

## Implementation of Material Requirement Planning (MRP) on The Procurement of Natural Materials of The KM 48+600 Karawang Toll Road Widening

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### Abstract

Trading companies or manufacturing companies and service companies always have inventory. It is expected that MRP will be able to provide a solution to find out what methods can minimize inventory or storage costs. Procurement costs consist of the total cost of inventory with the cost of purchasing materials. In the procurement of natural materials, PT Kumala Wandira Danarta sets a maximum inventory cost of 5% of the procurement cost. This is to minimize costs resulting from inventory. Therefore, the application of MRP was chosen as a tool for controlling inventory costs through lot sizing methods including Lot For Lot, Period Order Quantity, Fixed Period Requirement, and Fixed Order Quantity. And the result is that all of these lot sizing techniques produce inventory costs below 5% of procurement costs and the Fixed Period Requirement becomes the lot sizing method with the lowest inventory cost, amounting to Rp. 11,490,000 and procurement costs Rp. 716,365,000.

**Keywords:** Inventory cost control, MRP, Lot sizing

### Abstrak

*Perusahaan dagang atau perusahaan manufaktur dan perusahaan jasa selalu memiliki persediaan. Diharapkan MRP mampu memberikan solusi untuk mengetahui metode apa yang dapat meminimalkan biaya persediaan atau penyimpanan. Biaya pengadaan terdiri dari total biaya persediaan dengan biaya pembelian bahan. Dalam pengadaan bahan alam, PT Kumala Wandira Danarta menetapkan biaya persediaan maksimal sebesar 5% dari biaya pengadaan. Hal ini untuk meminimalkan biaya yang timbul dari persediaan. Oleh karena itu, penerapan MRP dipilih sebagai alat untuk mengendalikan biaya persediaan melalui metode lot sizing yang meliputi Lot For Lot, Period Order Quantity, Fixed Period Requirement, dan Fixed Order Quantity. Dan hasilnya semua teknik lot sizing tersebut menghasilkan biaya persediaan dibawah 5% dari biaya pengadaan dan Fixed Period Requirement menjadi metode lot sizing dengan biaya persediaan terendah yaitu sebesar Rp. 11.490.000 dan biaya pengadaan Rp. 716.365.000.*

**Kata Kunci:** Pengendalian biaya persediaan, MRP, Lot sizing

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### 1. Introduction

Planning and control of raw materials is very important in an industrial company [1]. Inventory control is an activity to maintain and control, as well as a technique of ordering and monitoring goods in quantity, amount and time as planned [2]. Every company, whether it's a trading company or a manufacturing company as well as a service company, always keeps supplies. Also included in the construction service company, it is hoped that MRP will be able to provide solutions to find out what methods can minimize inventory or storage costs. Therefore, the author wants to apply several MRP methods and find out which costs can emphasize the lowest costs. The company regulates expenses for inventory costs to a maximum of 5%.

Table SEQ Table \\* ARABIC 1. Maximum

Material	Maximum Inventory Cost			
	Quantity	Price	Ordering Cost	5%
Split	1,027	210,000	215,670,000	10,783,500
Base B	1,541	185,000	285,085,000	14,254,250
Base A	972	210,000	204,120,000	10,206,000

The ordering cost for all natural materials is Rp. 270,000 per day and a saving fee of Rp. 2,300,000 for one month. And there are also remnants of material from the previous project, we consider these natural materials as on hand, namely: split stone 36 m<sup>3</sup>, basecourse b 234 m<sup>3</sup>, and basecourse a 142 m<sup>3</sup>.

## 2. Methods

This research begins with data observation at PT Kumala Wandira Danarta, such as master production schedule, bill of materials, hoop costs, ordering costs, material on hand. measured results The lot sizing techniques that will be used are Lot For Lot (LFL), Period order quantity (POQ), Fixed Period Requirements (FPR), Fixed Order Quantity (FOQ). The lowest cost will be chosen as a recommendation for the use of MRP in the Karawang km 48+600 toll road widening project.

### Inventory

In general, basically inventory is a very important thing in every company in the production process, it can be goods or services. Inventories include all goods owned by the company at a certain time, with the aim of being resold or consumed in the company's normal operating cycle as goods held for sale or assumed to be in the future, all tangible goods can be referred to as inventory, depending on the nature and type of company business [3].

### MRP Concept

Material Requirement Planning is a system that regulates the materials needed for the production process because with MRP the company can streamline the warehouse and at the same time prevent the possibility of running out of materials or a scheduling system for raw material requirements based on the time stage for production operations [4]. MRP is primarily based on the state of the material and work-in-process inventory and the master production schedule. MRP is a method used to make a material requirements plan by taking into account the amount and time of arrival of the material.

### Lot-sizing system in MRP

The lotting process is a process to determine the optimal order size for each product item based on the results of the calculation of net needs [5]. This study will use four lotting systems, namely LFL, POQ, FPR, and FOQ.

#### Lot For Lot (LFL)

Lot For Lot (LFL), this method aims to minimize storage costs per unit to zero, because the lot size is the same as the requirement [6]. The lot for lot (LFL) method or minimal inventory method is based on the idea of providing inventory (producing) as needed in at that time. So the costs incurred are only in the form of ordering costs.

#### Period Order Quantity (POQ)

The period order quantity (POQ) method is a method that can help the process of controlling the inventory of raw fabric materials. The POQ technique is also known as the Economic Time Cycle. This POQ technique is used to determine the order time interval (Economic Order Interval) [7].

This method uses an approach to the concept of the number of economic orders used in each period which are discrete or diverse demand. The calculation of the period order quantity (POQ) method uses an economical ordering basis which will later be used as supporting data to calculate the optimal order interval.

$$POQ = \frac{\sqrt{2S}}{DH} \quad (1)$$

Information

- D = Amount of goods needed
- S = Ordering cost
- H = Storage cost

### Fixed Period Requirements (FPR)

FPR technique onbasically uses the concept of a constant ordering interval, while the size of the order quantity (lot size) varies. In the FPR method, the time interval between orders is fixed with the size according to the net needs of each period included in the predetermined order interval.

### Fixed Order Quantity (FOQ)

The FOQ technique uses a fixed order quantity for a certain inventory item that can be determined arbitrarily or based on intuitive factors. In using In this technique, if necessary, the number of orders is enlarged to match the amount of high net demand in a certain period that must be fulfilled, which means that the size of the order quantity (lot sizing) is the same for all subsequent periods in the planning.

## 3. Research Results

### Master Production Schedule (MPS)

MRP concept begins with the creation of a Master Production Schedule (MPS). The master production schedule is the company's short-term production plan to regulate the use of natural materials in producing the final product, which will be used to organize the production plan and control. This system generates a production schedule from the start of the project to completion, a schedule for purchasing raw materials, a production implementation schedule and employee work schedules.

Table SEQ Table \\* ARABIC

Sub Project	Period									
	3	4	5	6	7	8	9	10	11	
Agregat										
Split	16	105	54	108	109	106	106	50		
Base B				100	395	380	395	300	205	
Base A				25	120	330	210	319	110	
Another										
Split					100	190	72	47		
Base B										
Base A										

Product structure can be defined as the components or materials that are incorporated into a product during the manufacturing process. The following is the product structure of natural materials for the 48+600 km Karawang toll road widening project. What is obtained after calculating the amount of material needed for each job that uses split stone, basecourse b, basecourse a.



Figure SEQ Figure \\* ARABIC

**Lot For Lot (LFL)**

The lot for lot method is better known as the minimal inventory method. With the LFL method, the material ordering will be carried out by the company according to the amount required in the field. This method also has a risk, namely if there is a delay in delivery, the work will also stop.

Table SEQ Table \\* ARABIC

Period	Plant Order Realese LFL								Total
	3	4	5	6	7	8	9	10	
PORel Split	85	54	108	209	296	178	97		1027
PORel Base b				261	380	395	300	205	1,541
PORel Base a				3	330	210	319	110	972

**Period Order (POQ)** **Quantity**

Calculation of the order quantity (POQ) method is a development of the EOQ method, which will later be used as supporting data to calculate the optimal order interval.

$$EOI = \frac{EOQ}{R} \quad (2)$$

Information:

EOI = Economic order interval in one period

EOQ = Optimal order quantity

R = Average demand per period

Table 4. Plant Order Realese POQ

Period	Plant Order Realese POQ								Total
	3	4	5	6	7	8	9	10	
PORel Split	139		317		474		7		1027
PORel Base b				641		695		205	1541
PORel Base a				333		529		110	972

**Fixed Period Requirements (FPR)**

The FPR technique basically uses the concept of a constant ordering interval, while the size of the order quantity (lot size) varies. In the FPR method, the time interval between orders is made fixed with the size according to the net needs of each period included in the predetermined order interval. The following is the order interval that we set from the logistics side. Intervals order stone split 3, basecourse b 2, basecourse a 2

Table 5. Plant Order Realese (FPR)

Period	Plant Order Realese FPR								Total
	3	4	5	6	7	8	9	10	
PORel Split	24			68			9		1027
PORel Base b	7			3			7		1541
PORel Base a				64		69		20	972
				1		5		5	

PORel	33	52	11	972
Base a	3	9	0	

**Fixed Order Quantity (FOQ)**

The FOQ technique uses a fixed order quantity for a certain inventory item that can be determined arbitrarily or based on intuitive factors. In using In this technique, if necessary, the number of orders is enlarged to match the amount of high net demand in a certain period that must be fulfilled, which means that the size of the order quantity (lot sizing) is the same for all subsequent periods in the planning. The order quantity of split is 354, basecourse b 590, basecourse a 372.

Table 6. Plant Order Realese FOQ

Period	Plant Order Realese FOQ							Total
	3	4	5	6	7	8	9	
PORel	35			35	31			1027
Split	4			4	9			
PORel				59	59		36	
Base B				0	0		1	1,027
PORel				37		37	22	972
Base A				2		2	8	

**Ordering Cost**

Ordering costs are costs incurred in connection with ordering goods or costs incurred as a result of orders starting from placing the order until the availability of the goods. The ordering cost for all natural materials is Rp. 270,000 per one day. And ordering costs are company expenses related to inventory [8]. The ordering cost is Rp. 2,300,000 for one month. The cost of saving in 12 periods or 3 months = 2,300,000 x 3 = Rp. 6.900,000.

Table 7. LFL Ordering Cost

Period	LFL Ordering Cost		
	Delivery	Cost	Total Cost
1	0	270,000	-
2	0	270,000	-
3	0	270,000	-
4	1	270,000	270,000
5	1	270,000	270,000
6	1	270,000	270,000
7	3	270,000	810,000
8	3	270,000	810,000
9	4	270,000	1,080,000
10	3	270,000	810,000
11	2	270,000	540,000
12	0	270,000	-
Total			4,860,000

Table SEQ Table \\*

Period	FPR Ordering Cost		
	Delivery	Cost	Total Cost
1	0	270,000	-
2	0	270,000	-
3	0	270,000	-
4	2	270,000	540,000
5	0	270,000	-
6	0	270,000	-
7	6	270,000	1,620,000
8	0	270,000	-
9	6	270,000	1,620,000
10	1	270,000	270,000
11	2	270,000	540,000
12	0	270,000	-
Total			4,590,000

Table SEQ Table \\* ARABIC 9.

Period	FOQ Ordering Cost		
	Delivery	Cost	Total Cost
1	0	270,000	-
2	0	270,000	-
3	0	270,000	-
4	3	270,000	810,000
5	0	270,000	-
6	0	270,000	-
7	5	270,000	1,350,000
8	5	270,000	1,350,000
9	3	270,000	810,000
10	3	270,000	810,000
11	0	270,000	-
12	0	270,000	-
Total			5,130,000

Table SEQ Table \\* ARABIC 10.

Period	POQ Ordering Cost		
	Delivery	Cost	Total Cost
1	0	270,000	-
2	0	270,000	-
3	0	270,000	-
4	2	270,000	540,000
5	0	270,000	-
6	3	270,000	810,000
7	5	270,000	1,350,000
8	4	270,000	1,080,000
9	6	270,000	1,620,000
10	1	270,000	270,000
11	2	270,000	540,000
12	0	270,000	-
Total			6,210,000

### Inventory Cost

Inventory costs can be calculated after the holding costs and ordering costs of each lot sizing method are found.

Table SEQ Table \\* ARABIC

No	Lot Sizing	Ordering Cost	Storage Cost	Inventory Cost
1	LFL	4,860,000	6,900,000	11,760,000
2	FPR	4,590,000	6,900,000	11,490,000
3	FOQ	5,130,000	6,900,000	12,030,000
4	POQ	6,210,000	6,900,000	13,110,000

### Procurement Costs

Procurement costs can be calculated after the procurement costs and material purchase costs from each lot sizing method are found.

Table 12. Procurement Cost

Lot Sizing	Inventory Cost	Material Cost	Procurement Cost
LFL	11,760,000	704,875,000	716,635,000
FPR	11,490,000	704,875,000	716,365,000
FOQ	12,030,000	704,875,000	716,905,000
POQ	13,110,000	704,875,000	717,985,000

### 4. Conclusion

Based on the results and analysis of MRP calculations using the Lot sizing method, Lot For Lot, Economic Order Quantity, Period Order Quantity, Fixed Period Requirements, and Fixed Order Quantity. In the Karawang Toll Road Widening project KM 48 + 600 Karawang. It can be concluded as follows.

- The lot sizing technique that produces the most optimal cost to determine the number of sizes for each order of natural materials in this study is Fixed Period Requirements This technique produces the minimum cost among other lot sizing techniques.
- Lot technique The minimum amount of natural material procurement costs using the FPR lot sizing method. For each cost is the cost of buying material Rp. 704,875,000, inventory costs Rp. 11.49 million. The minimum total cost of procuring natural materials in the Karawang KM 48 + 600 Karawang Toll Road Widening project using the MRP lot sizing technique Fixed Period Requirements is Rp. 716,365,000.
- The maximum inventory cost is Rp. 35,243,750 then the cost of inventory produced by each lot sizing, LFL Rp. 11.760.000, FPR Rp. 11,490,000, FOQ Rp. 12.030.000, POQ Rp. 13.110.000.
- So all MRP lot sizing methods can produce inventory costs below the maximum inventory cost set by the company.

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