Raw Material Planning and Control with MRP Method to Maintain Accurate Production Amounts in UKM Allwooden Woodworking

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Abstract—**Allwooden Woodworking is a Micro and Small Enterprise (MSE) which is an entrepreneurship in the production of furniture, such as tables, chairs, and cupboards. These MSEs focus on the selection of good and quality raw materials. This study aims to find out when raw materials in MSE can be available at the right time with the amount according to the demand of suppliers. The method used in this research is Material Requirement Planning (MRP). The results obtained from this study are in the form of planning and controlling raw materials that contain scheduling material purchases and product manufacture regularly and determining the size of an economical order of raw materials to avoid product overstock.**

Keywords: **Raw Materials; Entrepreneurship; Material Requirement Planning; MSE**

I. INTRODUCTION

The production process is largely determined by the availability of raw materials. If the company does not have enough raw materials, it will have difficulty meeting consumer needs. Production runs smoothly if the company's management can plan and control the inventory of raw materials properly. According to [1], inventory control is an activity that is a sequence of each other to plan time, quantity, quality, and costs. Inventories are deposits of materials in the form of raw materials, materials in process, and finished goods. From the company's point of view, inventory is an investment capital to store materials under certain conditions [2].

All wooden Woodworking is a Small and Micro Enterprise (SME) that is an entrepreneurship in the production of table furniture, chairs, and cupboards. These SMEs focus on the selection of good and quality raw materials. Due to the high market demand, these SMEs produce furniture in various forms according to the wishes of consumers. Availability of raw materials in SMEs is often a problem due to not doing the planning properly. This happens because these SMEs do the recording and scheduling of production manually. The problem that often arises is the difference in the recording which results in a shortage or excess of the ordered raw materials.

The purpose of this research is to find out when raw materials in Allwooden Woodworking SMEs can be available at the right time with the amount requested to the supplier through the application of the Material Requirement Planning (MRP) Method.

II. LITERATURE REVIEW

Planning is an attempt to set goals. Production planning aims to carry out special planning in the field of production [3]. According to [4], planning has an important meaning for all activities carried out by the company, using methods to achieve these goals.

Control is supervision which at the same time can take some action for the necessary improvement. The control function is to carry out supervision of workers in the company including data collection as useful input to determine follow-up actions in future improvement efforts [4].

Inventory is an activity that includes goods belonging to the company with the intent to sell in a certain period as well as material supplies that are still there [5]. According to [6], inventory is one of the important things for an entity for both manufacturing and services.

Inventory control is an activity from a sequence that is closely related according to what has been planned in terms of time, quantity, quality, or cost [1]. The purpose of inventory control, among others, is so that the company does not run out of raw materials which can result in the cessation of production activities, to

maintain the availability of raw materials in quantities that are not excessive, and to control ordering costs.

A. Production Planning and Inventory Control (PPIC)

Production Planning and Inventory Control (PPIC) is the process of entering and leaving materials in a working system to meet market demand and proper distribution to minimize production costs. Production planning and control are carried out at the beginning of the process before carrying out production activities, aiming to determine what must be done from beginning to end. Planning and control activities should not stop until the process is complete so that the results are as expected. According to [7], PPIC is the part that has the general task of receiving orders from the marketing department and ensuring that the orders have been completed and delivered to consumers on time.

B. Demand Forecasting

Forecasting is the art and science of predicting future events. To overcome demand forecasting problems, it is necessary to use enhanced data to anticipate potential declines orincrease sales shortly and develop strategies that companies must take to overcome certain conditions [8]. According to [39], forecasting is one of the activities that are considered capable of being used as the basis for making a company's product strategy. Forecasting is a form of business by applies various approaches, both qualitative and quantitative. Forecasting drives decisions so managers need immediate and accurate information about actual demand. Accurate forecast result has several important criteria, namely: The accuracy of a forecasting result is measured by the results of the habit and the consistency of the forecast. [10]

C. Material Requirement Planning

Material Requirement Planning or MRP is a technique or tool for determining the right material requirements by using several input data such as a list of raw material requirements, inventory data, receiving schedules, and master production schedules. Meanwhile, according to [10], MRP is one of the concepts for planning the requirements of the right goods in the production process. The purpose of MRP is to reduce inventory, reduce lead times, deliver on time, and improve production system efficiency. In addition, the purpose of using the MRP method is to find the right way to regulate product requirements in the production process according to needs so that the required products can be fulfilled on time [10]. So, it can be concluded that MRP is a technique for planning and scheduling raw materials used for the production process according to material requirements, inventories, estimated receipts, and production schedules. The use of MRP can provide information about how much and when a required raw material will be ordered. So that it can always be available when needed when production is running.

III. METHODOLOGY

The planning and control of raw materials in this study uses the Material Requirement Planning (MRP) method. In the MRP system, the costs used can be minimized every month to save production costs. With this MRP system, the direct impact that can be felt is to expedite the production process and increase efficiency because at the same time more results will be obtained. In addition, MRP helps to schedule raw material inventory to make it easier to operate and increase product delivery commitments to consumers.

Demand for items is divided into two types, namely independent and dependent requests. Independent demand is the demand for items that are not influenced by market factors. While dependent demand occurs if the demand for the item is influenced by demand for other items (Kusuma, 2017). MRP is a method designed to schedule production into a net requirement of all items. MRP was developed to assist companies in addressing item requirements effectively and efficiently.

IV. RESULT

A. Bill of Material

The planning and control of raw materials in this study uses the Material Requirement Planning (MRP) method. In the MRP system, the costs used can be minimized every month to save production costs. With this MRP system, the direct impact that can be felt is to expedite the production process and increase efficiency because at the same time more results will be obtained. In addition, MRP helps to schedule raw material inventory to make it easier to operate

and increase product delivery commitments to consumers.

B. Demand Forecasting

Demand forecasting is done by projecting historical data from product demand. Historical data is obtained from recap data or databases from companies. By processing historical data, it is hoped that the pattern of demand for a product can be read and accurately predicted. The methods used in predicting demand patterns include the moving average method, simple exponential smoothing, and holts.Of those three methods, the better method was chosen among the others. The choice of method is done by calculating the forecast error of each method. forecast error that is used as a parameter for choosing the method, among others, is MSE, MAD, and MAPE.

Table 1. Bill of Material

Item	Material	Quantity	Dimensions	Decision
Frame	Slimar Wood	1	680 x 5 x 5 = 17000 cm^3 = 0,017 m^3	Make
Cushion	Pallet	1	5 pcs	Make
Back support	Pallet	1	1 pcs	Make
Sending Sealer	Solvent Based	1	200 ml	Buy
Melamine	Pernis	1	200 ml	Buy
Paint	-	1	250 ml	Buy
Hardener	Epoxy	1	20 ml	Buy
Thinner	-	1	750 ml	Buy
Glue	PVAC	1	100 ml	Buy
Nail Gun	Annular Ring Nail	1	24 pcs	Buy
Putty	Sunpolac	1	100 gr	Buy
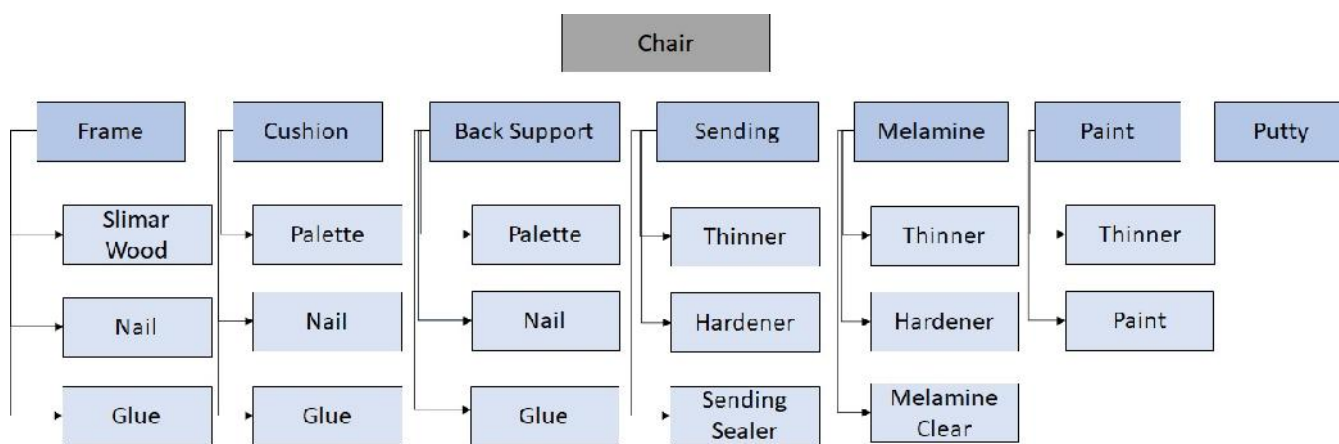
Figure 1. Bill of Material

Table 2 : Demand Forecast Moving Average

Period (n)	Demand (Dt)	Lt	Ft	Et	$(Et)^2$	At	(Et/Dt)	
1	40							
2	48							
3	40	42.7						
4	44	44.0	43	-1.33	1.78	1.33	-0.03030303	0.030303
5	48	44.0	44	-4	16	4	-0.08333333	0.083333
6	40	44.0	44	4	16	4	0.1	0.1
7	40	42.7	44	4	16	4	0.1	0.1
8	56	45.3	43	-13.3333	177.8	13.33333	-0.23809523	0.238095
9	52	49.3	45	-6.66667	44.44	6.666667	-0.12820512	0.128205
10	42	50.0	49	7.333333	53.78	7.333333	0.17460317	0.174603
11			50					

Table 3: Demand Forecast Simple Exponential Smoothing

Period (n)	Demand (Dt)	Lt	Ft	Et	$(Et)^2$	At	(Et/Dt)	
0		45						
1	40	44.5	45	5	25	5	0.125	0.125
2	48	44.85	44.5	-3.5	12.25	3.5	-0.07292	0.072917
3	40	44.365	44.85	4.85	23.5225	4.85	0.12125	0.12125
4	44	44.3285	44.365	0.365	0.133225	0.365	0.008295	0.008295
5	48	44.69565	44.3285	-3.6715	13.47991	3.6715	-0.07649	0.07649
6	40	44.22609	44.69565	4.69565	22.04913	4.69565	0.117391	0.117391
7	40	43.80348	44.22609	4.226085	17.85979	4.226085	0.105652	0.105652
8	56	45.02313	43.80348	-12.1965	148.7552	12.19652	-0.2178	0.217795
9	52	45.72082	45.02313	-6.97687	48.67673	6.976871	-0.13417	0.134171
10	42	45.34873	45.72082	3.720816	13.84447	3.720816	0.088591	0.088591
11			45.34873					

Table 4: Demand Forecast Holts

Period (n)	Demand (Dt)	Lt	Tt	Ft	Et	$(Et)^2$	At	(Et/Dt)	
0		41.46667	0.642424						
1	40	41.89818	0.600242	42.10909	2.109091	4.448264	2.109091	0.052727	0.052727
2	48	43.04858	0.710274	42.49842	-5.50158	30.26734	5.501576	-0.11462	0.114616
3	40	43.38297	0.635097	43.75886	3.758856	14.129	3.758856	0.093971	0.093971
4	44	44.01626	0.634735	44.01807	0.018067	0.000326	0.018067	0.000411	0.000411
5	48	44.9859	0.701716	44.651	-3.349	11.21583	3.349004	-0.06977	0.069771
6	40	45.11885	0.587963	45.68761	5.687612	32.34893	5.687612	0.14219	0.14219
7	40	45.13613	0.473827	45.70681	5.706814	32.56773	5.706814	0.14267	0.14267
8	56	46.64896	0.681628	45.60996	-10.39	107.9529	10.39004	-0.18554	0.185536
9	52	47.79753	0.775016	47.33059	-4.66941	21.80338	4.669409	-0.0898	0.089796
10	42	47.91529	0.643565	48.57255	6.572548	43.19839	6.572548	0.156489	0.156489
11				48.55886					
12				49.20242					
13				49.84599					

Table 5 : Forecast Error Comparison

Error	MA	SES	HOLTS
MSE	47	32.46	29.79
MAD	5.81	4.92	4.77
MAPE	12.20	10.68	10.48

Table 6 : Master Production Scheduling

Month	Weekly Needs (Upper Approximation)				TOTAL
	1	2	3	4	
1	13	13	13	13	49
2	13	13	13	13	50
3	13	13	13	13	50

Table 7: On Hand Value, Lead Time, Lot Size

Level	Item	On Hand	Lead Time	Lot Size
			(Period)	
0	Chair	0	1	1
1	Frame	0	1	1
2	Slimar Wood (m3)	0.03	1	0.005
2	Nail (pcs)	60	1	30
1	Cushion	0	1	1
2	Palette (pcs)	0	1	1000
2	Nail (pcs)	24	1	30
2	Glue (pcs)	4580	1	5000
1	Back Support	0	1	1
2	Palette (pcs)	310	1	1000
2	Nail (pcs)	24	1	30
2	Glue (pcs)	0	2	5000
1	Sending	0	1	1
2	Thinner (ml)	5000	1	5000
2	Hardener (ml)	5000	1	5000
2	Sending Sealer (ml)	5000	1	5000
1	Melamine	0	1	1
2	Thinner (ml)	3600	1	5000
2	Hardener (ml)	2240	1	5000
2	Sending Sealer (ml)	5000	1	5000
1	Paint	0	1	5000
2	Thinner (ml)	4100	1	5000
2	Paint (ml)	5000	1	5000
1	Putty (gr)	5000	1	5000

Table 8: Material Purchase Planning

Month	Week	Item	Quantity	Decision
1	0	Slimar Wood	$0{,}055 \text{ m}^3$	Buy
		Nail (540+480+90) (pcs)	1.110 pcs	Buy
		Palette (pcs)	1.000 pcs	Buy
		Thinner (10.000+15.000+15.000) (ml)	40.000 ml	Buy
		Sending Sealer (ml)	5.000 ml	Buy
		Glue (ml)	5.000 ml	Buy
		Melamine Clear (ml)	5.000 ml	Buy
		Paint (ml)	10.000 ml	Buy
	1	Frame (pcs)	49 pcs	Make
		Cushion (pcs)	49 pcs	Make
		Back support (pcs)	49 pcs	Make
		Sending (ml)	5.000 ml	Buy
	2	Melamine (ml)	5.000 ml	Buy
2	0	Chair (pcs)	49 pcs	Make
		Slimar Wood	$0{,}085 \text{ m}^3$	Buy
		Nail (600+510+90) (pcs)	1.200 pcs	Buy
		Thinner (15.000+10.000+15.000) (ml)	40.000 ml	Buy
		Sending Sealer (ml)	10.000 ml	Buy
		Melamine Clear (ml)	10.000 ml	Buy
		Paint (ml)	10.000 ml	Buy
	1	Frame (pcs)	50 pcs	Make
		Cushion (pcs)	50 pcs	Make
		Back Support (pcs)	50 pcs	Make
		Sending (ml)	10.000 ml	Buy
		Melamine (ml)	10.000 ml	Buy

	2	Putty (gr)	5.000 gr	Buy
3	0	Chair (pcs)	50 pcs	Make
		Slimar wood	0,085 m^3	Buy
		Nail (600+510+120) (pcs)	1.230 pcs	Buy
		Glue (5.000+5.000) (ml)	10.000 ml	Buy
		Thinner (15.000+15.000+15.000) (ml)	45.000 ml	Buy
		Sending Sealer (ml)	10.000 ml	Buy
		Melamine Clear (ml)	10.000 ml	Buy
		Paint (ml)	15.000 ml	Buy
	1	Frame (pcs)	50 pcs	Make
		Cushion (pcs)	50 pcs	Make
		Back support (pcs)	50 pcs	Make
		Sending (ml)	10.000 ml	Buy
		Melamine (ml)	10.000 ml	Buy
		Putty (gr)	5.000 gr	Buy
	2	Chair (pcs)	50 pcs	Make

Table 9: Material Purchase Cost

Month	Week	Item	Quantity	Unit Price (Rp)	Total (Rp)
1	0	Slimar wood	0,055 m^3	15.000	825.000
		Nail	1.110 pcs	550	610.500
		Palette	1.000 pcs	6.000	6.000.000
		Thinner	40.000 ml	75.000	600.000
		Sending Sealer	5.000 ml	330.000	330.000
		Glue	5.000 ml	165.000	165.000
		Melamine Clear	5.000 ml	330.000	330.000
		Paint	10.000 ml	270.000	270.000

2	0	Slimar wood	0,085 m^3	15.000	1.275.000
		Nail	1.200 pcs	550	660.000
		Thinner	40.000 ml	75.000	600.000
		Sending Sealer	10.000 ml	330.000	660.000
		Melamine Clear	10.000 ml	330.000	660.000
		Paint	10.000 ml	270.000	810.000
	1	Putty	5.000 gr	65.000	65.000
3	0	Slimar wood	0,085 m^3	15.000	1.275.000
		Nail	1.230 pcs	550	676.500
		Glue	10.000 ml	165.000	330.000
		Thinner	45.000 ml	75.000	600.000
		Sending Sealer	10.000 ml	330.000	660.000
		Melamine Clear	10.000 ml	330.000	660.000
		Paint	15.000 ml	270.000	810.000
	1	Putty	5.000 gr	65.000	65.000

C.   Forecast Error Comparation
From Table 5, the HOLTS method has the smallest Mean Absolute Deviation (MAD) value of 4.77. This shows that forecasting is done using the HOLTS method to get more accurate results.

D. Master Production Scheduling
Master production scheduling is a component of the production schedule obtained from the disaggregation of product requirements at a certain period. In this research, Master Production Schedule is derived from demand forecasting by leveling needs every week.

From table 6, the weekly needs approximation for production quantity is 13 each week.

E. Material Requirement Planning
In processing the material requirements planning data, it is necessary to make assumptions that are obtained by brainstorming with the owner of the company. The assumptions determined include assumptions about the lead time of material arrival, lot size, and the amount of existing stock owned by the company. Those assumptions are explained in Table 7.   The output of the Material Requirement Planning model is material purchase planning, which includes the amount and when the material should be purchased. The materials purchase plan is shown in Table 8.After determining the amount of material to be purchased, then calculate the estimated cost to be incurred in purchasing the material for a

certain period. The prediction of the material

V. CONCLUSION

By applying the Material Requirement Planning (MRP) method through the stages of making a Bill of Materials (BOM), demand forecasting, production planning using the Master Production Schedule (MPS), and scheduling material requirements for chair products, Allwooden Woodworking SMEs can find out when Raw materials in these SMEs can be available at the right time in the amount according to the supplier's request. This is very useful for maintaining the accuracy of the amount of production.

Raw materials at Allwooden Woodworking UKM canbe available at the right time and quantity, namely:

a) In the first month of week zero, it requires the procurement of materials in the form of Slimar Wood (0.055 m3), Nails (1,110 pcs), Pallets (1,000 pcs), Thinner (40,000 ml), Sending Sealer (5,000 ml), Melamine Clear (5,000 ml) , and Paint (10,000 ml).

b) In the first month of the first week, it requires the procurement of materials in the form of Frame (49 pcs), Sitting Mat (49 pcs), Backrest (49 pcs), Sending (5,000 ml), and Melamine (5,000 ml).

c) In the first month of the second week, it requires the procurement of materials in the form of Chairs (49 pcs).

d) In the second month of week zero, it requires the procurement of materials in the form of Slimar Wood (0.085 m3), Nails (1,200 pcs), Thinner (40,000 ml),

purchase cost is shown in Table 9. Sending Sealer (10,000 ml), Melamine Clear (10,000 ml), and Paint (10,000 ml).).

e) In the second month of the first week, it requires the procurement of materials in the form of Frame (50 pcs), Sitting Mat (50 pcs), Backrest (50 pcs), Sending (10,000 ml), Melamine (10,000 ml), and Putty (5,000 gr).

f) In the second month of the second week, it requires the procurement of materials in the form of Chairs (50 pcs).

g) In the third month of week zero, it requires the procurement of materials in the form of: Slimar Wood (0.085 m3), Nails (1,230 pcs), Glue (10,000 ml), Thinner (45,000 ml), Sending Sealer (10,000 ml), and Melamine Clear (10,000 ml).).

h) In the third month of the first week, it requires the procurement of materials in the form of Frame (50 pcs), Sitting Mat (50 pcs), Backrest (50 pcs), Melamine (10,000 ml), and Putty (5,000 gr).

i) In the third month of the second week, it requires the procurement of materials in the form of Chairs (50 pcs).

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REFERENCES

[1] Ahyari, "Manajemen Produksi Perencanaan Sistem Produksi", Fourth Edition, Lembaga FE Universitas Gadjah Mada Publisher, Yogyakarta, 2014.

[2] B. Alexandri, "Manajemen Keuangan Bisnis", Second Edition, Alfabeta Publisher, Bandung, 2009.

[3] S. Assauri, "Manajemen Produksi dan Oprasi", Revision Edition, Lembaga Penerbit FE UI, Jakarta, 2004.

[4] D. Ferdinan, H. Bambang, dan E. Sutomo, 2016,"Rancang Bangun Sistem Informasi Perancangan Bahan Baku Menggunakan Metode Material Requirement Planning Pada Perusahaan Mebel", Surabaya, 2016.

[5] L. Sumayang, "Dasar-Dasar Manajemen Produksi dan Operasi", Salemba Empat Publisher, Jakarta, 2003.

[6] D. Martani, "Akuntansi Keuangan Menengah Berbasis PSAK", 2nd Edition Book, Salemba Empat Publisher, Jakarta, 2016.

[7] R. Reksohadiprodjo, "Perencanaan dan Pengawasan Produksi", Lembaga Penerbit

.

FE Universitas Gadjah Mada, Yogyakarta, 1983.

[8] Rangkuti,F, "Manajemen Persediaan" , PT. Gramedia Pustaka Utama, Jakarta 2005.

[9] Martha, K. A., & Setiawan, P. Y., "Analisis Material Requirement Planning Produk Coconut Sugar pada Kul-Kul Farm", E-Jurnal Manajemen, 7 (12), 6532-6560

[10] Hindarto, Ribka P., & Dalulia, Primahasmi., "Perencanaan Kebutuhan Material Untuk Produk Disposable Protective Mask Selama Pandemi Covid 19 di Kota Malang", Journal of Industrial View, Volume 03, No 01 Mei 2021 Page35-42.