EASTERN INTERNATIONAL UNIVERSITY

BECAMEX BUSINESS SCHOOL

PROBLEM SET 1

Course: SCLM 459 - PRODUCTION PLANNING AND CONTROL

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A. Analysis of the Production Environment

1. Describe the company's Production Layout

a. Production layout:

The production layout of the Advanced Manufacturing Center (AMC) follows a Functional Layout, also known as a Process Layout, as machinery and equipment are arranged based on specific functions. This layout is evident in the distinct zones within the facility, such as the welding area, where all welding-related equipment is grouped, and the CNC lathe area, where precision machining tasks are centralized. Which is known for its core are state-of-the-art CNC machines, including 3-axis and 4-axis models, which provide high-precision machining capabilities to meet the stringent demands of modern industries. Complementing this is the integration of advanced CAD/CAM software, enabling efficient computer-aided design and manufacturing, ensuring that even the most complex projects can be executed with accuracy and speed. Additionally, the raw material or components storage area is strategically separated to facilitate easy access and efficient workflow between functions. This organization allows the AMC to handle a variety of manufacturing tasks efficiently, particularly for custom or specialized production requirements, while maintaining flexibility and optimizing resource utilization.

b. Benefits and limitation:

The process layout provides various advantages, making it an adaptable option for manufacturing processes. One significant advantage is its versatility, which allows it to produce a wide range of items and handle special requests without being limited to a single production line. It also ensures optimal resource allocation, as machinery and equipment are shared across different products, eliminating redundancy and increasing consumption. Furthermore, the layout encourages specialization, allowing each functional area to focus on a specific operation, resulting in higher output quality and consistency. It also offers scalability, making it easy to add new equipment or adapt processes as demand changes.

However, this layout has several restrictions. Complex material handling is a substantial difficulty since products must move between functional areas, resulting in longer transportation times and greater prices. It may also lead to workflow inefficiency, as non-linear material flow causes bottlenecks during peak production hours. Furthermore, the arrangement necessitates higher skill levels for personnel, who must be able to operate a variety of equipment and manage many operations. Last but not least, automation is more difficult to apply in a process layout than in a product layout since the functional arrangement does not follow a simple sequential procedure.

2. **Classify the production model**

Advanced Manufacturing Center (AMC) applies two types of models: **make-to-order (MTO) and engineer-to-order (ETO).**

The center applies make-to-order because:

- The first reason is that AMC does not stock components or finished goods but stock materials because they only focus on producing the exact quantity that customers need or producing 1-2 excess products to save samples for later. For materials, they stock common materials in production.
- The second reason is that this is a newly established advanced manufacturing center, the number of customers is not stable and customer demand is not clearly predicted, so production is only carried out when there is an order from a customer.
- In addition, for a new center, this model helps minimize inventory risks and reduce storage costs, which is very suitable for new businesses with limited capital like AMC. In addition, the MTO model also makes it easy to adjust products according to market feedback.

With engineer-to-order:

- AMC has a professional design team, so it takes advantage of the ETO model to design orders based on customer requirements and ideas, or deploy completely new designs for products for customers to refer to.
- Applying ETO helps AMC differentiate itself by designing unique products to order and meeting the exact needs of customers.

AMC **does not use the MTS and ATO** production models because MTS is only suitable for large businesses with a stable customer base and long-term contracts to know clearly the products to be produced. As for ATO, AMC said that they currently do not accept assembly because most of the companies that place orders want to keep information about the final product confidential, so they only need components.

3. **Determine the type of production**

AMC's production process is classified as **job production** because it manufactures individual orders, ensuring that the specific needs and goals of the customer are fully addressed. AMC’s goal is to support startup businesses and small-to-medium enterprises (SMEs) with smaller-scale requirements, which results in short lead times and small economic order quantities (EOQs).

Additionally, AMC’s production process can also be categorized as **project production** because each order is managed and treated as a project. For orders without existing drawings

or where customers have ideas but lack design expertise, AMC provides a dedicated design team to create products' design based on customer ideas, ensuring that the final product meets both functional and aesthetic expectations. By offering this service, AMC supports clients who have innovative ideas but lack the technical knowledge, tools and design expertise to have complete design and get finished products.

Therefore, AMC's production process belongs to both **job production** and **project production**.

4. **Demand management**

According to information shared by AMC, the factory usually receives small and medium-sized orders, not too large or customized orders. Therefore, they will not use any specific forecasting or inventory management method but will mainly rely on the orders received.

In the case of receiving an order with a lot of new materials to be purchased, they will calculate the time and give a suitable time for delivery, then make a specific purchasing plan. The company has probably applied the Just in time method to manage inventory. Instead of storing a large amount of inventory, Just In Time aims to receive goods only when they are needed for the production process, materials will be ordered according to specific orders, helping to minimize storage costs and increase production efficiency. Some of the benefits of this approach include helping AMC minimize inventory and capital congestion, ensure the correct raw material is imported according to customer orders, reduce scrap, be flexible in changing production processes and products, reduce costs related to indirect labor such as transportation, storage and inventory management, and respond quickly and flexibly to customer needs, thereby reducing pressure from customers and strengthening commercial relationships.

In terms of supply chain and demand management, AMC mainly cooperates with suppliers according to customer orders as well as regularly cooperates with familiar partners. In terms of customer demand forecasting, AMC said that they will often cooperate with ASPIRE companies to be able to get new orders and cooperate with old customers. So AMC will not usually have a specific demand forecasting method, and may not need one yet. Because the factory currently only accepts small orders and custom designs, they will rely mainly on when orders come in rather than predicting. They only plan to stock standard, common materials that will fit a variety of orders.

B. Demand forecasting

1. Input data / Quickly Describe data

Main Content: A monthly sales report for two years (2023 and 2024).

Data Structure:

Column "Month": Lists months from 1 to 12.

Column "Sales Value (VND)": Recorded revenue for each month.

Column "Notes": Details related to specific orders or projects.

Year 2023:

Revenue starts being recorded in May, with a value of 2,000,000 VND.

From June onward, revenue increased significantly, peaking in November at 57,835,750 VND.

Total revenue for the year: 180,011,761 VND.

Year 2024:

Revenue is recorded consistently from January, with a peak in April at 105,893,900 VND.

Total revenue for the year: 943,044,100 VND, which is significantly higher than in 2023.

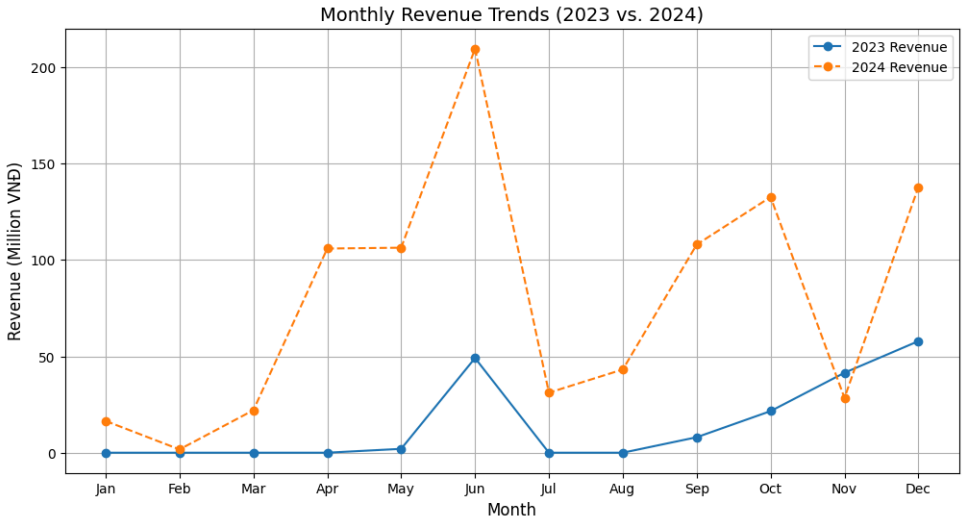
Revenue Growth: A clear and strong growth trend from 2023 to 2024, particularly in the middle months of the year.

2. Data analysis

a. Revenue Trends

The Advanced Manufacturing Center (AMC) at Eastern International University experienced remarkable growth from 2023 to 2024. In 2023, the total revenue was 180,011,761 VND, which increased substantially to 943,044,100 VND in 2024, representing a 424% growth rate. This significant expansion reflects improved operational capacity, a larger customer base, and increased order volumes.

Monthly revenue trends show a notable shift from 2023 to 2024. In 2023, revenue generation was concentrated in the latter half of the year, with no income recorded from January to April. The peak revenue for 2023 occurred in December, reaching 57,853,750 VND. In contrast, 2024 saw a more consistent revenue distribution throughout the year, with significant peaks in April (105,898,900 VND), May (106,333,000 VND), June (209,563,400 VND), and December (137,766,000 VND).



b. Seasonality Analysis

Both years experienced higher revenues during the mid to late year months, specifically from May to December. June 2024 stood out with the highest monthly revenue of 209,563,400 VND, likely due to the completion of multiple large projects. December consistently showed strong performance across both years. Conversely, the early months of the year (January to March) demonstrated relatively lower revenues in both 2023 and 2024.

c. Variability in Demand

Revenue fluctuations were more pronounced in 2023, with significant variations between months of no orders (January to April) and high-revenue months like December. While 2024 showed reduced variability, notable peaks in June and December contrasted with lower-revenue months such as February.

d. Factors Influencing Demand

The growth trend can be attributed to an expanded customer base and increased project volume, as well as AMC's enhanced capabilities attracting more orders. Seasonal patterns suggest that high demand during mid to late year months may be linked to industrial cycles or fiscal year-end projects. The consistent high demand in December indicates its importance as a critical period for project completion. External influences, such as economic growth and regional industrial development, likely contributed to the overall increase in demand for AMC's services. These factors collectively shaped the center's impressive revenue growth and evolving demand patterns from 2023 to 2024.

3. Forecasting method

					t	0.50					
					t-1	0.30			Alpha	0.30	
					t-2	0.20			F2 = D1		
2023											
Month	Revenue (VNĐ)	3-Month Moving Average	Forecast Error	| Forecast Error |	Weighted Moving Average	Forecast Error	| Forecast Error |	Exponential Smoothing	Forecast Error	| Forecast Error |
1	0									
2	0							0.00	0.00	0.00
3	0							0.00	0.00	0.00
4	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	2,000,000	0.00	2,000,000.00	2,000,000.00	0.00	2,000,000.00	2,000,000.00	0.00	2,000,000.00	2,000,000.00
6	49,095,000	666,666.67	48,428,333.33	48,428,333.33	1,000,000.00	48,095,000.00	48,095,000.00	600,000.00	48,495,000.00	48,495,000.00
7	0	17,031,666.67	(17,031,666.67)	17,031,666.67	25,147,500.00	(25,147,500.00)	25,147,500.00	15,148,500.00	(15,148,500.00)	15,148,500.00
8	0	17,031,666.67	(17,031,666.67)	17,031,666.67	15,128,500.00	(15,128,500.00)	15,128,500.00	10,603,950.00	(10,603,950.00)	10,603,950.00
9	8,024,228	16,365,000.00	(8,340,772.00)	8,340,772.00	9,819,000.00	(1,794,772.00)	1,794,772.00	7,422,765.00	601,463.00	601,463.00
10	21,579,183	2,674,742.67	18,904,440.33	18,904,440.33	4,012,114.00	17,567,069.00	17,567,069.00	7,603,203.90	13,975,979.10	13,975,979.10
11	41,459,600	9,867,803.67	31,591,796.33	31,591,796.33	13,196,859.90	28,262,740.10	28,262,740.10	11,795,997.63	29,663,602.37	29,663,602.37
12	57,853,750	23,687,670.33	34,166,079.67	34,166,079.67	28,808,400.50	29,045,349.50	29,045,349.50	20,695,078.34	37,158,671.66	37,158,671.66
Total:	**180,011,761**		**92,686,544.33**	**177,494,755.00**		**82,899,386.60**	**167,040,930.60**		**106,142,266.13**	**157,647,166.13**
		MFE	10,298,504.93			9,211,042.96			9,649,296.92	
		MAD		19,721,639.44			18,560,103.40			14,331,560.56

					t	0.50				
					t-1	0.30		Alpha	0.30	
					t-2	0.20		F2 = D1		
2024										
Month	Revenue (VND)	3-Month Moving Average	Forecast Error	| Forecast Error |	Weighted Moving Average	Forecast Error	| Forecast Error |	Exponential Smoothing	Forecast Error	| Forecast Error |
1	16,476,000									
2	1,701,000							16,476,000.00	(14,775,000.00)	14,775,000.00
3	22,033,800							12,043,500.00	9,990,300.00	9,990,300.00
4	105,898,900	13,403,600.00	92,495,300.00	92,495,300.00	14,822,400.00	91,076,500.00	91,076,500.00	15,040,590.00	90,858,310.00	90,858,310.00
5	106,333,000	43,211,233.33	63,121,766.67	63,121,766.67	59,899,790.00	46,433,210.00	46,433,210.00	42,298,083.00	64,034,917.00	64,034,917.00
6	209,563,400	78,088,566.67	131,474,833.33	131,474,833.33	89,342,930.00	120,220,470.00	120,220,470.00	61,508,558.10	148,054,841.90	148,054,841.90
7	31,122,000	140,598,433.33	(109,476,433.33)	109,476,433.33	157,861,380.00	(126,739,380.00)	126,739,380.00	105,925,010.67	(74,803,010.67)	74,803,010.67
8	43,175,000	115,672,800.00	(72,497,800.00)	72,497,800.00	99,696,620.00	(56,521,620.00)	56,521,620.00	83,484,107.47	(40,309,107.47)	40,309,107.47
9	107,960,000	94,620,133.33	13,339,866.67	13,339,866.67	72,836,780.00	35,123,220.00	35,123,220.00	71,391,375.23	36,568,624.77	36,568,624.77
10	132,615,000	60,752,333.33	71,862,666.67	71,862,666.67	73,156,900.00	59,458,100.00	59,458,100.00	82,361,962.66	50,253,037.34	50,253,037.34
11	28,400,000	94,583,333.33	(66,183,333.33)	66,183,333.33	107,330,500.00	(78,930,500.00)	78,930,500.00	97,437,873.86	(69,037,873.86)	69,037,873.86
12	137,766,000	89,658,333.33	48,107,666.67	48,107,666.67	75,576,500.00	62,189,500.00	62,189,500.00	76,726,511.70	61,039,488.30	61,039,488.30
Total:	**943,044,100**		**172,244,533.33**	**668,559,666.67**		**152,309,500.00**	**676,692,500.00**		**261,874,527.31**	**659,724,511.31**
		MFE	19,138,281.48			16,923,277.78			23,806,775.21	
		MAD		74,284,407.41			75,188,055.56			59,974,955.57

4. Forecast result

In forecasting 2023 and 2024 revenue, three main methods were used including 3-Month Moving Average, Weighted Moving Average, and Exponential Smoothing.

The 3-Month Moving Average method is a prediction method based on the average of the most recent three months. This method is easy to implement and quickly provides a short-term prediction that is useful in tracking short-term trends without the noise of random fluctuations. The result of this method for 2024 is MFE of 19,138,281.48 VND and MAD of 74,284,407.41 VND. Meanwhile, Weighted Moving Average focuses on giving greater weight to recent values, helping to better reflect recent changes in the data. This improves forecast accuracy when there are large short-term fluctuations. This method for 2024 has an MFE of 16,923,277.78 VND and MAD of 75,188,055.56 VND. Through 2023 and 2024, the MFE and MAD of these two methods are relatively close to each other, which shows that the company is stable.

Finally, Exponential Smoothing is a method that considers all past data but with decreasing weights over time. This is useful when the data has large variations but still maintains an overall trend. The result of this method for 2024 is MFE of 23,806,775.21 VND and MAD of 59,974,955.57 VND.

Of the three methods above, Exponential Smoothing is proposed as the most optimal method. Although this method has the highest MFE, it has the lowest MAD, showing that this method's predictions are more stable and less volatile than other methods, reflecting the sustainable development of the business. career. This is especially useful when the data tends to change but there is still a general trend to capture.

In general, revenue tends to increase quite strongly, especially in the middle months of the year (April, May and June), showing that the company's business operations are effective.

Additionally, there are fluctuations and differences between some months in revenue. Forecasting for 2025, revenue may continue to grow based on the growth momentum over the past two years. Using forecasting can help companies adjust to revenue fluctuations, focus on low revenue growth, forecast more accurately, and manage more effectively.

C. Forecasting report

1. A brief overview of the Advanced Manufacturing Center and the company's production goals.

The Advanced Manufacturing Center (AMC) is a cutting-edge facility that is equipped with modern machinery and technology, dedicated to serving startup businesses and small-to-medium enterprises (SMEs). The company offers a diverse range of manufacturing services, including machining solutions, design calculations, measurements, and quality assurance. AMC's key production goals focus on delivering high-quality products that meet customer specifications, ensuring timely delivery of orders while maintaining flexibility for changing requirements, optimizing resource utilization to minimize production costs, and fostering a collaborative and innovative environment that supports product development and enhances customer satisfaction.

2. A detailed analysis of the production environment and production type.

AMC employs a functional layout, also known as a process layout, where machinery and equipment are organized based on their specific functions, such as welding and CNC machining areas. This layout provides versatility, making it adaptable to a wide range of products and custom orders. It also ensures efficient resource utilization by minimizing

redundancy and allows specialization that enhances quality and consistency. Additionally, this layout is scalable and can accommodate new equipment and changing production demands. However, it has its limitations, such as complex material handling, increased transportation time and costs, potential workflow inefficiencies during peak production, higher skill requirements for personnel, and challenges in automation due to non-linear material flow. AMC primarily operates under a Make-to-Order (MTO) model, producing goods only after receiving specific customer orders, which minimizes inventory risks and reduces storage costs. The company also adopts an Engineer-to-Order (ETO) model, leveraging its in-house design team to create custom solutions based on customer requirements, thus offering unique and tailored products. The production types include Job Production, focusing on individual orders to meet unique customer needs, and Project Production, treating each order as a distinct project, particularly for custom design and development. AMC's design team actively collaborates with customers to translate their ideas into tangible products.

3. The process and results of demand forecasting.

The process of demand forecasting for AMC involves several key steps. First, revenue data for the years 2023 and 2024 was collected, along with an analysis of monthly revenue trends, seasonality, variability in demand, and factors influencing demand. Three forecasting methods were employed: the 3-Month Moving Average, which calculates the average revenue of the most recent three months to predict the next month's revenue; the Weighted Moving Average, which assigns greater weight to more recent months to better reflect short-term changes; and Exponential Smoothing, which considers all past data with decreasing weights over time to capture overall trends despite variations. Among these methods, Exponential Smoothing was found to be the most optimal for AMC, as it had the lowest Mean Absolute Deviation (MAD), indicating more stable and less volatile predictions despite having the highest Mean Forecast Error (MFE). Based on the growth trends observed in 2023 and 2024, revenue is expected to continue growing in 2025, with seasonal peaks anticipated in the mid to late months of the year, similar to previous years.

4. Recommendations for improvement.

To enhance AMC's growth and efficiency, it is recommended that it continue leveraging the exponential smoothing method due to its low mean absolute deviation (MAD), which makes

it ideal for future forecasting by accounting for both recent trends and long-term patterns. Additionally, adjusting production schedules to align with peak demand periods from May to December will ensure that sufficient inventory and resources are available during these critical months. Implementing a Just-In-Time (JIT) inventory system will help AMC reduce holding costs and minimize waste by ensuring materials and products are ordered and produced as needed. Expanding AMC's customer base through targeted marketing and sales strategies, as well as building strong relationships with existing customers, will drive repeat business and referrals. Investing in automation technologies will improve operational efficiency, reduce lead times, and enable AMC to scale up production to meet increasing demand without compromising quality. Lastly, it is crucial to regularly review and update forecasting models to ensure their accuracy and relevance, incorporating feedback from past performance and testing new techniques as needed.

D. Appendix

Group Nobita_SCLM 459_Problem set 1