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Application of Distribution Activity Planning with Distribution Requirement Planning Method on Pump Products In PT. XYZ

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Abstract

PT. XYZ is a company engaged in oil and gas manufacturing. The products made are ESP pumps or petroleum pumps. PT. XYZ has not yet applied a special method of planning demand in each of its distribution areas. This company also does not have a distribution activity schedule for the products to be shipped. This condition results in companies experiencing problems meeting customer demands and incurring excess distribution costs because they do not have optimal distribution activities. Therefore, the solution to this problem is to use the Distribution Requirement Planning (DRP) method. Distribution Requirements Planning is a method used to determine every need in the distribution process. By applying this DRP method, distribution costs can be reduced by IDR 15.920.327 with a cost reduction percentage of 32.61%.

Keywords
Distribution Areas, Distribution Activities, Distribution Costs, Distribution Requirement Planning, ESP Pump

1. Introduction
Many companies compete and maintain their companies in the industrial world because the times are growing. Customers need products of good quality and easy to obtain. One of the important things in fulfilling customer satisfaction is receiving requests on time and according to orders. Therefore, companies need an effective and efficient

distribution process to minimize distribution costs so as not to cause waste to the company and not disappoint customers. One of the companies that accepted the field practice work program was PT. XYZ. This company has a product, namely petroleum pumps. This research focuses on the demand planning system for scheduling distribution activities at PT. XYZ. This research provides several solutions to companies planning distribution activity schedules with the Distribution Requirement Planning (DRP) method regarding effective and efficient distribution process planning. This DRP solution improves the distribution system to have optimal distribution activities and minimize costs to the company. Distribution activities focus on physical activities such as delivery and how to design distribution networks, segmentation/clustering distribution points, scheduling, determining routes, and determining delivery consolidation. The objective of this research focuses on the Production Planning and Inventory Control section. Therefore, it is focused on the company's distribution activities. The following is the purpose of the analysis at PT. XYZ is observing and studying distribution activities, production planning, and inventory control at PT. XYZ. In addition, observing and knowing the factors that influence the planning of product distribution activities at PT. XYZ and train analytical skills by looking at the problems that exist in the factory and problem-solving solutions.

2. Literature Review

The following is a literature review that is used as follows.

2.1 Production Planning and Inventory Control

Production, planning & inventory control is an activity to prepare and control the stock of raw materials produced from raw materials to finished materials. PPIC is responsible for planning and controlling the production process to run according to the predetermined target (Pujawan dan Mahendrawathi, 2012; Ngatilah et al, 2019).

2.2 Distribution Requirement Planning

DRP is a method that provides a framework for implementing a centralized push system in inventory distribution management (Gaspersz, 2005). The DRP method is used so that the distribution activities of this distributor company are optimal. DRP can anticipate future demand by planning at each level in the distribution network. This method can be used to predict problems before they happen. This result can also give the decision maker a broader paradigm to solve an inventory problem in the distribution network (Kelen et al, 2019).

2.3 Forecasting

Forecasting is the art and science of predicting future events. Forecasts will generally be based on past data, which is analyzed using certain methods. Data from sales forecasts can be used as a basis for production planning (Heizer dan Render, 2015). According to Spyros (2004) that the forecasting method is divided into two models, namely qualitative forecasting and quantitative forecasting. Qualitative forecasting is generally subjective, influenced by intuition, emotions, education and experience. While quantitative forecasting includes methods that have a calculation formula, such as linear trend methods, moving averages, single exponential smoothing, cyclical, quadratic and constant (Christifan, 2020, Gozali, 2021, Gunawan, 2021).

2.4 Economic Order Quantity

Economic Order Quantity (EOQ)(Heizer & Render (2015)is an inventory management method that determines the number of orders/purchases made and how many quantities must be ordered to minimize the total cost (the sum of ordering costs and holding costs). EOQ is a mathematical model that determines the number of items ordered to meet the projected demand with optimized inventory costs (Christifan, 2020; Gozali, 2020, Wahyuni, 2014)

2.5 Safety Stock

The existence of safety stock to overcome uncertainty in demand, waiting period, and supply. Safety Stock (SS) is an inventory carried out to protect or maintain the possibility of a shortage of materials/goods, for example, due to the use of materials that are greater than the original estimate or delays in receiving the ordered materials (Eddy Herjanto, 1999). The waiting period (lead time) is the distance from the time the order is submitted until the goods or materials ordered are received (Djuhana, 2020; Lefta, 2020).

3. Methods

The analysis begins with a literature review. The literature review aims to determine what variables are from the existing problems. After that, identifying the problems that occur in the company is carried out. When identifying the

problem, the necessary data collection is carried out on the problems. After the required data is sufficient, then the data that has been collected is processed using the distribution requirements planning method. After completion, the results of the data processing will be analyzed. From the analysis obtained, then make conclusions from the analysis carried out. The flowchart of the methods can be seen in Figure 1.

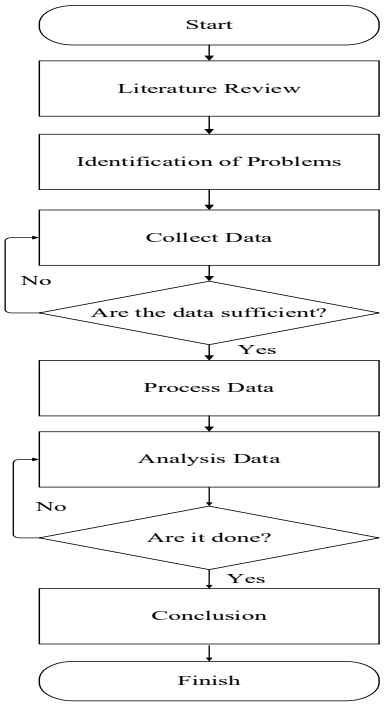

Figure 1. Flowchart of Methods

4. Data Collection

Based on the identification of existing problems. So the data used is the demand for finished products from companies in each distribution area in 2020. PT. XYZ has a sales system in a tender, where each region has different requests. The following are some distribution areas at PT. XYZ and product demand data for each region can be seen in Figure 2 and Table 1.

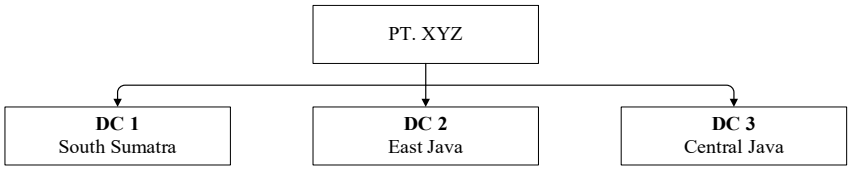

Figure 2. Distribution Areas PT. XYZ

Table 1. Product Request Data

Months	South Sumatra	East Java	Central Java
January	2	2	1
February	3	2	2
March	3	2	3
April	2	2	1
May	1	1	2
June	3	2	1

Months	South Sumatra	East Java	Central Java
July	2	1	3
August	2	2	0
September	1	2	2
October	3	3	1
November	2	1	1
December	3	2	3
TOTAL	**27**	**22**	**20**

Based on the table above, it can be seen that the total demand for the South Sumatra region is 27 units, the total demand for the East Java region is 22 units, and the total demand for the Central Java region is 20 units. Based on the identification of existing problems. There are data from various costs used for data analysis. The cost data used are order, carrying, and shipping. Cost data can be seen in Table 2 to Table 4.

Table 2. Order Costs

No	Description	Cost (Rp/Month)
1	Office and administrative stationery	IDR 18.000
2	Phone	IDR 7.000
3	*Set Up Cost*	IDR 50.000
Total		**IDR 75.000**

Table 3. Carrying Costs

Product	Selling Price/ Unit	Product	Cost/ Unit	Total Cost
ESP Pump	IDR 71.880.000	8	IDR 2.270	IDR 18.160

Table 4. Shipping Costs

No	Region	Costs			Total cost
		Driver	Fuel & Toll	Unloading	
1	South Sumatra	IDR 2.000.000	IDR 424.625	IDR 4.955.000	IDR 7.379.625
2	East Java	IDR 2.000.000	IDR 790.483	IDR 1.710.000	IDR 4.500.483
3	Central Java	IDR 2.000.000	IDR 675.259	IDR 1.710.000	IDR 4.385.259

Based on the cost table above, it can be seen that the total order cost is IDR 75.000. Meanwhile, the total carrying cost is IDR 18.160. The total shipping costs for each region are South Sumatra IDR 7.379.625, East Java for IDR 4.500.483, and Central Java for IDR 4.385.259.

From the data obtained, an analysis of the company's distribution activities can be made using the method used by the company. The following is frequency of delivery in each distribution area can be seen in Table 5.

Table 5. Frequency of Delivery

Region	Frequency of Delivery	Distribution Cost
South Sumatra	3	IDR 22.138.875
East Java	3	IDR 13.501.449
Central Java	3	IDR 13.155.777
Total	**9**	**IDR 48.796.101**

From the calculation of the total ordering and shipping costs, the following results are obtained.
Carrying cost = IDR 18.160
Shipping Cost = IDR 48.796.101
Distribution Cost = IDR 18.160 + IDR 48.796.101 = IDR 48.814.261.

By using the method used by the company, the total distribution cost was IDR 48.814.261 in 2020 for all shipping areas.

5. Results and Discussion

5.1 Forecasting

In facing the future, every company plans activities to achieve the vision mission that has been carried out. One of them is planning with forecasting that estimates how much demand for its products by customers. Demand forecasting is one way to reduce the risk of the uncertainty of demand for the products offered (Deitiana Tita, 2011). Forecasting determines the forecasting method followed by error testing and determines the method with the smallest error. Forecasting is carried out for the next year using demand data in 2020. This subsection will show forecasting on ESP Pump products for the South Sumatra, East Java, and Central Java regions.

Before forecasting, it is necessary to have a pattern of historical data to describe the state of the existing historical data. The following is a pattern of historical sales data from several regions from January 2020 to December 2020, as shown in Figure 3.

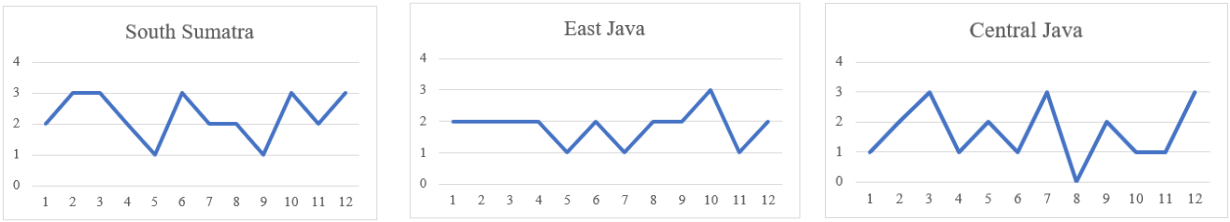

Figure 3. Historical Data Pattern

Based on the historical data pattern of product demand from the three distribution areas, the pattern of product demand data is included in the horizontal data pattern, where the data fluctuates around the average. Therefore, a suitable method for this pattern to be used in forecasting is the time series method. The time series method used in this forecast is the Single Exponential Smoothing (SES) and Moving Average (MA) methods. The selection of the right forecasting method is based on the error value it has. The right forecasting method is the method that has the smallest error value from each error value. The results of forecasting and calculating errors in the Single Exponential Smoothing and Moving Average methods can be seen in Table 6 to Table 8.

Table 6. Forecasting for the South Sumatra

ESP PUMP – SOUTH SUMATRA					
	Bias	MAD	MSE	Standar Error	MAPE
SES (0,1)	0.258	0.643	0.635	0.881	0.339
SES (0,3)	0.232	0.655	0.636	0.881	0.349
SES (0,5)	0.210	0.666	0.639	0.884	0.359
SES (0,7)	0.192	0.677	0.645	0.888	0.367
SES (0,9)	0.177	0.687	0.652	0.893	0.375
MA (n=2)	0.000	0.800	0.950	1.090	0.458
MA (n=3)	-0.037	0.778	0.975	1.120	0.494
MA (n=4)	0.000	0.688	0.734	0.990	0.443

Table 7. Forecasting for the East Java

ESP PUMP – EAST JAVA					
	Bias	MAD	MSE	Standar Error	MAPE
SES (0,1)	-0.352	0.732	0.904	1.051	0.426
SES (0,3)	-0.332	0.741	0.898	1.048	0.430
SES (0,5)	-0.314	0.751	0.896	1.047	0.435

ESP PUMP – EAST JAVA					
	Bias	MAD	MSE	Standar Error	MAPE
SES (0,7)	-0.299	0.761	0.897	1.047	0.439
SES (0,9)	-0.286	0.770	0.900	1.049	0.444
MA (n=2)	-0.150	0.950	1.275	1.262	0.508
MA (n=3)	-0.185	1.000	1.321	1.303	0.525
MA (n=4)	-0.344	0.906	1.117	1.220	0.490

Table 8. Forecasting for the Central Java

ESP PUMP - CENTRAL JAVA					
	Bias	MAD	MSE	Standar Error	MAPE
SES (0,1)	0.441	0.958	1.27	1.246	0.394
SES (0,3)	0.239	1.037	1.376	1.297	0.466
SES (0,5)	0.194	1.12	1.606	1.401	0.516
SES (0,7)	0.184	1.228	1.93	1.536	0.574
SES (0,9)	0.182	1.369	2.403	1.714	0.65
MA (n=2)	0.1	1	1.55	1.392	0.442
MA (n=3)	-0.074	0.963	1.383	1.333	0.457
MA (n=4)	0.031	0.969	1.305	1.319	0.432

From the calculation of the Single Exponential Smoothing and Moving Average methods from each existing distribution area, the smallest error in each region is found in the Single Exponential Smoothing method with an alpha value of 0.1. Therefore, a tracking signal test was carried out in each distribution area, as shown in Table 9.

Table 9. Tracking Signal

SINGLE EXPONENTIAL SMOOTHING (0.1)			
Months	South Sumatra	East Java	Central Java
January	-	-	-
February	1.000	-1.000	1.000
March	2.000	-1.636	2.000
April	2.455	0.260	2.455
May	0.661	-1.033	3.410
June	1.765	-1.133	3.534
July	1.841	-2.378	3.742
August	1.876	-2.402	3.052
September	0.118	-2.388	3.864
October	1.465	-0.347	3.732
November	1.441	-1.800	3.584
December	2.703	-3.969	2.007

Analysis of tracking signal values for the forecasting model must be within acceptable limits (maximum +4 and minimum -4) (Heizer and Render, 2005). From the tracking signal table above, it can be concluded that the forecasting is valid because the tracking signal value should not exceed -4 and +4.

5.2 Forecasting Result

After forecasting, calculating errors, and selecting the method with the smallest error, the following is a plot of the actual data, and the forecasting data can be seen in Table 10.

Table 10. Actual Data and Forecasting Data

Bulan	South Sumatra		East Java		Central Java	
	Actual	Forecast	Actual	Forecast	Actual	Forecast
January	2	-	2	-	2	-
February	3	2	2	2	3	1
March	3	2	2	2	3	1
April	2	2	2	2	2	1
May	1	2	1	2	2	1
June	3	2	2	2	4	1
July	2	2	1	1	3	1
August	2	1	2	2	4	2
September	1	2	2	2	3	1
October	3	2	3	2	2	2
November	2	2	1	2	4	2
December	3	2	2	2	3	1
TOTAL	**27**	**21**	**22**	**21**	**35**	**14**

From the table above, it can be seen the results of the actual data and forecasting data from each region. There is a demand forecast of 21 units for the South Sumatra region. There is a demand forecast of 21 units for the East Java region. For the Central Java region, there are 14 forecasting units. The graph of the actual data plot and forecasting can be seen in Figure 4.

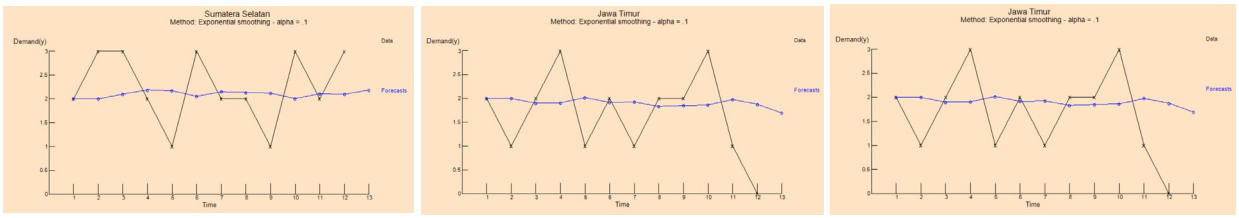

Figure 4. Actual Data and Forecasting Data

5.3 Economic Order Quantity and Safety Stock

In the Distribution Requirement Planning method, it is important to perform an EOQ calculation to determine the economic order quantity. In addition, it is also necessary to calculate safety stock to avoid the possibility of stock shortages when making deliveries. PT. XYZ has a service level of 90%. The following is table of the EOQ and Safety Stock calculation results for each region can be seen in Table 11.

Table 11. EOQ and Safety Stock

Product	**Pompa ESP**		
Region	**South Sumatra**	**East Java**	**Central Java**
Demand	21	21	14
Carrying Cost/unit	2270	2270	2270
Order Cost	75000	75000	75000
EOQ	11	11	9
Standart Deviation	0.072286048	0.060848097	0.131153969
Service Factor	1.282	1.282	1.282
Safety Stock	0	0	0

5.4 Distribution Requirement Planning (DRP)

The following is a calculation of DRP to customers by entering existing data. DRP calculation results for all products for distribution in South Sumatra, East Java and Central Java. The following is a DRP calculation seen in Table 12 to Table 14.

Table 12. Distribution Requirement Planning South Sumatra

DRP ESP Pump - South Sumatra														Frequency of Delivery	Project On Hand
Lead Time	3 Months														
Lot Size (Unit)	11														
Safety Stock (Unit)	0														
Period	***Past Due***	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**		
Gross Requirement		0	2	2	2	2	2	2	1	2	2	2	2		
Projected On Hand	0	0	9	7	5	3	1	10	9	7	5	3	1	**2**	**60**
Net Requirement			2					1							
Planned Order Receipt			11					11							
Planned Order Release	11				11										

The Distribution Requirement Planning table above can be calculated as follows.

Carrying Cost = 60 x Rp 2.270 = Rp 136.200
Shipping Cost = 2 x Rp 7.379.625 = Rp 14.759.250
Total Distribution Cost = Rp 136.200 + Rp 14.759.250 = Rp 14.895.450

Table 13. Distribution Requirement Planning East Java

DRP ESP Pump - East Java														Frequency of Delivery	Project On Hand
Lead Time	3 Months														
Lot Size (Unit)	11														
Safety Stock (Unit)	0														
Period	***Past Due***	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**		
Gross Requirement		0	2	2	2	2	2	1	2	2	2	2	2		
Projected On Hand	0	0	9	7	5	3	1	0	9	7	5	3	1	**2**	**50**
Net Requirement			2						2						
Planned Order Receipt			11						11						
Planned Order Release	11					11									

The Distribution Requirement Planning table above can be calculated as follows.

Carrying Cost = 50 x Rp 2.270 = Rp 113.500
Shipping Cost = 2 x Rp 4.500.483 = Rp 9.000.966
Total Distribution Cost = Rp 113.500 + Rp 9.000.966 = Rp 9.114.466

Table 14. Distribution Requirement Planning Central Java

DRP ESP Pump - Central Java														Frequency of Delivery	Project On Hand
Lead Time	3 Months														
Lot Size (Unit)	9														
Safety Stock (Unit)	0														
Period	***Past Due***	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**		
Gross Requirement		0	1	1	1	1	1	1	2	1	2	2	1		
Projected On Hand	0	0	8	7	6	5	4	3	1	0	7	5	4	**2**	**50**
Net Requirement			1								2				
Planned Order Receipt			9								9				
Planned Order Release	9							9							

The Distribution Requirement Planning table above can be calculated as follows.

Carrying Cost = 50 x Rp 2.170 = Rp 113.500
Shipping Cost = 2 x Rp 4.385.259 = Rp 8.770.518
Total Distribution Cost = Rp 113.500 + Rp 8.770.518 = Rp 8.884.018

Based on the calculation of the table above, it can be concluded that the total distribution costs of each region use the distribution requirements planning method. So the total distribution cost for the South Sumatra region is IDR 14.895.450, the East Java region is IDR 9.114.466, and the Central Java region is IDR 8.884.018.

5.5 Distribution Cost Analysis

After planning distribution activities using the DRP method, it is necessary to compare the results of the total distribution costs before and after applying the DRP method. Data on the comparison of total costs can be seen in Table 15 to Table 17.

Table 15. Distribution Costs Before Applying the DRP Method

Shipping Cost	IDR	48.796.101
Carrying Cost	IDR	18.160
Total Distribution Cost	IDR	48.814.261

Table 16. Distribution Costs After Applying the DRP Method

Region	Distribution Cost	
South Sumatra	IDR	14.895.450
East Java	IDR	9.114.466
Central Java	IDR	8.884.018
Total	**IDR**	**32.893.934**

Table 17. Distribution Costs Before and After Applying the DRP Method

Distribution Costs Before Applying the DRP Method	Distribution Costs After Applying the DRP Method
IDR 48.814.261	**IDR 32.893.934**
Cost Reduction	
IDR 15.920.327	
32.61%	

From the cost table above, it can be concluded that there was a decrease in costs after using the distribution requirements planning method. The decrease in costs occurred by IDR 15.920.327 with a percentage decrease in costs of 32.61%.

6. Conclusion

From the analysis conducted, it can be concluded that PT. XYZ produces ESP pumps with a make to order or pre-order production process depending on customer demand. PT. XYZ in collaboration with PT. Pertamina. The petroleum pump produced will be planted into the ground to extract petroleum. Products manufactured are made of stainless steel. Therefore, PT. XYZ makes various pump pressure variations and ensures good quality. In addition, the PPIC division of the company coordinates with the sales department to manage the fulfilment of consumer demands, coordinates with the production department to arrange production schedules, coordinates with the distribution department to manage distribution activities for ESP pump products. Based on the above, it can be concluded that the PPIC division must have good communication skills to coordinate the process well. PT. XYZ has three distribution areas: South Sumatra, East Java, and Central Java. This company has a sales system using tenders with various distribution areas. Therefore, the demand from each region varies according to customer needs. PT. XYZ does not have a method for planning distribution activity requests. Therefore, the total costs incurred by the company during 2020 for distribution costs were IDR 48.796.101. When using the DRP method for planning demand for distribution activities, the total distribution costs incurred by the company are IDR 32.893.934.

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Biography

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