

# **Material Requirement Planning and Inventory Control Application Program of Crispy Retail at PT. Diva Mitra Bogatama with Application Program Based on c# Programming Language**

**Lina Gozali, Florencia Irena, Lilyana Jap, Fransiska Lefta,  
Andri Tan Wijaya, Frans Yusuf Daywin**  
Industrial Engineering Department  
Engineering Faculty, Universitas Tarumangara,  
Jakarta, Indonesia, 12310

[ligoz@ymail.com](mailto:ligoz@ymail.com), [florencia.545150001@stu.untar.ac.id](mailto:florencia.545150001@stu.untar.ac.id), [lilyanajap@yahoo.com](mailto:lilyanajap@yahoo.com),  
[fransiskalefta@gmail.com](mailto:fransiskalefta@gmail.com), [andritanwijayaaa@gmail.com](mailto:andritanwijayaaa@gmail.com), [fransjusuf42@gmail.com](mailto:fransjusuf42@gmail.com)

**Siti Rohana Nasution**  
Universitas Pembangunan Nasional "Veteran"  
Jakarta

[sitirohananasution@gmail.com](mailto:sitirohananasution@gmail.com)

## **Abstract**

PT. Diva Mitra Bogatama is a company engaged in seasoned flour industry. One of its products is crispy retail. In the production process, PT. Diva Mitra Bogatama does not use quantitative calculation methods in planning and controlling raw materials, thus, the company often has problems and losses of the availability of raw materials. Therefore, it is necessary to use an application program for planning and controlling raw materials. Through this application program, the company can be facilitated in calculating the planning and control of raw materials so that losses due to excess raw materials, and delays in delivery due to hampered production processes can be reduced. Forecasting method chosen based on the smallest error is cyclic. The MRP methods are LFL, EOQ, LUC, POQ, and Silver Meal. Another calculation method is continuous review (Q, r) backorder method. The chosen method is the method that has the smallest cost. The cost of wheat flour using the continuous review (Q, r) backorder method is Rp 106.371.229 and the cost of corn flour with continuous review (Q, r) backorder method is Rp 24.609.342.

**Keywords: Inventory, Forecasting, MRP, Application Program**

## **1. Introduction**

PT. Diva Mitra Bogatama is a company engaged in seasoned flour industry located in the Pulo Gadung industrial area. One of its products is multipurpose seasoning flour or Crispy Retail. At present, PT. Diva Mitra Bogatama does not use quantitative calculation methods in planning and controlling raw materials. As a result, the company often has problems in the availability of raw materials. The lack of raw materials causes delay in distribution, moreover, the stacked up raw materials also causes losses. Therefore, it is necessary to use an application program for planning and controlling raw materials. Through this application program, the company can be facilitated in calculating the planning and control of raw materials so that losses due to excess raw materials, and delays in delivery due to hampered production processes can be reduced.

## 2. Literature Review

### 2.1 Forecasting

According to Astana, 2007 [1], forecasting is the process of estimating (measuring) the amount or number of things in the future based on data in the past that are analyzed scientifically, specifically using statistical methods. The forecasting methods that are used are single moving average, double moving average, weighted moving average, single exponential smoothing, double exponential smoothing, linear regression, and cyclic. The methods that are used to find the smallest error (the best method) in forecasting methods are MAD, MSE, MAPE, and SDE. The cyclic method is a periodic up or down in the long run [2].

### 2.2 ABC Analysis

ABC Analysis is a method of classifying goods based on rank values from the highest to lowest values. It is divided into 3 large groups called A, B, and C. According [3], ABC classification is as follows: Class A: 20% of inventories, value of 80%; Class B: 30% of inventories, value of 15%; Class C: 50% of inventories, value of 5%.

### 2.3 Safety Stock

Safety stock is inventories that are indicated to overcome excess demand or use of raw materials, because there is uncertainty in the level of demand and waiting time, which is saved to reduce the risk of shortages of raw materials [4].

### 2.4 Material Requirement Planning Methods

Material Requirement Planning Methods that are used in this research are Lot for Lot, Economic Order Quantity, Period Order Quantity, Silver Meal, and Least Unit Cost. Period Order Quantity or POQ method is a method for keeping fixed orders every period of the EOQ adjusting to the amount produced or purchased. The

POQ formula is as follows:  $EOI = \frac{EOQ}{R} = \sqrt{\frac{2C}{RPH}}$ .....(1)

Remarks:

EOI is an economical ordering interval in one period

C is the cost of ordering each time

H is the percentage of storage costs per period

P is the price or cost of purchasing the unit

R is the average demand per period

### 2.5. Continuous Review (Q,r) Backorder Method

This method is an inventory model that serves to prevent companies from experiencing a shortage of raw material supplies to goods desired by consumers, so that the company can delay the fulfillment of demand for goods and immediately makes emergency reservations, on the other hand consumers want to wait until the goods are available. This Continuous Review Backorder Method can calculate (Safety Stock), (Reorder Point), (Stock Out), so the total cost can be minimized (Gozali, 2013). How to calculate:

a. Calculates the Q value in the condition without the stockout with the formula:

$$Q_{ij} = \sqrt{\frac{2D_j[S_j + \pi_j \sigma_{Lj} g(k)_{ij}]}{h_j}} \dots\dots\dots (2)$$

Remarks:

$D_j$  is annual average demand

$S_j$  is setup cost

$\pi_j$  is the cost of backorder cost per unit

$\sigma_{Lj} g(k)_{ij}$  is expected number of stockout units

$h_j$  is holding cost per unit per year

b. Calculates the *Order Stockout Rate* (OSOR<sub>j</sub>) or P(M>B)

$$OSOR_j = \frac{h_j Q_{oj}}{\pi_j D_j} \dots\dots\dots(2a)$$

- c. Calculates *safety factor* (k)ij or zij from OSORj using a standard normal distribution table.
- d. Calculates the partial expectation g(k)ii or E(z)

$$g(k)_{ij} = \frac{Q_{ij} USOR_j}{\sigma_{Lj}} \dots\dots\dots(2b)$$

- e. Calculates Unit Stockout Rate (USORj).
- f. g(k)ij put back into the formula Qij to find the lot size.
- g. Looking for the value of g (k) ij from the calculation of Qij with the help of USORj that has been calculated.
- h. Calculates reorder point (Rj)

$$R_j = D_{Lj} + k_j * \sigma_{Lj} \dots\dots\dots (2c)$$

- i. Calculates safety stock (SS).

$$SS_j = k_j * \sigma_{Lj} \dots\dots\dots (2d)$$

- j. Calculates the amount of backorder unit (Bj).

$$B_j = \sigma_{Lj} g(k)_j \dots\dots\dots(2e)$$

- k. Calculates the frequent of ordering raw materials (mj).

$$m_j = \frac{D_j}{Q_j} \dots\dots\dots(2f)$$

- l. Calculates the order interval for raw materials (Tj)

$$T_j = \frac{1}{m_j} = \frac{Q_j}{D_j} \dots\dots\dots(2g)$$

- m. Calculates *Unit Service Level* (USL)

$$USL_j = 1 - USOR_j \dots\dots\dots(2h)$$

- n. Calculates the total inventory costs.(TC)

$$TC_j = D_j P_j + \left(\frac{S_j D_j}{Q_j}\right) + h_j \left(\frac{Q_j}{2} + SS_j\right) + \left(\frac{\pi_j D_j B_j}{Q_j}\right) \dots\dots\dots(2i)$$

### 3. Research Methodology

The object of this research is PT. Diva Mitra Bogatama which is located in Pulo Gadung Industrial Area. The research methodology can be seen in figure 1.

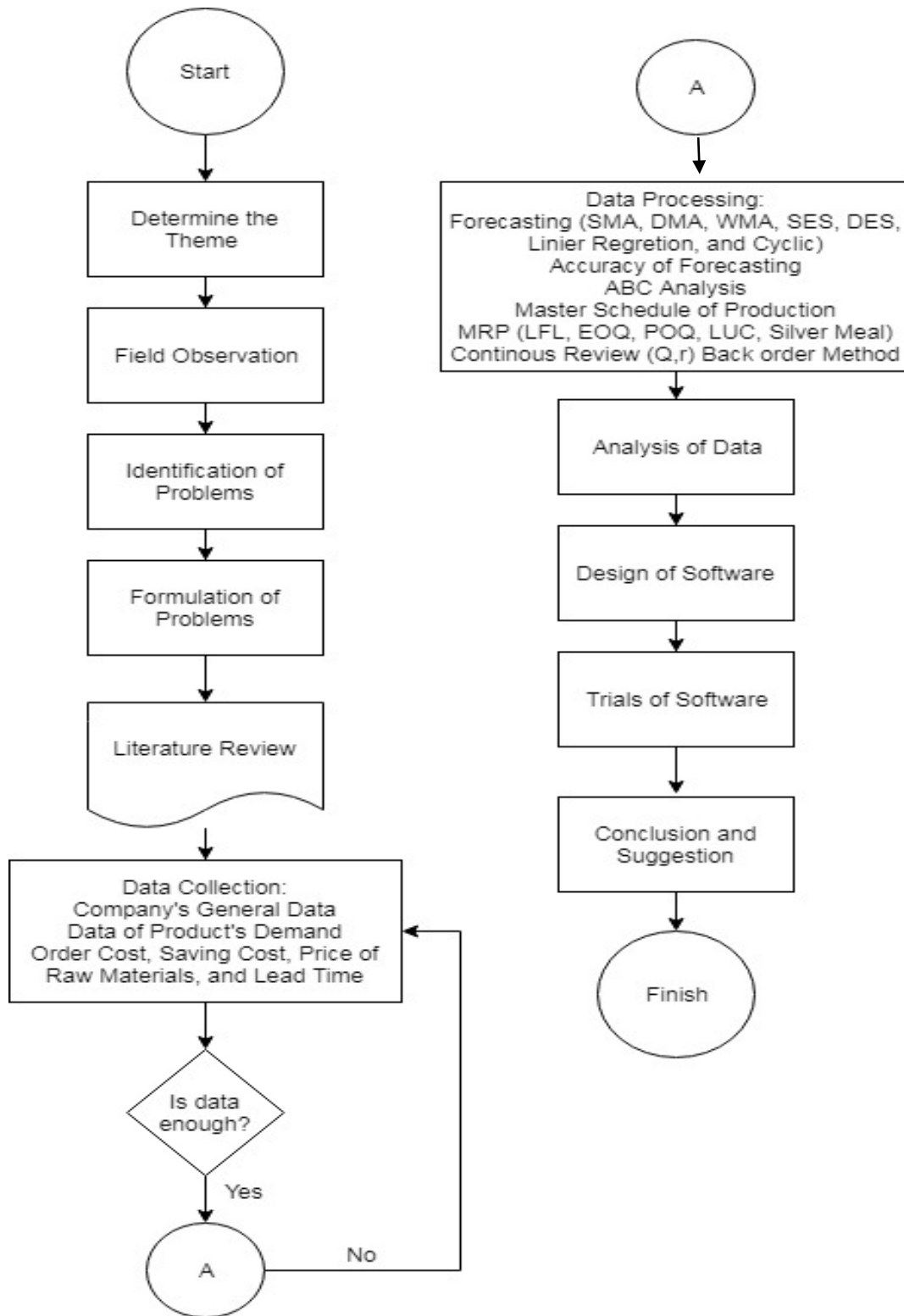


Figure 1 Research Methodology

## 4. Result and Implementation

### 4.1 Data Collection and Parameters

The data collection activity starts from retrieving the existing primary data of products demands, order cost, inventory cost, and lead time for each product items. For Forecasting analysis, this research uses the time series demand data of analysis. The data used to calculate the demand forecasting data does not always have to meet the normal curve standard requirement.

### 4.2 Result of Calculation

The demand of crispy retail from January 2019 until December 2019 can be seen in Figure 2.

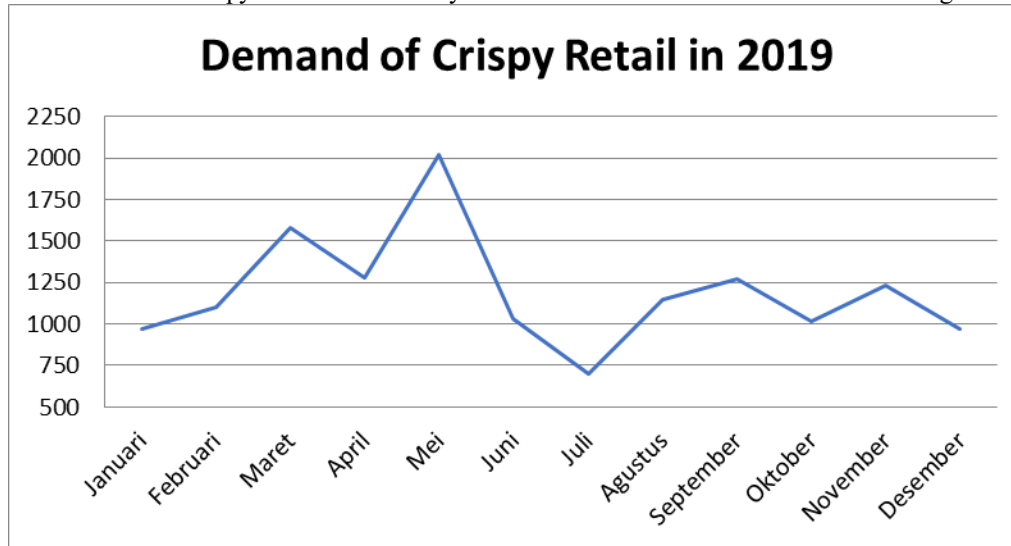


Figure 2. Demand of Crispy Retail Order cost, holding cost, purchase cost, and lead time can be seen in Table 1.

Table 1. Order Cost, Holding Cost, Purchase Cost, and Lead Time

Raw Materials	Order Cost	Holding Cost	Purchase Cost	Lead Time
Wheat Flour	Rp 5.750.000	Rp 10.000	Rp 6.500	1 month
Corn Flour	Rp 5.500.000	Rp 12.000	Rp 7.500	1 month

The results of calculation of error values of various forecasting methods can be seen in Table 2.

Table 2. The Calculation of Error Values of Forecasting Methods

Method	SMA2	SMA3	SMA5	DMA2	WMA 3	SES0,1
MAD	370	313.22	254.57	438.33	323	280.27
MSE	220150	173003	83130.2	293703	172623	148609
SDE	469.2	441.17	353.12	574.82	440.68	404.31
MAPE(%)	33.99	29.6	28.64	43.09	30.54	22.27
Method	SES0,3	SES0,5	SES0,7	SES0,9	SIKLIK	LINIER
MAD	295.36	317.82	352.55	378	<b>230.33</b>	233.92
MSE	151735	161822	177075	199505	<b>80336.8</b>	100020
SDE	408.54	421.91	441.34	468.46	<b>296.04</b>	330.32

<b>Method</b>	<b>SMA2</b>	<b>SMA3</b>	<b>SMA5</b>	<b>DMA2</b>	<b>WMA 3</b>	<b>SES0,1</b>
MAPE(%)	25.55	28.11	30.97	32.59	<b>18.96</b>	20.22
<b>Method</b>	<b>DES0,1</b>	<b>DES0,3</b>	<b>DES0,5</b>	<b>DES0,7</b>	<b>DES0,9</b>	
MAD	310	359.9	442.4	492	607.5	
MSE	150993	183007	234216	318913	473130	
SDE	429.59	472.94	535.04	624.33	760.44	
MAPE(%)	26.31	32.76	39.18	41.55	52.17	

The results of forecasting in 2020 using the cyclic method can be seen in Table 3.

Table 3. Forecasting in 2020

Month	Result	Month	Result	Month	Result	Month	Result
Jan	994	April	994	July	992	Okt	992
Feb	1371	Mei	1371	August	1371	Nov	1369
Mar	1215	Jun	1215	Sept	1215	Dec	1218

The results of ABC analysis of crispy retail raw materials can be seen in Table 4.

Table 4. ABC Analysis

No	Raw Materials	Fund Absorption Percentage (%)	Cumulative Percentage of Fund Absorption (%)	Percentage of Item Type (%)	Cumulative Percentage of Item Type (%)	Category
1	Wheat Flour	66,44	66,44	10,00	10,00	A
2	Corn Flour	10,10	76,54	10,00	20,00	A
3	Smooth MSG	9,29	85,83	10,00	30,00	B
4	Tapioca Flour	4,04	89,87	10,00	40,00	B
5	Batter Crisp/Kreation 20 CS	2,52	92,39	10,00	50,00	B
6	Premix	2,48	94,87	10,00	60,00	B
7	White Pepper	1,82	96,69	10,00	70,00	C
8	Smooth Salt	1,70	98,38	10,00	80,00	C
9	SAPP	1,01	99,39	10,00	90,00	C
10	Sodium Bicarbonat	0,61	100,00	10,00	100,00	C

The results of *safety stock*'s calculation from category A can be seen in Table 5.

Table 5. The Calculation of Safety Stock of Crispy Retail Raw Materials

Raw Materials	Standard Deviation (95%, Z=1,65)	Safety Stock (kg)
Wheat Flour	122,78	202,58
Corn Flour	16,18	26,69

The master schedule for wheat flour production can be seen in Table 6 while the master schedule for corn flour production can be seen in Table 7.

**Table 6. Master Schedule of Wheat Flour**

Time Period	Past due	1	2	3	4	5	6	7	8	9	10	11	12
Sales Forecast		754.73	1040.87	922.51	754.73	1040.74	922.51	753.21	1040.74	922.51	753.21	1039.08	924.17

**Table 7. Master Schedule of Corn Flour**

Time Period	Past due	1	2	3	4	5	6	7	8	9	10	11	12
Sales Forecast		99.44	137.14	121.54	99.44	137.12	121.54	99.24	137.12	121.54	99.24	136.90	121.76

The method of calculating the planning and control of wheat flour raw materials can be seen in Table 8 and the raw material of corn flour in Table 9.

**Table 8. Calculation of Total Costs of Wheat Flour's Raw Materials**

Methods	Costs			Total Costs
	Purchase	Order	Holding	
LFL	Rp70.648.617	Rp69.000.000	Rp0	Rp139.648.617
EOQ	Rp72.972.545	Rp63.250.000	Rp55.415.181	Rp191.637.726
POQ	Rp70.648.617	Rp34.500.000	Rp54.362.332	<b>Rp88.862.332</b>
Silver Meal	Rp70.648.617	Rp69.000.000	Rp0	Rp139.648.617
LUC	Rp70.648.617	Rp69.000.000	Rp0	Rp139.648.617
Continuos Review (Q,r) Backorder				Rp 106.371.229

**Table 9. Calculation of Total Costs of Corn Flour's Raw Materials**

Methods	Costs			Total Costs
	Purchase	Order	Holding	
LFL	Rp10.740.136	Rp66.000.000	Rp0	Rp76.740.136
EOQ	Rp12.402.765	Rp27.500.000	Rp24.297.917	Rp64.200.682
POQ	Rp10.740.136	Rp22.000.000	Rp18.252.725	Rp40.252.725
Silver Meal	Rp10.740.136	Rp33.000.000	Rp8.594.835	Rp52.334.971
LUC	Rp10.740.136	Rp22.000.000	Rp18.252.725	Rp50.992.861
Continuos Review (Q,r) Backorder				<b>Rp 24.609.342</b>

## Application Program

The application program that will be designed is a program that helps company in calculating material requirements planning and probability inventory control of crispy retail products. There are several calculation features:

1. Forecasting: The company input the demand data for one year, they can choose several forecasting methods, and they can also know the best method (with smallest error value).
2. Calculation of total cost with material requirement planning's methods: lot for lot, economic order quantity, periodic order quantity, silver meal, and least unit cost.
3. Calculation of total cost with continuous review (Q,r) backorder method.
4. The summary to know the best method for each raw materials.

## 5. Conclusion

The best forecasting method for crispy retail products is the cyclic method. This method has the smallest error value compared to other methods. Based on ABC analysis, the raw materials for crispy retail products included in category A are wheat flour and corn flour. The calculation of safety stock for wheat flour is 202.58 kg and for corn flour is 26.69 kg. The method used for the calculation of raw materials are POQ for wheat flour worth Rp 88.862.332 and the continuous review (Q, r) backorder method for corn flour worth Rp 24.609.342. Both methods are chosen because they have the smallest total cost.

## 6. References

- [1]. Astana, I Nyoman Yudha, 2007. *Perencanaan Persediaan Bahan Baku Berdasarkan Metode MRP (Material Requirement Planning)*. Jurnal Ilmiah Teknik Sipil. Vol.11, No.2.
- [2]. Gozali, Lina, Adianto, dan Hendrik Halim, 2013. *Usulan Sistem Pengendalian Bahan Baku dengan Metode Continuous Review (Q,r) Backorder pada PT. Karuniatama Polypack*. Jakarta: Program Studi Teknik Industri Universitas Tarumanagara.
- [3]. Nasution, Arman Hakim dan Prasetyawan, Yudha, 2008. *Perencanaan dan Pengendalian Produksi*. Yogyakarta: Graha Ilmu.
- [4]. Schroeder, Goldstein dan Rungtusanatham, 2010. *Operations Management: Contemporary Concepts and Cases*. McGraw-Hill.
- [5]. Tersine, Richard J, 1994. *Principles of Inventory and Materials Management Fourth Edition*. New Jersey: PTR Prentice-Hall, Inc

**Lina Gozali** is a lecturer of Industrial Engineering Department at Universitas Tarumanagara since 2006 and a freelance lecturer at Universitas Trisakti since 1995. She got her Bachelor degree at Trisakti University, Jakarta - Indonesia, then she graduated Master Degree at STIE IBII, Jakarta – Indonesia, and graduated her Ph.D at Universiti Teknologi Malaysia, Kuala Lumpur – Malaysia in 2018. Her apprentice college experience was in paper at Kertas Bekasi Teguh, shoe at PT Jaya Harapan Barutama, automotive chain drive industry at Federal Superior Chain Manufacturing. She teaches Production System and Supply Chain Management Subjects and her Ph.D research about Indonesian Business Incubator. She actively writes for almost 40 publication since 2008 in Industrial Engineering research sector such as: Production Scheduling, Plant Lay Out, Maintenance, Line Balancing, Supply Chain Management, Production Planning and Inventory Control. She had been worked at PT. Astra Otoparts Tbk as International Business Development Department for 4 years, Citibank, N.A as customer service for 1 year, PT. Pandrol as assistant marketing manager for 1 year. PT. Texmaco as merchandiser for 3 years.

**Frans Yusuf Daywin** is a Senior Professor at Tarumanagara University whose expertise in Agriculture Machinery. He graduated his master study as a **master of science**, in Mechanical Science at University of Philippines and his undergraduate and Ph.D at Institute Pertanian Bogor.

**Florenzia Irena and Fransiska Lefta, and Andri Tan Wijaya.** They are all undergraduate students of Tarumanagara University majoring in Industrial Engineering.



**Siti Rohana Nasution** is a lecturer at the Industrial Engineering Study Program at UPN Veteran Faculty of Engineering in Jakarta since August 2019. She has been a freelance lecturer at UPN V Jakarta since 2005 and Tarumanegara University since 2008. From 2004 to 2019 she was assigned as DPK to the Faculty of Industrial Engineering Study Program Technical University of Pancasila. In 1994 she was appointed as a civil servant and was assigned to the IST AKPRIND Yogyakarta until 2003. She received her bachelor's degree from the Islamic University of Indonesia, and attained her master's degree in Engineering from the University of Indonesia. The research carried out covers the fields of Lean Manufacturing, Ergonomics, Production Systems and Factory Facility Layout Planning. Community Service is carried out on community-based waste management.

**Lilyana Jap** is a freelance lecturer of Industrial Engineering Department at Universitas Tarumangara since 2017 till present, graduated her master degree from University of Indonesia, majoring on Environmental science (industrial scope). She is interested in in-depth research of modelling system with systems thinking methods and system dynamics approaches. Her previous research was using Power sim 10, with utmost analytical about modelling in system dynamics, from Causal loop until intervention schemes.