text{Min}) \times \text{Utilization}(\%)$$

$$Batches\ per\ Week = RPT\ Basis \times \frac{Machine\ Utilization\ per\ Week(Min)}{RPT(Min)}$$

$$Machine\ Capacity = Batches\ per\ Week \times Load\ size$$

Hint: Is it feasible to sequentially model every step? Make appropriate assumptions to simplify the analysis.

4.2.3 Task 3

<refer to Excel – Workstations>

To meet the forecasted demand, capital investment is required to procure machines for workstations. This process involves various stages and multiple stakeholders – from Micron's suppliers who manufacture the machines, to the engineers who install the machines, and to you, the Industrial Engineer that plans and coordinates the whole process.

Below are some of the terms that may guide you in this process:

Attribute	**Definition**
Order Lead Time	Time from when Micron first places an order for a machine with a supplier, and when the machine is received by Micron.
Machine Installation	Time required to install and qualify a machine upon its receipt
Machine Release	Machine is installed, qualified, and able to begin processing wafers

Based on the calculated requirement in Task 2 and machines available in the Excel – Workstations Tab, assess whether Micron can meet the forecasted demand. Based on the results of this assessment, you may make any recommendations to Micron's leadership team as well.

4.3 Question 3

<refer to Excel – Hourly Machine Requirements>

To hit FAB's daily production output target, certain number of machines must be available at every hour of the day to be utilized to complete a certain process (i.e., Herring).

Machine X,Y and Z performs the same process the same way. The difference lies in daily operating costs and their maintenance schedule.

Machine Details	**Number of Machines Available**	**Daily Operating Cost per Machine**
Machine X	100	$ 10,400.00
Machine Y	100	$ 9,000.00
Machine Z	100	$ 8,200.00

Machine Details	**Maintenance Schedule**
Machine X	**2 hours** of Maintenance **every consecutive 22 hours** of work
Machine Y	**2 hours** of Maintenance **every consecutive 10 hours** of work
Machine Z	**3 hours** of Maintenance **every consecutive 9 hours** of work

Your job as an Industrial Engineer is to formulate a linear program or otherwise, to determine the number of each machine utilized and optimize their work schedule such that the total operating cost of machines is minimized while meeting the hourly machine requirements.

In your report, you should explain the objective, decision variables and constraints considered in your linear program. Write your numerical answer in the table provided in the sheet named "Hourly Machine Requirements". Your answer should include the number of each machine utilized and the total operating costs.

5. Format of Submission

Participants are to submit the following at the end of the competition.

For Pre-University,

File Type	Naming convention	To include:
PDF	P_GroupName_Report	Question 1,2,3
Excel Workbook (.xlsx)	P_GroupName_AnswerSheet	Answer Sheet
Any format	P_GroupName_Supporting_Document	Supporting Documents for Task 4.2.1

For Undergraduates,

File Type	Naming convention	To include:
PDF	U_GroupName_Report	Question 1,2,3
Excel Workbook (.xlsx)	U_GroupName_AnswerSheet	Answer Sheet
Any format	U_GroupName_Supporting_Document	Supporting Documents for Task 4.2.1

Note for Supporting Documents:

You may submit the workings you have used to derive your answer for Task 4.2.1. This can be in the form of an Excel file/programming script or any other files.

Submission of Documents:

Zip the above documents and submit your answers in one zip folder.

For **Pre-University**, name your Zip folder as **P_*GroupName_Answer.***

For **Undergraduates**, name your Zip folder as **U_*GroupName_Answer.***

Submissions of the zip folder must be done by **20th Feb 2359 on *Micron NUS ISE BACC 2022 Case Question Submission Google Forms***. Late submissions will be subjected to penalties.

THE END