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Optimizing Production Process through Production Planning and Inventory Management in Motorcycle Chains Manufacturer

Shelvy Kurniawan[1] and Steven Sanjaya Raphaeli[2]

[1,2]Management Department, BINUS Business School Undergraduate Program, Bina Nusantara University
Jln. K. H. Syahdan No. 9, Jakarta Barat 11480, Indonesia
[1]shelvy.kurniawan001@binus.ac.id; [2]stevensanraphaeli@gmail.com

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Abstract **-** Based on the data, there were still shortages of production from year to year and demand were unstable in motorcycle chains manufacturer in Indonesia. To overcome these problems, the purpose of this research was to make production planning and inventory control consisting of forecasting, aggregate planning, Master Production Schedule (MPS), and Material Requirements Planning (MRP). Forecasting used the additive decomposition method (average of all data), multiplicative decomposition (centered on moving average), and winter method (additive and multiplicative). Aggregate planning used chase strategy, level strategy, and transportation model. Moreover, MRP used lot for lot, Economic Order Quantity (EOQ), and Periodic Order Quantity (POQ) methods. The test shows several results. First, the best forecasting is additive decomposition (average of all data) with MAD value of 3.033,57, MSE with 13.590.490, and MAPE with 10,083%. Second, the best aggregate planning is transportation model with the total cost of Rp7.708.398.390,00. Last, the best MRP method is the lot for lot with total cost Rp7.162.567.653,00.

Keywords: production process, production planning, inventory management

I. INTRODUCTION

In motorcycle chains manufacturer, there are two main types of motorcycle chains produced. Those are drive chain and cam chain. Drive chain is used on motorcycle wheels, while cam chain is on engine parts. Drive chain consists of 428-H, 428, 420, and 520 types. Meanwhile, the cam chain is 25, 25-H, and 25-SH types.

Table 1 summarizes the demand and production data for each motorcycle chain. In Table 1, it can be analyzed that the company has a problem in forecasting the demand. It is seen from the error rate in every type of chains. Moreover, the biggest error rate comes from 428-H drive chain. The lack of production is due to the poor control that mainly lies in production planning and inventory management. Therefore, it is difficult for the quantity of production to meet the demand from customers.

Table 1 Demand and Production in October 2014 - September 2017

Type	Demand	Production	Production vs demand	Error rate (%)
25-SH	1.428.312	1.569.700	141.388	9,90
25-H	1.280.090	1.327.990	47.900	3,74
25	521.100	532.110	11.010	2,11
428-H	1.196.328	998.845	-197.483	16,51
428	672.800	609.760	-63.040	9,37
420	1.250.600	1.272.430	21.830	1,75
520	891.190	842.870	-48.320	5,42

(Source: Motorcycle chains manufacturer, 2017)

Production planning and inventory control studied in this research are for 428-H type of drive chain. It is because 428-H type has the biggest production deficiency level in the last three years. It is about 16,51% as presented in Table 1. Lack of production reduces the profits that should be earned by the company directly. Thus, the company loses the opportunity to optimize their profit. The lost sales and revenue of the company for 428-H drive chain type can be seen in Table 2 and Table 3. Besides considering the biggest forecast error in 428-H drive chain, this research also focuses on 428-H because this type gives the highest contribution to the company revenue about 30,06% as presented in Figure 1.

Table 2 Demand and Production of 428-H Type

Year	Demand	Production	Gap
2014-2015	409.050	301.660	-107.390
2015-2016	388.478	372.730	-15.748
2016-2017	398.800	324.455	-74.345
Total	1.196.328	998.845	-197.483

(Source: Motorcycle chains manufacturer, 2017)

Table 3 Lost Revenue of 428-H Type

Lost Sales(Unit)	Price/Unit(Rp)	Lost Revenue(Rp)
197.483	48.638,00	9.605.178.154,00

(Source: Motorcycle chains manufacturer, 2017)

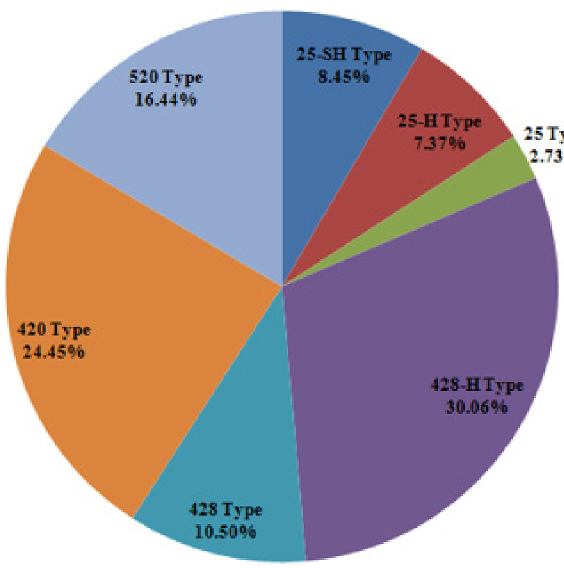

Figure 1 Revenue Contribution in
October 2017 - September 2017
(Source: Motorcycle chains manufacturer, 2017)

Based on the previous explanation, this research focuses on production planning and inventory management. It will be started with one of the crucial parts in production planning and inventory control, that is the forecasting process. This is in line with the statement from Chen and Blue in Rakićević and Vujošević (2015). They said that all issues of a supply chain planning system started with demand forecasting. It served as the basis of every planning activity. Vujosevic in Rakićević and Vujošević (2015) also explained forecasting as the art and science of predicting future events. Moreover, Reid and Sanders (2011) explained that there were four types of demand patterns in forecasting methods. First, it was level or horizontal pattern. This pattern had no trend and stationary. Second,there was a trend pattern. This pattern has a stable tendency to grow or decrease. Third, the seasonal pattern had repeated fluctuations of data at any given interval. Fourth, it was a cyclical pattern. This pattern was similar to a seasonal pattern. For example, the length and magnitude of the cycle might vary due to business and economic fluctuations.

Production planning and inventory control are not only the forecasting stage, but it also progresses to the aggregate planning process. The importance of aggregate planning to match capacity with demand is explained by Chen and Huang (2010). They stated that in highly competitive and fluctuating business environment, companies around the world had increasingly emphasized on aggregate production planning. It was for determining the best way to match capacity with demand forecasting. It was also for varying customers' orders over the medium term by adjusting regular and overtime production rates, subcontracting and back ordering rates, inventory levels, labor levels, and other controllable factors. Aggregate planning is an approach to determine the quantity and time of production in the intermediate term. It is usually in 3 to 18 months (Heizer, Render, & Munson, 2017).

According to Stevenson (2015), there are several strategies in aggregate planning. It consists of level capacity strategy, chase demand strategy, and transportation model. Heizer, Render, and Munson (2017) explained that the level strategy was an aggregate plan in which production was similar from period to period. To maintain the constant output rate, the company could let the finished goods inventory vary to buffer the difference between demand and production. Meanwhile, the chase strategy was a planning strategy that set production to be equal to demand forecasting. For transportation model, Stevenson (2015) explained that aggregate planning would adjust the capacity to the required demand while minimizing cost.

Based on the aggregate planning result, MPS and MRP can be planned. According to Heizer, Render, and Munson (2017), MPS plans what and when the production is. Meanwhile, MRP is a dependent demand technique that uses bill-of-materials, inventory, expected receipts. Islam, Rahman, Saha, and Saifuddoha (2013) suggested that MRP as a material control system. It attempted to keep adequate inventory levels to assure that the required materials were available when it was needed. The relationship between MRP and MPS is explained by Gharakhani (2011). MRP is a plan for the production and purchase of the components used in making items in the MPS.

Furthermore, Heizer, Render, and Munson (2017) also stated that there were three lot sizing methods. Those can be used in deciding number of orders in MRP. Those are the lot for lot, Economic Order Quantity (EOQ), and Periodic Order Quantity (POQ). Stevenson (2015) explained the differences between lot for lot and EOQ model. First, in the lot for lot model, the order for each period was equal to the demand in that period. Second, in EOQ model, it identified the optimal order quantity by minimizing the total of the special annual cost. It varied from the size and frequency of order. In POQ model, Heizer, Render, and Munson (2017) stated that it was a lot sizing technique by ordering the required quantity for a specified time between orders such as in every three weeks.

Based on the previous explanation, it can be seen that all the processes starting from forecasting, aggregate planning, MPS, and MRP are needed to optimize the production process. There are several literature reviews used in this research. Akpinar and Yumusak (2016) discussed the decomposition forecasting and aggregate production planning methods such as chase strategy, level strategy, and hybrid strategy, and MRP using DOQ and EOQ. Several methods mentioned are also used in this research. However, the researchers also add the other methods such as winter additive and multiplicative methods in the processing of demand forecasting. It is because there may be a seasonal pattern by using the minitab application to expand the choice of forecasting methods that can be selected. Dinesh, Arun, and Pranav (2014) explained the relationship between forecasting and MRP. Based on the forecasted demand, MRP was done. Then, orders were done to purchase materials, and the materials were stocked.

There are four purposes for this research. First, the researchers analyze which forecasting method is the most appropriate to be applied in motorcycle chains manufacturer. It is based on the historical demand pattern and the smallest error rate on the 428-H type. Second, the researchers analyze which aggregate planning methods that produce the smallest cost in fulfilling the company's demand. Third, the researchers create MPS that can meet all demands for 428-H type in October 2017 to September 2018. Last, the researchers analyze MRP to search the lowest cost of lot sizing method which can be used by motorcycle chains manufacturer.

II. METHODS

This research is a descriptive research. The data collection in this research is a cross-sectional. According to Sekaran and Bougie (2013), in cross-sectional research, the data are taken only once in days, weeks, or months to answer research questions.

This research begins by retrieving data of orders from the company. Then, the data are used to determine the demand pattern. The demand pattern based on the demand graph is seasonal. Some suitable forecasting methods for the seasonal pattern are selected. They are additive decomposition method (average of all data), additive decomposition (center moving average), multiplicative decomposition (average of all data), multiplicative decomposition (center moving average), winter additive method, and winter multiplicative method. The researchers provide several forecasting method tests to search for the best forecasting method. The method should suit the company's demand pattern. Aras and Gülay (2017) mentioned that to improve the forecasting accuracies, researchers had been using various combination techniques. In particular, the use of dissimilar methods for forecasting time in data was expected to provide superior results.

In this research, to choose the most suitable forecasting method for the company, error rate checking with Mean Absolute Deviation (MAD), Mean Square Error (MSE), and Mean Absolute Percent Error (MAPE) is done. According to Chopra and Meindl (2010), MAD measures the total error in the forecast regardless of the signs. MSE can be associated with variants of forecast error. Meanwhile, MAPE is the average of the absolute error value described as a percentage of the real value.

Then, the method which has the smallest error rate is used to do the aggregate planning. In this research, aggregate planning is done using three methods. Those are chase strategy, level strategy, and transportation model. Then the aggregate planning method is chosen based on the smallest cost. The selected aggregate planning method is used in making MPS and MRP. MRP consists of the lot for lot, EOQ, and POQ method. Then, the best MRP method is selected based on the smallest cost.

III. RESULTS AND DISCUSSIONS

The results contain the calculation according to the method described. Results and discussion are conducted sequentially starting from forecasting, aggregate planning, MPS, and MRP.

The first thing to be discussed is about forecasting. Analysis of demand pattern is done using data from October 2014 until September 2017. It is shown in Figure 2.

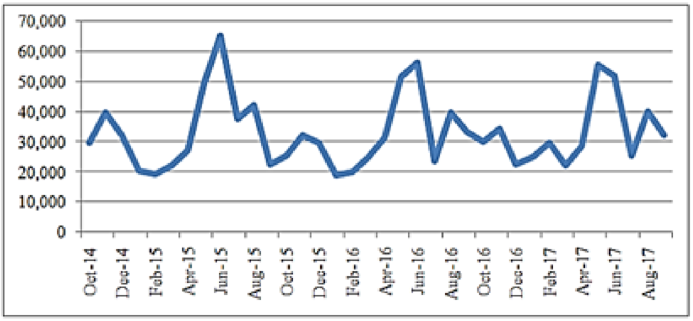

Figure 2 Demand Pattern of 428-H
(Source: Motorcycle chains manufacturer, 2017)

From Figure 2, it can be seen that the demand has a seasonal pattern. This seasonal pattern is present in every May and June. The demands in both periods are always higher than the other periods. Based on the interview with the company, demand in May and June is high because the months approach Eid Al-Fitr day (Eid Al-Fitr in 2015 was on July 17, Eid Al-Fitr in 2016 was on July 6, and Eid Al-Fitr in 2017 was on 25 June). Thus, many manufacturers prepare the stock of goods for sale in that peak season. From Figure 1, it can also be seen that demand after the peak season (Eid Al-Fitr period) always goes down and it happens every year.

By knowing the data pattern of the company's demand, the appropriate method to forecast the company's demand can be determined. Some forecasting methods that match the seasonal data pattern and are used in this research are: (1) additive decomposition (centered moving average), (2) additive decomposition (average of all data), (3) multiplicative decomposition (centered on moving average), (4) multiplicative decomposition (average of all data), (5) winter (additive method), and (6) winter (multiplicative method).

In Table 4, it shows the error rate for each forecasting method. The seasonal additive decomposition (average of all data) method is the method with the smallest MAD and MSE levels. MAD equals to 3.033,571 and MSE is 13.590.490. Regarding MAPE, the smallest error comes from multiplicative decomposition method (average of all data). Although the additive decomposition method does not have the smallest error in MAPE, the MAPE score is close to the smallest score. MAPE score for multiplicative decomposition (average of all data) is equal to 10,074. Meanwhile, MAPE for additive decomposition (average of all data) is 10,083. Thus, it can be concluded that the additive decomposition (average of all data) is the most accurate forecasting method. Therefore, this method is used to find the forecast value of the next period. The forecasting result is used in the aggregate planning. The additive decomposition (average of all data) method is shown in Table 5.

Table 4 Error Level Comparison
of Several Forecasting Methods

Forecasting Method	MAD	MSE	MAPE(%)
Additive Decomposition (Centered Moving Average)	3.481.726	16,690,960	11,69
Additive Decomposition (Average of All Data)	3.033.571	13,590,490	10,083
Multiplicative Decomposition (Centered Moving Average)	3.463.495	16,540,650	11,538
Multiplicative Decomposition (Average of All Data)	3.055.989	13,658,400	10,074
Winter (Additive Method)	4.175	22,918,164	14
Winter (Multiplicative Method)	4.127	22.139.608	14

(Source: Researchers, 2017)

Table 5 Forecasting Result using
Additive Decomposition (Average of All Data)

Year	Month	Forecast
	Oct	27.941
2017	Nov	34.883
	Dec	27.609
	Jan	20.853
	Feb	22.419
	Mar	22.581
	Apr	28.314
2018	May	51.426
	Jun	57.064
	Jul	28.194
	Aug	39.934
	Sep	28.439

(Source: Researchers, 2017)

After getting the forecasting result, the researchers do the aggregate planning. To make the aggregate plan, the required data are forecasted demand, production capacity data, and cost data. Table 6 contains production capacity data, both regular, overtime, and subcontracts that have been adjusted to the working day during the forecasting period. The regular monthly capacity is a regular production capacity in a day multiplied by the number of working days in a month. Then, overtime capacity is based on daily overtime capacity multiplied by the number of working days per month. In Table 7, the list of the costs used in aggregate planning processing is presented.

Table 6 Production Capacity

Month	Working Days	Regular Capacity (1380/day)	Overtime Capacity	Subcontract Capacity
Oct-17	21	28.980	14.490	15.000
Nov-17	22	30.360	15.180	15.000
Dec-17	18	24.840	12.420	15.000
Jan-18	22	30.360	15.180	15.000
Feb-18	19	26.220	13.110	15.000
Mar-18	21	28.980	14.490	15.000
Apr-18	20	27.600	13.800	15.000
May-18	20	27.600	13.800	15.000
Jun-18	15	20.700	10.350	15.000
Jul-18	22	30.360	15.180	15.000
Aug-18	21	28.980	14.490	15.000
Sep-18	19	26.220	13.110	15.000
Total	240	331.200	165.600	180.000

(Source: Motorcycle chains manufacturer, 2017)

Table 7 Cost in Aggregate Planning

Type of Cost	Amount
Regular time cost	Rp19.650,00/ unit
Overtime Cost	Rp20.028,00/ unit
Subcontract Cost	Rp23.000,00/ unit
Holding Cost	Rp282,00/ unit
Backorder Cost	Rp3.925,00/ unit
Lost Sales Cost	Rp28.988,00/ unit

(Source: Motorcycle chains manufacturer, 2017)

Then, all the data is processed using POM QM software. It calculates the cost of each method of aggregate planning. The result is presented in Table 8.

Table 8 Cost Comparison of Several
Aggregate Planning Methods

Cost	Chase Strategy (Rp)	Level Strategy (Rp)	Transportation Model (Rp)
Regular Time	6.057.859.000,00	6.508.080.000,00	6.321.267.450,00
Overtime	907.849.200,00	1.142.317.000,00	1.361.182.992,00
Subcontracting	575.598.000,00	32.683.000,00	0
Inventory	0	47.747.110,00	25.947.948,00
Shortage	319.273.800,00	19.146.150,00	0
Total	7.860.580.000,00	7.749.974.000,00	7.708.398.390,00

(Source: Researchers, 2017)

Based on the comparison of costs in Table 8, aggregate planning using transportation model requires the smallest cost compared to other methods. It amounts about Rp7.708.398.390.00. This is because the transportation model always puts production which the minimum cost will be incurred. Therefore, aggregate planning with transportation model will be used in planning MPS. Then, MPS is presented in Table 9.

Table 9 also shows Projected on Hand (PAB) and Available to Promise (ATP). PAB is the expected amount of inventory at the beginning of each period. Then, ATP is the information about how many available products in specific periods are for the customer to order.

Based on the MPS in Table 9, the results obtained in October 2017 shows that the company needs to produce 10.868 units in the first week, 10.868 units in the second week, and 7.245 units in the fourth week. According to the aggregate planning result, the researchers can calculate MRP. In calculating MRP, the primary data needed is MPS to determine gross requirements material. In addition, other data such as the bill of material and on hand material are also needed. Table 10 presents materials which are needed to create a 428 H type drive chain.

Table 10 presents used materials to make a unit of 428-H drive chain. The materials consist of ILP, OLP, pin, bush, and roller. Inner Link Plate (ILP) is an inner plate of the chain structure. Outer Link Plate (OLP) is on the outside. Pin serves as a load holder that works on the chain. Bush is a bearing on the roller. Then, roller smoothes the movement on the sprocket, because the roller is part of the chain that has direct contact on the sprocket. The requirements are ILP (0,331kg), OLP (0,292kg), pins (0,285 kg), bush (0,153kg), and roller (0,183kg).

Next, material on hand is the remaining material from the previous period at the beginning of the next period. Table 11 presents the number of available materials at the beginning of the period of October 2017.

Based on the data, MRP is analyzed using three methods. Those are the lot for lot, EOQ, and POQ. Then, based on those MRP methods, the total cost is compared. The company selects MRP method with the smallest cost. The comparison of the total cost for each MRP method is presented in Table 12.

Based on the information in Table 12, the cost of MRP with lot for lot technique has a smaller cost than EOQ and POQ. This is because the lot for lot method has a minimal cost. The order is done only as much as the quantity needed. This prevents the buildup of inventory in the lot for lot method. In Table 13 to Table 17, MRP calculation using the lot for lot method is presented.

In Table 13, on-hand stock of ILP is 2.400 units. Moreover, the gross requirement for the first week is 3.597. Thus, numbers of order that should be received in the first week are 1.197 units. Considering the lead time, the 1.197 units should be ordered 1 week before the purchase order schedule.

Table 9 Master Production Schedule
for October and November 2017

On Hand	0	Lot Size		43.470		Lot Size		45.540
		C.A.		28.980		C.A.		33.844
Month		October				November		
Week	1	2	3	4	5	6	7	8
Forecast	6.985	6.985	6.985	6.985	8.721	8.721	8.721	8.721
Order	6.985	6.985	6.985	6.985	8.721	8.721	8.721	8.721
PAB	3.883	7.766	781	1.040	3.704	6.368	8.721	0
MPS	10.868	10.868		7.245	11.385	11.385	11.074	
ATP	3.883	-3.102		260	2.664	2.664	-6.368	
CUM ATP	3.883	781	781	1.040	3.704	6.368	0	0
Demand		27.941				34.883		

(Source: Researchers, 2017)

Table 10 Bill of Material 428 H Drive Chain

Material	Requirements/ product (unit)	Mass/unit (gr)	Mass/product (kg)
ILP	126	2,627	0,331
OLP	125	2,334	0,292
Pin	124	2,3	0,285
Bush	126	1,212	0,153
Roller	126	1,453	0,183

(Source: Motorcycle chains manufacturer, 2017)

In Table 14, the on-hand stock of OLP is 2.800 units and the gross requirement is 3.171 in the first week of October. The numbers of order should be received in the first week are 371 units. Considering the time, 371 units should be ordered one week before the purchase.

In Table 15, the on-hand stock of pin is 5.200 units. Then, the gross requirement for the first week is 3.099. Since the number of on-hand stock is higher than the number of units needed, the company does not need to open new purchase to the supplier.

Similarly, Table 16 shows that the on-hand stock of bush is 12.952 units. The gross requirement for the first week is 1.660. The on-hand stock is higher than the number of units needed. Thus, the company does not need to open new purchase to the supplier.

In Table 17, the on-hand stock of roller is 8.208 units, and the gross requirement for the first week is 1.990. The numbers of on-hand stock are greater than the units needed. Therefore, the company does not need to open new purchase to the supplier.

Table 11 Material on Hand at the Beginning of October 2017

Material	On Hand (kg)
ILP	2.400
OLP	2.800
Pin	5.200
Bush	12.952
Roller	8.208

(Source: Motorcycle chains manufacturer, 2017)

Table 12 Cost Comparison of MRP Method

Lot Sizing Method	Total of Material Cost (Rp)
Lot For Lot	7.162.567.653,00
EOQ	7.422.257.959,00
POQ	7.233.019.872,00

(Source: Researchers, 2017)

Table 13 MRP using Lot for Lot Method for ILP Material in October to November 2017

Part Number	-			Description		ILP		
BOM UoM	Kg			On-hand		2.400		
Lead Time	1 week			Order Policy		LFL		
Safety Stock	-							
Month	Oct				Nov			
Period	1	2	3	4	5	6	7	8
Gross Requirements	3.597	3.597	0	2.398	3.768	3.768	3.666	0
Scheduled Receipts								
PAB|2400	0	0	0	0	0	0	0	0
Net Requirements	1.197	3.597	0	2.398	3.768	3.768	3.666	0
Purchase Receipts	1.197	3.597		2.398	3.768	3.768	3.666	
Purchase Releases|1,197	3.597		2.398	3.768	3.768	3.666		3.083

(Source: Researchers, 2017)

Table 14 MRP using Lot for Lot Method for OLP Material in October to November 2017

Part Number	-			Description		OLP		
BOM UoM	Kg			On-hand		2.800		
Lead Time	1 week			Order Policy		LFL		
Safety Stock	-							
Month	Oct				Nov			
Period	1	2	3	4	5	6	7	8
Gross Requirements	3.171	3.171	0	2.114	3.322	3.322	3.231	0
Scheduled Receipts								
PAB|2800	0	0	0	0	0	0	0	0
Net Requirements	371	3.171	0	2.114	3.322	3.322	3.231	0
Purchase Receipts	371	3.171	0	2.114	3.322	3.322	3.231	0
Purchase Releases|371	3.171	0	2.114	3.322	3.322	3.231	0	2.718

(Source: Researchers, 2017)

Table 15 MRP using Lot for Lot Method for Pin Material in October to November 2017

Part Number	-		Description		OLP			
BOM UoM	Kg		On-hand		2.800			
Lead Time	1 week		Order Policy		LFL			
Safety Stock	-							
Month	Oct				Nov			
Period	1	2	3	4	5	6	7	8
Gross Requirements	3.171	3.171	0	2.114	3.322	3.322	3.231	0
Scheduled Receipts								
PAB|2800	0	0	0	0	0	0	0	0
Net Requirements	371	3.171	0	2.114	3.322	3.322	3.231	0
Purchase Receipts	371	3.171	0	2.114	3.322	3.322	3.231	0
Purchase Releases|371	3.171	0	2.114	3.322	3.322	3.231	0	2.718

(Source: Researchers, 2017)

Table 16 MRP using Lot for Lot Method for Bush Material in October to November 2017

Part Number	-		Description		Bush			
BOM UoM	Kg		On-hand		12.952			
Lead Time	1 week		Order Policy		LFL			
Safety Stock	-							
Month	Oct				Nov			
Period	1	2	3	4	5	6	7	8
Gross Requirements	1.660	1.660	0	1.106	1.739	1.739	1.691	0
Scheduled Receipts								
PAB|12952	11.292	9.633	9.633	8.526	6.788	5.049	3.358	3.358
Net Requirements	0	0	0	0	0	0	0	0
Purchase Receipts	0	0	0	0	0	0	0	0
Purchase Releases								

(Source: Researchers, 2017)

Table 17 MRP using Lot for Lot Method for Roller Material in October to November 2017

Part Number	-		Description		Roller			
BOM UoM	Kg		On-hand		8.208			
Lead Time	1 week		Order Policy		LFL			
Safety Stock	-							
Month	Oct				Nov			
Period	1	2	3	4	5	6	7	8
Gross Requirements	1.990	1.990	0	1.326	2.084	2.084	2.027	0
Scheduled Receipts								
PAB|8208	6.218	4.229	4.229	2.902	818	0	0	0
Net Requirements		0	0	0	0	1.266	2.027	0
PO Receipts		0	0	0	0	1.266	2.027	0
PO Releases					1.266	2.027	0	1.705

(Source: Researchers, 2017)

IV. CONCLUSIONS

Based on the research that has been done, there are several conclusions. First, the company should apply the method of forecasting using additive decomposition (average of all data). It can overcome the problem of production shortages as experienced by the company in the last three years. The additive decomposition (average of all data) method can result in more accurate forecasting. It is because the forecasting method conforms to the seasonal data pattern and has the smallest error rate compared to other forecasting methods.

From the forecasting result, it can be continued to the aggregate planning. The calculation of aggregate planning in this research is done by using three methods that are chase strategy, level strategy, and transportation model. Based on the three methods, the total cost is calculated to determine the best method based on the lowest total cost. The chosen method in this research is the transportation model. It has the smallest cost compared to other methods. Transportation model produces the smallest total cost because the allowance for excess capacity in the previous period can be used in the period which the demand is high. The cost generated by backorder charges and subcontract costs can be eliminated by this method.

Then, from the result of aggregate planning using transportation model, MPS which schedules the weekly production is made. In the made MPS, PAB is positive. This proves that the made MPS can meet customer's demand.

MRP in this research uses three lot sizing methods. Those are the lot for lot, EOQ, and POQ. The selection of the best method is made by choosing the smallest total cost of those three methods. In this research, the smallest total cost is generated by lot for lot method. This is because the lot for lot method has a minimal inventory cost. It is due to the order that is done as much as the quantity needed to prevent the accumulation of inventory.

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