Formosa Journal of Multidisciplinary Research (FJMR)
Vol. 3, No. 5 2024: 1467-1480

Material Planning for Upper Structure Work Based on the Material Requirement Planning (MRP) Method in the Kasih Ibu Hospital Construction Project, Surakarta

Aprilia Regita Tri Cahyani[1]*, I Nyoman Dita Pahang Putra[2]
Universitas Pembangunan Nasional "Veteran" Jawa Timur
Corresponding Author: Aprilia Regita Tri Cahyani apriliacahyani10@gmail.com

A R T I C L E I N F O

Keywords: Economic Part Period, Least Unit Cost, Material Requirement Planning, Planning

Received : 23, March
Revised : 22, April
Accepted : 21, May

A B S T R A C T

Material inventory in construction projects is something that needs to be managed because it affects the smooth running of a construction project. To overcome this problem, material scheduling was carried out based on the Material Requirement Planning (MRP) method using the Economic Part Period (EPP) lot size technique and the Least Unit Cost (LUC) lot size technique. This research aims to produce material planning processes and results. MRP is a scheduling method to find out the material and quantity of material needed, as well as when the order will be placed. The calculation results obtained using the MRP method are that the EPP lot size requires a total material inventory cost of IDR 20,847,682,834, while the LUC lot size requires an inventory cost of IDR 20,851,272,531. The difference in total costs is IDR 3,589,697 so the EPP lot size is more economical compared to LUC.

DOI: https://doi.org/10.55927/fjmr.v3i5.9525
ISSN-E: 2829-8896
https://journal.formosapublisher.org/index.php/fjmr

INTRODUCTION

Material inventory in construction projects is something that needs to be managed properly because it affects the smooth running of a construction project. Material needs are one of the largest construction project expenses, if the inventory of material needs is not managed properly, it results in the late arrival of materials which has an impact on the delay in the progess of work in the fiels (Messah, Widodo, & Adoe, 2013). Material Requirement Planning can help when ordering materials so that the quantity can be measured according to the needs in the field, the contractor company only needs to buy materials when needed according to the schedule.

The Kasih Ibu Hospital Construction Project in Surakarta consists of the construction of a 14-story north building and a 5-story south building. This project is located in the center of Surakarta City and is located close to residential areas, which means this project has limited land, especially for supplies of construction materials. Based on these conditions, it is necessary to plan for appropriate supplies of construction materials so that project implementation can proceed according to plan. One solution that can be used to overcome this problem is by using the Material Requirement Planning method to optimize material procurement with the amount of construction material to be ordered.

Based on this background description, the researcher tried to look comprehensively at the material planning process using the Economic Part Period (EPP) lot size technique, the material planning process using the Least Unit Cost (LUC) lot size technique, as well as the results of material planning comparisons between lot size techniques. EPP and LUC.

LITERATURE REVIEW

Planning

Planning is a process that attempts to anticipate trends in the future by determining appropriate plans or strategies to realize planned goals (Juniarti & Luxviyanta, 2021).

There are two aspects to planning, namely the planning formulation and the implementation process. Planning aims to control and evaluate an activity process because the nature of the plan is as a reference in carrying out an activity (Setiya, Raharjo, & Hadiwibowo, 2022).

Material Inventory

Material is an item that plays an important role in a company. The absence of materials will have an impact on stopping the process of carrying out work in the field (Sungkono & Sulistiyowati, 2016).

Inventory has a direct effect on the profits of a project because if there is a material delay, the contractor is hampered in carrying out work according to schedule. The aspect to pay attention to in material inventory is material control. For example, if the storage capacity is insufficient and there are still materials that are not yet available, material overstock will result in a decrease in the quality of the material due to being stored for too long (Dianto & Widati, 2023).

Upper Structure Work

Based on SNI 1726:2012, the upper structure of a building is all parts of the building structure that are above ground level (BSN, 2012). Upper structural work in buildings is repetitive/typical work. It is necessary to pay attention to the sequence (movement pattern) of work including materials so that work can be achieved quickly and stably to achieve the target implementation time (Maddeppungeng, Desdiani, & Aditya, 2019).

Material Requirement Planning

Material Requirement Planning is a method that functions to determine the type of material to be ordered when to place the order, and what quantity of material is needed to meet material demand in the field (Lienardo & Jin, 2020). In addition, MRP can increase the efficiency of material inventory so that material delivery times can be planned (Febrianti & Marzuki, 2011). In implementing construction projects, the MRP method functions to meet material needs that will be used in carrying out work in the project and can plan appropriate materials, optimal quantities and prices of materials, and appropriate times (Bayudhana & Kamandang, 2023).

Lot Sizing Techniques

The lotting (quantity) or lot sizing process is a calculation process in determining the optimum order quantity for each material which is based on netting (net requirements) which is related to determining the quantity of material that must be ordered (Yasa & Mandala, 2020).

Economic Part Period

Economic Part Period (EPP) is a lot-size technique with the concept of ordering materials in a cumulative period that approaches the value of the Economic Part Period factor (Nursyanti, 2019). EPP can avoid having too much material inventory and avoid ordering too little material (Amdes, Puspita, & Yuliza, 2019). This method balances ordering costs and holding costs using the EPP equation as follows:

$$EPP = A / h \quad \ldots\ldots\ldots\ldots\ldots \quad (1)$$

Based on the equation, the value of A is the unit cost of ordering (IDR/order) while the value of h is the unit cost of storing (IDR/unit/period).

Least Unit Cost

Least Unit Cost (LUC) is a lot size technique with a material planning concept that is selected based on the smallest cost per unit value so that the number of material orders or the period can vary (Chandradevi & Puspitasari, 2016). LUC uses trial and error from the smallest cost per unit to determine the lot results used in ordering materials (Sungkono & Sulistiyowati, 2016). The last value is declared optimal if the smallest cost per unit obtained from the total cost is divided by the number of trial lot sizes (Khan & Sitania, 2023).

Based on the description of the background of the problem and theoretical basis, the researcher describes the framework as follows.

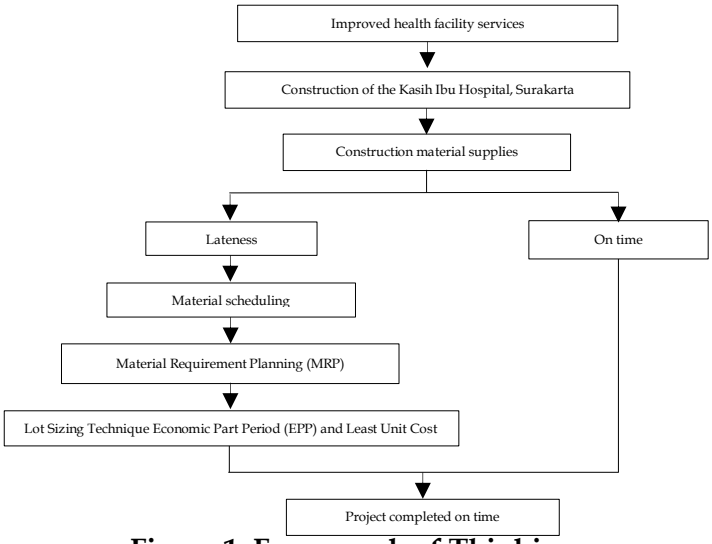

Figure 1. Framework of Thinking

METHODOLOGY

The research object was carried out at the North Building Construction Project of Kasih Ibu Hospital, Surakarta on floors P1 to P6. The research subject discusses material planning for upper structure work based on the Material Requirement Planning method. Through research, the process and results of material planning with lot size Economic Part Period (EPP) and Least Cost Unit (LUC) can be identified. This research uses quantitative research methods. Secondary data was obtained from project documents: S-curve, construction cost estimate, and material data. The research stages can be described in the following diagram:

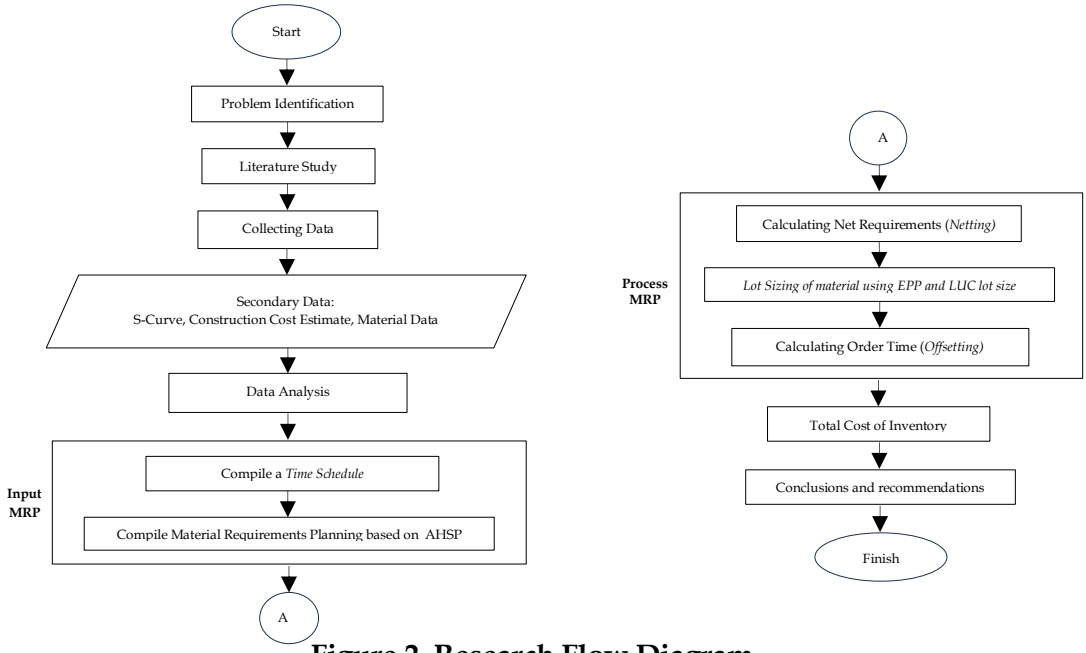

Figure 2. Research Flow Diagram

RESULT AND DISCUSSION

Analysis of Material Requirements Per week

The calculation is done by calculating the duration of each work item and dividing the weights each week, then a schedule is obtained for each job per floor. Calculation of work duration:

$$Work\ Duration = \frac{work\ volume}{total} \times Duration/floor \quad \ldots\ldots\ldots\ldots (2)$$

Weight distribution per week:

$$Weight = weight\ of\ work\ /\ duration\ of\ work \quad \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

The time schedule results are as follows:

Table 1. Time Schedule

Work items	Weight	Time			2023																				
					March				April				May					June				July			
		Start	Finish	Duration	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	
Floor P1 Elv +1.500 ; Floor P1-M Elv +3.000 ; Floor 2 Elv +3.950																									
- Beams	0,54%	11/03/23	20/04/23	40	0,09%	0,09%	0,09%	0,09%	0,09%	0,09%															
- Slabs	0,55%	25/03/23	20/04/23	26			0,14%	0,14%	0,14%	0,14%															
- Columns	0,41%	26/03/23	21/04/23	26			0,10%	0,10%	0,10%	0,10%															
Floor P2 Elv +4.500 ; Floor P2-M Elv +6.000																									
- Beams	0,62%	25/03/23	11/05/23	33			0,12%	0,12%	0,12%	0,12%			0,12%												
- Slabs	0,51%	25/03/23	11/05/23	33			0,10%	0,10%	0,10%	0,10%			0,10%												
- Columns	0,36%	08/04/23	19/05/23	27					0,09%	0,09%			0,09%	0,09%											
Floor P3 Elv +7.500 ; Floor P3-M Elv +9.000 ; Floor 3 Elv +7.950																									
- Beams	0,71%	08/04/23	25/05/23	33					0,14%	0,14%			0,14%	0,14%	0,14%										
- Slabs	0,53%	08/04/23	25/05/23	33					0,11%	0,11%			0,11%	0,11%	0,11%										
- Columns	0,41%	06/05/23	01/06/23	26									0,10%	0,10%	0,10%	0,10%									
Floor P4 Elv +10.500 ; Floor P4-M Elv +12.000																									
- Beams	0,71%	15/04/23	08/06/23	40						0,12%			0,12%	0,12%	0,12%	0,12%	0,12%								
- Slabs	0,54%	15/04/23	08/06/23	40						0,09%			0,09%	0,09%	0,09%	0,09%	0,09%								
- Columns	0,38%	13/05/23	08/06/23	26										0,10%	0,10%	0,10%	0,10%								
Floor P5 Elv +13.500 ; Floor P5-M Elv +15.000 ; Floor 5 Elv +15.950																									
- Beams	0,65%	10/06/23	07/07/23	27														0,16%	0,16%	0,16%	0,16%				
- Slabs	0,50%	10/06/23	07/07/23	27														0,13%	0,13%	0,13%	0,13%				
- Columns	0,38%	24/06/23	13/07/23	19																0,13%	0,13%	0,13%			
Floor P6 Elv +16.500 ; Floor P6-M Elv +17.900																									
- Beams	0,63%	24/06/23	21/07/23	27																0,16%	0,16%	0,16%	0,16%		
- Slabs	0,50%	24/06/23	21/07/23	27																0,13%	0,13%	0,13%	0,13%		
- Columns	0,41%	08/07/23	28/07/23	20																		0,14%	0,14%	0,14%	

Source: The computation's outcome, 2024

The next stage is to calculate material requirements based on the AHSP obtained from the 2023 Surakarta City HSPK using the formula:

$$Material\ Requirements = Material\ volume \times AHSP\ coefficient \quad \ldots\ldots (4)$$

The results of material requirements are divided according to the duration of each week according to the schedule. The results of the analysis of material requirements based on AHSP are as follows:

Table 2. Material Requirements Per Week Based on AHSP

Item Material		2023																				Total
		March				April				May					June				July			
		17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	
Class III wood (Slabs & Beams)	m³	2	2	16	16	24	31	-	-	22	15	15	7	7	9	9	19	19	9	9	-	233
Class III wood (Column)	m³	-	-	2	2	5	5	-	-	5	7	5	5	2	-	-	3	3	7	4	4	58
Nails 5cm – 12 cm	kg	23	23	160	160	265	335	-	-	248	222	200	117	92	94	94	217	217	158	127	35	2.787
Formwork oil	liter	12	12	92	92	144	179	-	-	136	111	100	59	46	47	47	108	108	79	63	18	1.453
Class II wooden beams (Beams)	m³	1	1	2	2	3	5	-	-	3	2	2	1	1	1	1	3	3	1	1	-	36
Class II wooden beams (Slabs & Columns)	m³	-	-	5	5	8	10	-	-	7	6	6	4	3	2	2	6	6	5	4	1	79
9 mm thick plywood	sheet	20	20	161	161	253	313	-	-	237	194	175	103	81	82	82	190	190	138	111	31	2.542
8/10cm wooden dolken 4m long (Beams & Columns)	bar	115	115	371	371	620	738	-	-	622	607	496	358	233	161	161	477	477	491	336	176	6.926
8/10cm Wooden dolken 4m long (Slabs)	bar	-	-	1.648	1.648	2.473	3.160	-	-	2.201	1.512	1.512	687	687	928	928	1.818	1.818	891	891	-	22.802
Ø8 Rebar	kg	5	5	7	7	10	13	-	-	8	6	6	3	3	2	2	3	3	2	2	-	87
D10 Rebar	kg	2.095	2.095	16.687	16.687	23.811	28.165	-	-	17.602	15.793	13.779	8.669	6.412	5.287	5.287	13.171	13.171	10.770	7.990	2.887	210.359
D13 Rebar	kg	8	8	7.697	7.697	15.347	21.732	-	-	21.723	14.034	14.034	6.385	6.385	9.701	9.701	19.153	19.153	9.452	9.452	-	191.663
D16 Rebar	kg	233	233	784	784	1.373	1.721	-	-	1.488	1.340	1.138	750	549	354	354	967	967	921	656	308	14.920
D19 Rebar	kg	3.033	3.033	6.694	6.694	10.484	13.641	-	-	10.608	6.947	6.947	3.156	3.156	4.486	4.486	8.915	8.915	4.429	4.429	-	110.053
D22 Rebar	kg	3.424	3.424	13.923	13.923	23.393	26.378	-	-	22.988	25.918	20.016	16.449	9.473	4.502	4.502	17.589	17.589	21.731	13.147	8.645	267.013
Rebar Tie wire	kg	126	126	654	654	1.063	1.309	-	-	1.063	915	799	506	371	348	348	854	854	676	510	169	11.344
Ready Mix K-350	m³	28	28	208	208	333	853	-	-	767	723	688	598	557	105	105	256	256	208	158	56	6.134

Source: The computation's outcome, 2024

Determination of Costs in Material Inventory

Purchasing costs are the costs used to purchase the required materials (Maddeppungeng, Setiawati, & Tuqa, 2021). This cost is known based on material prices from unit price analysis and logistics data. Purchase costs can be presented in the following table:

Table 3. Purchasing Costs

Item Material		Unit	Material Prices	
1	Class III wood (Slabs & Beams)	m^3	IDR	86.667
2	Class III wood (Column)	m^3	IDR	140.000
3	Nails 5cm - 12 cm	kg	IDR	3.067
4	Formwork oil	liter	IDR	800
5	Class II wooden beams (Beams)	m^3	IDR	72.900
6	Class II wooden beams (Slabs & Columns)	m^3	IDR	60.750
7	9 mm thick plywood	sheet	IDR	16.917
8	8/10cm wooden dolken 4m long (Beams & Columns)	bar	IDR	20.000
9	8/10 cm Wooden dolken 4m long (Slabs)	bar	IDR	60.000
10	Ø8 Rebar	kg	IDR	18.375
11	D10 Rebar	kg	IDR	18.375
12	D13 Rebar	kg	IDR	18.375
13	D16 Rebar	kg	IDR	18.375
14	D19 Rebar	kg	IDR	18.375
15	D22 Rebar	kg	IDR	18.375
16	Rebar Tie wire	kg	IDR	300
17	Ready Mix K-350	m^3	IDR	758.000

Source: HSPK Surakarta city and Logistik Data, 2023

Ordering costs include communication costs (internet and telephone) and administration costs. Order costs can be presented in the following table:

Table 4. Ordering Costs

Unit		Cost/order	
1	Internet and Telephone	IDR	3.000
2	Administration	IDR	1.500
	Total	IDR	4.500

Source: Logistic Data, 2023

Storage costs (holding costs) include inventory or capital costs of 6.75% per year (Bank Indonesia Interest Rate March-June 2023) and depreciation or damage costs when storing materials are assumed to be 2% (wooden materials) and 0.5% (rebar material) of the material unit price (Lienardo & Jin, 2020). In calculations, one year is assumed to have 50 weeks.

Calculation of storage costs:

$$Holding\ cost/week = material\ price \times \frac{\%\ storage\ costs}{50} \quad \ldots\ldots\ldots (5)$$

Table 5. Holding Costs

Item Material		Material Prices	%Holding Costs / Year	Holding Cost / Week
1	Class III wood (Slabs & Beams)	IDR 86.667	8,75%	IDR 152
2	Class III wood (Columns)	IDR 140.000	8,75%	IDR 245
3	Nails 5cm - 12 cm	IDR 3.067	6,75%	IDR 4
4	Formwork oil	IDR 800	6,75%	IDR 1
5	Class II wooden beams (Beams)	IDR 72.900	8,75%	IDR 128
6	Class II wooden beams (Slabs & Columns)	IDR 60.750	8,75%	IDR 106
7	9 mm thick plywood	IDR 16.917	8,75%	IDR 30
8	8/10cm wooden dolken 4m long (Beams & Columns)	IDR 20.000	8,75%	IDR 35
9	8/10cm wooden dolken 4m long (Slabs)	IDR 60.000	8,75%	IDR 105
10	Ø8 Rebar	IDR 18.375	7,25%	IDR 27
11	D10 Rebar	IDR 18.375	7,25%	IDR 27
12	D13 Rebar	IDR 18.375	7,25%	IDR 27
13	D16 Rebar	IDR 18.375	7,25%	IDR 27
14	D19 Rebar	IDR 18.375	7,25%	IDR 27
15	D22 Rebar	IDR 18.375	7,25%	IDR 27
16	Rebar Tie wire	IDR 300	6,75%	IDR 0
17	Ready Mix K-350	IDR 758.000	6,75%	IDR 1.023

Source: The computation's outcome, 2024

***Material Requirement Planning using Lot Size Economic Part Period* (EPP)**

The process of determining the lot value is to compare ordering costs and storage costs with the results in the following table:

Table 6. Economic Part Period (EPP) Value

Item Material		A	h	EPP
1	Class III wood (Slabs & Beams)	IDR 4.500	IDR 152	30
2	Class III wood (Columns)	IDR 4.500	IDR 245	18
3	Nails 5 cm - 12 cm	IDR 4.500	IDR 4	1.087
4	Formwork oil	IDR 4.500	IDR 1	4.167
5	Class II wooden beams (Beams)	IDR 4.500	IDR 128	35
6	Class II wooden beams (Slabs & Columns)	IDR 4.500	IDR 106	42
7	9 mm thick plywood	IDR 4.500	IDR 30	152
8	8/10cm wooden dolken 4m long (Beams & Columns)	IDR 4.500	IDR 35	129
9	8/10cm wooden dolken 4m long (Slabs)	IDR 4.500	IDR 105	43
10	Ø8 Rebar	IDR 4.500	IDR 27	169
11	D10 Rebar	IDR 4.500	IDR 27	169
12	D13 Rebar	IDR 4.500	IDR 27	169

13	D16 Rebar	IDR 4.500	IDR 27	169
14	D19 Rebar	IDR 4.500	IDR 27	169
15	D22 Rebar	IDR 4.500	IDR 27	169
16	Rebar Tie wire	IDR 4.500	IDR 0	11.111
17	Ready Mix K-350	IDR 4.500	IDR 1.023	4

Source: The computation's outcome, 2024

Material lot calculations are carried out based on the EPP value and material requirements per week. The lot value is taken from the value closest to the EPP value but is not allowed to be greater than the EPP value. The lot calculation starts again in the unfulfilled period after finding the value of the previous lot. The following is an example of lot calculation results:

Table 7. Lot Calculation of Class III Wood Material (Slabs and Beams) - EPP

T	*Net Req.*	*Inventory Period*	*Part-Period*	*Accumulated Part-Period*	*Lot*
17	2	0	0	0 < 30	2
18	2	1	2	2 < 30	**5**
19	16	2	32	34 < 30	21
19	16	0	0	0 < 30	16
20	16	1	16	16 < 30	**32**
21	24	2	48	64 < 30	56
21	24	0	0	0 < 30	**24**
22	31	1	31	31 < 30	55
22	31	0	0	0 < 30	31
25	22	1	22	22 < 30	**54**
26	15	2	30	53 < 30	69
26	15	0	0	0 < 30	15
27	15	1	15	15 < 30	30
28	7	2	14	29 < 30	**37**
29	7	3	21	50 < 30	44
29	7	0	0	0 < 30	7
30	9	1	9	9 < 30	16
31	9	2	19	28 < 30	**26**
32	19	3	56	84 < 30	44
32	19	0	0	0 < 30	19
33	19	1	19	19 < 30	**37**
34	9	2	18	37 < 30	46
34	9	0	0	0 < 30	9
35	9	1	9	9 < 30	**18**

Source: The computation's outcome, 2024

Calculation of total costs after calculating the lot value using the Economic Part Period lot size technique with the equation:

Total inventory cost = (number of order periods × order cost) + (number of inventories × holding costs) + (material price × PORc amount) ……. (6)

So the material inventory costs using the EPP lot size technique are as follows:

Table 8. Total Inventory Costs using the EPP Lot Size Technique

Item Material		Total Order Cost	Total Cost of Savings	Total Purchase Cost	Total Inventory Cost
1	Class III wood (Slabs & Beams)	IDR 36.000	IDR 24.211	IDR 20.165.068	IDR 20.225.279
2	Class III wood (Columns)	IDR 22.500	IDR 19.318	IDR 8.099.803	IDR 8.141.620
3	Nails 5cm - 12 cm	IDR 22.500	IDR 15.833	IDR 8.546.555	IDR 8.584.888
4	Formwork oil	IDR 9.000	IDR 7.171	IDR 1.162.118	IDR 1.178.290
5	Class II wooden beams (Beams)	IDR 13.500	IDR 12.123	IDR 2.646.135	IDR 2.671.758
6	Class II wooden beams (Slabs & Columns)	IDR 18.000	IDR 20.256	IDR 4.781.034	IDR 4.819.290
7	9mm thick plywood	IDR 58.500	IDR 21.725	IDR 43.004.432	IDR 43.084.658
8	8/10cm wooden dolken 4m long (Beams & Columns)	IDR 76.500	IDR 76.487	IDR 138.518.283	IDR 138.671.270
9	8/10cm wooden dolken 4m long (Slabs)	IDR 67.500	IDR 2.595.600	IDR 1.368.101.788	IDR 1.370.764.888
10	Ø8 Rebar	IDR 9.000	IDR 9.895	IDR 1.590.319	IDR 1.609.213
11	D10 Rebar	IDR 81.000	IDR 1.004.736	IDR 3.865.340.465	IDR 3.866.426.201
12	D13 Rebar	IDR 72.000	IDR 3.848	IDR 3.521.798.920	IDR 3.521.874.767
13	D16 Rebar	IDR 81.000	IDR 106.948	IDR 274.151.861	IDR 274.339.809
14	D19 Rebar	IDR 76.500	IDR 1.373.778	IDR 2.022.231.382	IDR 2.023.681.660
15	D22 Rebar	IDR 81.000	IDR 1.642.108	IDR 4.906.361.873	IDR 4.908.084.981
16	Rebar Tie wire	IDR 18.000	IDR 8.874	IDR 3.403.259	IDR 3.430.134
17	Ready Mix K-350	IDR 22.500	IDR 515.743	IDR 4.649.555.886	IDR 4.650.094.129
Total Material Inventory Costs - EPP Lot Size Technique					**IDR 20.847.682.834**

Source: The computation's outcome, 2024

***Material Requirement Planning using Lot Size Least Unit Cost* (LUC)**

Lot calculations with Least Unit Cost are done by trial and error to find the smallest value of the cost per unit. An example of lot calculation results is as follows:

Table 9. Lot Calculation of Class III Wood Material (Slabs and Beams) - LUC

T	n	*Trial Lot Size*	*Ordering Cost*	*Holding Cost*	*Total Cost*	*Cost per Unit*
17	0	2	IDR 4.500	IDR 152	IDR 4.652	IDR 2.017
18	1	5	IDR 4.500	IDR 502	IDR 5.002	IDR 1.084
19	2	21	IDR 4.500	IDR 5.333	IDR 9.833	IDR 479
20	3	**36**	IDR 4.500	IDR 12.579	IDR 17.079	IDR 468

21	4	61	IDR 4.500	IDR 27.258	IDR 31.758	IDR 524
21	0	24	IDR 4.500	IDR 152	IDR 4.652	IDR 192
22	1	**55**	IDR 4.500	IDR 4.872	IDR 9.372	IDR 169
25	2	78	IDR 4.500	IDR 11.674	IDR 16.174	IDR 208
25	0	22	IDR 4.500	IDR 152	IDR 4.652	IDR 207
26	1	**38**	IDR 4.500	IDR 2.457	IDR 6.957	IDR 185
27	2	53	IDR 4.500	IDR 7.066	IDR 11.566	IDR 219
27	0	15	IDR 4.500	IDR 152	IDR 4.652	IDR 306
28	1	**22**	IDR 4.500	IDR 1.202	IDR 5.702	IDR 258
29	2	29	IDR 4.500	IDR 3.303	IDR 7.803	IDR 269
29	0	7	IDR 4.500	IDR 152	IDR 4.652	IDR 672
30	1	16	IDR 4.500	IDR 1.579	IDR 6.079	IDR 372
31	2	**35**	IDR 4.500	IDR 4.433	IDR 8.933	IDR 256
32	3	53	IDR 4.500	IDR 12.875	IDR 17.375	IDR 325
32	0	19	IDR 4.500	IDR 152	IDR 4.652	IDR 251
33	1	**37**	IDR 4.500	IDR 2.966	IDR 7.466	IDR 201
34	2	46	IDR 4.500	IDR 5.739	IDR 10.239	IDR 221
34	0	9	IDR 4.500	IDR 152	IDR 4.652	IDR 509
35	1	**18**	IDR 4.500	IDR 1.539	IDR 6.039	IDR 330

Source: The computation's outcome, 2024

Calculation of total costs after calculating the lot value using the Least Unit Cost lot size technique using the equation:

Total inventory cost = (number of order periods × order cost) + (number of inventories × holding cost) + (material price × number of PORc) …… (6)

So the total material inventory costs calculated based on the Least Cost Unit lot size technique are as follows:

Table 10. Total Inventory Costs using LUC Lot Size Technique

Item Material		Total Order Cost	Total Cost of Savings	Total Purchase Cost	Total Inventory Cost
1	Class III wood (Slabs & Beams)	IDR 31.500	IDR 43.850	IDR 20.165.068	IDR 20.240.418
2	Class III wood (Columns)	IDR 22.500	IDR 2.725	IDR 8.099.803	IDR 8.145.027
3	Nails 5cm - 12 cm	IDR 22.500	IDR 18.712	IDR 8.546.555	IDR 8.587.767
4	Formwork oil	IDR 9.000	IDR 7.417	IDR 1.162.118	IDR 1.178.536
5	Class II wooden beams (Beams)	IDR 13.500	IDR 13.888	IDR 2.646.135	IDR 2.673.523
6	Class II wooden beams (Slabs & Columns)	IDR 18.000	IDR 29.525	IDR 4.781.034	IDR 4.828.558
7	9 mm thick plywood	IDR 58.500	IDR 6.537	IDR 43.004.432	IDR 43.089.469

8	8/10cm wooden dolken 4m long (Beams & Columns)	IDR 76.500	IDR 76.487	IDR 138.518.283	IDR 138.671.270
9	8/10cm wooden dolken 4m long (Slabs)	IDR 67.500	IDR2.595.600	IDR 1.368.101.788	IDR 1.370.764.888
10	Ø8 Rebar	IDR 13.500	IDR 9.623	IDR 1.590.319	IDR 1.613.442
11	D10 Rebar	IDR 81.000	IDR 1.004.736	IDR 3.865.340.465	IDR 3.866.426.201
12	D13 Rebar	IDR 72.000	IDR 3.490.274	IDR 3.521.798.920	IDR 3.525.361.194
13	D16 Rebar	IDR 81.000	IDR 106.948	IDR 274.151.861	IDR 274.339.809
14	D19 Rebar	IDR 76.500	IDR 1.373.778	IDR 2.022.231.382	IDR 2.023.681.660
15	D22 Rebar	IDR 81.000	IDR 1.642.108	IDR 4.906.361.873	IDR 4.908.084.981
16	Rebar Tie wire	IDR 13.500	IDR 12.196	IDR 3.403.259	IDR 3.428.955
17	Ready Mix K-350	IDR 81.000	IDR 519.946	IDR 4.649.555.886	IDR 4.650.156.833
Total Material Inventory Costs - LUC Lot Size Technique					**IDR 20.851.272.531**

Source: The computation's outcome, 2024

After material planning was carried out using two lot sizes, namely EPP and LUC, the results of the total inventory cost comparison were obtained as follows:

Table 11. Comparison of Total MRP Costs

Item Material		**Material Inventory Costs**	
		EPP	**LUC**
1	Class III wood (Slabs & Beams)	IDR 20.225.279	IDR 20.240.418
2	Class III wood (Columns)	IDR 8.141.620	IDR 8.145.027
3	Nails 5cm - 12 cm	IDR 8.584.888	IDR 8.587.767
4	Formwork oil	IDR 1.178.290	IDR 1.178.536
5	Class II wooden beams (Beams)	IDR 2.671.758	IDR 2.673.523
6	Class II wooden beams (Slabs & Columns)	IDR 4.819.290	IDR 4.828.558
7	9 mm thick plywood	IDR 43.084.658	IDR 43.089.469
8	8/10cm wooden dolken 4m long (Beams & Columns)	IDR 138.671.270	IDR 138.671.270
9	8/10cm wooden dolken 4m long (Slabs)	IDR 1.370.764.888	IDR 1.370.764.888
10	Ø8 Rebar	IDR 1.609.213	IDR 1.613.442
11	D10 Rebar	IDR 3.866.426.201	IDR 3.866.426.201
12	D13 Rebar	IDR 3.521.874.767	IDR 3.525.361.194
13	D16 Rebar	IDR 274.339.809	IDR 274.339.809
14	D19 Rebar	IDR 2.023.681.660	IDR 2.023.681.660
15	D22 Rebar	IDR 4.908.084.981	IDR 4.908.084.981
16	Rebar Tie wire	IDR 3.430.134	IDR 3.428.955
17	Ready Mix K-350	IDR 4.650.094.129	IDR 4.650.156.833
Total Material Inventory Costs		**IDR 20.847.682.834**	**IDR 20.851.272.531**

Cost Difference	IDR 3.589.697

Source: The computation's outcome, 2024

DISCUSSION

Based on the results of the material planning analysis for the Kasih Ibu Surakarta Hospital Construction Project based on the Material Requirement Planning method, it can be seen in Table 8 that the Economic Part Period lot size technique requires material inventory costs of IDR 20,847,682,834 with 170 orders. In table 10 it can be seen that the Least Unit Cost lot size technique requires material inventory costs of IDR 20,851,272,531 with 182 material orders. So it can be seen in Table 11 that the difference in total material inventory costs between the EPP and LUC lot size techniques is IDR 3,589,697.

The EPP lot size technique produces more optimum and economical results than the LUC lot size technique because the total ordering frequency is less so it requires a lower total ordering cost. Regarding material storage costs, the LUC lot size technique has more material inventory so it requires higher storage costs compared to the EPP lot size technique.

CONCLUSION AND RECOMMENDATION

Based on the results of data analysis, the following conclusions were obtained:

1. Calculations using the Economic Part Period lot size require an ordering fee of IDR 765,000 with 170 orders. Storage costs require IDR 7,458,654 so the total material inventory is IDR 20,847,682,834.
2. Calculation with the Least Unit Cost lot size requires an ordering cost of IDR 819,000 with 182 orders. Storage costs are IDR 10,994,351 so the total material inventory is IDR 20,851,272,531.
3. Material planning with lot size produces more economical costs compared to LUC lot size with a difference in storage costs of IDR 54,000 and a difference in storage costs of IDR 3,535,697 so the total cost difference is IDR 3,589,697.

ADVANCED RESEARCH

Further research might be carried out with different types of work such as Architectural work and Mechanical, Electrical, and Plumbing (MEP) work. Apart from that, further research can use different lot size techniques to find out the comparison of costs compared to the lot size of Economic Part Period and Least Unit Cost.

REFERENCES

Amdes, M. P., Puspita, F. M., & Yuliza, E. (2019). Penerapan metode Economic Part Period (EPP) dan metode Part Period Balancing (PPB) dalam perencanaan pengendalian persediaan alat suntik pada perusahaan farmasi. *Jurnal Penelitian Sains, 21*(3), 168-174. doi:https://doi.org/10.56064/jps.v21i3.522

Bayudhana, Z. D., & Kamandang, Z. R. (2023). Material Requirement Planning Berdasarkan Hasil Resource Leveling Pada Proyek Konstruksi Jalan Tol. *Jurnal Peradaban Sains, Rekayasa dan Teknologi, 11*(1), 259-271. doi:https://doi.org/10.37971/radial.v11i1.392

BSN. (2012). *SNI 1726:2012 Tata Cara Perencanaan Gempa Untuk Struktur Bangunan Gedung dan Non Gedung*. Jakarta: Badan Standardisasi Nasional Retrieved from https://iisee.kenken.go.jp/worldlist/27_Indonesia/Indonesia_SNI_1726_2012_GEMPA.pdf

Chandradevi, A., & Puspitasari, N. B. (2016). Penerapan Material Requirement Planning (MRP) dengan Mempertimbangkan Lot Sizing dalam Pengendalian Bahan Baku pada PT. Phapros, Tbk. *Performa, 15*(1), 10. doi:https://doi.org/10.20961/performa.15.1.13760

Dianto, Z. N., & Widati, E. (2023). Analisis Management Inventory Untuk Menghindari Death Stock Product di TB. Sinar Baru. *Jurnal Ilmiah Akuntansi, Keuangan, dan Bisnis, 4*(1), 50-72. doi:https://doi.org/10.36490/value.v4i1.631

Febrianti, M. S., & Marzuki, M. (2011). Perencanaan Persediaan Bahan Material Percetakan Dengan Metode MRP (Material Requirements Planning) Studi Kasus CV. Krakatau di Bandar Lampung. *Explore: Jurnal Sistem Informasi dan Telematika, 2*(2), 331298. doi:https://doi.org/10.36448/jsit.v2i2.341

Juniarti, D. A. T., & Luxviyanta, C. A. (2021). *Metode Pengendalian Persediaan dengan MRP* (W. Kurniawan Ed.). Banyumas: CV. Pena Persada.

Khan, N. A., & Sitania, F. D. (2023). Analisis Perbandingan Metode Least Unit Cost, Silver Meal, dan Metode Perusahaan dalam Pengendalian Persediaan Plafon PVC (Studi Kasus: XYZ). *G-Tech : Jurnal Teknologi Terapan, 7*(1), 155-164. doi:https://doi.org/10.33379/gtech.v7i1.1890

Lienardo, D. A., & Jin, O. F. (2020). Analisis Perbandingan Metode Material Requirements Planning (MRP) Dengan Metode Pengendalian Material Di Proyek A. *JMTS: Jurnal Mitra Teknik Sipil, 3*, 223-236. doi:https://doi.org/10.24912/jmts.v3i2.7045

Maddeppungeng, A., Desdiani, D., & Aditya, R. A. (2019). Analisis Risiko Biaya Dan Waktu pada Pelaksanaan Pekerjaan Struktur Atas Proyek Gedung Bertingkat Tinggi (Studi Kasus: Proyek Bangunan Gedung Bertingkat Tinggi di DKI Jakarta dan Sekitarnya). *Fondasi: Jurnal Teknik Sipil, 8*(2), 109-119. doi:http://dx.doi.org/10.36055/jft.v8i2.7347

Maddeppungeng, A., Setiawati, D. N., & Tuqa, B. (2021). Perencanaan Persediaan Material Dengan Menggunakan Metode Material Requirement Planning (MRP) Pada Proyek Apartemen (Studi Kasus: Proyek Pembangunan Nines Plaza & Residence Tower B). *Fondation: Journal of Civil Engineering, 10*(1), 69-80. doi:https://doi.org/10.36055/fondasi.v10i1.10624

Messah, Y. A., Widodo, T., & Adoe, M. L. (2013). Kajian Penyebab Keterlambatan Pelaksanaan Proyek Konstuksi Gedung Di Kota Kupang. *Jurnal Teknik Sipil, 2*(2), 157-168. doi:https://doi.org/10.35508/jts.2.2.157-168

Nursyanti, Y. (2019). Persediaan Kebutuhan Bahan Baku Komponen Produk Rumah Lampu Downlight (Rd). *Jurnal Manajemen, 9*(1), 300195. doi:https://doi.org/10.26460/jm.v9i1.991

Setiya, T., Raharjo, T., & Hadiwibowo, Y. (2022). Manajemen Pembangunan Berkelanjutan Desa (SDGs Desa) Dimulai dari Penyusunan Peraturan Desa SDGs Desa. *CONSEN: Indonesian Journal of Community Services Engagement, 2*(2), 54-66. doi:http://dx.doi.org/10.57152/consen.v2i2.457

Sungkono, M. A., & Sulistiyowati, W. (2016). Perencanaan dan Pengendalian Bahan Baku Untuk Meningkatkan Efisiensi Produksi Dengan Metode Material Requirement Planning dan Analytical Hierarchy Process di PT. XYZ. *Spektrum Industri, 14*(1), 11. doi:http://dx.doi.org/10.12928/si.v14i1.3684

Yasa, I. M. S., & Mandala, K. (2020). Material Requirement Planning Untuk Memenuhi Produksi Pada CV. Bangun Cipta Artha Di Badung. *E-Journal Manajemen, 9*. doi:https://doi.org/10.24843/EJMUNUD.2020.v09.i02