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The Improvement of Inventory Cost: A Case Study on New Inventory and Forecasting Model of PT MCP

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Abstract: *In the middle of growing chemical market in Indonesia with CAGR (Compound Annual Growth Rate) of 6.8% from 2024 to 2032, currently PT MCP is facing business issue of sudden revenue and profit decrease in 2023. From the top three highest cost compared to another company in the same industry, inventories is the highest and operating cost is the second highest which show indication of inefficiencies. In order to survive in this competitive industry, the research is focused with objectives to identify to which extend the company implemented inventory management system, to identity the root cause of high inventories, to find the most suitable solution to the root cause that could be implemented and to find the best forecasting method and inventory model for the company. The methodology of the research is using mixed-methods approach, which are qualitative method by semi structured group-interview, and quantitative method for data processing and analysis. Primary data from group interview and secondary data from literature study and data from the company support the analysis of the research. The current gap that is having high concern is the high inventories with the issues of lost of order to competitor, higher selling price, inefficiency of work in supply chain department, high forecast gap, and current forecasting method manually calculated using Microsoft Excel formula that is frequently causing human error. From the issues, three root causes are found using CRT (Current Reality Tree) method which are absence of forecasting model, aggregate planning and inventory model to determine the inventory calculation. Three products from the top three revenue stream which represent 40.93% of the total company sales revenue are chosen, which are liquid glucose brix 85, maltodextrin DE10-12, and jelly mix JG 704. In order to improve the forecast accuracy, Minitab as software tools is being used for data analysis to choose the most suitable forecasting method with the least MAPE (Mean Absolute Percentage Error), MAD (Mean Absolute Deviation), MSD (Mean Squared Deviation) and TS (Tracking Signal) within 3MAD. Time series analysis is performed due to the historical data availability, the identified pattern of data, and the forecast horizon which is short. Data is further analyzed by comparing moving average, weighted moving average, simple exponential smoothing method, and exponential smoothing with trend. The best forecasting method with the least forecast error then further chosen to determine the most suitable inventory model to solve high inventories of the company business issue. Fixed order quantity model and fixed time period model are compared and chosen based on each product demand to find the optimum cost. Aggregate planning is also chosen for the company to manage the strategy of inventory and cost based on the most optimum cost. The final result indicates that the improvement in forecasting accuracy of the best forecasting method for each product could lower the forecast gap from 15,51% into into 2,1%, and save total annual cost by 27,81%.*

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Keywords: demand forecasting, inventory model, forecast accuracy, inventory cost, Current Reality Tree

1. Introduction

Indonesia's chemical industry has growth opportunities every year yet faces significant challenges to adapt to market changes and regulatory pressures. According to Expert Market Research (2024), Indonesia's basic chemical market is projected at a CAGR 6,8% between 2024 to 2032. As the industry keeps on growing, companies must focus on innovation and sustainability to thrive in a dynamic and competitive environment.

Based on a study by Kumar and Reinartz (2016), to survive in this fast-moving industry, the company must satisfy customers with the quality of the product, competitiveness in selling price, on-time delivery service, excellent service to customers, after-sales support, availability of product, transparency, personalization, also innovation and improvement. In this regard, supply chain and inventory management play an important role in sustaining the competitive advantage of chemical companies. The ability to forecast demand accurately and maintain optimal inventory levels are two main components in supply chain management for chemical companies to respond to market volatility.

PT MCP is one of the chemical companies in Indonesia that is currently struggling with decreasing revenue and profit in the midst of an expanding market. Data analysis found that the operational cost was inefficient and inventories were high. This issue needs to be further analyzed to help management in decision-making to stay competitive in the growing market. Proper root cause analysis of the problem should help the company to improve the business operation, especially in terms of supply chain and inventory management, thus bringing cost optimization and increasing competitiveness in the market by selecting the best forecasting model and inventory model.

2. Literature Review

The chemical industry presents unique challenges for demand forecasting and inventory management due to the diversity of products, regulatory requirements, and market volatility. The chemical industry deals with a wide range of products, each with distinct demand patterns. Research by Chen, Drezner, Ryan, and Simchi-Levi (2017) emphasizes the importance of segmenting products based on their demand characteristics and applying tailored forecasting and inventory management strategies.

Maintaining inventory costs is essential for ensuring the smooth operation of its business. Based on research by Zheng and Chen (2024), the primary reason companies hold inventory is to achieve greater economic advantages. However, excessive inventory resulted in too much cash and impacted liquidity. Therefore, controlling inventory costs is a key element of SCM. The more developed a company’s inventory cost control system is, the more efficient its SCM will be.

Based on research by Mehrotra and Sehgal (2024), ordering costs increase when a higher number of orders are placed frequently with small quantities, but the inventory carrying cost decreases. In contrast, when the orders are placed infrequently and in larger quantities, inventory carrying cost increases due to higher stock piled up but the ordering cost decreases.

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Economic Order Quantity (EOQ)'s purpose is to find an equilibrium point that represents optimal order quantity that balances the frequency as well, as optimizes the inventory holding cost. By implementing inventory management practices, the EOQ model decreases the total incremental cost and enhances overall operational efficiency. The research concluded that the precise EOQ calculation and strategic planning resulted in cost savings and improved resource allocation.

Research by Pulido-Rojano, Pizarro-Rada, Padilla-Polanco, Sánchez-Jiménez, and De-la-Rosa, (2020) studies the optimization of inventory cost in a company that sells disposable products with a probabilistic inventory model and independent demand. The research compares three forecasting methods which are moving average, weighted moving average, and exponential smoothing method to identify which method is the most suitable with the lowest mean squared error. Then, the research conclude that the required quantity in annual policy is defined by using economic order quantity and the lowest dispersion value, and it lowers the inventory cost and guarantees a service level. Different measures also compare the demand using the standard deviation of historical data, the mean deviation of forecast error, and the mean deviation of historical data. Demand from three different products is also compared to find the total annual cost for two inventory policies. The result conc of 95%.

A study by Zheng and Chen (2024) writes that implementing the right inventory method could enhance effectiveness and efficiency and further control the inventory cost. Analysis conducted on small medium enterprises and studies the demand forecasting plan and improvement of the forecast accuracy to further calculate the reorder point and quantity. Single exponential smoothing forecast method is used for products with A class (fast moving and high value), and for B class and C class with slow-moving products use GM method is. There is also another category with zero consumption of spare parts within a year that is categorized as infrequent spare parts which does not need inventory models, only order when needed. The authors also compare with three other methods which are analytics hierarchy process, super efficiency, data envelopment analysis, and grey relational analysis to compare the weight relationship among indicators and further reduce the subjectivity in decision-making, to create improved ABC inventory classification. Results show that the inventory cost is decreased and has better support on the operational efficiency. The integrated approach builds a better supply chain management system and it is reflected by the matureness of the inventory cost control system.

3. Research Methodology

The research methodology is divided into three phases. The first phase is the qualitative method to find the gap in the current operations of the company. The second phase also uses qualitative methods to find the root cause, then the third phase is solving the root cause through improvement based on the findings. Davies and Hughes (2014) write that the qualitative method is suitable to get insightful feedback from the people within the organization. A semi-structured interview is recommended to be the main source of qualitative methods. According to the result from qualitative analysis, the current reality tree is chosen as the tool to explore and conclude the root cause. In relation to the root cause of the business issue, the third phase of research is analyzing the improvement model needs to be further implemented by using statistical and inventory optimization models. Statistical analysis is used to convert current existing forecasts into more suitable methods that can enhance forecast accuracy. A suitable inventory model was also chosen to optimize the safety stock to buffer against uncertainties. The current forecasting method that the company uses is qualitative forecasting by the supply chain department using manual Microsoft Excel with lead time data to predict when to buy. Each customer is being

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asked for their monthly demand for the next quarter or the whole year, which is causing disruption and mismatch because customers are not yet sending the PO, yet no binding contract during forecast demand calculation, so they could easily break the promise to buy based on their needs. The research intended to improve the forecasting model. The method used to perform data analysis in this study is intended to achieve research objectives by using mathematical modeling. Organizing the forecast data with quantitative models and formulas could help the company to predict the forecast better. The products chosen are the top three with the highest contribution to the revenue according to Figure 1. The data analysis methods are explained in Figure 2.

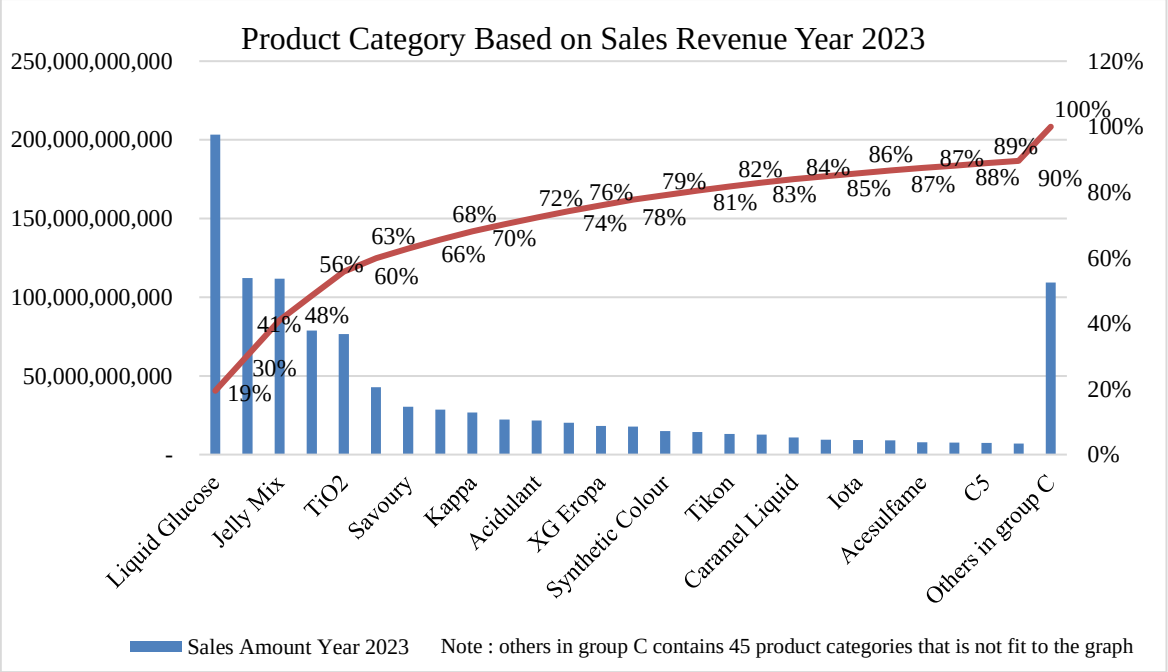

Figure 1: Product Category Based on Sales Revenue Year 2023

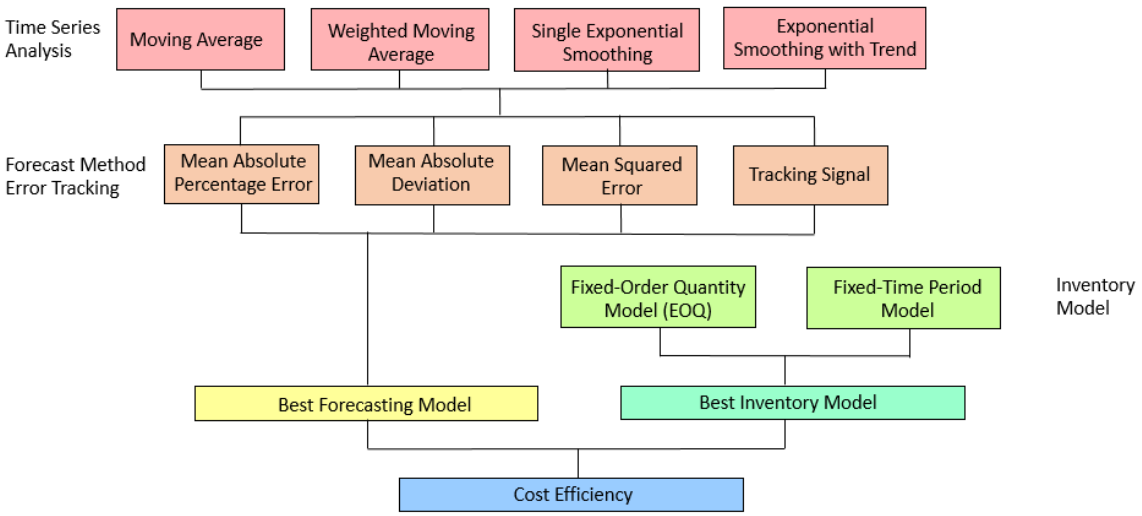

Figure 2: Data Analysis Method

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4. Results and Discussion

4.1. Gap Analysis on Company Inventory Management System

Based on group semi-structured interview result, the gap analysis of the problem along year 2023 could be summarized into Table 1.

Table 1: Gap Analysis from Interview 1

	No	Gap on the Existing Company Inventory Management System
High Inventories	1	Lost of orders to competitors.
	2	Higher selling price due to high buying price and high freight cost.
	3	Inefficiency in work process of supply chain department.
	4	High forecast gap.
	5	Current forecasting method manually calculated using Excel formula that frequently causing human error.

4.2. Root Cause Analysis

The causal analysis performed in this research is conducted by CRT diagram based on the result from group semi-structured interview. The UDE and the root cause are presented in Figure 3.

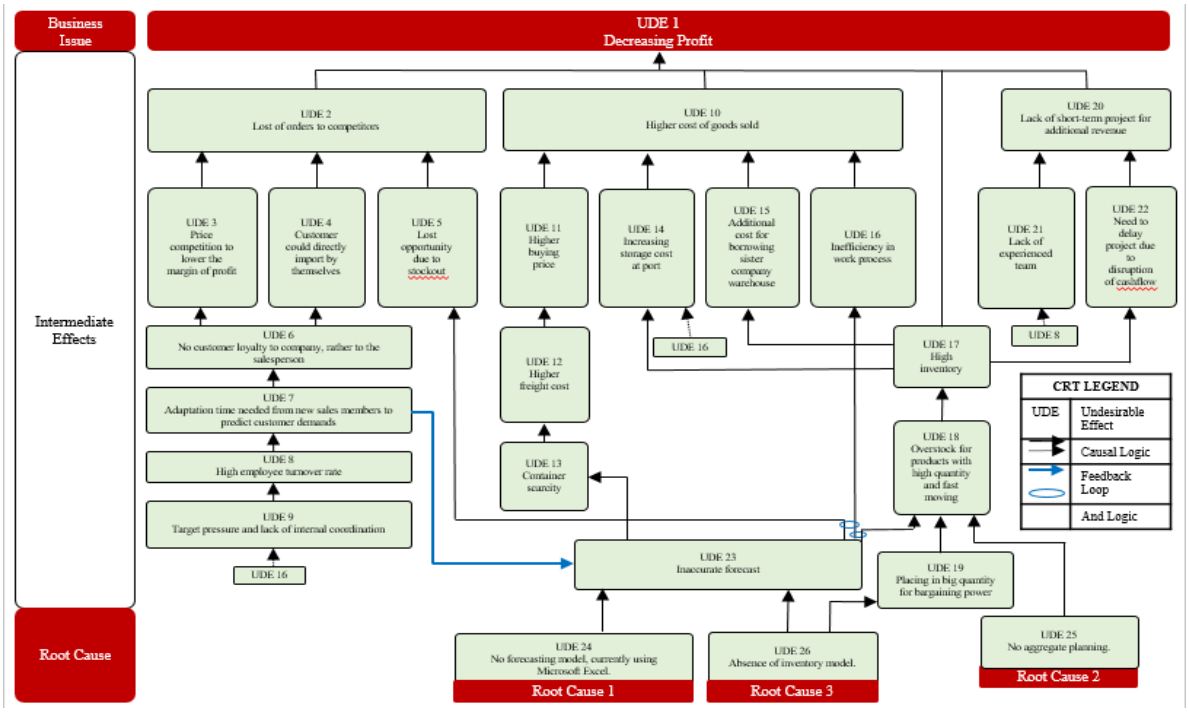

Figure 3: Current Reality Tree

From the figure derived from the result of interview, the author concluded that the root cause are absence of forecasting model, aggregate planning and inventory model. Solving these three root causes should be able to lead significant improvement that will solve the business issue.

4.3. Data Analysis

Based on the result of root cause analysis, the author need to improve the forecasting method and using software to help the operation. Based on historical actual sales data collected over time (in months), time series analysis is performed to project the demand forecasting, based on the characteristics of each product. Several methods on time series analysis are compared to choose the best method with the least error to predict future demand with result on Table 2.

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Table 2: Result of Forecasting

No	Forecasting Method	Liquid Glucose Brix 85				Maltodextrine DE10-12				Jelly Mix JG 704			
		MAPE	MAD	MSD	TS Overall	MAPE	MAD	MSD	TS Overall	MAPE	MAD	MSD	TS Overall
1	MA (2 months)	6,80	1,3,E+05	2,5,E+10	-1,62	10	4,7,E+04	3,0,E+09	-7,68	9	1469	3,1,E+06	-0,86
2	MA (3 months)	7,23	1,3,E+05	2,8,E+10	-2,71	9	4,6,E+04	3,2,E+09	-8,83	9	1468	3,2,E+06	-0,20
3	MA (4 months)	6,88	1,3,E+05	2,7,E+10	-2,05	10	4,9,E+04	3,6,E+09	-10,19	9	1441	3,1,E+06	0,52
4	MA (5 months)	6,23	1,2,E+05	2,1,E+10	-5,68	10	4,9,E+04	4,0,E+09	-11,63	9	1446	3,1,E+06	1,02
5	MA (6 months)	6,05	1,1,E+05	1,9,E+10	-6,05	10	5,1,E+04	4,6,E+09	-14,25	9	1479	3,2,E+06	0,37
6	MA (7 months)	5,55	1,1,E+05	1,7,E+10	-17,87	9	5,0,E+04	4,9,E+09	-18,38	9	1410	3,1,E+06	2,38
7	WMA (2 months)	6,58	1,2,E+05	2,5,E+10	0,50	9,51	4,6,E+04	2,9,E+09	-7,30	6,86	1139	2,0,E+06	-0,71
8	WMA (3 months)	6,74	1,3,E+05	2,6,E+10	-1,10	9,07	4,4,E+04	2,9,E+09	-7,57	6,17	1020	1,7,E+06	-0,32
9	WMA (4 months)	6,61	1,2,E+05	2,5,E+10	-3,72	9,48	4,7,E+04	3,1,E+09	-8,47	6,08	989	1,5,E+06	0,44
10	WMA (5 months)	5,60	1,1,E+05	1,8,E+10	-4,75	9,51	4,7,E+04	3,3,E+09	-8,82	6,48	1050	1,8,E+06	0,76
11	WMA (6 months)	5,54	1,0,E+05	1,8,E+10	-4,39	9,45	4,8,E+04	3,6,E+09	-10,78	7,07	1150	2,1,E+06	-0,28
12	WMA (7 months)	4,94	9,5,E+04	1,4,E+10	-2,56	8,85	4,8,E+04	3,9,E+09	-15,26	6,03	986	1,4,E+06	1,78
13	Simple Exponential Smoothing	6,13	1,1,E+05	2,1,E+10	-4,46	9,00	4,3,E+04	2,6,E+09	-8,01	9,00	1396	2,9,E+06	2,35
14	Exponential Smoothing with Trend	6,04	1,1,E+05	2,0,E+10	-8,09	9,00	4,3,E+04	2,7,E+09	0,76	9,00	1398	3,1,E+06	2,40

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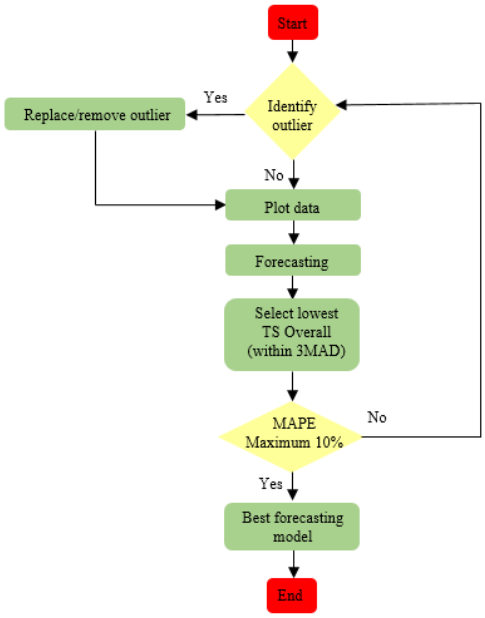

Figure 4: Flowchart of Selecting Best Forecasting Model

The alpha in simple exponential smoothing, along with alpha and delta in exponential smoothing with trend are calculated based on the optimum value in the Minitab software. The criteria for the best forecasting model chosen is explained in Figure 4. Selected forecast model is having overall tracking signal within 3MAD with the lowest value, and the MAPE also below 10% to ensure that the forecast does not have high percentage of error, then the best forecasting model is chosen accordingly. The best forecasting method for liquid glucose brix 85 is weighted moving average 2 months, for maltodextrine DE10-12 is exponential smoothing with trend, and for jelly mix JG 704 is moving average 3 months.

The forecast also adjusted based on management point of view to increase target of sales. Considering that the target of sales usually higher on February and March to prepare for Ramadhan season, liquid glucose brix 85 and maltodextrine DE10-12 forecast added by 20% to match the target of sales, and jelly mix JG704 added by 50%. Since jelly mix production decrease in March according to the effective working day in corresponding month, so jelly mix JG 704 forecast decrease by 50% on March. For October all the forecast also increased, by 20% for liquid glucose and maltodextrine and 50% for jelly mix JG 704. This is to anticipate the high season to grab the moment to increase sales and have some projects prepared. After being adjusted, the final forecast shown on Figure 5, Figure 6, and Figure 7.

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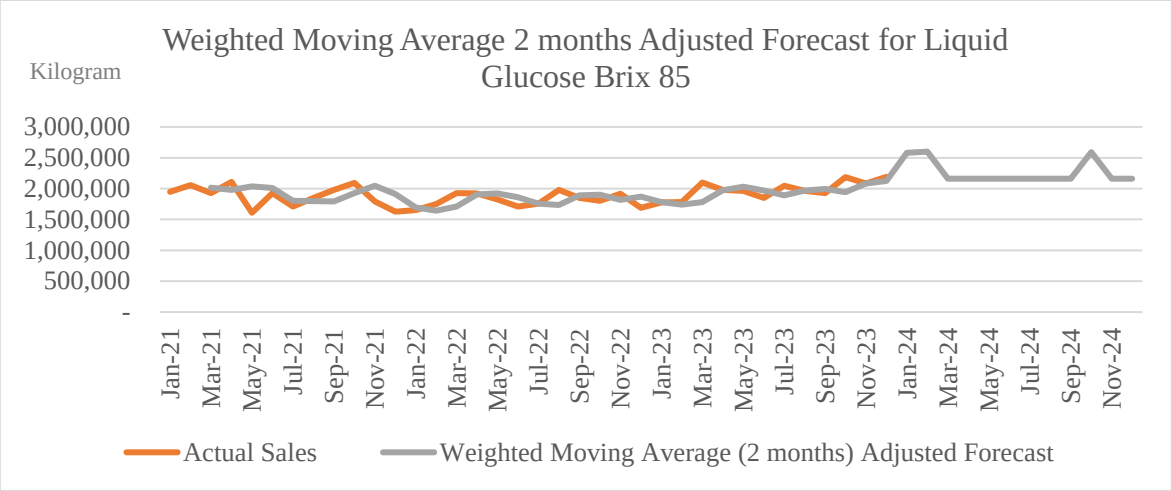

Figure 5: Weighted Moving Average 2 Months Adjusted Forecast for Liquid Glucose Brix 85

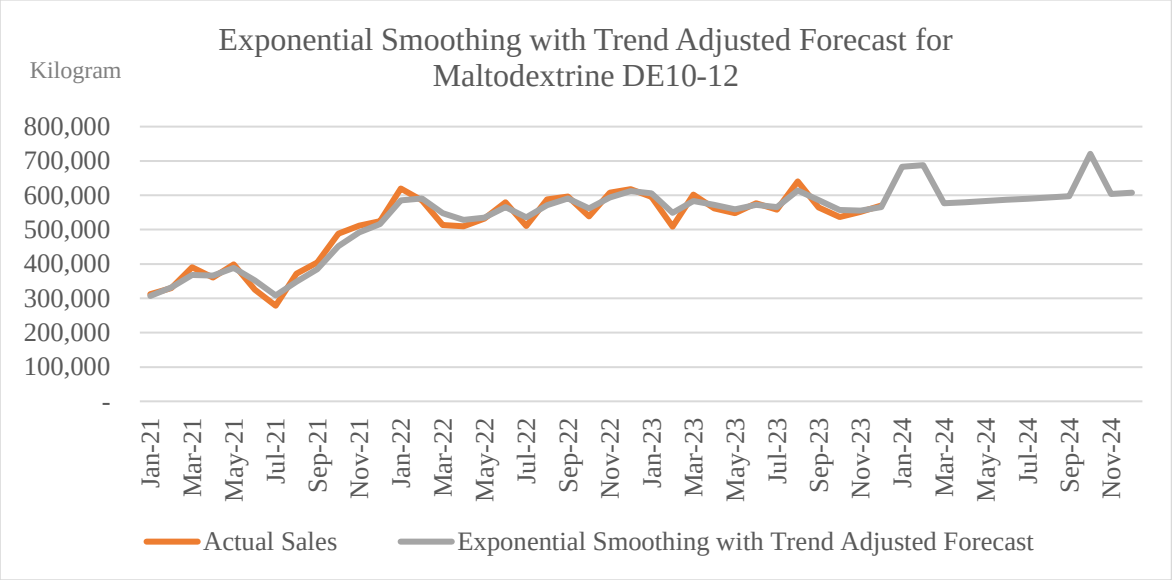

Figure 6: Exponential Smoothing with Trend Adjusted Forecast for Maltodextrine DE10-12

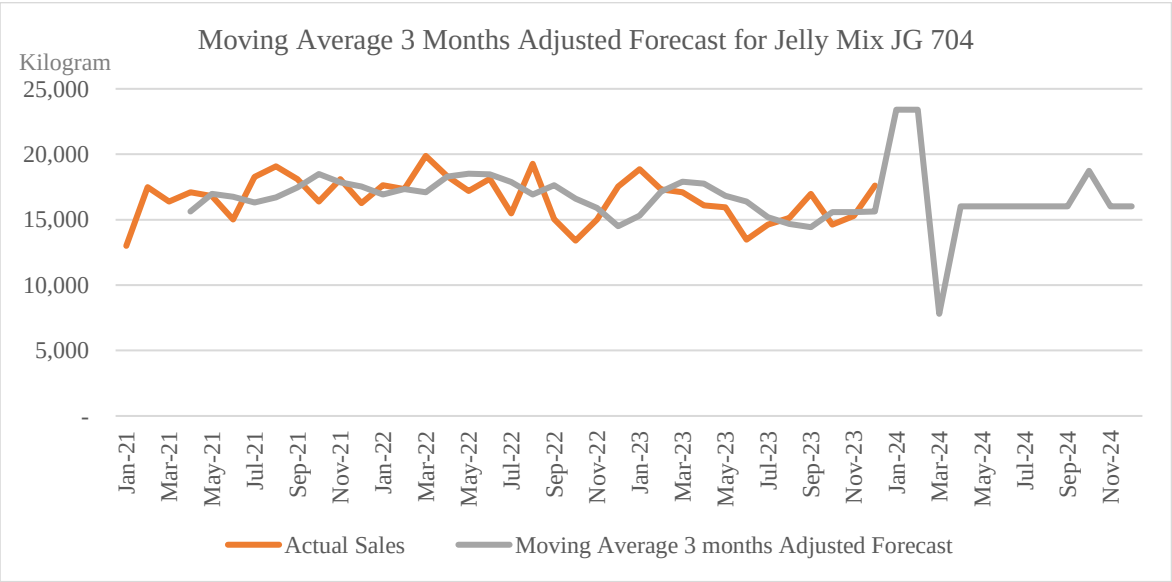

Figure 7: Moving Average 3 Months Adjusted Forecast for Jelly Mix JG 70

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The final forecast further compared with the current actual sales from 2024 to see the gap between the existing forecast with the new forecast model, as seen on Table 3.

Table 3: Forecast Gap Between Existing and New Forecast Model

Period	Liquid Glucose Brix 85						Maltodextrine DE10-12						Jelly Mix JG 704					
	Existing Forecast 2024 (in kg)	Actual Demand 2024 (in kg)	Forecast Gap (Existing Vs Actual)	New Forecast 2024 (in kg)	Actual Demand 2024 (in kg)	Forecast Gap (New Forecast Vs Actual)	Existing Forecast 2024 (in kg)	Actual Demand 2024 (in kg)	Forecast Gap (Existing Vs Actual)	New Forecast 2024 (in kg)	Actual Demand 2024 (in kg)	Forecast Gap (New Forecast Vs Actual)	Existing Forecast 2024 (in kg)	Actual Demand 2024 (in kg)	Forecast Gap (Existing Vs Actual)	New Forecast 2024 (in kg)	Actual Demand 2024 (in kg)	Forecast Gap (New Forecast Vs Actual)
Jan-24	2.650.000	2.472.868	7%	2.579.310	2.472.868	4%	775.000	655.650	15%	683.366	655.650	4%	22.000	21.250	3%	23.396	21.250	9%
Feb-24	2.800.000	2.566.246	8%	2.599.782	2.566.246	1%	775.000	653.775	16%	687.521	653.775	5%	25.000	22.275	11%	23.403	22.275	5%
Mar-24	2.575.000	2.249.525	13%	2.159.661	2.249.525	-4%	775.000	529.475	32%	576.396	529.475	8%	12.500	8.275	34%	7.804	8.275	-6%
Apr-24	2.350.000	2.028.900	14%	2.162.391	2.028.900	6%	600.000	574.300	4%	579.859	574.300	1%	18.750	15.925	15%	16.022	15.925	1%
May-24	2.550.000	2.379.800	7%	2.161.299	2.379.800	-10%	825.000	605.175	27%	583.321	605.175	-4%	16.500	17.025	-3%	16.022	17.025	-6%
Jun-24	2.550.000	2.248.269	12%	2.161.735	2.248.269	-4%	850.000	643.425	24%	586.783	643.425	-10%	18.000	16.925	6%	16.022	16.925	-6%
Jul-24	2.550.000	2.237.492	12%	2.161.561	2.237.492	-4%	850.000	551.625	35%	590.245	551.625	7%	18.000	15.550	14%	16.022	15.550	3%
Aug-24	2.650.000	2.362.257	11%	2.161.631	2.362.257	-9%	850.000	667.975	21%	593.708	667.975	-13%	18.000	14.625	19%	16.022	14.625	9%
Sep-24	2.550.000	2.220.725	13%	2.161.603	2.220.725	-3%	850.000	655.500	23%	597.170	655.500	-10%	20.000	14.975	25%	16.022	14.975	7%
Oct-24	2.800.000	2.507.400	10%	2.593.937	2.507.400	3%	850.000	757.775	11%	720.758	757.775	-5%	25.000	18.900	24%	18.725	18.900	-1%
Nov-24	2.550.000	2.380.385	7%	2.161.609	2.380.385	-10%	900.000	651.561	28%	604.095	651.561	-8%	18.500	14.425	22%	16.022	14.425	10%
Dec-24	2.550.000	2.217.788	13%	2.161.611	2.217.788	-3%	850.000	570.950	33%	607.557	570.950	6%	18.500	16.856	9%	16.022	16.856	-5%
Total	31.125.000	27.871.654	10%	27.226.129	27.871.654	-2%	9.750.000	7.517.186	23%	7.410.780	7.517.186	-1%	230.750	197.006	15%	201.505	197.006	2%

Result indicates that after the new forecast model is made, the forecast gap is significantly improved to be closer to the actual demand (actual sales). For liquid glucose brix 85, the total existing forecasting still have 10% difference with the actual amount, but after the new forecasting, it is reduced into 2% of gap only. For maltodextrine DE10-12, the total forecast gap with the existing forecasting 23% into 1% of gap. For jelly mix JG 704, the total forecast gap with the existing forecasting 15% down into 2% of gap.

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4.4. Aggregate Planning

As the forecast is finalized for the next 12 months, the aggregate planning could be made to analyze which strategy is the best for the company to choose. The first and second product are trading commodity with no production process involved, therefore the aggregate planning only analyzed for the third product which is jelly mix JG 704.

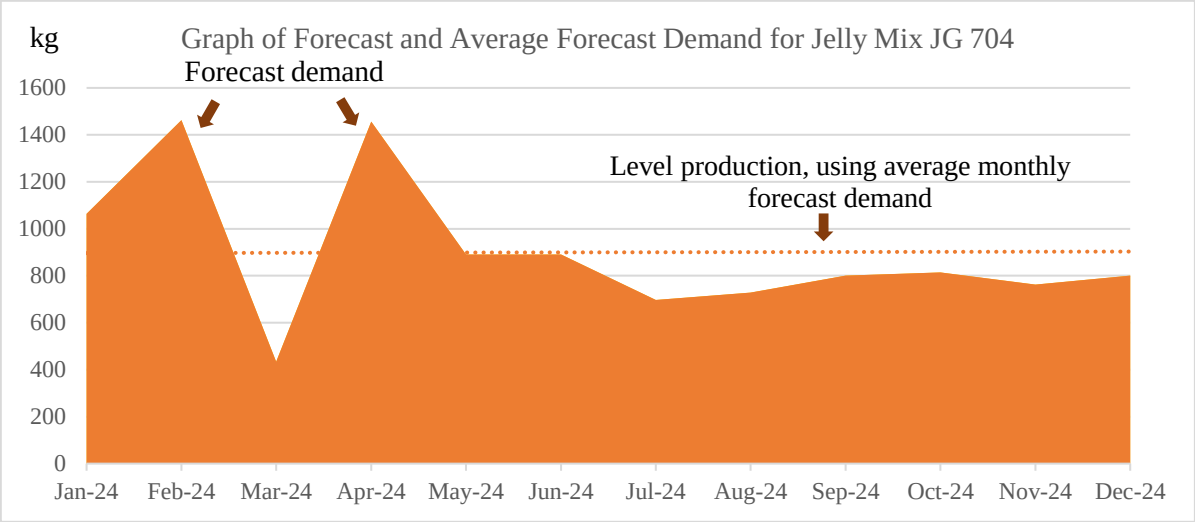

Figure 8: Graph of Forecast and Average Forecast Demand for Jelly Mix JG 704

Table 4: Summary of Cost for Aggregate Planning

Cost	Level Production Strategy	Chase Demand Strategy	Mixed Strategy
Labor cost	IDR 480.000.000	IDR 450.000.000	IDR 385.000.000
Overtime	-	-	IDR 11.646.208
Inventory holding	IDR 456.781.112	IDR 210.259.880	IDR 143.016.376
Hiring and firing	-	IDR 19.500.000	IDR 19.000.000
Total cost	**IDR 936.781.112**	**IDR 679.759.880**	**IDR 558.662.584**

Based on the result on Table 4 and qualitative interview, the company does not use any subcontractor. In terms of high demand, the company will pay for the overtime cost and in terms of low demand, the excess production stored as inventory. Result described that the best strategy with the lowest cost is the mixed strategy between chase level strategy and level production strategy. The company need to balance the overtime, hiring and firing cost, with the inventory level also to achieve the most economical cost.

4.5. Inventory Model

After forecasting the demand for the following year, the author calculate the annual cost to compare between fixed order quantity model and fixed time model to find the best model for each product based on its demand. For trading commodities which are liquid glucose and maltodextrine, inventory model is selected based on the lowest amount of total annual cost. For manufactured product which is jelly mix, the management is preferably choose fixed order quantity model due to the high price.

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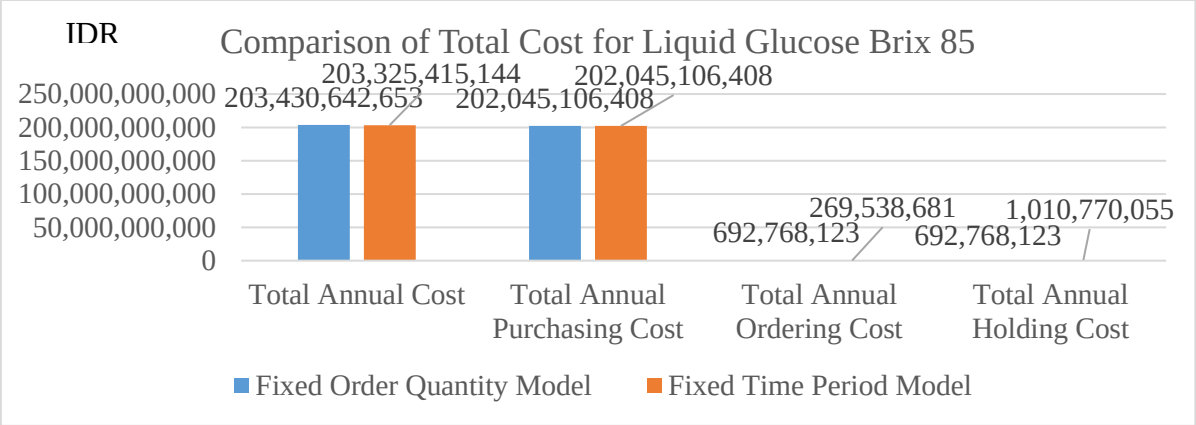

Figure 9: Comparison of Total Cost for Liquid Glucose Brix 85

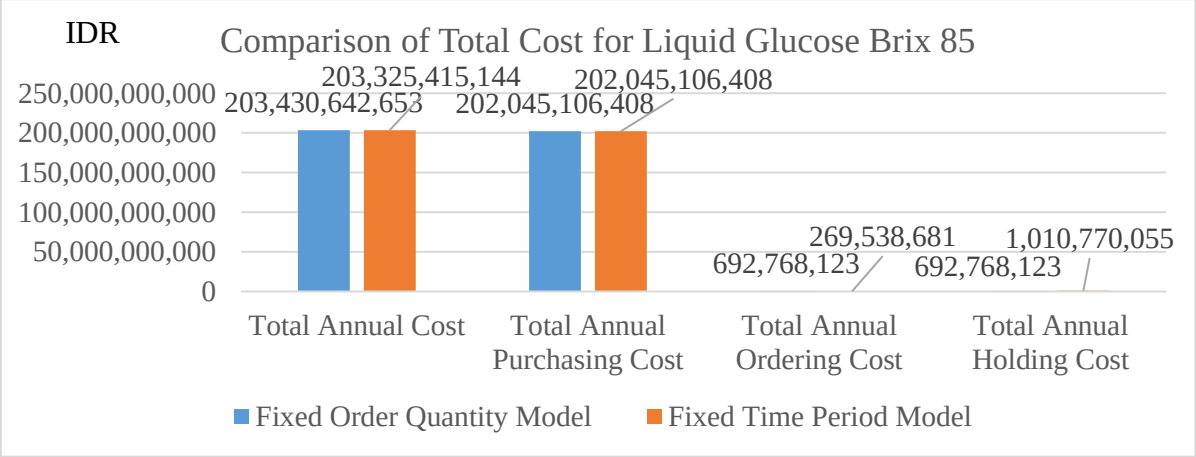

Figure 10: Comparison of Total Cost for Maltodextrine DE10-12

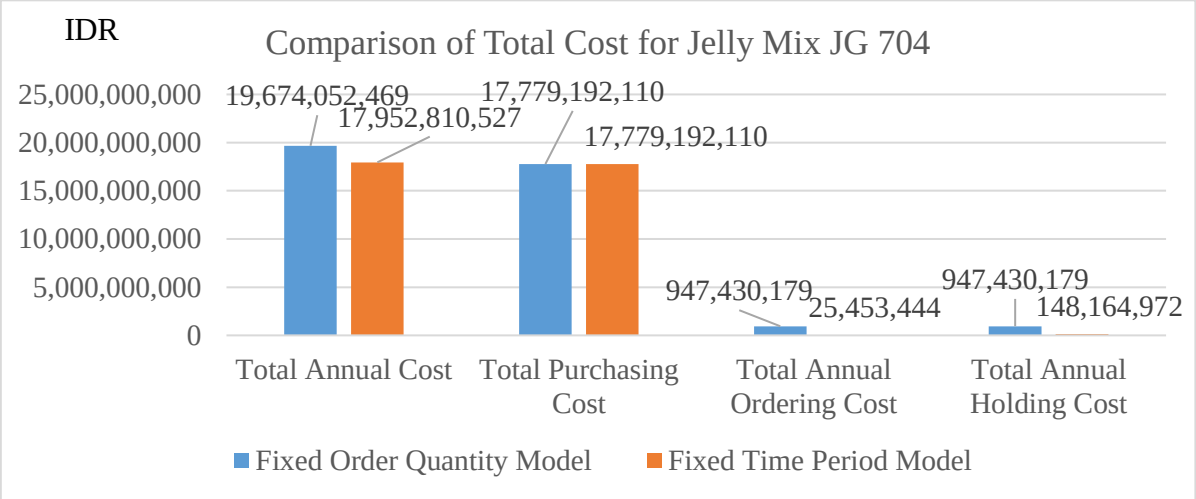

Figure 11: Comparison of Total Cost for Jelly Mix JG 704

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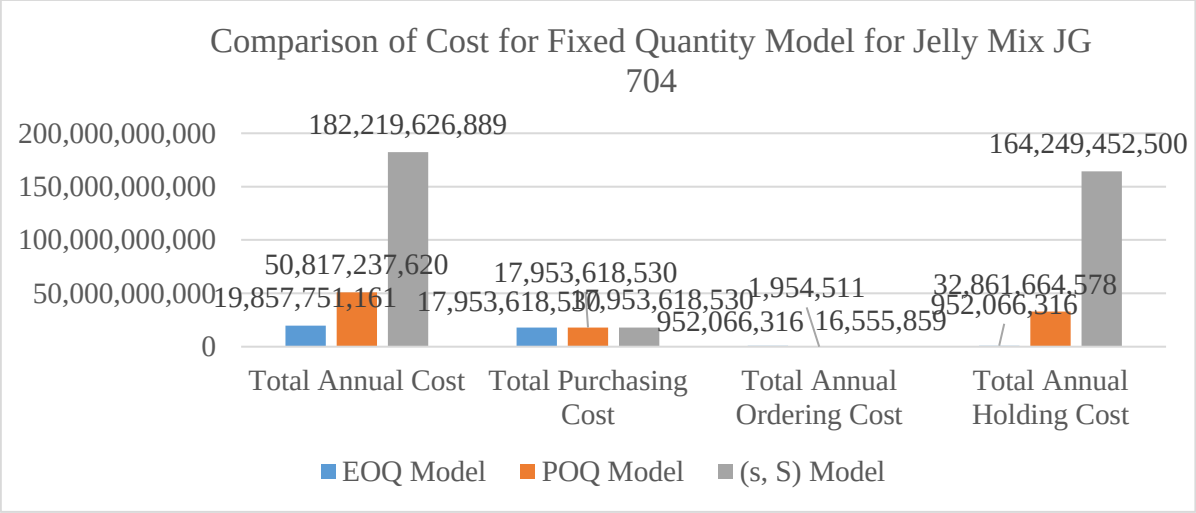

Figure 12: Comparison of Total Cost of Fixed Order Quantity Model for Jelly Mix JG 704

Table 6: Result of Inventory Model

	Liquid Glucose Brix 85	Unit	Maltodextrine DE10-12		Jelly Mix JG 704	Unit
Total annual demand	27.226.129	kg	7.410.780	kg	201.505	kg
Lead time	75	days	75	days	14	days
Review time	30	days	30	days		
EOQ					294	kg
Safety stock	251.446	kg	68.442	kg	182	kg
Reorder point	5.946.914	kg	1.920.127	kg	7.911	kg
Unit Cost	7.421	IDR/kg	5.383	IDR/kg	88.232	IDR/kg
Best Model	P model		P model		Q model (EOQ)	

Demand is variable which is known from the forecasting, but the lead time is constant which are contributes to the selection of inventory model. For liquid glucose brix 85 and maltodextrine DE10-12, the best inventory model chosen based on lowest annual cost is fixed time period and also confirmed with management with the interview that for trading products (liquid glucose and maltodextrine) preferable to use fixed time period model due to lower cost and also fixed order quantity is difficult to monitor and requires a lot of workload for high quantity of goods.

Meanwhile for jelly mix JG 704, although fixed time period model has lower total annual cost compared to fixed order quantity model, due to the product has high price (as mentioned on Table 6) that will burdening company's cashflow for stocking, product easily spoiled (quality deteriorates), the management decide to use fixed order quantity model. Considering that jelly mix undergoes production process, demand known from the forecasting shows variable demand and independent with constant lead time, no discount from supplier to buy in large quantity, after comparing several type of fixed order quantity model, the EOQ has the lowest total annual cost.

Based on the total annual demand from the forecast model and considering that the lead time is constant, the EOQ, safety stock, and reorder point are described after calculated in Table 6. For liquid glucose brix 85, the reorder point is 5.946.914 kg with the safety stock 251.446 kg. For maltodextrine DE10-12, the reorder point is 1.920.127 kg with safety stock 68.442 kg. For jelly

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mix JG 704, the reorder point is 7.911 kg with safety stock 182 kg, and EOQ 294 kg. Current situation of the company is not calculating the reorder point and safety stock level. Determining the reorder point helps the company to notice if the stock is not sufficient enough to meet demand until the new order arrive and to prevent stockout, so the company could place order beforehand. Calculating the safety stock also helps the company to have buffer against unexpected situation. By effectively managing the reorder point and safety stock level, the company could optimize inventory levels, avoid stockouts, and improve overall supply chain efficiency.

According to the data analysis result, the solution offered for the business issue is comparing forecasting method based on the data with the least error with the help of Minitab as software and then to choose the inventory model of each product. The implementation of Minitab could help analyzing data to increase the forecast accuracy and to avoid human error. The aggregate planning with the lowest cost is the mixed strategy (chase level and level production strategy) with the help of forecasting as an importance factor to determine the demand for next period. The summary of the business solution further described in Table 7.

Table 7: Comparison of Existing and New Model

Product	Demand			Total Annual Cost	
	Existing Forecast	New Forecast Model	Actual Demand	Existing Inventory Model	New Inventory Model
Liquid Glucose Brix 85	31.125.000 kg	27.226.129 kg	27.871.654 kg	IDR 254.088.937.500	IDR 203.325.415.144
Maltodextrine DE10-12	9.750.000 kg	7.410.780 kg	7.517.186 kg	IDR 59.055.750.000	IDR 40.208.419.850
Jelly Mix JG 704	230.750 kg	201.505 kg	197.006 kg	IDR 23.269.983.750	IDR 19.674.052.469
Total	41.105.750 kg	34.838.414 kg	35.585.846 kg	IDR 336.414.671.250	IDR 263.207.887.463
Difference	15,51%	-2,10%		IDR 73.206.783.787	27,81%

The new forecast model chosen by considering the lowest error decreases the forecast gap from 15,51% to 2,1% which is closer to the actual demand, so the company will not buy too much and having high inventory. The new inventory model also could save cost IDR 73.206.783.787 or about 27,81% with additional investment for software (Minitab) for IDR 37.728.900 per year. By customizing the forecast method based on each product characteristics of data and choosing the best inventory model, it eliminates the root cause of the business issue which are absence of forecasting model, aggregate planning, and inventory model and helps the company to solve current business issue which is high inventories.

5. Conclusion

The research is concluded into following points.

1) The implementation of company inventory management system currently facing some gaps or issues that are contributing to the high amount of inventories which are :
   a. Lost of orders to competitors.
   b. Higher selling price due to high buying price and high freight cost.
   c. Inefficiency in work process of supply chain department.
   d. High forecast gap.

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e. Current forecasting method manually calculated using Excel formula that causing frequent human error

2) The three root causes of the business issue identified are absence of forecasting model (currently using Microsoft Excel), aggregate planning, and absence of inventory model.

3) The most suitable solution to the root cause are customizing forecasting model for each product with the lowest error, calculate aggregate planning strategy based on the optimum cost, and determine the inventory model with the result from interview with management and applied the best practice for the company.

4) The best forecasting method and inventory model for the company are weighted moving average 2 months with fixed time period model for liquid glucose, exponential smoothing with trend and fixed time period model for maltodextrine and moving average 3 months with fixed quantity order model (EOQ) for jelly mix.

This solution helps to lower the forecast gap from 15,51% to 2,1%, and lower total annual cost IDR 73.206.783.787 or equals to 27,81% with additional investment for software (Minitab) for IDR 37.728.900 per year. The new model also helps the operational by efficiently saving 1 working day to calculate forecast.

Recommendation

The limitation of this research enables author to recommend some actions that the company could implement in the future such as:

1) As there is an adjustment in the final forecasting based on management consideration, marketing strategy needed to balance the forecast in order to be achieve target and to maintain the forecast gap.
2) To improve the forecasting system by setting alerts if any anomalies data occurred and perform analysis.
3) To set alerts in the inventory system that could trigger notification when the inventory level fall below ROP and overstock.

The author also proposed some research topics for future research which are:

1) To do research in forecasting using machine learning models for complex relationships between variables like market conditions, supplier lead times, and customer demand, with comparing several software of forecasting.
2) To develop performance dashboard for real time tracking of inventory level and integration of demand forecasting.

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