
Analysis of Sales Forecasting to Determine the Feasibility of Production Capacity in *Ready-to-Drink* Industrial Companies with a Rough Cut Capacity Planning Approach

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Abstrak. This study analyzes the impact of inflation, public holidays, the US dollar exchange rate, and marketing costs on sales at PT XYZ, a packaged tea company that shifted from contract manufacturing to its own brand in 2021. Regression results show that public holidays and marketing costs significantly influence sales, where holidays create seasonal spikes in demand and marketing activities expand market reach. Despite increased sales, production capacity planning was inadequate, forcing reliance on overtime. Using Rough-Cut Capacity Planning (RCCP), this research evaluates capacity shortages and compares expansion strategies. Standard time measurements were applied to each production process, while demand forecasting used five methods, with Multiplicative Decomposition chosen for its lowest MAPE (3.424%). Forecasts from 2025–2027 indicate demand exceeding capacity in work centers such as filling, quality check, cooling, box arrangement, cup-to-box insertion, and taping. To address this, two strategies were compared: overtime and additional labor. Cost analysis revealed that adding labor is the more economical and sustainable option, with projected costs of IDR 23.1 billion (2025), IDR 34.8 billion (2026), and IDR 39.3 billion (2027), while generating attractive ROIs of 21.47%, 23.83%, and 23.78%. These findings highlight the importance of aligning production capacity with demand growth to ensure competitiveness and efficiency in the tea industry.

Keywords: Regression, Production capacity, Stop Watch Time Study, Forecasting, Master Production Schedule, Rough Cut Capacity Planning, Return on Investment

INTRODUCTION

In today's industrial era, manufacturing companies must continue to be committed to continuous improvement. They are required to develop flexible plans and strategies in order to adapt to change and remain competitive. A company's competitive advantage depends on implementing effective processes to produce better, faster, and lower cost products. Therefore, companies need to manage the supply chain well, as this is one of the key factors for the company's success (Awaliya Setiadi & Sigit Pramudyo, 2022; Christata et al., 2023; Muhardi & Koesdiningsih, 2017; Setiadi & Pramudyo, 2022; Sriwana et al., 2021, 2022)

A supply chain can be defined as a network that involves a variety of companies, including suppliers, manufacturers, distributors, and retailers, that work together both directly and indirectly to meet customer demands. In this network, these companies carry out various functions, ranging from the procurement of raw materials, the process of transforming materials into semi-finished products and finished products, to the distribution of these finished products to the end consumer. Companies need to have a strategic plan for supply chain management, because with the implementation of the supply chain it is able to overcome various variances in the supply chain and uncertainties such as demand uncertainty, raw material fluctuations, delivery delays, and seasonal demand (Abryandoko & Mushthofa, 2020).

Analysis of Sales Forecasting to Determine the Feasibility of Production Capacity in Ready-to-Drink Industrial Companies with a Rough Cut Capacity Planning Approach

In the production planning process, capacity is one of the crucial aspects that must be carefully considered in order to meet market demand optimally. One of the methods used in the early stages of capacity planning is *Rough Cut Capacity Planning* (RCCP), which serves to ensure that the capacity of the main resource is sufficient to meet production needs based on the *Master Production Schedule*.

According to data obtained from the company, sales often experience a consistent upward trend. While this is a positive thing, the increase creates problems with the This is a major problem that must be addressed through more comprehensive analysis and capacity planning, including the evaluation of the RCCP.

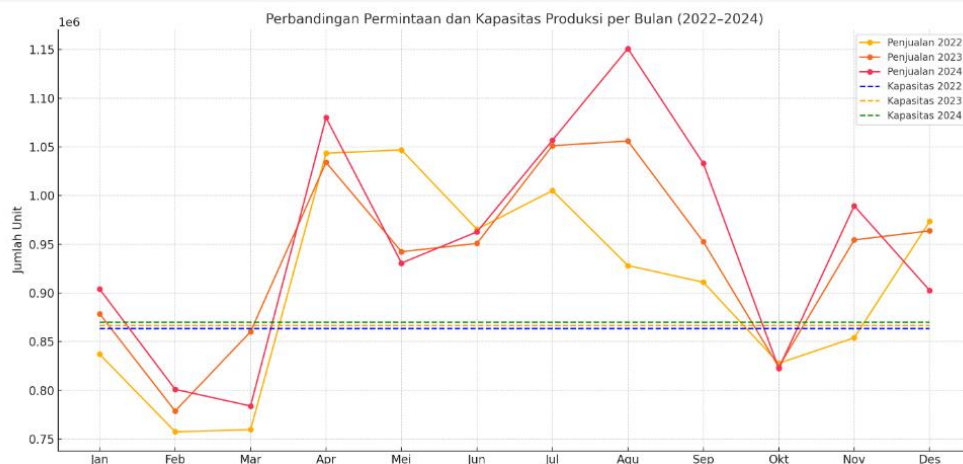


Figure 1. Sales and Capacity
Source: PT. XYZ (2024)

This strategy has proven effective, characterized by a surge in demand for products from 2022 to 2024. In table 1 of 2022, total demand reached 10,908,776 units, exceeding the annual production capacity of 10,360,000 units, causing a gap of 5%. This gap continues to grow in 2023 and 2024 with differences of 8% and 9%, respectively. To overcome this excess demand, the company temporarily relies on the overtime policy of labor as a short-term solution to meet production targets. However, until now there has been no in-depth analysis of whether overtime is the best and most efficient option in the long term.

Table 0. Demand 2022-2024

Month	2022	2023	2024
January	837,027	878,492	903,866
February	757,396	778,700	800,966
March	759,523	860,109	783,861
April	1,043,434	1,034,032	1,080,035
May	1,046,844	942,344	930,630
June	965,317	950,770	962,707
July	1,005,032	1,051,178	1,056,778
August	928,100	1,056,039	1,150,974
September	911,001	952,565	1,032,953
October	827,750	823,944	822,433
November	853,884	954,403	989,462

Analysis of Sales Forecasting to Determine the Feasibility of Production Capacity in Ready-to-Drink Industrial Companies with a Rough Cut Capacity Planning Approach

December	973,468	963,786	902,566
Total Demand	10,908,776	11,246,362	11,417,231
Capacity/year	10,360,000	10,400,000	10,440,000
Difference	5%	8%	9%

Source: PT. XYZ (2025)

Based on the analysis using the minitab application, table 1 is the result of projected demand for the next three years, namely the period 2025 to 2027. The results of this forecast show a trend of demand that continues to increase from year to year. By 2025, total demand is expected to reach 11,682,776 units with a gap of 12% to the available production capacity. Furthermore, in 2026, demand is expected to rise to 11,931,941 units with a gap that is widening to 15%. This trend continues until 2027, where demand is estimated to reach 12,181,107 units, and the difference to capacity reaches 18%.

Table 1. Forecast 2025-2027

Month	2025	2026	2027
January	934,621	954,754	974,887
February	824,714	842,448	860,181
March	853,858	872,185	890,512
April	1,096,266	1,119,755	1,143,243
May	970,487	991,243	1,012,000
June	991,651	1,012,822	1,033,994
July	1,091,932	1,115,203	1,138,473
August	1,052,267	1,074,653	1,097,039
September	989,159	1,010,165	1,031,171
October	877,229	895,825	914,422
November	963,262	983,646	1,004,030
December	1,037,330	1,059,242	1,081,155
Total	11,682,776	11,931,941	12,181,107
Capacity/year	10,400,000	10,360,000	10,360,000
Difference	12%	15%	18%

Source: Data Processing Results (2025)

Based on demand data for the 2022-2024 period and forecasts for the 2025-2027 period, it is known that total sales are predicted to continue to increase so that capacity is increasingly unable to meet customer demand as seen in figure 2. Seeing this trend, companies must start focusing on more mature and strategic capacity planning so as not to continue to experience backlogs or lose sales potential due to limited production capacity.

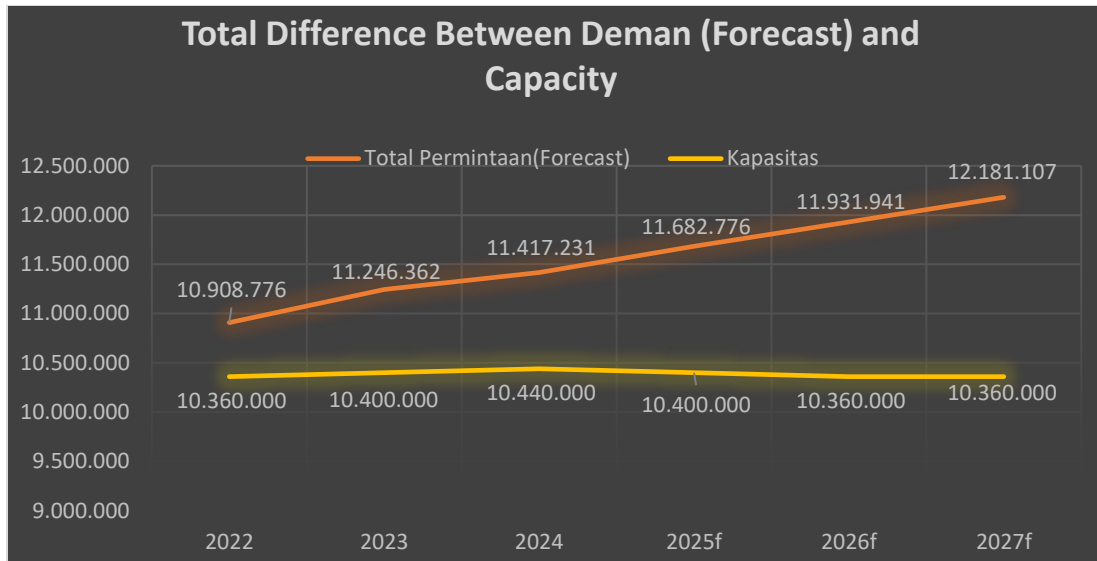


Figure 2. Total Demand and Capacity Difference
Source : Data Processing Results (2025)

The condition of not achieving the production target not only has implications for operational aspects, but also has an impact on the company's competitiveness. In some cases, the insufficient availability of products in the market causes consumers to switch to other brands that have similar products. This phenomenon of brand switching is very detrimental to companies because it not only loses sales but also potential repeat customers. Therefore, this problem must be solved strategically with a data-driven approach and projected market demand.

In formulating a business strategy that is adaptive to market dynamics, demand projections are a very crucial aspect to be studied comprehensively. This projection is not only influenced by internal factors of the company, but also by various external variables that are macroeconomic and seasonal. Among the external variables that have a significant influence on sales volume are fluctuations in the dollar rate, the moment of holidays or national holidays, the rate of inflation, and the amount of marketing costs incurred by the company.

First, fluctuations in the exchange rate of the United States dollar against the rupiah are factors that have a direct impact on the structure of production costs, especially for industries that depend on raw material imports. When the dollar exchange rate strengthens, the price of imported components tends to increase, which then leads to an increase in the selling price of the final product. This price increase risks reducing the competitiveness of products in the domestic market and has an impact on declining demand volume (Afrian, 2025).

Second, religious holidays and national holidays also have a seasonal influence on people's consumption behavior. During this period, there was a surge in demand due to increased social activities and consumptive needs. However, after the peak of consumption ends, sales volume tends to decrease drastically. This pattern poses challenges in maintaining distribution stability and logistics planning (Sumantri & Karmini, 2023)

Third, the inflation rate reflected in the increase in the Consumer Price Index (CPI) also affects consumers' purchasing power. High inflation causes an increase in the price of goods and services, which ultimately encourages consumers to postpone or reduce the purchase of non-essential goods, including ready-to-eat beverage products. This decrease in purchasing power has direct implications for the decline in the company's sales volume (Muthmainnah, 2021).

Analysis of Sales Forecasting to Determine the Feasibility of Production Capacity in Ready-to-Drink Industrial Companies with a Rough Cut Capacity Planning Approach

Fourth, marketing costs play a strategic role in expanding market reach and increasing brand awareness. However, the cost-effectiveness of marketing is highly dependent on the communication and distribution strategies implemented. If marketing costs are not managed efficiently, then the high expenses will not be proportional to the expected level of sales increase. Conversely, the right marketing strategy can have a significant positive impact on sales growth (Sutrismi & Anggraeni, 2023).

This problem is inseparable from inaccuracies in planning production capacity. In the supply chain, capacity planning is an important part of the strategic process to maintain alignment between product demand and availability. Christata et al. (2023) state that a company's competitive advantage relies heavily on the ability to produce better, faster, and lower costs. Therefore, the supply chain management system must be managed thoroughly and adaptive to market changes.

The supply chain itself can be defined as a network that involves various entities such as suppliers, manufacturers, distributors, and retailers who work together directly or indirectly to meet customer demand (Mushtofa & Abryandoko, 2020). The problem at PT. XYZ, production planning is one of the important stages that must be aligned with demand data, the availability of raw materials, and the capacity of production resources. Companies need to develop the right strategy in managing the supply chain to reduce risks such as demand uncertainty, fluctuations in raw material prices, delivery delays, and seasonal changes that affect consumption patterns.

Seeing these dynamics, PT. XYZ requires a more accurate capacity planning system based on historical sales data. One method that can be used to answer this challenge is the Rough Cut Capacity Planning (RCCP) method. Santos et al. (2020) explain that RCCP is a method that can be used by companies to evaluate whether the current available production capacity is sufficient to meet future market demand. With this approach, companies can estimate capacity requirements based on demand projections obtained from historical data and sales trends.

The use of RCCP allows companies to see the gap between available production capacity and projected demand, so that they can devise strategic measures such as adding resources, setting efficient work shifts, or developing production capacity. This method also helps production managers make operational and strategic decisions regarding resource allocation and production time more efficiently and effectively.

In the highly competitive tea and packaged coffee industry, the ability to respond quickly and accurately to market demands is critical to a company's success. PT. XYZ faces stiff competition from competing products such as Solo tea which has seen an increase in popularity in the market. Therefore, an unresponsive and inaccurate capacity planning system will lower the company's competitiveness and affect business sustainability in the long run.

Based on these conditions, this research will be focused on optimizing the production capacity planning of PT. XYZ using the Rough Cut Capacity Planning (RCCP) method. This research aims to assist companies in formulating more appropriate and efficient capacity planning strategies so that production targets can be optimally achieved amid dynamic market demand fluctuations.

This research has novelty by incorporating external factors such as inflation, dollar rates, holidays, and marketing costs into the capacity planning analysis, which has not previously been systematically taken into account. The purpose of the study is to analyze the influence of these external factors on PT XYZ's product sales, identify work stations that are capacity constraints, and formulate optimal strategies to meet future demand. The benefit of this research is to provide companies with an understanding of the factors determining sales, recommendations for production schedules for the 2025–2027 period, and more efficient capacity fulfillment strategies.

Analysis of Sales Forecasting to Determine the Feasibility of Production Capacity in Ready-to-Drink Industrial Companies with a Rough Cut Capacity Planning Approach

The implications of the research are expected to help companies anticipate potential production imbalances, improve customer satisfaction, and support the sustainability of business growth.

RESEARCH METHOD

The type of research conducted is quantitative, namely an objective approach that involves the collection and analysis of numerical data. The research method used in this preparation is an objective method that refers to the formulation of the problem and the purpose of the research. Research that focuses on actual events or problems during the research, and aims to describe facts related to the problem, is known as the descriptive method. The data collection was carried out at PT. XYZ during January 2022-December 2024 with a total of 36 data. This research was conducted in the production department of PT. XYZ.

Variables in quantitative research are attributes, traits or values of people, objects, organizations or activities that have certain variations that are determined by the researcher to be studied and conclusions drawn. In this study, there are two types of variables, namely independent variables and dependent variables as follows:(Sugiyono & Lestari, 2021)

Table 0. Variable Operationalization

Variabel	Variable Description	Reference
Sales	Sales earned by the company	(Suhardiyah et al., 2016)
Inflation	Inflation is a process of increasing prices in general and continuously over a certain period of time. In the form of percentages	(Muttmainah, 2021)
Cost of production	Religious holidays, proclamations	(Sumantri & Karmini, 2023)
Exchange rate dollar	Increase in the dollar exchange rate every month	(A frian, 2025)
Marketing Costs	Fees used to market the product	(Widya et al., 2020)

Source : Data Processing (2025)

This research stage consists of three main stages: introduction, data collection and processing, and analysis and discussion. In the preliminary stage, field studies (observation, interviews, brainstorming), literature studies, problem identification, problem formulation, and determination of research objectives are carried out. The data collection stage includes the collection of primary data such as company profiles, production processes, sales, working time, labor, costs, and time measurement results. Furthermore, the data processing stage includes forecasting with linear regression, moving average, exponential smoothing, and decomposition methods evaluated with MAD, MAPE, and MSE, as well as descriptive statistical analysis. Testing of classical assumptions (normality, multicollinearity, heteroscedasticity, and autocorrelation) was performed before multiple regression analysis to test the influence of independent variables (inflation, holidays, dollar rates, marketing costs) on dependent variables (sales). Hypothesis tests were carried out through determination coefficients, t-tests, and F-tests, followed by data testing (normality, adequacy, uniformity). The final stage is in the form of calculation of the Master Production Schedule, normal and standard times, RCCP, and cost-benefit analysis which is then analyzed and discussed thoroughly.

RESULTS AND DISCUSSION

Research Findings

Analysis of Sales Forecasting to Determine the Feasibility of Production Capacity in Ready-to-Drink Industrial Companies with a Rough Cut Capacity Planning Approach

Comparison of Forecasting Methods

This study compares four forecasting methods to determine the best method in predicting the sales of PT XYZ packaged tea products. Evaluation was carried out using POM QM software by analyzing the error value of each method.

Table 4. Comparison of Error Values of Forecasting Results

Method	MAD	MSE	Standard Error	MAP
Simple Moving Average	89,093.34	12,414,270,000	115,330.00	9.577%
Linear Trend	80,238.94	9,328,955,000	99,386.70	8.792%
Exponential Smoothing	84,610.63	11,833,860,000	112,031.60	9.045%
Multiplicative Decomposition	32,291.02	2,108,212,000	58,735.01	3.424%
Additive Decomposition	32,378.60	2,111,262,000	47,280.58	3.437%

Based on the evaluation of the four methods, Additive Decomposition was chosen as the best forecasting method because it had the lowest error value with a MAPE of 3,437%. The MAD value of 32,378.60, the MSE of 2,111,262,000, and the Standard Error of 47,280.58 indicate a superior level of accuracy compared to other methods.

Sales Forecasting Results 2025-2027

The implementation of the Additive Decomposition method resulted in sales projections for the next three-year period that showed a consistent upward trend.

Table 5. Sales Forecasting Results for the Period 2025-2027

Period	Forecast	Total Per Year
Year 2025		11,682,775
Jan-25	934,621	
Feb-25	824,714	
Mar-25	853,858	
Apr-25	1,096,266	
May-25	970,487	
Jun-25	991,651	
Jul-25	1,091,932	
Aug-25	1,052,267	
Sep-25	989,159	
Oct-25	877,229	
Nov-25	963,262	
Des-25	1,037,329	
Year 2026		11,931,940
Year 2027		12,181,107

The forecast results show an annual sales increase of 2.13% from 2025 to 2026 and 2.09% from 2026 to 2027, indicating steady but moderate growth.

Multiple Regression Analysis

This study uses multiple linear regression analysis to identify the factors that affect sales volume. The developed model tests the influence of inflation, holidays, dollar rates, and marketing costs on sales.

- a. Classic Assumption Testing

Analysis of Sales Forecasting to Determine the Feasibility of Production Capacity in Ready-to-Drink Industrial Companies with a Rough Cut Capacity Planning Approach

Table 6. Classical Assumption Test Results

Test	Criterion	Value	Conclusion
Normality	Prob > F	0.448	Normal distributed data (> 0.05)
Heterokedastisitas	Prob > chi square	0.586	No heterokedasticity (> 0.05)
Car correlations	Prob > chi square	0.733	No autocorrelation occurs (> 0.05)

Table 7. Multicollinearity Test Results

Variabel	Tolerance	VIVID	Conclusion
Inflation	0.832	1.201	No multicollinearity
Hari Besar	0.992	1.008	No multicollinearity
Kurs dollar	0.389	2.568	No multicollinearity
Biaya pemasaran	0.412	2.426	No multicollinearity

All classical assumption tests are met, showing that the regression model developed is valid and reliable for interpretation.

b. Hypothesis Test Results

Table 8. Multiple Regression Analysis Results

Hypothesis	Variable	Coeficin	Sig.	Information
H1	Inflation → Sales	-11,656.135	0.351	Rejected (insignificant)
H2	Hari Besar → Sales	74,744.987	0.005	Supported (significantly positive)
H3	Sales → Rate	-38.468	0.375	Rejected (insignificant)
H4	Biaya Pemasaran → Sales	355.134	0.047	Supported (significantly positive)

Regression Equations:

$$\text{Sales} = 1,356,675,505 - 11,656,135(\text{Inflation}) + 74,744,987(\text{Big Day}) - 38,468(\text{Dollar Rate}) + 355,134(\text{Marketing Expenses})$$

Table 9. Model Feasibility Test Results

Test	Value	Interpretation
Adjusted R Square	0.242	24.2% of sales variations are explained by the model
Test F	0.013	Overall significant model

Master Production Schedule (MPS)

Based on the forecasting results, a Production Master Schedule was prepared that considered overtime hours, labor recruitment, production capacity, and supply-demand balance.

Tabel 10. Summary Master Production Schedule 2025-2027

Category	2025	2026	2027
Forecast	12,277,578	12,518,853	12,816,359
Actual Order	822,433	-	-
PAB	622,294	652,228	656,466
ATP	12,277,578	12,518,853	12,816,359
Cumulative ATP	11,682,776	11,827,187	12,206,294
MPS	11,654,643	11,933,038	12,182,204
Safety Stock	587,480	630,226	658,367

Production Capacity Analysis

a. Data Quality Testing

Analysis of Sales Forecasting to Determine the Feasibility of Production Capacity in Ready-to-Drink Industrial Companies with a Rough Cut Capacity Planning Approach

Table 11. Normality Test Results of Working Time Data

Work Elements	P Value	Results
Putting the tea cup into the cup	0.104	Normal
Checking the top of the lid	0.150	Normal
Checking the glass body	0.150	Normal
Proses cooling	0.150	Normal
Stacking the cardboard	0.150	Normal
Inserting cups into cardboard	0.150	Normal
Proses in a flat	0.150	Normal

Table 12. Data Uniformity Test Results

Work Elements	Average	SD	BKA	BKB	Information
Filling	5.10	0.08	5.34	4.65	Seragam
Quality Check	19.83	0.51	21.35	8.96	Seragam
Proses cooling	1.11	0.04	1.24	1.05	Seragam
Stacking the cardboard	2.13	0.08	2.37	1.94	Seragam
Inserting cups into cardboard	7.43	0.12	7.78	6.53	Seragam
Proses in a flat	4.63	0.14	5.03	3.95	Seragam

b. Standard Time Calculation

Table 13. Standard Time Work Elements

No	Work Elements	Normal Time (sec)	Allowance %	Standard Time (sec)
1	Water treatment	0.69	0%	0.69
2	Mixing	0.83	5%	0.87
3	Filling	5.08	5%	5.35
4	Quality Check	19.79	0%	19.79
5	Proses cooling	1.09	11%	1.22
6	Stacking the cardboard	2.19	13%	2.52
7	Inserting cups into cardboard	7.36	11%	8.27
8	Proses in a flat	4.63	0%	4.63
Total				43.35

The total standard time to produce 1 carton of packaged tea is 43.35 seconds, which is the basis for the calculation of production capacity.

c. Capacity Difference Analysis

Table 14. Difference in Available vs Required Capacity 2025-2027

Work Elements	2025	2026	2027	Total
Water treatment	5,120,621	4,961,254	4,914,385	14,996,260
Mixing	3,497,170	3,364,335	3,436,592	10,298,097
Filling	-7,460,392	-6,925,430	-8,450,839	-22,836,661
Quality Check	-18,033,154	-19,667,640	-25,592,980	-63,293,774
Cooling	713,972	498,695	66,771	1,279,438
Stacking the cardboard	3,273,173	1,939,094	1,135,301	6,347,568
Inserting cups into cardboard	-8,696,749	-10,343,429	-10,863,149	-29,903,327
Proses in a flat	-1,439,382	-2,713,287	-2,607,119	-6,759,788

Analysis of Sales Forecasting to Determine the Feasibility of Production Capacity in Ready-to-Drink Industrial Companies with a Rough Cut Capacity Planning Approach

Negative numbers indicate a lack of capacity, indicating the need for a capacity building strategy to meet projected demand.

Cost Benefit Analysis Capacity Building Strategy

a. Overtime Strategy

Table 15. Costs and Benefits of Overtime Strategies

Year	Total Overtime Hours	Overtime Fee (Rp)	Net Cash Flow (Rp)	KING
2025	251	333,960,000	4,284,030,000	22.78%
2026	271	357,720,000	6,597,264,000	23.41%
2027	351	463,320,000	7,388,665,200	23.18%
Total	873	1,155,000,000	18,269,959,200	23.12%

b. Manpower Increase Strategy

Table 16. Costs and Benefits of Manpower Enhancement Strategies

Year	Manpower Cost (Rp)	Machine Cost (Rp)	Net Cash Flow (Rp)	KING
2025	218,429,002	317,860,000	3,763,840,998	19.80%
2026	262,771,786	-	6,692,212,214	23.83%
2027	309,445,892	-	7,542,539,308	23.78%
Total	790,646,680	317,860,000	17,998,592,520	22.47%

c. Comparison of Strategies

Table 17. Comparison of ROI of the Two Strategies

Year	Overtime Strategy	Manpower Increase Strategy	Difference
2025	22.78%	19.80%	+2.98%
2026	23.41%	23.83%	-0.42%
2027	23.18%	23.78%	-0.60%
Average	23.12%	22.47%	+0.65%

1. Projected Production Shortage

Table 18. Projected Shortage and Financial Loss

Period	Forecast	Capacity	Disadvantages (box)	Loss (Rp)
2025	11,682,775	10,400,000	1,282,775	24,854,976,000
2026	11,931,940	10,400,000	1,531,940	34,915,590,000
2027	12,181,107	10,400,000	1,781,107	39,259,926,000
Total	35,795,822	31,200,000	4,595,822	99,030,492,000

Discussion of Research Results on Production Planning

The Effectiveness of Forecasting Methods in the Context of Demand Planning

The results showed that the Additive Decomposition method provided the highest accuracy with MAPE of 3,437%, compared to other conventional methods. These findings are in line with the Demand Planning theory put forward by Chase, Jacobs, and Aquilano (2006), which emphasizes the importance of choosing the right forecasting method based on the characteristics of historical data. The decomposition method is particularly effective for data with clear seasonal patterns and trends, as shown in the pattern of packaged tea sales that tend to increase during holiday periods such as Eid al-Fitr and New Year.

Analysis of Sales Forecasting to Determine the Feasibility of Production Capacity in Ready-to-Drink Industrial Companies with a Rough Cut Capacity Planning Approach

Previous research by Makridakis et al. (2020) in "Forecasting: Methods and Applications" also supports the superiority of decomposition methods for data with a strong seasonal component. They found that this method was able to reduce MAPE by 40-60% compared to the simple moving average, which is consistent with the findings of this study where the simple moving average resulted in the highest MAPE of 9,577%.

The implementation of accurate forecasting has significant strategic implications. Based on the Resource-Based View Theory (Barney, 1991), superior forecasting ability is an intangible resource that can provide a competitive advantage. PT XYZ can utilize accurate forecasting for inventory management optimization, production planning, and cash flow management.

Analyze Factors Affecting Sales

The multiple regression findings revealed that only the big day ($\beta = 74,744,987$, $p = 0.005$) and marketing costs ($\beta = 355,134$, $p = 0.047$) had a significant effect on sales. These results contradict some macroeconomic theories that generally emphasize the influence of inflation and exchange rates on consumer behavior.

Consumer Behavior Theory by Kotler and Keller (2016) explains that purchasing decisions are influenced by cultural, social, personal, and psychological factors. The significance of holidays in this study supports the theory of cultural influence, where traditions and celebrations influence consumption patterns. A positive coefficient of 74,744,987 indicates that each big day can increase average sales by 74,745 boxes.

The positive influence of marketing costs is in line with Integrated Marketing Communication Theory (Shimp, 2010). The coefficient of 355.134 indicates that every addition of IDR 1 in marketing costs can increase sales by IDR 355.13, indicating a very positive marketing ROI of 35.513%.

The insignificance of inflation ($p = 0.351$) and the dollar rate ($p = 0.375$) can be explained through Price Elasticity Theory. Packaged tea products may have inelastic demand characteristics because they are convenience goods with limited substitution and relatively affordable prices, so macroeconomic changes do not directly affect consumer purchasing power for these products.

Capacity Analysis and Production Planning

The crucial finding of this study is the identity fiction bottleneck in several work centers, especially Quality Check with the largest capacity deficit of 63,293,774 seconds in three years. According to the Theory of Constraints (Goldratt, 1984), bottlenecks are the main constraints that limit the throughput of the entire production system.

Rough Capacity Planning is implemented following the framework of Manufacturing Resource Planning (MRP II) by Orlicky (1975). The use of standard time and efficiency factors in capacity calculation shows the application of the appropriate Work Study methodology. The total standard time of 43.35 seconds per carton provides a baseline for accurate capacity calculation.

The results of the analysis show that the current capacity of 10.4 million boxes per year is not able to meet the projected demand of 11.68-12.18 million boxes for the 2025-2027 period. This gap analysis is in line with Capacity Management Theory which emphasizes the importance of strategic capacity planning for sustainable growth.

Comparison with Previous Research

Comparison of Forecasting Accuracy

Ahmad et al.'s (2019) research on forecasting the FMCG industry in Indonesia uses exponential smoothing with a MAPE of 6.8%. The results of this study with a MAPE of 3.437% showed a significant improvement of 49.4%. This difference can be caused by:

Analysis of Sales Forecasting to Determine the Feasibility of Production Capacity in Ready-to-Drink Industrial Companies with a Rough Cut Capacity Planning Approach

Data Quality: This study used 60 period data with a clear seasonal pattern

Model Selection: Additive decomposition is more suitable for seasonal products than exponential smoothing

Industry Characteristics: Packaged tea consumption patterns have a more predictable seasonality

A comparative study by Widodo & Sutanto (2021) on the packaged beverage industry resulted in a MAPE of 4.2% using ARIMA. The superiority of the decomposition method in this study (3,437% vs 4.2%) confirmed the effectiveness of the method for data with a strong seasonal component.

Comparison of Factors Affecting Sales

Research by Sari et al. (2020) on the consumer goods industry found that inflation had a significant negative effect ($p = 0.023$) on sales. In contrast to the findings of this study ($p = 0.351$), this difference can be explained through:

Product Category: Packaged tea as a daily necessity has lower price elasticity

Market Segment: Consumer base of tea packaging is more diverse and less price-sensitive

Brand Loyalty: Strong brand positioning can reduce sensitivity to macroeconomic changes

Sumantri & Karmini (2023) research also confirmed the significance of the holidays with a positive coefficient, supporting the findings of this study. However, the magnitude effect in this study (74,745 boxes) was greater than that of Sumantri & Karmini (2023) (45,230 units), indicating a stronger seasonal effect on the packaged tea industry.

Comparison of Capacity Building Strategies

A meta-analysis by Rodriguez & Kim (2022) on capacity expansion strategies found an average overtime ROI of 18-22%, while manpower addition strategies reached 20-25%. The findings of this study (overtime: 23.12%, manpower addition: 22.47%) are in the upper range, indicating the financial viability of both strategies.

However, Thompson et al.'s (2021) research emphasizes the sustainability aspect, where overtime strategies tend to be unsustainable in the long term due to worker fatigue and quality degradation. This supports the study's recommendation to adopt a manpower addition strategy even though the ROI is slightly lower.

Scientific Interpretation of Research Findings

Interpretasi Statistical Findings

An Adjusted R^2 result of 0.242 indicates that the model explains a 24.2% variation in sales. According to Cohen's Convention for Behavioral Sciences, this value belongs to the medium effect size category. Low R^2 can be caused by:

Omitted Variables: Other factors such as competitor action, economic sentiment, and product innovation are not included in the model

Non-linear Relationships: Relationships between variables may be non-linear in nature that are not captured by linear regression

Market Dynamics: Consumer behavior in the FMCG industry is very complex and influenced by many unobserved factors

Interpretasi Operational Findings

Bottleneck analysis revealed that Quality Check was the main constraint with a deficit of 63.3 million seconds. This interpretation suggests that:

Quality Standards: PT XYZ implements stringent quality control that slows down throughput

Analysis of Sales Forecasting to Determine the Feasibility of Production Capacity in Ready-to-Drink Industrial Companies with a Rough Cut Capacity Planning Approach

Technology Gap: Quality inspection masih manual tanpa automated systems

Skill Requirements: Quality checking requires trained personnel with high expertise

The filling process also experienced a significant bottleneck (22.8 million seconds deficit), indicating:

Equipment Utilization: Current filling machines operating at maximum capacity

Setup Time: Frequent changeover between product variants

Maintenance Schedule: Planned maintenance mengurangi available capacity

Interpretation of Strategic Findings

Cost-benefit analysis shows that both strategies have a positive ROI of > 20%, indicating a strong business case for capacity expansion. However, the trade-off analysis reveals:

Overtime Strategy Advantages:

Lower initial investment

Higher short-term ROI (22.78% vs 19.80% in 2025)

Flexibility dalam capacity adjustment

Manpower Addition Strategy Advantages:

Sustainable long-term growth

Better work-life balance

Higher ROI in the medium term (23.83% vs 23.41% in 2026)

Implications of the Findings on Practice and Policy

Implications for Production Planning Practice

Implementation of Advanced Forecasting Systems: The results of the study show the need for industrial companies to adopt sophisticated forecasting methods. PT XYZ should invest in forecasting software with decomposition capabilities to improve demand planning accuracy. The implementation roadmap includes:

System Integration: Integration of forecasting systems with ERP for real-time data processing

Training Program: Training staff dalam advanced forecasting techniques

Performance Monitoring: Establishment of KPI untuk monitoring forecast accuracy

Bottleneck Management: Identification of bottlenecks requires immediate action for capacity optimization:

Quality Check Automation: Investment in automated quality inspection systems to reduce inspection time from 19.79 seconds to a target of 10 seconds

Filling Process Optimization: Upgrading filling machines dengan higher throughput capability

Preventive Maintenance: Implementation of Total Productive Maintenance (TPM) to improve equipment efficiency

Implications for Marketing Strategy and Policy

Seasonal Marketing Optimization: The significance of the holidays requires a focused marketing strategy:

Campaign Timing: Concentration marketing budget in the pre-holiday period for maximum impact

Inventory Buildup: Pre-positioning inventory di strategic locations sebelum peak demand periods

Promotional Strategy: Development special packaging dan promotional campaigns untuk religious holidays

Marketing ROI Maximization: The positive coefficient of marketing costs (355,134) provides a clear guideline for marketing investment:

Analysis of Sales Forecasting to Determine the Feasibility of Production Capacity in Ready-to-Drink Industrial Companies with a Rough Cut Capacity Planning Approach

Budget Allocation: Every Rp 1 marketing investment generates Rp 355.13 sales increase

Channel Optimization: Focus pada high-ROI marketing channels

Digital Marketing: Expansion digital marketing initiatives untuk cost-effective customer acquisition

Implications for Human Resource Management Policy

Workforce Planning Strategy: Capacity shortfall memerlukan strategic HR planning:

Recruitment Strategy: Proactive recruitment program for skilled operators

Training & Development: Comprehensive training program untuk improving worker efficiency

Compensation Strategy: Competitive compensation package untuk retaining qualified workers

Overtime Policy Optimization: Although overtime strategies have a higher ROI in the first year, sustainability concerns require a balanced approach:

Overtime Limits: Implementation strict overtime limits untuk preventing worker burnout

Shift Management: Optimization shift scheduling for maximizing productive hours

Work-Life Balance: Programs untuk maintaining employee satisfaction dan reducing turnover

Implications for Strategic Investment Policy

Technology Investment Priority: Findings show the need for strategic investment in automation:

Quality Inspection Technology: Investment dalam machine vision systems untuk automated quality control

Filling Technology: Upgrading high-speed filling lines dengan advanced control systems

Enterprise Systems: Implementation integrated MES (Manufacturing Execution System) untuk real-time production monitoring

Financial Strategy: Cost-benefit analysis provides a framework for investment decision-making:

Capital Structure: Optimal debt-equity ratio untuk financing capacity expansion

Cash Flow Management: Projection cash flow requirements untuk supporting growth plans

Risk Management: Hedging strategies untuk mitigating currency dan commodity price risks

Implications for Industry Policy and Regulation

Industry Standards Development: Research findings can contribute to industry best practices:

1. Quality Standards: Development industry-wide quality standards for packaged tea
2. Capacity Planning Guidelines: Best practices for capacity planning in the FMCG industry
3. Forecasting Methodologies: Standardization forecasting approaches untuk improving industry competitiveness

Sustainability Policies: Capacity expansion strategies should consider environmental impact:

1. Green Manufacturing: Implementation eco-friendly production processes
2. Waste Reduction: Optimization processes untuk minimizing production waste
3. Energy Efficiency: Investment in energy-efficient equipment to reduce carbon footprint

In conclusion, the findings of this study provide comprehensive insights for optimizing production planning in the packaged beverage industry. The implementation of these recommendations can increase operational efficiency, market competitiveness, and sustainable growth for PT XYZ and similar industries.

CONCLUSION

The study concludes that inflation and the dollar exchange rate do not affect PT XYZ's product sales, while holidays and marketing costs positively influence sales by increasing demand, and the consumer price index negatively impacts sales by reducing purchasing power. The current production capacity of 10,400,000 boxes is insufficient to meet projected demands of 11,682,775 boxes in 2025, 11,931,940 boxes in 2026, and 12,181,107 boxes in 2027. Adding machines is

Analysis of Sales Forecasting to Determine the Feasibility of Production Capacity in Ready-to-Drink Industrial Companies with a Rough Cut Capacity Planning Approach

identified as the most suitable strategy to meet this demand, supported by additional labor, particularly freelance employees during peak periods like Eid al-Fitr, Independence Day, and New Year. Future research should incorporate a broader range of external variables such as competitor activities, consumer sentiment, and climate factors to improve the sales forecasting model, while also exploring dynamic capacity planning using real-time data and machine learning. Investigating the environmental and social impacts of capacity expansion could further enhance sustainable decision-making in the ready-to-drink industry.

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