

Optimizing Inventory Management in Micro Small Medium Enterprise (MSME) Using Material Requirement Planning (MRP)

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Abstract

The current business climate of increasing competition implies that all companies need to be as efficient as possible at every level, which includes inventory management. To have adequate quantities of high quality inventory available is basically the goal of every company in running their business, this is why inventory management is crucial. In addition to it, a well inventory management is also able to help companies minimize the costs of carrying inventory which leads to the service and profit optimization. Thus, the implementation of inventory management should be considered in every business scale, including Micro, Small and Medium Enterprise (MSMEs). Investigating the effectiveness of inventory management in MSMEs is way important since the existence of MSMEs itself has a big contribution to the growth of Indonesia's national gross domestic product. The purpose of this study was to optimize inventory management in a MSMEs in Indonesia, Warung Nasi Uduk Cani, by applying Material Requirement Planning (MRP) method for the production process. The use of this MRP method is intended for increasing Warung Nasi Uduk Cani's efficiency of its material procurement in order to fulfill the customer demand in the right amount and at the right time. The MRP will be built based on the owner's financial record and bill of material. The results of the discussion show that MRP can help adjust fluctuation in demand, reduce waste, prevent shortages, increase cost efficiency and more accurate estimates of material requirements and ordering schedule.

Keywords

Inventory Management, Micro, Small and Medium Enterprise (MSMEs), MRP, Material Procurement Cost.

1. Introduction

In Indonesia, the domestic economic activities are dominated by Micro, Small and Medium Enterprises (MSMEs). The MSMEs sector shows a vigorous part in the economy being the admission point for business owners to form and build new enterprises that can generate wealth and employment (Hamzani and Achmad 2016). The MSMEs sector is the central point of people's economic development (Gandhi et al. 2021). According to the official time series data issued by the Ministry of Cooperative and SME for the period of 2000–2017, the total number of MSMEs in Indonesia increased every year; from 39.784 million units to more than 59 million units by 2017. But there are also some MSMEs that stop operating and out of business due to several factors which make MSMEs suffer losses. There are several criteria that should be incorporated to delegate more productive enterprise in Indonesia (Nurcahyo 2017). The weaknesses of MSMEs that can lead to losses are marketing difficulties, limited access to financing sources as well as human resources and raw material difficulty. Many micro enterprises do not pay attention to production planning because they think their business does not yet need it (Ramadhani et al. 2021). It is essential that MSMEs get proper advisory services. Without proper advisory and guidance, many new entrepreneurs stuck and fail. The focus must be given on technological advancements in the operational processes (Nema 2019).

Inventory management is important to the overall success of all aspects of business, especially in MSME that produces food. The raw materials for food products have a limited consumption period and require a suitable storage with certain characteristics. But the implementation of inventory management in MSMEs are still rarely used due to lack

of knowledge about the importance of inventory management. However, inventory management is needed to manage inventory effectively and efficiently in order to ensure the product continuity and raw materials availability.

Material Requirement Planning (MRP) is one type of methods that can be used to optimize inventory of MSME from the aspect of cost and inventory utilization. In the end, cost comparison can be perform to discover how significant the improvement that the company can perform if the company is applicate the theory on their material purchasing system (Iasya 2018). This study aims to analyze and give improvement for inventory in MSME using MRP Method. We believe that the result will be essential for the sustainability of MSME.

1.1 Objectives

The objective of this paper is to find the better way to improve the inventory management in MSME by implementing MRP method to maintain the availability of materials to focus on the resources with the highest value goods so that the production will be more effective and become more profitable.

2. Literature Review

Micro, Small, and Medium Enterprises (MSMEs) is an enterprise with a relatively small capital and financial resources thus having a major interaction with the owner due to the small number of employees (Narasi Statistik 2013). Based on government regulation No. 20 of 2008, MSMEs is defined as follows: 1) Criteria for Micro, which has a maximum net assets of Rp50,000,000.00 excluding land and buildings, or having an annual sales, at most Rp300,000,000.00; 2) Criteria for Small Business that has net assets of more than Rp50,000,000.00 up to Rp500,000,000.00 excluding land and buildings, or having an annual sales of more than Rp300,000,000.00 up to the Rp2,500,000,000.00; 3) Criteria Medium Enterprises which has net assets of more than Rp500,000,000.00 up to at most Rp10,000,000,000 excluding land and buildings, or having an annual sale over Rp2,500,000,000 up to at most Rp50,000,000,000.

According to Jutla et al. (2002), MSMEs are contributing significantly to the economy and the economic growth of a country. As one of the developing countries, the economic growth of Indonesia is also largely supported by the existence of Micro, Small, and Medium Enterprises (MSMEs) (Hayasi 2007). Furthermore, MSMEs had shown its big contribution to sustain economic stability in Indonesia when the economic crisis hit Indonesia in 1997, and it still can survive until now. In response to this, the government of Indonesia is putting much effort to support the development of MSMEs in size and number by improving the performance of MSMEs since MSMEs can absorb a lot of labors including those who do not have any education degree. Thus, it is very important to improve the performance of MSMEs in Indonesia. The performance of MSMEs itself really depends on the role and behavior of the business owner or entrepreneur in managing its business. However, the owners may experience many difficulties in the management and development effort such as poorly applied of inventory management. Inventory management should be taken into attention since inventories are defined as a significant portion of the current assets of any business enterprise and effective inventory policies in a supply chain should ensure that the right inventory levels are held in the right place at the right time, at the lowest costs possible (Brigham and Ehrhard 2005).

The business' owner effort to manage and develop their MSMEs is further challenged by the current business climate where competition level is high. While ensuring that they stay in that high competition, they still have goals to reduce cost and improve effectiveness in their own enterprise. This puts pressure on owners to look for areas where they can improve and reduce inventories without hurting the level of service provided. Production planning involves basic concepts such as what to produce, when to produce, and how much to produce (Putra et al. 2021). Through the years, a number of inventory management methods were developed to assist the effective management inventories. Regina et al. (2021) MPS helps determine the amount of production needed per period to meet anticipated customer demand using data of the beginning inventory and the demand forecast for a particular end item.

In the 1960s and 1970s the Material Requirement Planning (MRP) systems were developed to help business determine exactly when and how much material to purchase (Heizer and Render 2011). Through MRP, we can see the most obvious shortcoming that can help us focus on labor efficiency (Plenert 1999). According to Arnold et al. (2008), MRP is a plan for the production and purchase of the components used in making the items in the Master Production Schedule. MRP is made up of a range of functions integrated with financial reports to form an integrated management system. Nachtmann et al. (2005) pointed the fact that much of a company's costs can be attributed to the amount it invests in the inventory and associated holding, transportation, and management costs. Effective management of

inventory is critical to MSMEs profitability. Thus, it is important to investigate the right method for realizing effective inventory management.

3. Methods

The methods used in this research is Material Requirement Planning (MRP) method. First we determine what components are needed to meet the master production schedule and calculate the periods when components must be available in inventory using MRP Method.

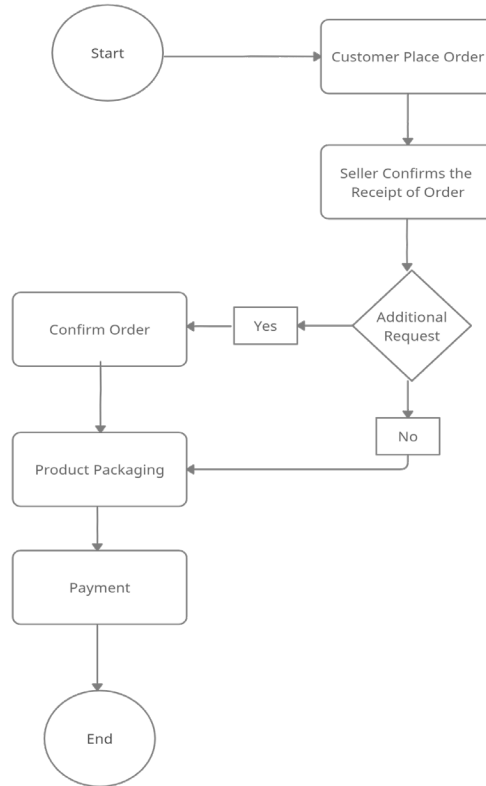


Figure 1. Flowchart of Business Process

4. Data Collection

Warung Nasi Uduk Cani produces many types of food for the customer. We decided to choose three kinds of food product in which they are a best seller and 2 of the least sold food items. The three items are Nasi Uduk, Original Cheese Stick, and Kentang Mustofa. Each and every product has their own unique product structure. The structure of each product is shown below.

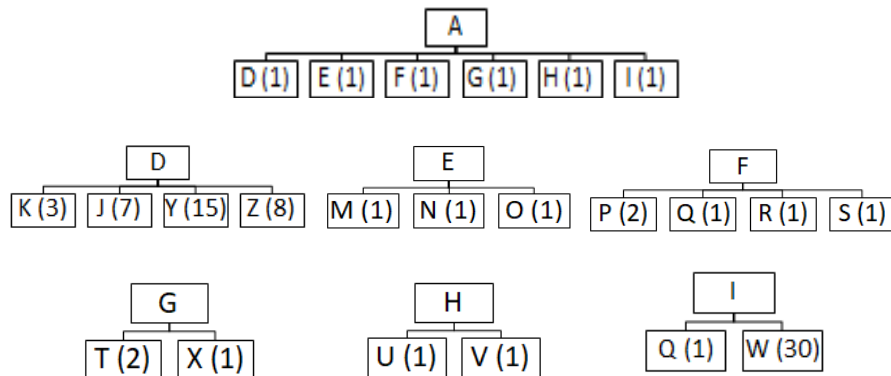


Figure 2. Product structure from Nasi Uduk (A)

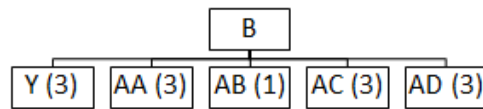


Figure 3. Product structure from Original Cheese Stick (B)

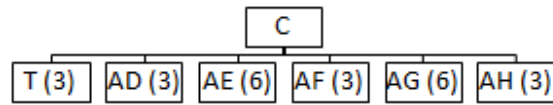


Figure 4. Product structure from Kentang Mustofa (C)

Based on the product structure, we know that some materials are used for more than one product or sub-product while others are not. We also know that product A has 2 levels of product structure while product B and C only have 1 level. Most material also has a different lot size, making it difficult to record inventory. The Bill of Material (BOM) along with the lead time and lot size will be shown in the table below.

Table 1. Bill of Material (BOM) for each product

Code	Unit	Needs			Lead Time	Lot Size	Price per Lot
		Product 1	Product 2	Product 3			
A	70 portion	✓			1 Day	1	-
B	15 pack		✓		1 Day	1	-
C	15 pack			✓	1 Day	1	-
D	1 portion	1	-	-	0 Day	1	-
E	1 portion	1	-	-	0 Day	1	-
F	1 portion	1	-	-	0 Day	1	-
G	1 portion	1	-	-	0 Day	1	-
H	1 portion	1	-	-	0 Day	1	-
I	1 portion	1	-	-	0 Day	1	-
J	1 liters	7	-	-	1 Day	1	Rp13.000
K	1 piece	3	-	-	1 Day	1	Rp10.000
L	1 kg	1	-	-	1 Day	1	Rp35.000
M	1 liter	1	1	-	1 Day	1	Rp25.000
N	3 kg	1	-	-	1 Day	1	Rp20.000
O	½ kg	1	-	-	1 Day	1	Rp6.000

P	1 piece	2	-	-	1 Day	2	Rp12.000
Q	12 sachet	1	-	-	1 Day	1	Rp16.500
R	100 gram	1	-	-	1 Day	1	Rp3.000
S	100 gram	1	-	-	1 Day	1	Rp3.500
T	¼ kg	2	-	3	1 Day	1	Rp6.500
U	4 pack	1	-	-	1 Day	4	Rp15.000
V	1 sachet	1	-	-	1 Day	1	Rp1.000
W	1 pack	1	-	-	1 Day	1	Rp21.000
X	½ kg	1	-	-	1 Day	1	Rp16.000
Y	200ml	15	3	-	1 Day	3	Rp3.000
Z	1 tbs	8	-	-	1 Day	16	Rp3.500
AA	1 kg	-	3	-	1 Day	1	Rp12.000
AB	12 item	-	1	-	1 Day	1	Rp19.500
AC	100 gr	-	3	-	1 Day	3	Rp12.000
AD	1 sachet	-	3	3	1 Day	3	Rp1.000
AE	1 kg	-	-	6	1 Day	1	Rp12.500
AF	¼ kg	-	-	3	1 Day	1	Rp8.000
AG	1 box	-	-	6	1 Day	2	Rp2.000
AH	1 tbs	-	-	3	1 Day	3	Rp7.500

Based on data from Warung Nasi Uduk Cani, we earned the number of sales for five week. The data is the number of demands the company has to fulfill based on the MTO scheme. This data will be served as input for the MPS as it only provides us with the number of end items needed at the end of each week.

Table 2. Master Production Schedule for Five Week

No.	Product	Week 1	Week 2	Week 3	Week 4	Week 5
1	Nasi Uduk	420	420	420	420	420
2	Original Cheese Stick	15	15	15	0	15
3	Kentang Mustofa	15	15	0	15	15
Total		450	455	435	450	450

Table 3. Master Production Schedule of Original Cheese Stick for Five Week

Week	1	2	3	4	5
Forecast	10	10	10	10	10
Actual Order	8	11	6	5	8
Opening Inventory	0	5	9	14	4
Requirement	10	11	10	10	10
Net Inventory Before Production	-10	-6	-1	4	-6
MPS	15	15	15	0	15
Projected Inventory	5	9	14	4	9
Available To Promise	7	-2	*	-5	7

Table 4. Master Production Schedule of Kentang Mustofa for Five Week

Week	1	2	3	4	5
Forecast	10	10	10	10	10
Actual Order	9	10	7	8	8
Opening Inventory	0	5	10	0	5
Requirement	10	10	10	10	10
Net Inventory Before Production	-10	-5	0	-10	-5
MPS	15	15	0	15	15
Projected Inventory	5	10	0	5	10
Available To Promise	6	*	-7	-1	*

Using the data found in Figure 2 (Product A structure), Figure 3 (Product B structure), Figure 4 (Product C structure), Table 1 (The Bill of Materials), and Table 2 (Master Production Schedule) we may create an MRP table for five week of demand. The MRP will be based on the assumption that on hand inventory at the beginning of week 1 is 0 for all material, sub-assembly, and enditem as the company has just started their business. There is no storage fee as the company does not provide the storage cost data. The MRP table will be shown in the table below.

Table 5. Material Requirement Planning for Five Week

Part Code	MRP	Week																																				
		1							2							3							4							5								
		1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7		
A	Planned Order Release	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70
B	Planned Order Release	15																																				
C	Planned Order Release	15																																				
D	Planned Order Release	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70
E	Planned Order Release	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70
F	Planned Order Release	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70
G	Planned Order Release	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70
H	Planned Order Release	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70
I	Planned Order Release	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
J	Planned Order Release	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
K	Planned Order Release	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
L	Planned Order Release	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
M	Planned Order Release	12																																				
N	Planned Order Release	2			1																																	
O	Planned Order Release	6																																				
P	Planned Order Release	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	
Q	Planned Order Release	6																																				
R	Planned Order Release	6																																				
S	Planned Order Release	4			2																																	
T	Planned Order Release	5	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
U	Planned Order Release	4	2																																			
V	Planned Order Release	6																																				
W	Planned Order Release	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
X	Planned Order Release	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Y	Planned Order Release	18																																				
Z	Planned Order Release	32			16																																	
AA	Planned Order Release	3																																				
AB	Planned Order Release	1																																				
AC	Planned Order Release	3																																				
AD	Planned Order Release	6																																				
AE	Planned Order Release	6																																				
AF	Planned Order Release	3																																				
AG	Planned Order Release	6																																				
AH	Planned Order Release	3																																				

5. Results and Discussion

From the MRP we calculate the cost of material procurement from week 1 to week 5. We use unit, lot size, and prices from Bill of Materials to calculate the material cost. The cost prices per week will be illustrated in the graph below.

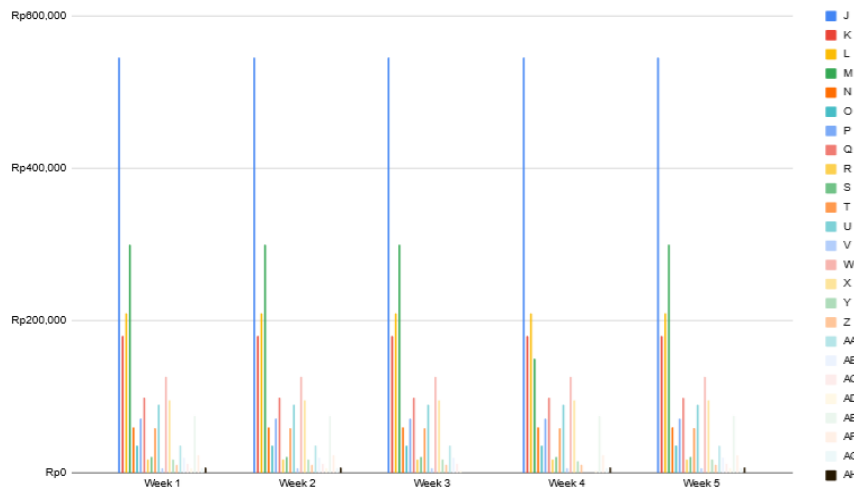


Figure 5. Production cost for each week

5.1 Numerical Results

Table 6. Material Procurement Cost with MRP

Material Procurement with MPS	Week				
	1	2	3	4	5
Cost	Rp2.133.000	Rp2.133.000	Rp2.017.500	Rp1.909.500	Rp2.133.000
Total Cost	Rp10.326.000				

From the table, the material procurement cost with MRP will be Rp10.326.000 for five weeks of production. Furthermore, to find out how well the use of the MRP is to utilize inventory and increase efficiency compared to the actual material cost calculation of Warung Nasi Uduk Cani, we need a comparison of the material procurement cost for five weeks. The actual procurement cost is obtained from the financial records that covers the material being used for the operation of Warung Nasi Uduk Cani during week 1 until week 5. Below attached the table of the current or actual material procurement cost data.

Table 7. Actual Material Procurement Cost

Actual Material Procurement Cost	Week				
	1	2	3	4	5
Cost	Rp2.247.000	Rp2.247.000	Rp2.247.000	Rp2.247.000	Rp2.247.000
Total Cost	Rp11.235.000				

From Tabel 7 we can see the actual total cost for five weeks is Rp11.235.000. Both actual cost material procurement and material procurement cost with MRP calculation are then compared to see the difference if Warung Nasi Uduk Cani uses MRP in their operation. The difference between the actual cost and MRP cost is shown in the table below.

Table 8. Material Procurement Cost Comparison Between Actual and with MRP

Actual Cost Material Procurement	Material Procurement Cost with MRP	Efficiency	
		In Price	Percentage
Rp11.235.000	Rp10.326.000	Rp909.000	8,09%

Based on the cost comparison from Table 8, it is found that the implementation of MRP in the operation of Warung Nasi Uduk Cani enables them to save up to Rp909.000 or equal to increasing 8,09% efficiency. Further, the use of MRP can optimize the utilization of inventory corresponding to the amount and schedule the items are ordered.

5.2 Graphical Results

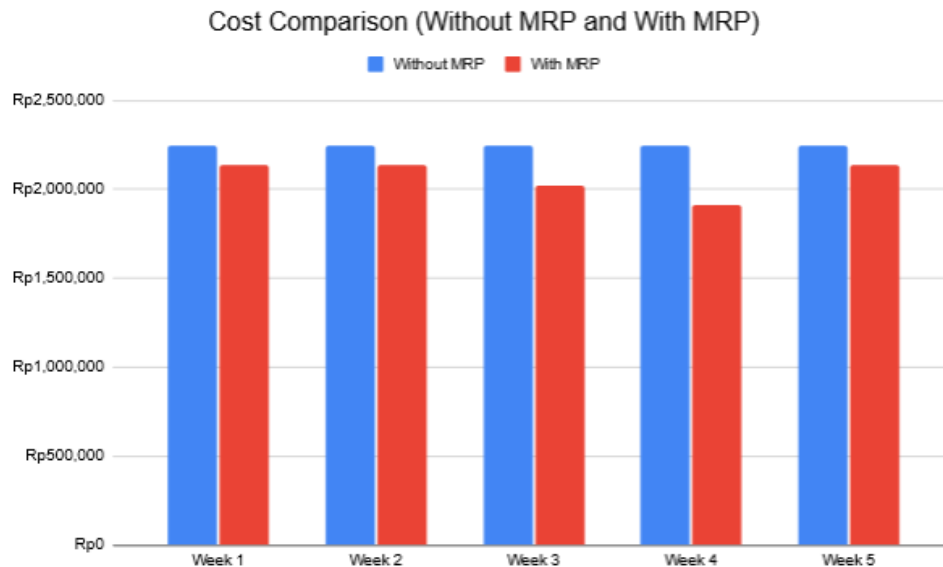


Figure 6. Cost Comparison between with and without MRP

The graph shows the material procurement cost that implements Material Requirement Planning is lower than the actual material cost that doesn't apply MRP. This difference can have a significant impact on MSME's budget.

5.3 Proposed Improvements

Currently, Warung Nasi Uduk Cani has not implemented a production strategy, thus allowing business processes to not run efficiently and have high costs. Therefore, we propose a production based on Material Requirement Process that our team has made. (Table 5). By implementing MRP, Warung Nasi Uduk Cani can overcome the inability to determine the production planning to fulfill the customer demand in the right amount and on the right time, when materials should be purchased and how much.

6. Conclusion

Warung Nasi Uduk Cani is categorized as a Micro, Small, and Medium Enterprises (MSME) that produces many types of food. This MSME has not implemented the inventory management in determining the right quantity of raw materials to optimize the utilization of inventory and reduce procurement cost. Therefore, Material Requirement Planning (MRP) is the appropriate method to solve this problem.

The MRP result is obtained from the Master Production Schedule (MPS). It contains the production forecast per week, actual order per week, and so on, which are essential to calculate the MRP. The MRP shows the quantity of raw materials and the total procurement cost per day for 5 weeks to be used as a comparison with the actual procurement cost.

Based on the comparison result, it can be figured that Warung Nasi Uduk Cani can save the material procurement cost up to Rp909.000 or equal to increasing 8,09% efficiency using MRP Method. In its inventory capacity as MSME, the implementation of MRP in the purchasing of raw materials saves a lot of money to the company.

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Biography

Naura Diva Atmika is an undergraduate student of Industrial Engineering from Universitas Indonesia. She is interested in Business Analysis, Product Management, and Quality Systems.

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