

Lever Assy Product Distribution Needs Planning with the Distribution Requirement Planning Method in the Automotive Industry

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Abstract

The market demand to get quality products is not enough to be answered only by the company's ability to provide the requested products, the company's ability to fulfill order stock, low prices, order time targets, and marketing capabilities. Planning for product availability and distribution processes is also needed to meet consumer needs. PT XYZ is a company engaged in the automotive sector as a supplier. The problem that occurs is that there is an over cost distribution so that the company has to increase costs for the distribution of Lever Assy products. One of the reasons that allegedly caused the problem was because the forecasting that became the basis for the company to take policies in the distribution process of the Lever Assy product was not done properly. The goal to be achieved in this study is to plan distribution needs by considering the demand aspect to avoid over cost distribution. The results of this study show that the total cost incurred based on the company method is Rp71,614,500, while using the distribution requirement planning method is Rp52,864,500, which means that there is a savings of Rp.18,750,000 with a percentage of 26%.

Keywords: *distribution, distribution requirement planning, forecasting*

Abstrak

Tuntutan pasar untuk mendapatkan produk berkualitas, tidaklah cukup hanya dijawab dengan kemampuan perusahaan dalam menyediakan produk yang diminta, kemampuan perusahaan dalam memenuhi stok pesanan, harga yang murah, target waktu pesanan, dan kemampuan pemasaran. Perencanaan ketersediaan produk dan proses distribusinya juga diperlukan untuk memenuhi kebutuhan konsumen. PT XYZ merupakan perusahaan bergerak di bidang otomotif sebagai *supplier*. Permasalahan yang terjadi adanya *over cost distribution* sehingga perusahaan harus menambah biaya untuk distribusi produk *Lever Assy*. Salah satu penyebab yang disinyalir menimbulkan permasalahan tersebut adalah karena peramalan yang menjadi dasar perusahaan untuk mengambil kebijakan pada proses distribusi produk *Lever Assy* ini tidak dilakukan dengan baik. Tujuan yang akan dicapai pada penelitian ini adalah perencanaan kebutuhan distribusi dengan mempertimbangkan aspek permintaan untuk menghindari *over cost distribution*. Hasil penelitian ini menunjukkan bahwa total biaya yang dikeluarkan berdasarkan metode perusahaan adalah sebesar Rp71.614.500, sedangkan dengan menggunakan metode *distribution requirement planning* sebesar Rp52.864.500, yang berarti terjadi penghematan sebesar Rp.18.750.000 dengan persentase sebesar 26%.

Kata Kunci: *distribusi, kebutuhan perencanaan distribusi, peramalan*

1. Introduction

Forecasting is an activity to carry out a production in the future by a company, based on determining the amount of demand for a certain product so that it is used as a target in producing the product in the future[1]. Through forecasting, we can determine and estimate future needs both in terms of quantity, quality, time, and in meeting the demand for both products and services[2]. The use of forecasting methods and comparing multiple forecasting methods to model time series with trend and seasonal patterns. The use of forecasting performance effectiveness, especially to answer whether complex methods always provide better forecasting than simpler methods [3]. Forecasting activities are a business function to estimate the sales and use of products so that they can be made in the right quantities[4].

Distribution is the part responsible for planning, implementing, and controlling the flow of materials from producers to consumers with a profit. This movement or flow of materials consists of physical supply which is the movement and storage of raw materials from suppliers to manufacturers, and physical distribution which has the movement of finished goods from the factory to customers [5].

One of the right methods in supporting the fulfillment of the previous forecasting method is by taking into account the distribution system with the distribution requirement planning (DRP) method. Distribution Requirement Planning is an application of Material Requirement Planning (MRP) logic numbers. The Bill of Material (BOM) inventory in MRP is replaced with Bill of Distribution (BOD) in Distribution Requirement Planning (DRP) using Time Phased on Point (TPOP) logic to require the procurement of needs on the network[6]. Distribution Requirement Planning emphasizes scheduling activities more than booking activities[7]. Distribution Requirement Planning anticipates future needs by planning at every level of the distribution network [8]. PT XYZ is a company engaged in producing car safety parts with several departments that work together to achieve the company's goals. PT XYZ in planning its distribution needs is closely interconnected with the product forecasting process to maintain the distribution flow to distributors.

The forecasting process greatly affects the goods to be distributed, so the company needs to review the planning of distribution needs by considering the forecasting process so that there is no over-cost distribution during the distribution process. The distribution requirement planning method is applied in the process of determining distribution needs at PT XYZ with the purpose of this study to determine the application of forecasting that is suitable for use in Lever Assy products if PT XYZ applies the forecasting method and the application of its distribution planning needs with the Distribution Requirement Planning method.

Based on the research of [9] which discusses the determination of the distribution needs of wheat products with the distribution requirement planning method, it shows that the distribution requirement planning method is quite good and effective in determining the number of products distributed and planning schedules and deliveries on each line. The distribution requirement planning method also helps researchers in determining the lowest distribution costs. Based on research [10] that discusses the inventory control system in food companies with the distribution requirement planning method, it was found that the distribution requirement planning method proposes much more efficient distribution costs by paying attention to the product forecasting process. The purpose of this study is product forecasting and the implementation of Lever Assy distribution needs with the Distribution Requirement Planning method at PT XYZ.

2. Material and Methods

The object of this research is the 4L45W product at PT XYZ. In this study, the author carried out several stages, namely: identifying problems, understanding previous research, observation and data collection, and data analysis. Data collection is carried out by several techniques, namely literature studies, interviews, observations, and documentation. The interview was used to obtain data on the distribution system, and the third party logistics system on the 4L45W product. Documentation is used to obtain demand data on 4L45W products, as well as supporting data for distribution requirement planning methods, as well as company profiles.

Literature studies are used to find out primary and secondary data in research on the distribution requirement planning method, as well as observation to find out job issues in the delivery process. Data processing techniques using the distribution requirement planning method. Control is carried out on the processing of the data for the distribution process. Here are the steps to process the data:

- a. Collect historical data on 4L45W product orders from the period of January 2021 to December 2021, for forecasting processing[11].
- b. Collect data on distribution systems, lot sizes, safety stock, lead time, and policy lot sizes and so on for the processing of the Distribution Requirement Planning method.
- c. Collect Job Issue data based on 4 categories of people, systems, procedures, and products. for data processing of Fishbone diagrams and pareto diagrams.
- d. Data processing using Moving average, exponential smoothing, and Linear Regression methods.
- e. Analyze with Summary Forecasting to see the Mean Square Error (MSE), as data for the processing of the Distribution Requirement Planning method.
- f. Conducting forecasting tests with Tracking Signal and continued with the Distribution Requirement Planning method.
- g. Time Phased Net Requirement. The Net Requirement identifies when the inventory level (schedule Receipt + Projected on Hand of the previous period) is met by the Gross Requirement for a period: $\text{Net Requirement} = (\text{Gross Requirement} + \text{Safety Stock}) - (\text{Schedule Receipts} + \text{Projected on hand previously})$. The recorded Net Requirement value is a positive value.

- h. After that, a planned order is generated for the amount of the Net Requirement (a certain lot size) in that period.
- i. Determine the day on which the order must be placed (Planned Order Release) by subtracting the scheduled day of the Planned Order Receipts by the lead time.
- j. Projected On Hand in that period. Projected On Hand (Projected On Hand Previous Period + Schedule Receipt + Planned Order Receipts) – (Gross Requirement).
- k. The magnitude of the Planned Order Release becomes the Gross Requirement in the same period for the next level of the distribution network.
- l. Calculate the cost of Bill of Distribution and analyze the pareto chart and fishbone chart from other data.

3. Results and Discussion

Forecasting

The forecasting data processing model uses the exponential smoothing method with the type of double exponential smoothing and moving average.

a. Calculation of double exponential smoothing method

Data processing of the double exponential smoothing (DES) method was carried out using the setting of $\alpha = 0.4; 0.6; 0.8$ with the help of the Microsoft Excel application in **Table 1–3** is obtained with the following formula:

$$F_{t+1} = \alpha X_t + (1 - \alpha)F_1 \quad (1)$$

Table 1. Double Exponential Smoothing at 4L45W A1

Periode	(x)	F, $\alpha=0,4$	F, $\alpha=0,6$	F, $\alpha=0,8$
1	1444			
2	1440	1441	1439	1438
3	3084	2755	3412	3740
4	2600	2893	3028	2948
5	1440	1968	1421	1082
6	1920	1935	1747	1762
7	1470	1560	1321	1270
8	1680	1579	1559	1618
9	2870	2554	3068	3346
10	1540	1891	1642	1406
11	2330	2229	2325	2403
12	1820	1958	1824	1743
MSE		216	3623	8040

Resource: (Author, 2023)

Table 2. Double Exponential Smoothing at 4L45W A2

Periode	(x)	F, $\alpha=0,4$	F, $\alpha=0,6$	F, $\alpha=0,8$
1	4140			
2	3630	3732	3528	3324
3	4922	4602	5017	5554
4	5690	5581	6143	6468
5	4070	4655	4216	3414
6	5260	5180	5283	5616
7	3702	4135	3576	2983
8	4520	4344	4330	4647
9	5340	5104	5503	5944
10	5320	5399	5608	5577
11	3710	4205	3589	2822
12	2300	2567	1618	1024
MSE		368807	319639	191576

Resource: (Author, 2023)

Table 3. Double Exponential Smoothing at 4L45W A3

Periode	(x)	F, $\alpha=0,4$	F, $\alpha=0,6$	F, $\alpha=0,8$
1	3380			
2	2238	2466	2010	1553
3	3336	2979	3190	3675
4	2974	2931	2997	2964
5	3244	3137	3282	3374
6	3054	3076	3086	3003
7	2150	2328	1958	1574
8	2570	2366	2351	2558
9	3346	3033	3424	3846
10	1890	2158	1820	1248
11	884	996	382	-55
12	404	175	-244	-274
MSE		218279	34915	1032

Resource: (Author, 2023)

After processing double exponential smoothing data, it is followed by the use of the moving average method and described in the form of graphics to find out the right forecasting method to determine the distribution needs that describe the actual in the field [12].

Table 4. Double Exponential Smoothing at 4L45W A1

		Method			
t		MA(2)	MA(2x3)	SSE(MA2)	SSE(MA2x3)
1	1444				
2	1440	1442		4	
3	3084	2262		675684	
4	2600	2842	2182	58564	174724
5	1440	2020	2375	336400	873602
6	1920	1680	2181	57600	67947
7	1470	1695	1798	50625	107803
8	1680	1575	1650	11025	900
9	2870	2275	1848	354025	1043803
10	1540	2205	2018	442225	228803
11	2330	1935	2138	156025	36736
12	1820	2075	2072	65025	63336
Total	23638	22006	18262	2207202	2597653

Resource: (Author, 2023)

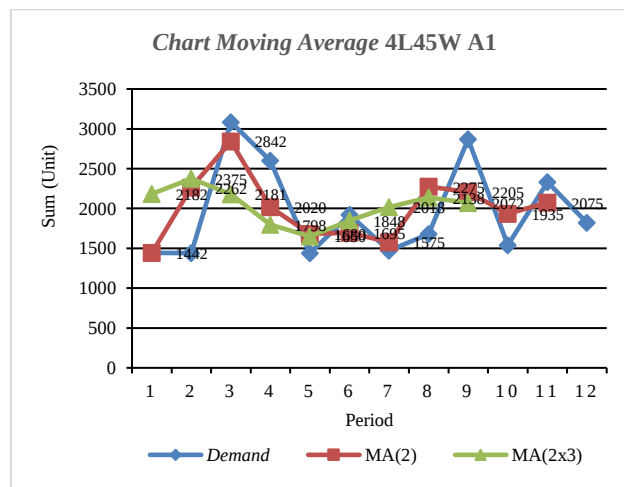


Figure 1. Chart Moving Average 4L45W A1
Resource: (Author, 2023)

Table 5. Moving Average 4L45W A2

		Method			
t		MA(2)	MA(2x3)	SSE(MA2)	SSE (MA2x3)
1	4140				
2	3630	3885		65025	
3	4922	4276		417316	
4	5690	5306	4489	147456	1442401
5	4070	4880	4821	656100	563500
6	5260	4665	4950	354025	95893
7	3702	4481	4675	606841	947378
8	4520	4111	4419	167281	10201
9	5340	4930	4507	168100	693334
10	5320	5330	4790	100	280547
11	3710	4515	4925	648025	1476225
12	2300	3005	4283	497025	3933611
Total	52604	49384	41860	3727294	9443090

Resource: (Author, 2023)

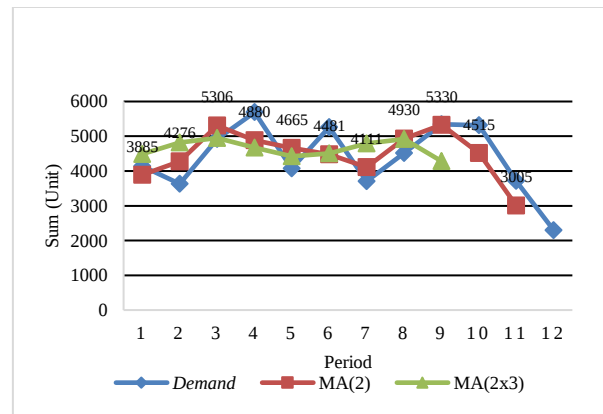


Figure 2. Chart Moving Average 4L45W A2
Resource: (Author, 2023)

Table 6. Moving Average 4L45W A3

		Method			
t		MA(2)	MA(2x3)	SSE(MA2)	SSE(MA2x3)
1	3380				
2	2238	2809		326041	
3	3336	2787		301401	
4	2974	3155	2917	32761	3249
5	3244	3109	3017	18225	51529
6	3054	3149	3138	9025	7000
7	2150	2602	2953	204304	645344
8	2570	2360	2704	44100	17867
9	3346	2958	2640	150544	498436
10	1890	2618	2645	529984	570528
11	884	1387	2321	253009	2064969
12	404	644	1550	57600	1312552
Total	29470	27578	23885	1926994	5171475

Resource: (Author, 2023)

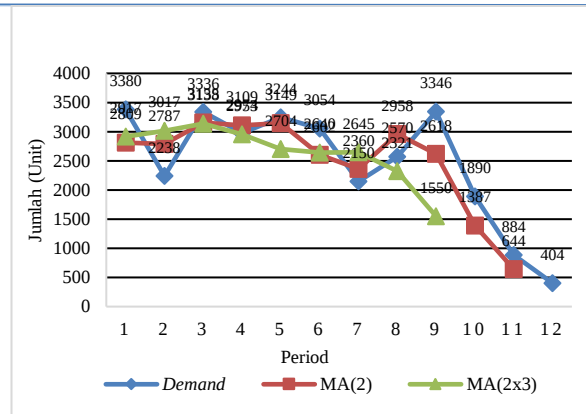


Figure 3. Chart Moving Average 4L45W A3
Resource: (Author, 2023)

The next step is to find the smallest error value (MSE) to verify the forecast data. The smallest MSE value was obtained as an indicator that the actual value and forecasting were quite accurate with 4L45W A1 at DES 0.4, 4L45W A2 at MA (2x2), and 4L45W A3 DES (0.8) as shown in **Table 7**.

Table 7. 4L45W Forecasting Data Verification

Verification of Forecasting Data		
4L45W A1 DES (0,4)	4L45W A2 MA (2X2)	4L45W A3 DES 0,8
1441	3885	1553
2755	4276	3675
2893	5306	2964
1968	4880	3374
1935	4665	3003
1560	4481	1574
1579	4111	2558
2554	4930	3846
1891	5330	1248
2229	4515	-55
1958	3005	-274

Resource: (Author, 2023)

After obtaining the forecast data with the smallest error value, the next step is to find out whether the forecast data is uniform through testing the tracking signal on each forecast data that has been selected with the help of the Microsoft Excel application, as shown in **Tables 8–10** and **Figure 4–6** [13].

Table 8. Tracking Signal Calculation on 4L45W A1

n	A	F	RSFE				MAD	TS
1	1.444	1441	3	3	3	3	3	1
2	1.440	2755	-1315	-1312	1315	1318	659	-2
3	3.084	2893	191	-1121	191	1509	503	-2
4	2.600	1968	632	-489	632	2141	535	-1
5	1.440	1935	-495	-984	495	2635	527	-2
6	1.920	1560	360	-624	360	2995	499	-1
7	1.470	1579	-109	-733	109	3104	443	-2
8	1.680	2554	-874	-1607	874	3978	497	-3
9	2.870	1891	979	-628	979	4956	551	-1
10	1.540	2229	-689	-1317	689	5645	565	-2
11	2.330	1958	372	-945	372	6017	547	-2

Resource: (Author, 2023)

Table 9. Tracking Signal Calculation on 4L45W A2

n	A	F	RSFE				MAD	TS
1	4.140	3885	255	255	255	255	255	1
2	3.630	4276	-646	-391	646	901	451	-1
3	4.922	5306	-384	-775	384	1285	428	-2
4	5.690	4880	810	35	810	2095	524	0
5	4.070	4665	-595	-560	595	2690	538	-1
6	5.260	4481	779	219	779	3469	578	0
7	3.702	4111	-409	-190	409	3878	554	0
8	4.520	4930	-410	-600	410	4288	536	-1
9	5.340	5330	10	-590	10	4298	478	-1
10	5.320	4515	805	215	805	5103	510	0
11	3.710	3005	705	920	705	5808	528	2

Resource: (Author, 2023)

Table 10. Tracking Signal Calculation on 4L45W A3

n	A	F	RSFE				MAD	TS
1	3.380	3885	-505	-505	505	505	505	-1
2	2.238	4276	-2038	-2543	2038	2543	1272	-2
3	3.336	5306	-1970	-4513	1970	4513	1504	-3
4	2.974	4880	-1906	-6419	1906	6419	1605	-4

Resource: (Author, 2023)

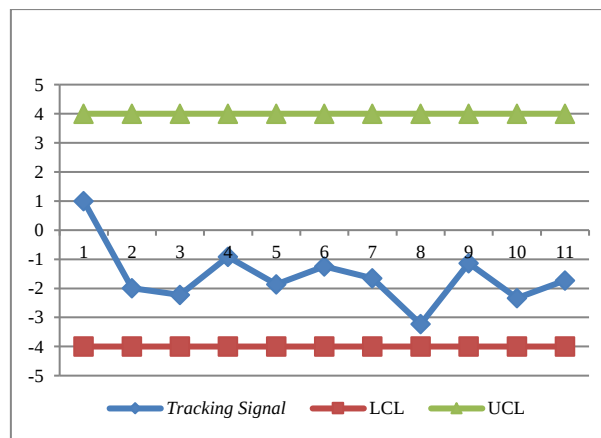


Figure 4. Chart Tracking Signal 4L45W A1
Resource: (Author, 2023)

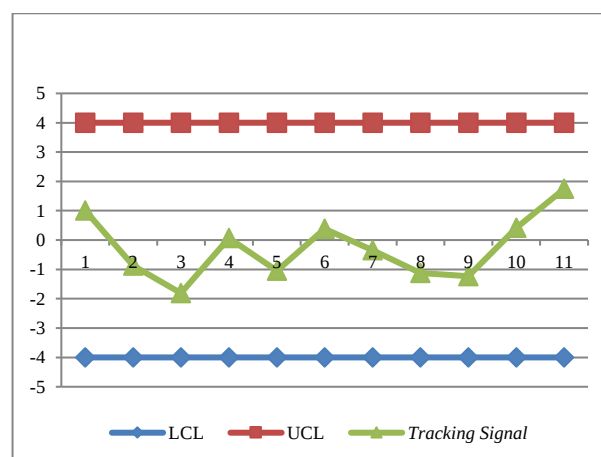


Figure 5. Chart Tracking Signal 4L45W A2
Resource: (Author, 2023)

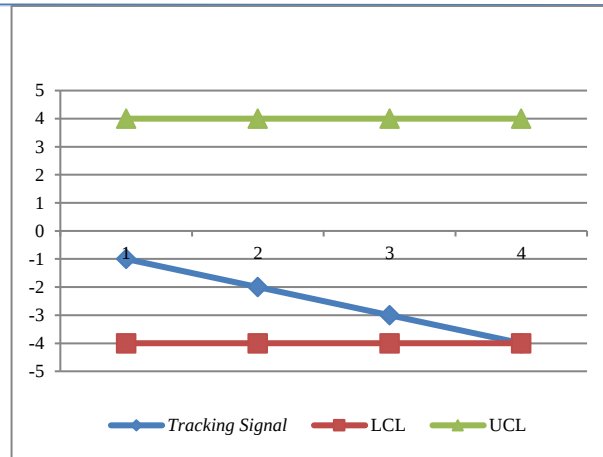


Figure 6. Chart Tracking Signal 4L45W A3
Resource: (Author, 2023)

Based on **Tables 8–10** and **Figures 4–6**, it can be seen that for 4L45W A1 and 4L45W A2 all data are uniform, while in 4L45W A3 there are 7 data that cannot be used and there are 4 data that can be used for the calculation of the next method.

Distribution Requirement Planning

The distribution requirement planning method is used to determine distribution needs by considering the forecast results that have been obtained previously[14]. Tables 11–13 explain the results of distribution requirement planning with planned order realization into gross requirements in the next distribution period so that the distribution cost of each 4L45W product can be determined.

Table 11. Distribution Requirement Planning at 4L45W A1

DISTRIBUTION REQUIREMENT PLANNING												
Part No	1										QTY	1
Part Name	4L45W A1										Project On Hand	100
Lead Time	2										Order Policy	LFL
Safety Stock	0										Lot Size	120
											Schedule Receipt	0
	Due Date	Periode										
		1	2	3	4	5	6	7	8	9	10	11
Gross Requirement		1441	2755	2893	1968	1935	1560	1579	2554	1891	2229	1958
Schedule Receipt												
PAB I		-1441	-2636	-2889	-1857	-1872	-1512	-1531	-2525	-1776	-2085	-1883
Net Requirement		1441	2636	2889	1857	1872	1512	1531	2525	1776	2085	1883
PO Receipt		1560	2640	3000	1920	1920	1560	1560	2640	1920	2160	1920
PO Release		2640	3000	1920	1920	1560	1560	2640	1920	2160	1920	0
PAB II		119	4	111	63	48	48	29	115	144	75	37

Resource: (Author, 2023)

Table 12. Distribution Requirement Planning at 4L45W A2

DISTRIBUTION REQUIREMENT PLANNING												
Part No	2										QTY	1
Part Name	4L45W A2										Project On Hand	100
Lead Time	2										Order Policy	LFL
Safety Stock	0										Lot Size	180
											Schedule Receipt	0
	Due Date	Periode										
		1	2	3	4	5	6	7	8	9	10	11
Gross Requirement		3885	4276	5306	4880	4665	4481	4111	4930	5330	4515	3005
Schedule Receipt												
PAB I		-3885	-4201	-5187	-4847	-4652	-4453	-4064	-4854	-5324	-4439	-2944
Net Requirement		3885	4201	5187	4847	4652	4453	4064	4854	5324	4439	2944
PO Receipt		3960	4320	5220	4860	4680	4500	4140	4860	5400	4500	3060
PO Release		5220	4860	4680	4500	4140	4860	5400	4500	3060	0	0
PAB II		75	119	33	13	28	47	76	6	76	61	116

Resource: (Author, 2023)

Table 13. Distribution Requirement at 4L45W A3

DISTRIBUTION REQUIREMENT PLANNING					
Part No	3	QTY	1		
Part Name	4L45W A3	Project On Hand	100		
Lead Time	2	Order Policy	LFL		
Safety Stock	0	Lot Size	180		
		Schedule Receipt	0		
	Due Date	Periode			
		1	2	3	4
Gross Requirement		1553	3675	2964	3374
Schedule Receipt					
PAB I		-1553	-3608	-2792	-3285
Net Requirement		1553	3608	2792	3285
PO Receipt		1620	3780	2880	3420
PO Release		2880	3420	0	0
PAB II		67	172	88	135

Resource: (Author, 2023)

Distribution Fees

Distribution costs are costs incurred consisting of delivery costs + transportation costs + order costs. In this study, a comparison of distribution costs was carried out between the methods commonly used by companies and the distribution requirement planning method to obtain more efficient distribution costs [15].

Table 14. Company Method Order Fee

Plant Product	Frequency Purchase Order (Cycle)	Order Fee	Total
MMKI A1	30	Rp250.000	Rp7.500.000
MMKI A2	30	Rp300.000	Rp9.000.000
MMKI A3	30	Rp200.000	Rp6.000.000
Total			Rp22.500.000

Resource: (Author, 2023)

Table 15. Transportation and Shipping Costs

Entity Cost	Cost	Qty	Total
Delivery Cost	Rp114.500	1	Rp114.500
Transportation Cost	Rp7.000.000	7	Rp49.000.000
Total			Rp49.114.500

Resource: (Author, 2023)

$$Total\ Cost\ (TC) = DC + tC + OC \quad (2)$$

The results of the calculation using the company's method show that the distribution cost in 2021 for all plants is IDR 71,614,500. In the distribution requirement planning method, the order cost is obtained by using the Distribution Requirement Planning method by looking at the planned order release 5 cycles per container to meet 1 month of demand for each product, then, the order cost in 12 months can be minimized in 5 cycles in **Table 16**.

Table 16. Distribution Requirement Planning Method Message Cost

Plant Product	Frequency Purchase Order (Cycle)	Order fee	Total
MMKI A1	5	Rp250.000	Rp1.250.000
MMKI A2	5	Rp300.000	Rp1.500.000
MMKI A3	5	Rp200.000	Rp1.000.000
Total			Rp3.750.000

Resource: (Author, 2023)

By using the distribution requirement planning method, a grand total distribution cost of = IDR 49,114,500 + IDR 3,750,000 = IDR 52,864,500 in 2021 for all plants.

Comparison of Distribution Costs

After obtaining the results of the distribution cost calculation, the next step is to compare the distribution costs incurred by the company with the distribution costs calculated by the Distribution Requirement Planning (DRP) method[16].

The planning and scheduling of distribution carried out in this study aims to be able to plan and control the distribution system from the company to the warehouse, so that it can anticipate the occurrence of stock out and over stock in the inventory, as well as optimize the product distribution system. A comparative recapitulation of product distribution costs in 2021 is presented in **Table 17** below.

Table 17. Comparative Recapitulation of the Two Methods

Criterion	Company Method	Method DRP	Difference
Delivery	30	5	25
Delivery interval	Less organized	More organized	-
Distribution Costs	Rp71.614.500	Rp52.864.500	Rp18.750.000

Resource: (Author, 2023)

Table 17 shows that the total distribution cost using the company method is IDR 71,614,500, greater than the distribution cost calculated by the Distribution Requirement Planning method, which is IDR 52,864,500. Based on these results, the difference between the two methods is obtained = IDR 71,614,500 – IDR 52,864,500 = IDR 18,750,000.

Based on the difference in these figures, we can find out the percentage of profit that the company gets if using the distribution requirement planning method, which is = $(\text{IDR } 71,614,500 - \text{IDR } 52,864,500) / (\text{IDR } 71,614,500) \times 100\% = 26\%$. Thus, the Distribution Requirement Planning method can be considered to be chosen to plan and schedule the distribution of plant products from the three products

4. Conclusion

Based on the results and discussion above, the results of forecasting were obtained by calculating using 2 methods, namely: the exponential smoothing method and the moving average method on the 4L45W product. The most optimal forecasting method for 4L45W A1 products is the DES 0.4 method; the 4L45W A2 product uses MA (2x2), and for the 4L45W A3 product uses DES 0.8. The results are obtained based on making decisions on the smallest mean square error value to get accurate forecasting on each method.

The calculation using the Distribution Resource Planning method results in distribution costs that are lower than the distribution costs used by the company with a difference of IDR 18,750,000 or in a percentage of 26%. Several proposals have been made to improve the problems related to distribution costs in XYZ company by considering four influential factors, namely people, systems, procedures, and products.

5. References

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