Optimizing Efficiency through Application of the Materials Requirement Planning and Demand Forecasting: A Case Study of a Small and Medium-Sized Enterprise in the Tea Beverage Industry

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Abstract

Planning and controlling material supply is vital for a company to support the production process. The tea industry is no exception; this industry requires material planning to optimize its company. Thus, this paper explores the implementation of MRP and demand forecasting to increase the overall efficiency by focusing on the tea industry. The company studied for this paper is CitraTea, which uses a make-to-stock system to optimize inventory and minimize costs. For demand forecasting, we use Holt-Winter's method to forecast the customer demand for the next 12 months. We also use the Economic Order Quantity method in making the Material Requirements Plan. As a result, the benefit-cost ratio of the 250 ml and 500 ml products before the improvement are 1.738 and 2.027, respectively. Meanwhile, the benefit-cost ratio after improvement is 2.281 and 2.817, respectively. These results indicate that an increase in the benefit-cost ratio has occurred. The results of analysis, calculation and validation have shown that implementing the demand forecasting, and MRP in the company helps reduce the number of costs and increase the company's profit.

Keywords
Production planning, Forecasting, Material requirement planning, Tea industry.

1. Introduction
Tea is a popular beverage that is consumed worldwide. In many countries, it plays a key role in shaping local tea cultures. Tea usually can be found in the market in the form of dried tea leaves and processed ready-to-drink tea beverages. Kale and Deshmukh (2020) have estimated the global ready-to-drink tea market size at $29.66 billion in 2019, and it is projected to increase to $38.96 billion by 2027. As a part of the general beverage market, the tea beverage sector has fluctuating consumer demand behavior that shows a sign of seasonality. The manufacturing process of the tea beverage can be classified as a made-to-stock manufacturing process (Nasrudin et al. 2017).

The application of material requirements planning (MRP) in reducing costs is not new, and the topic is still growing with new research; for example, studies by Nandhakumar et al. (2021); Zhu et al. (2022) and Ramya et al. (2021). However, studies specifically discussing the implementation of MRP in the tea beverage industry are still rare, especially in English. Our search can only find a study in English by Willyanto, Sembiring, and Sanjaya (2019), discussing the sugar raw material supply control in the tea beverage industry. The other studies we can find are by Nasrudin, Rivana, and Nurbani (2017) and Christi and Yuliawati (2018), all in Indonesian.

Therefore, this paper aims to explore the implementation of MRP and demand forecasting to increase the overall efficiency by focusing on the tea industry. In doing the research, we take as our case a tea company named CitraTea. The company, located in Bekasi, was first established in 2018. CitraTea has three products: Green Tea, Chamomile Tea, and Black Tea, with bottle sizes of 250 ml and 500 ml. In addition, there are two types of products sold: products with sugar and products without sugar. CitraTea's market segment is people who like quality tea drinks. In addition,

CitraTea also sells its products to school canteens and MSME canteens. This company is further suitable for the study because it is an SME, thus allowing us to analyze the implementation of MRP and demand forecasting methods in the SME context in the tea beverage industry.

1.1 Objectives
The objective of this study is to improve the efficiency of a tea industry by implementing MRP method and finding the optimal forecasting techniques to forecast the demand. These improvements will result in cost reductions, hence increasing the company's profit.

2. Literature Review

2.1 Process in the Tea Beverage Industry
According to Nguyen and Chuyen (2020), the process in the tea industry is relatively easy compared to other industries. In the tea industry, tea is taken from the storage and processed using a brewing method that is usually adapted to the type of tea itself. CitraTea, company that produces a tea, applies a make-to-stock process in the manufacture of its products. The following is the process at the CitraTea company:

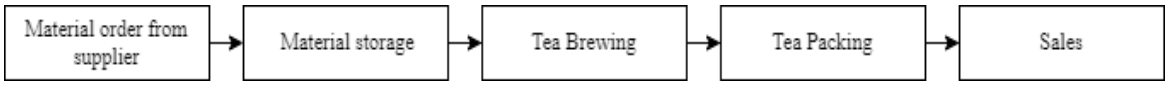

Figure 1. Process in CitraTea

At first, the company received material from supplier to make the tea. After that, the material will be stored in a storage warehouse which will later be used to make products. Then, the called tea will begin to be processed by brewing it according to consumer orders. After brewing, the tea will be packaged in a prepared bottle. After the tea has been packaged, the tea will be immediately sent to consumers.

2.2 Level Strategy in Aggregate Planning
Aggregate planning is a process of determining optimal levels of capacity, production, subcontracting, inventory, stockouts, and pricing within a specific period to balance capacity and demand with minimum cost (Chopra and Meindl, 2007). Consequently, its quality significantly impacts a company's profitability, making it one of the most critical areas of planning performed in the design of production systems (Nam & Logendran 1992).

Level strategy is a strategy that equalizes the production level each month of a planning period (Noegraheni & Nuradli, 2016). Unlike the chase strategy, the level strategy does not follow the trend movement of supply and demand. Regardless of the market demand, companies that adhere to this production model will follow its preestablished production output. This means companies will have an excess number of outputs during low market demand and a shortage of output during high demand.

2.3 Material Requirements Planning
The final product is manufactured or assembled from components that must be available in the right quantity and timing to meet MPS requirements (Moustakis 2000). If a company is missing components, it will not be able to build and ship products on time. Raw materials are a crucial factor in determining the smooth execution of a production process. It is a major factor that determines the smoothness of a production process. Error in determining the amount of raw material can cause a delay in production, inhibiting the manufacturer from producing the product on time. Thus, the raw material has a direct effect on company profits. To help plan the order of raw materials, Material Requirement Planning (MRP) is used. MRP is a time-phased priority planning technique that calculates raw material requirements and schedules supply to meet the demand of a product (Moustakis 2000). It establishes a schedule (priority plan) showing the components required at each level of the assembly and, based on lead times, calculates the time when these components will be needed.

2.4 Demand Forecasting
According to Tannan (2020), demand forecasting is the activity of estimating the quantity of a product or service that consumers will purchase. Demand forecasting also involves informal methods such as educated guesses and quantitative methods such as historical sales data. Demand forecasting systems, besides providing the company

keeping up with changing market conditions easily, provide convenience to the company in operational applications with its strategic and managerial level plans (Acar and Kocaoglu, 2014). As the forecasting performance goes down, the rate of fulfilling the customer's demands on time goes down. As a result, companies are moving towards expedited service with results that can be obtained quickly and other costly measures.

2.5 Holt Winter Method

The Holt-Winters method is a quantitative forecasting method that approximates seasonality and trends. According to Metcalfe and Cowpertwait (2009), The Holt-Winters method is divided into the Holt-Winters additive method and the Holt-Winters multiplication method. In the Holt-Winters method, time-series data are grouped into the initial and testing data. The initial data are the data of two seasonal periods or the first two years of time series data.

2.6 Economic Order Quantity (EOQ)

Heizer (2010) explains that EOQ is an inventory control technique that minimizes the total cost of ordering and inventory costs such as holding costs, shortage costs, and order costs. The EOQ method is specifically related to the amount of safety stock and the reorder point. The relationship between EOQ, safety stock, and reorder is that a company must determine an economical amount of raw material inventory when reordering raw material inventory with the amount of inventory that can guarantee a safety inventory unit. Formula that is applied in this method is as follows:

$$Q = \sqrt{\frac{2DS}{H}}$$

Where Q = EOQ units, D = demand in units (typically on an annual basis), S = order cost (per purchase order), and H = holding costs (per unit, per year).

3. Methods

This study is conducted from April 23rd to May 15th, 2022. The company that is used as a case study, CitraTea, is located in Bekasi, West Java, Indonesia. The method used in this study is considered as a quantitative method. Figure 2 shows the flow of this study. This research starts from problem identification and literature study. Then, the data is collected by interviewing business owners. The next stage in this research is to process the data using the Holt-Winter Method and EOQ methods. After that, the results and improvements will be validated, and conclusions will be drawn.

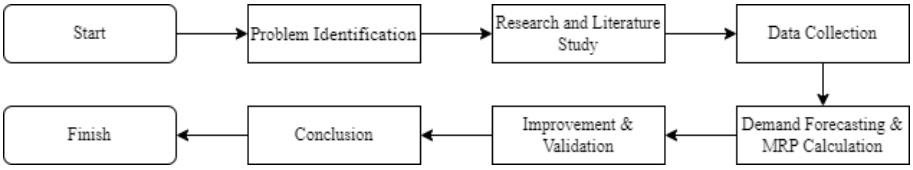

Figure 2. Research flow

The demand forecast calculation is done using the Holt-Winter's method, using the Python code developed by Queiroz (2015). The Holt-Winter method is chosen because it also considers seasonal factors, besides level and trend factors, so that it can produce more accurate forecasts. In addition, we also use the EOQ method to determine the economic amount for each order to minimize the total inventory cost. This method was chosen to obtain the most efficient level of equations in the use of the level production strategy.

As a tea beverage company, CitraTea has twelve different tea products. However, in this study, we choose two tea products: the black tea beverage with sugar for 250 ml and 500 ml size. The black tea products are chosen due to the highest sales for the last 12 months. The data that is collected for this study are the ingredients list and the sales data since January 2020. The ingredients list is used to make the bill of material while the sales data is used to create demand forecasts and MRP.

4. Data Collection

The black tea beverage is produced using two main components: product packaging and product composition. Product packaging is the finished container in the form of a bottle which the product composition (tea beverages) will be stored on. The bill of material (BOM) of the product consists of three level; the detail can be seen from the Figure 3 below.

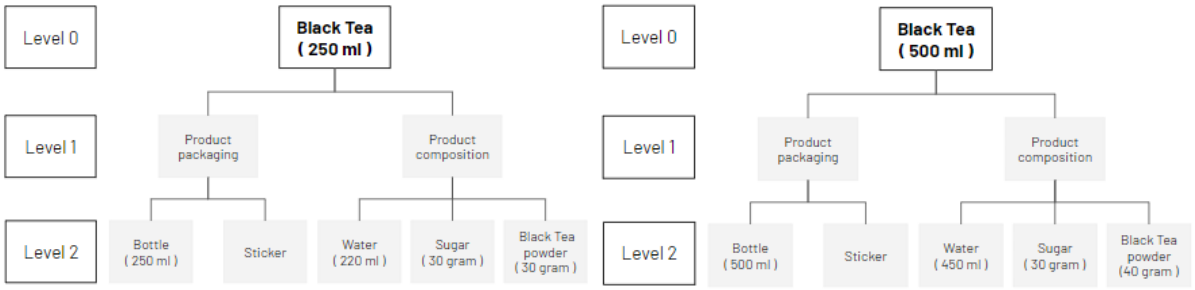

Figure 3. Bill of material of (a) black tea beverages 250 ml and (b) black tea beverages 500 ml

Both variances of the black tea beverages (250 ml and 500 ml) are made from the same material and ingredients but different composition values. Further detail regarding cost and quantity of bill of material of the black tea beverages is shown in the Figure 4 below.

BILL OF MATERIAL
BOM-000003

Product Code:	BLACK-TEA
Product Description:	Black tea beverage with 2 different sugar level and 2 different volume
Created Date:	
Comments:	Beverages consisting 2 different volume

Component Product	Quantity	Unit	Unit Cost	Total Cost
Black tea 250 ml with sugar	1	Bottle	Rp5.754,00	Rp5.754,00
- 250 ml bottle	1	Pcs	Rp1.800,00	Rp1.800,00
- 10x10 sticker	1	Pcs	Rp833,00	Rp833,00
- Black tea powder	30	Gram	Rp94,00	Rp2.820,00
- Sugar	15	Gram	Rp12,00	Rp180,00
- Water	220	ml	Rp0,55	Rp121,00
Black tea 500 ml with sugar	1	Bottle	Rp7.400,50	Rp7.400,50
- 500 ml bottle	1	Pcs	Rp2.200,00	Rp2.200,00
- 10x10 Sticker	1	Pcs	Rp833,00	Rp833,00
- Black tea powder	40	Gram	Rp94,00	Rp3.760,00
- Sugar	30	Gram	Rp12,00	Rp360,00
- Water	450	ml	Rp0,55	Rp247,50

Figure 4. Bill of material and cost of black tea beverages

The sale of the black tea beverages varies between each month. In most cases, the black tea 250 ml is sold more than the 500 ml version but the 500ml product sales increased rapidly in 2022. Table 1 and 2 shows the sales from January 2020 to March 2022.

Table 1. Sales data of black tea beverages from January 2020 to March 2022

Product	2020											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
250ml black tea	53	61	63	74	66	70	66	79	62	80	87	88
500ml black tea	55	53	51	45	70	50	66	54	47	62	52	76

Table 2. Sales data of black tea beverages from Jan 2021 to March 2022

Product	2021												2022		
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
250ml black tea	89	79	84	102	92	79	118	96	96	97	105	132	117	124	124
500ml black tea	73	55	83	93	71	74	89	64	84	108	111	105	137	110	133

For the calculation of EOQ values, the value of variables used is shown in the Table 4 below. Note that the ordering cost (per order) is assumed to be same as the unit cost.

Table 3. Values for the EOQ calculation

Item	Min order	Unit Cost (C)	Ordering Cost (S)	Carrying Cost (i)	Holding Cost (h)
250ml black tea	-	Rp5754	Rp5754	15%	Rp863
500ml black tea	-	Rp7400	Rp7400	15%	Rp1110
250ml bottle	100	Rp1800	Rp1800	15%	Rp270
500ml bottle	100	Rp2200	Rp2200	15%	Rp330
Sticker	12	Rp833	Rp833	15%	Rp125
Black tea powder (gram)	50000	Rp94	Rp94	15%	Rp14
Sugar (gram)	1000	Rp12	Rp12	15%	Rp2

5. Result and Discussion

5.1 Consumer Demand Forecasting

The demand forecasting is done by inputting the sales data into the Python code. By varying the parameters, we get different forecast and root mean square error (RMSE) values. To get the most reliable forecast, the parameters which result in lowest RMSE are used. Figure 5 shows the plots of RMSE for different parameter values, each for the (a) 250ml and (b) 500ml black tea products, respectively.

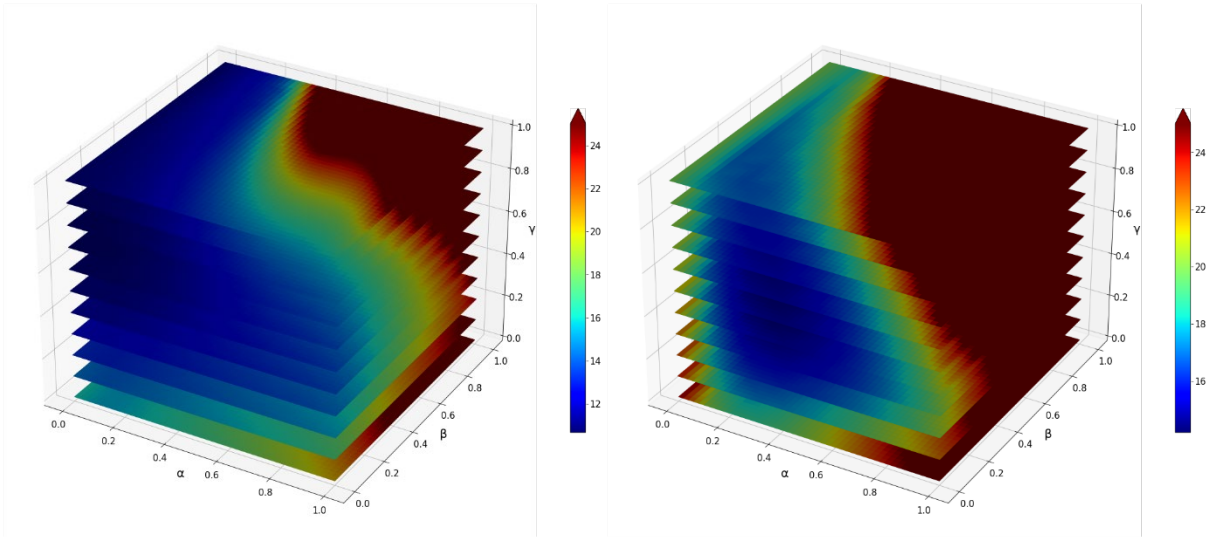

Figure 5. RMSE plot for forecasts of (a) 250ml and (b) 500ml black tea products

The colors in Figure 5. show the RMSE value of the forecast: red for high value and blue for low value. Using optimization, the resulting optimum parameters are given in the Table 4 below.

Table 4. Optimum parameters for the demand forecasting

Product	Parameter			Root Mean Square Error
	Level (α)	Trend (β)	Seasonal (γ)	
250ml Black Tea	0	0.9244962245	0.7610724405	10.6645451700
500ml Black Tea	0.0526933745	1.0000000000	0.3481012382	13.9742079455

Table 4 showed that the level parameters of the forecast are very low while the trend parameters are very high. This shows that the forecast puts little-to-no weight on the actual demand while relying heavily on the previous forecast. The high trend parameter indicates that the forecast is very sensitive to the recent trends. However, the seasonal parameter for the 250ml product is higher than the 500ml. This shows that the forecast for the 250ml product is more sensitive to the season. The final forecasts of both black tea products are shown below in Table 5. Figure 6 plots the actual demand and the forecasts for next 12 months, starting from April 2022.

Table 5. Demand forecasts for April 2022—March 2023

Product	Month												Total
	2022									2023			
	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	
250ml Black Tea	111	110	114	145	127	132	123	121	125	159	139	145	1551
500ml Black Tea	137	145	142	172	140	168	185	193	187	223	179	214	2085

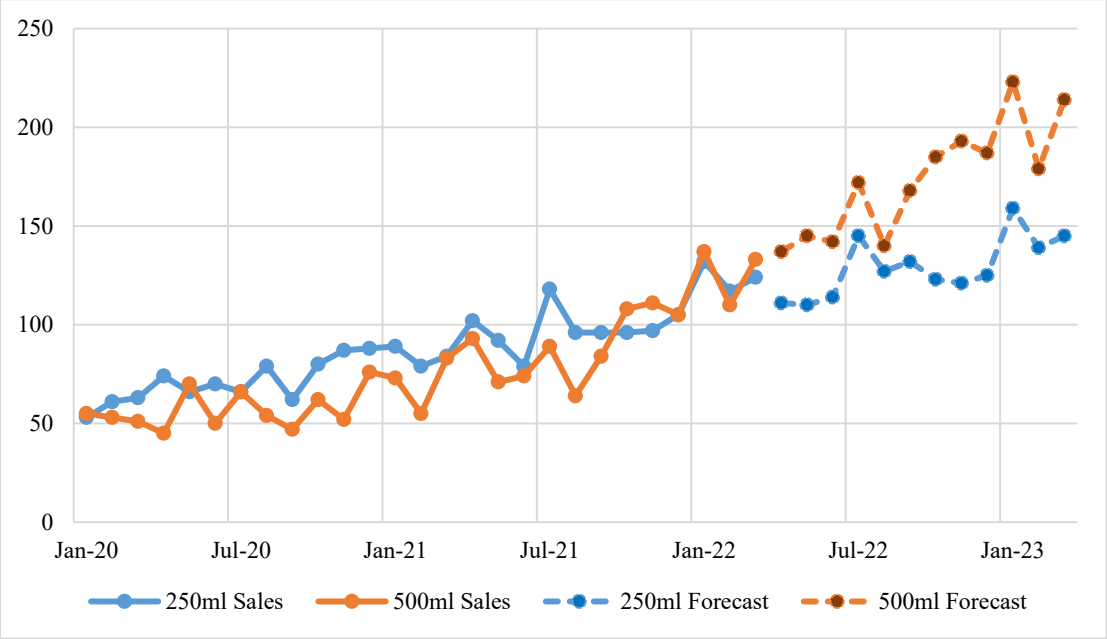

Figure 6. Plots of actual sales and forecast for black tea products

5.2 Master Production Scheduling

The collected data and forecast then are processed to develop the Master Production Schedule (MPS). The amount of production for each period is calculated directly by using the economic order quantity (EOQ) model, then rounded to the nearest five. The formula and calculation results of the EOQ model for each product are shown below.

$$\text{250ml Black Tea: EOQ} = \sqrt{\frac{2DS}{h}} = \sqrt{\frac{2 \times 1548 \times 5754}{\text{Rp863}}} = 143.6 \approx 145 \text{ units per order}$$

$$\text{500ml Black Tea: EOQ} = \sqrt{\frac{2DS}{h}} = \sqrt{\frac{2 \times 2084 \times 7400}{1110}} = 166.7 \approx 170 \text{ units per order}$$

From the EOQ values, the MPS are then developed as shown in Table 6 and 7, for 250ml and 500ml black tea products, respectively. Note that for the 500ml product, while the EOQ is found at 170 units per order, the order quantity used is 175 units because it is impossible to fulfill the demand forecast with only 170 units per order. Thus, the higher order quantity is used.

Table 6. MPS for 250ml black tea product

Period		2022									2023		
		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Forecast		111	110	114	145	127	132	123	121	125	159	139	145
Projected Available	0	34	69	100	100	118	131	8	32	52	38	44	44
MPS		145	145	145	145	145	145	0	145	145	145	145	145

Table 7. MPS for 500ml black tea product

Period		2022									2023		
		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Forecast		137	145	142	172	140	168	185	193	187	223	179	214
Projected Available	0	38	68	101	104	139	146	136	118	106	58	54	15
MPS		175	175	175	175	175	175	175	175	175	175	175	175

5.3 Material Requirement Planning

To develop the MRP, we count the EOQ for each component of the product. Table 8 shows the calculation of the EOQ for each component, listed along with the actual order quantity due to the minimum order amount and the monthly demands.

Table 8. EOQ calculation for product components

Item	D (unit)	S (Rupiah)	H (Rupiah)	EOQ (unit)	Actual (unit)
250ml bottle	1595	1800	270	146	200
500ml bottle	2100	2200	330	167	200
Sticker	3695	833	125	222	324
Black tea powder (gram)	131850	94	14	1326	50000
Sugar (gram)	86925	12	1.8	1077	8000

After calculating the amount of EOQ, we develop a material requirements plan (MRP) to plan the material requirements for CitraTea. The results of the MRP can be seen in Table 9 below.

Table 9. Material requirements plan for CitraTea

Period		2022									2023		
		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
250ml Black Tea													
Gross Requirement		111	110	114	145	127	132	123	121	125	159	139	145
Inventory	0	34	69	100	100	118	131	8	32	52	38	44	44
Net Requirement		111	76	45	45	27	14	-	113	93	107	101	101
Planned Order Receipt		145	145	145	145	145	145	-	145	145	145	145	145
Planned Order Release		145	145	145	145	145	145	-	145	145	145	145	145
500ml Black Tea													
Gross Requirement		137	145	142	172	140	168	185	193	187	223	179	214
Inventory	0	38	68	101	104	139	146	136	118	106	58	54	15
Net Requirement		137	107	74	71	36	29	39	57	69	117	121	160
Planned Order Receipt		175	175	175	175	175	175	175	175	175	175	175	175
Planned Order Release		175	175	175	175	175	175	175	175	175	175	175	175

250ml Bottle													
Gross Requirement		145	145	145	145	145	145	0	145	145	145	145	145
Inventory	0	55	110	165	20	75	130	130	185	40	95	150	5
Net Requirement		145	90	35	-	125	70	-	15	-	105	50	-
Planned Order Receipt		200	200	200	-	200	200	-	200	-	200	200	-
Planned Order Release		200	200	200	-	200	200	-	200	-	200	200	-
500ml Bottle													
Gross Requirement		175	175	175	175	175	175	175	175	175	175	175	175
Inventory	0	25	50	75	100	125	150	175	0	25	50	75	100
Net Requirement		175	150	125	100	75	50	25	-	175	150	125	100
Planned Order Receipt		200	200	200	200	200	200	200	-	200	200	200	200
Planned Order Release		200	200	200	200	200	200	200	-	200	200	200	200
Sticker													
Gross Requirement		320	320	320	320	320	320	320	320	320	320	320	320
Inventory	0	4	8	12	16	20	24	28	32	36	40	44	48
Net Requirement		320	316	312	308	304	300	296	292	288	284	280	276
Planned Order Receipt		324	324	324	324	324	324	324	324	324	324	324	324
Planned Order Release		324	324	324	324	324	324	324	324	324	324	324	324
Black Tea Powder													
Gross Requirement		11350	11350	11350	11350	11350	11350	7000	11350	11350	11350	11350	11350
Inventory	0	38650	27300	15950	4600	43250	31900	24900	13550	2200	40850	29500	18150
Net Requirement		11350	-	-	-	6750	-	-	-	-	9150	-	-
Planned Order Receipt		50000	-	-	-	50000	-	-	-	-	50000	-	-
Planned Order Release		50000	-	-	-	50000	-	-	-	-	50000	-	-
Sugar													
Gross Requirement		7425	7425	7425	7425	7425	7425	5250	7425	7425	7425	7425	7425
Inventory	0	575	1150	1725	2300	2875	3450	6200	6775	7350	7925	500	1075
Net Requirement		7425	6850	6275	5700	5125	4550	1800	1225	650	75	-	6925
Planned Order Receipt		8000	8000	8000	8000	8000	8000	8000	8000	8000	8000	-	8000
Planned Order Release		8000	8000	8000	8000	8000	8000	8000	8000	8000	8000	-	8000

5.4 Cost-benefit analysis

To find out how significant the improvement caused the impact, we calculated the benefit-cost ratio before and after improvement is made. The results of these calculations can be seen in the Table 10 and 11 below.

Table 10. Cost Benefit Ratio Before Improvement

Month	Black tea sold		Revenue		Production Cost		Profit	
	250ml	500ml	250ml	500ml	250ml	500ml	250ml	500ml
March 2021	84	83	Rp840,000	Rp1,245,000	Rp483,364	Rp614,269	Rp356,636	Rp630,731
April 2021	102	93	Rp1,020,000	Rp1,395,000	Rp586,942	Rp688,277	Rp433,058	Rp706,723
May 2021	92	71	Rp920,000	Rp1,065,000	Rp529,399	Rp525,459	Rp390,601	Rp539,541
June 2021	79	74	Rp790,000	Rp1,110,000	Rp454,592	Rp547,662	Rp335,408	Rp562,338
July 2021	118	89	Rp1,180,000	Rp1,335,000	Rp679,011	Rp658,674	Rp500,989	Rp676,326
August 2021	96	64	Rp960,000	Rp960,000	Rp552,416	Rp473,653	Rp407,584	Rp486,347
September 2021	96	84	Rp960,000	Rp1,260,000	Rp552,416	Rp621,670	Rp407,584	Rp638,330
October 2021	97	108	Rp960,000	Rp1,620,000	Rp552,416	Rp799,290	Rp407,584	Rp820,710
November 2021	105	111	Rp970,000	Rp1,665,000	Rp558,170	Rp821,492	Rp411,830	Rp843,508
December 2021	132	105	Rp1,050,000	Rp1,575,000	Rp604,205	Rp777,087	Rp445,795	Rp797,913
January 2022	117	137	Rp1,320,000	Rp2,055,000	Rp759,572	Rp1,013,914	Rp560,428	Rp1,041,086

February 2022	124	110	Rp1,170,000	Rp1,650,000	Rp673,257	Rp814,092	Rp496,743	Rp835,908
March 2022	124	133	Rp1,240,000	Rp1,995,000	Rp713,537	Rp984,311	Rp526,463	Rp1,010,689
Total Profit							Rp5,154,240	Rp8,579,461
Cost and Benefit Ratio							1.737820998	2.026799146

Table 11. Cost Benefit Ratio After Improvement

Month	Black tea sold		Revenue		Production Cost		Profit	
	250ml	500ml	250ml	500ml	250ml	500ml	250ml	500ml
April 2022	111	137	Rp1,110,000	Rp2,055,000	Rp483,380	Rp725,475	Rp626,620	Rp1,329,525
May 2022	110	145	Rp1,100,000	Rp2,175,000	Rp481,693	Rp771,503	Rp618,307	Rp1,403,497
June 2022	114	142	Rp1,140,000	Rp2,130,000	Rp500,947	Rp753,841	Rp639,053	Rp1,376,159
July 2022	145	172	Rp1,450,000	Rp2,580,000	Rp635,685	Rp916,176	Rp814,315	Rp1,663,824
August 2022	127	140	Rp1,270,000	Rp2,100,000	Rp558,297	Rp749,050	Rp711,703	Rp1,350,950
September 2022	132	168	Rp1,320,000	Rp2,520,000	Rp576,650	Rp891,626	Rp743,350	Rp1,628,374
October 2022	123	185	Rp1,230,000	Rp2,775,000	Rp539,613	Rp982,355	Rp690,387	Rp1,792,645
November 2022	121	193	Rp1,210,000	Rp2,895,000	Rp529,821	Rp1,029,442	Rp680,179	Rp1,865,558
December 2022	125	187	Rp1,250,000	Rp2,805,000	Rp548,048	Rp999,347	Rp701,952	Rp1,805,653
January 2023	159	223	Rp1,590,000	Rp3,345,000	Rp696,830	Rp1,187,577	Rp893,170	Rp2,157,423
February 2023	139	179	Rp1,390,000	Rp2,685,000	Rp610,473	Rp952,153	Rp779,527	Rp1,732,847
March 2023	145	214	Rp1,450,000	Rp3,210,000	Rp636,918	Rp1,142,017	Rp813,082	Rp2,067,983
Total Profit							Rp7,898,565	Rp18,106,455
Cost and Benefit Ratio							2.281434979	2.817424977

As can be seen from Table 10 and 11, the benefit-cost ratios of the 250 ml and 500 ml products before the improvement are 1,738 and 2,027, respectively. Meanwhile, the benefit-cost ratios after improvement are 2.281 and 2.817, respectively. These results indicate that an increase in the benefit-cost ratio has occurred.

6. Conclusion and Remarks

CitraTea is a tea company that makes tea drink menus for sale to consumers. In running the company, this company uses a make-to-stock system and a level strategy system in aggregate planning. However, CitraTea does not have a well-planned production scheduling and inventory control. This circumstance can result in companies losing opportunity costs to increase their profits.

By forecasting demand using demand forecasting and MRP calculations as well as the EOQ method, companies can maximize their profits. This condition can be seen by comparing the cost-benefit ratio data before and after forecasting, which shows an increase in the cost-benefit ratio. In addition to the terms increase in profit, the application of this method also resulted in companies fulfilling the customer demand schedule. Other than that, this method implementation helps the company in minimizing the possibility of the production capacity not meeting the customer demand and ease in analyzing how many raw materials are to be purchased to meet the demand.

In developing the material requirements plan, it is important to consider the variations in the demand and supply parameters and the robustness of the logistics chain when estimating the demand and economic order quantity. However, as the raw materials used by CitraTea to produce tea beverages are sourced directly, these variations can be minimized. The fluctuation in consumer demand, on the other hand, is handled by using the Holt-Winters forecasting method. Nevertheless, as a piece of research, we believe that this paper will be a beneficial contribution on the topic of the implementation of MRP in the tea beverage industry.

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