

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

*by Lina Gozali*

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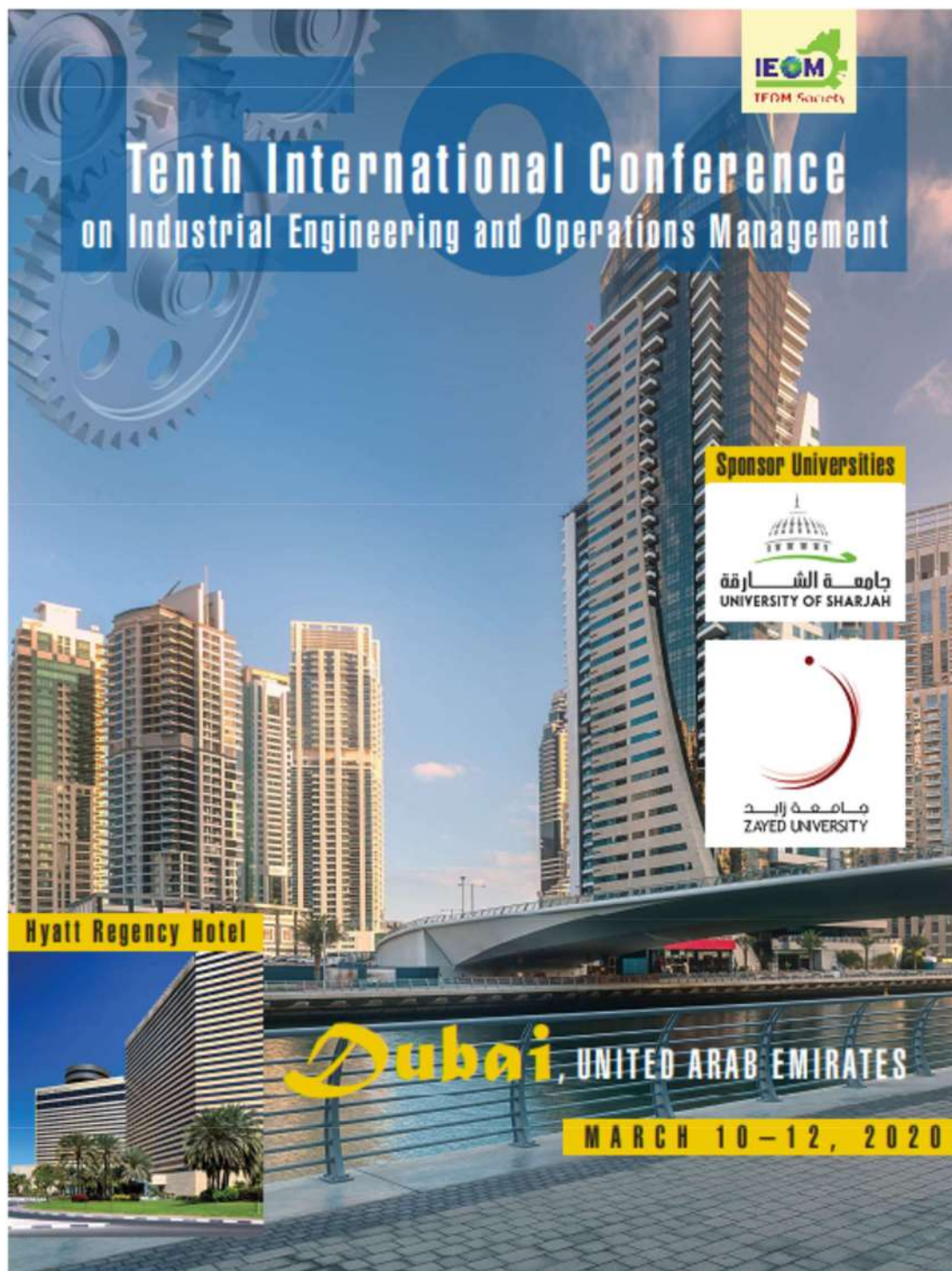
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## Welcome to the 10<sup>th</sup> Annual IEOM Society International Conference Dubai, United Arab Emirates

To All Conference Attendees:

On behalf of the IEOM Society International, we would like to welcome you to Dubai, United Arab Emirates and the 10<sup>th</sup> Annual International Conference on Industrial Engineering and Operations Management. This unique international conference provides a forum for academics, researchers and practitioners from many industries to exchange ideas and share recent developments in the fields of industrial engineering and operations management. This diverse international event provides an opportunity to collaborate and advance the theory and practice of major trends in industrial engineering and operations management. There were more than 700 papers/abstracts submitted from 60 countries, and after a thorough peer review process, approximately 470 have been accepted. The program includes many cutting-edge topics of industrial engineering and operations management. The theme of the conference is *"Operational Excellence in the era of Industry 4.0"*.

This conference will address many of the issues concerning continuous improvement for quality and service. Our keynote speakers will address some of these issues:

- Dr. Mr. Osman Sultan, CEO of Emirates Integrated Telecommunications Company (du), UAE
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- Professor Charles Mbohwa, Pro-Vice Chancellor Strategic Partnerships and Industrialization, University of Zimbabwe

The 17<sup>th</sup> IEOM Society Global Engineering Education session will feature distinguished speakers who will discuss the workforce readiness and engineering education challenges and opportunities. The Industry 4.0 will showcase major topics including IoT, AI, data analytics, iCloud, cybersecurity, automation, digital manufacturing and MSV. Industry Solutions will showcase best industry practices as well as shared experiences. Six panel sessions have been planned. They are: Industry 4.0, Global Engineering Education, Supply Chain and Logistics, Lean Six Sigma, Women in Industry and Academia and Healthcare Improvement.

The IEOM Society would like to express our deep appreciation to our sponsors, university partners, organization partners, exhibitors, authors, reviewers, keynote speakers, panelists, track chairs, advisors, the local committee and the many volunteers who have given so much of their time and talent to make this unique international conference an overwhelming successful event.

University of Sharjah and Zayed University, conference hosts, welcome all participants to Dubai. The IEOM Society Conference Planning Committee hopes you will enjoy Dubai and all that it has to offer with its diverse culture, rich history and exceptional cuisine.

Lastly, our sincere best wishes to you all for a successful conference and an enjoyable stay in Dubai.

Enjoy the conference!



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Conference Co-Chair  
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Dubai Aviation Engineering Projects  
Dubai, United Arab Emirates



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**4:30 – 6:00, WEDNESDAY****Data Analytics****Room 4**

Session Chair: Bencherif Houria, Institute of Health and Safety - University of Batna 2, Fesdis, Batna, Algeria

- ID 146 Analysis of School Performance in Delhi, India using Decision Tree Algorithm  
Abhishek Bhatnagar, and Nimesh B. Bhat, Department of Mechanical Engineering, Indian Institute of Technology Delhi New Delhi, Delhi India
- ID 562 Development of analytical models to understand customer behavior in the web service portal of a Mexican metallurgical company  
Jaime Quintana, Ana Lucia Martinez Akape, José Guadalupe Espinoza Ramirez, and Tanya Victoria Cabello Hernández, UDEM Monterrey, Nuevo Leon Mexico
- ID 637 Fraction on Red Betel Leaf Methanol (Piper scrotum) as Antibacterial Salmonella typhi  
M Chairul Basrun Umanak, and Rosita Mangesa, University of Iqra Baru, Namika, 97571, Indonesia Namika Maluku Indonesia
- ID 097 Indicator distance and color effects in comprehension of multiple time series graph  
Rosemary Seva, Katrina Chirjan, Nicole Estoista, and Judy Ann Wu, De La Salle University Manila NCR Philippines
- ID 324 Road accident data: from the use of model to the definition of public actions  
Bencherif Houria, Institute of Health and Safety - University of Batna 2, Fesdis, Batna, Algeria
- ID 688 Social Media Analytics and CSR of Indian Companies  
Deepanshu Veenar, Amrita School of Business, India  
Prof. Shekar Babu PhD, Founding Head, AMRITA Vishwa Vidyapeetham, Bengaluru, India

**4:30 – 6:00, WEDNESDAY****Product Design and Development****Room 5**

Session Chair: Myzan Noor, University Kuala Lumpur Kuala Lumpur wilayah persekutuan Malaysia

- ID 327 A Decision-based Design Framework for a Commercial Product  
Tanvir Iqbal Kaiser, and AKM Kais Bin Zaman, Department of Industrial and Production Engineering, Bangladesh University of Engineering and Technology (BUET), Dhaka, Bangladesh
- ID 438 An Experimental Study on the Performance of a Newly Developed Pico Hydroelectric Device  
Loren Aiyana S. Macasa, Marco E. Malabrigo, Esmond Adrial M. Ramos, and Rianha D. Barnes, School of Industrial and Engineering Management, Mapua University, Manila, Philippines
- ID 437 Design and Implementation of a Nurse Robot  
Ahmed Bensouda, Anas Abutaleb, Jory Alathani, Sadeem Alkinani, Sara Alghamdi, and Shahad Alkaydi, Electrical and Computer Engineering Department, Effat University, Jeddah, Makkah, Saudi Arabia
- ID 386 Development of a Low-Cost Solar Water Purifier Using Metaheuristic Process  
Sourav Kumar Ghosh, and Md. Mamunur Rashid, Department of Industrial and Production Engineering Bangladesh University of Textiles, Dhaka, Bangladesh
- Naurin Zoha, and Fariba Kabir Torsha, Department of Production and Industrial Engineering, Bangladesh University of Engineering and Technology, Dhaka, Bangladesh
- Israt Zarin Era, Department of Industrial and Management Systems Engineering, West Virginia University, United States
- ID 270 Mobile Application: The Study of Diverseness of Renewable Energy for Primary School Students  
Myzan Noor, and Siti Najihah Osmanuddin, University Kuala Lumpur Kuala Lumpur wilayah persekutuan Malaysia
- ID 469 Plants Extract Based Antibacterial Nanofibrous Mats for Biomedical Applications  
Md Abdus Shahid, and Ayub Ali, Dhaka University of Engineering & Technology (DUET) Gazipur 1707 Bangladesh
- ID 243 A Life Cycle Assessment (LCA) – Based Approach in the Development of a Re-Circulation System for Secondhand Textbooks in the Philippines  
Marvin I. Norofa, and Mark Andrew D. Acot, School of Industrial Engineering and Engineering Management, Mapua University Manila, Manila, Philippines

**4:30 – 6:00, WEDNESDAY****Operations Management****Room 6**

Session Chair: Priya Sachin Deole, Department of Physics, G.S.Tompe Art's, Comm. &amp; Science College, Chandur Bazar, Dist. Amravati (M.S) India

- ID 138 Factors contributing to Building Fire Incidents: A review  
R.M.D.L.M. Rathnayake, P. Sridaran, and M.D.T.E. Abeynayake, University of Moratuwa, Moratuwa, Western Province, Sri Lanka
- ID 332 From Literature Review to Conceptual Framework for Evaluation of Performance of Sustainable Service Supply Chain  
Ranjit Nagaria, and Divesh Kumar, Department of Management Studies, Malaviya National Institute of Technology Jaipur, Jaipur (INDIA) Jaipur Rajasthan, India
- ID 334 Modeling of External and Internal Enablers of Food Chain Logistics  
Akshay Patidar, Malaviya National Institute of Technology, Jaipur Rajasthan, India
- ID 129 Optimal Operation Policies for Vendor Machines with Product Dedicated Variant Towers  
Ertan YAKICI, National Defence University Istanbul Türkiye Turkey  
Hadi Sahin, and Serhan Duran, Industrial Engineering Department Middle East Technical University Ankara, Turkey
- ID 499 Simulation of Service Provision Process in Qazvin Gas Company with the Aim of Decreasing Waiting Time for Customers  
SIMA Rafiei, Qazvin University of Medical Sciences, Qazvin, Iran
- ID 157 The Relationship Between Occupational Stress and Job Performance: An Empirical Study in a South African Contact Centre  
Nokukhanya Ndlovu, Department of Quality and Operations Management, University of Johannesburg, Johannesburg, Gauteng, South Africa
- ID 144 The Relationship of TQM and Lean Production Towards Integrated Application  
Romulo Ullas, Tarlac State University, Calamba, Laguna, Philippines
- ID 618 Design of Job Scheduling Using BAT Algorithm to Minimize Makespan in Hybrid Flowshop  
Sumharri Batubara, Debbie Kamala Sariand Dhimas Aryo Wicaksono, Industrial Engineering Department, Faculty of Industrial Technology, Trisakti University, Kampus A USAKTI, Jl. Kyai Tapa No.1, Grogol, Jakarta Barat 11440, INDONESIA

**4:30 – 6:00, WEDNESDAY****Production Planning****Room 7**

Session Chair: Rene D. Estemero, Mapua University, Manila, Philippines

- ID 452 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 Gossali, Florencia Irena, and Lijana Jap, Industrial Engineering Department Engineering Faculty, Tarumanagara University Jakarta Dki Jakarta Indonesia
- Siti Rohana, Nasution Universitas Pembangunan Nasional "Veteran" Depok, Jawa Barat





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**2**  
**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**

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**16**

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**Abstract**

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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,  $15Q$ , 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 10

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:  $EOI = \frac{EOQ}{R} = \sqrt{\frac{2C}{RPH}} \dots \dots \dots (1)$

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:

Dj is annual average demand

Sj is setup cost

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

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

hj is holding cost per unit per year

b. Calculates the Order Stockout Rate (OSORj) 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)ij 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)

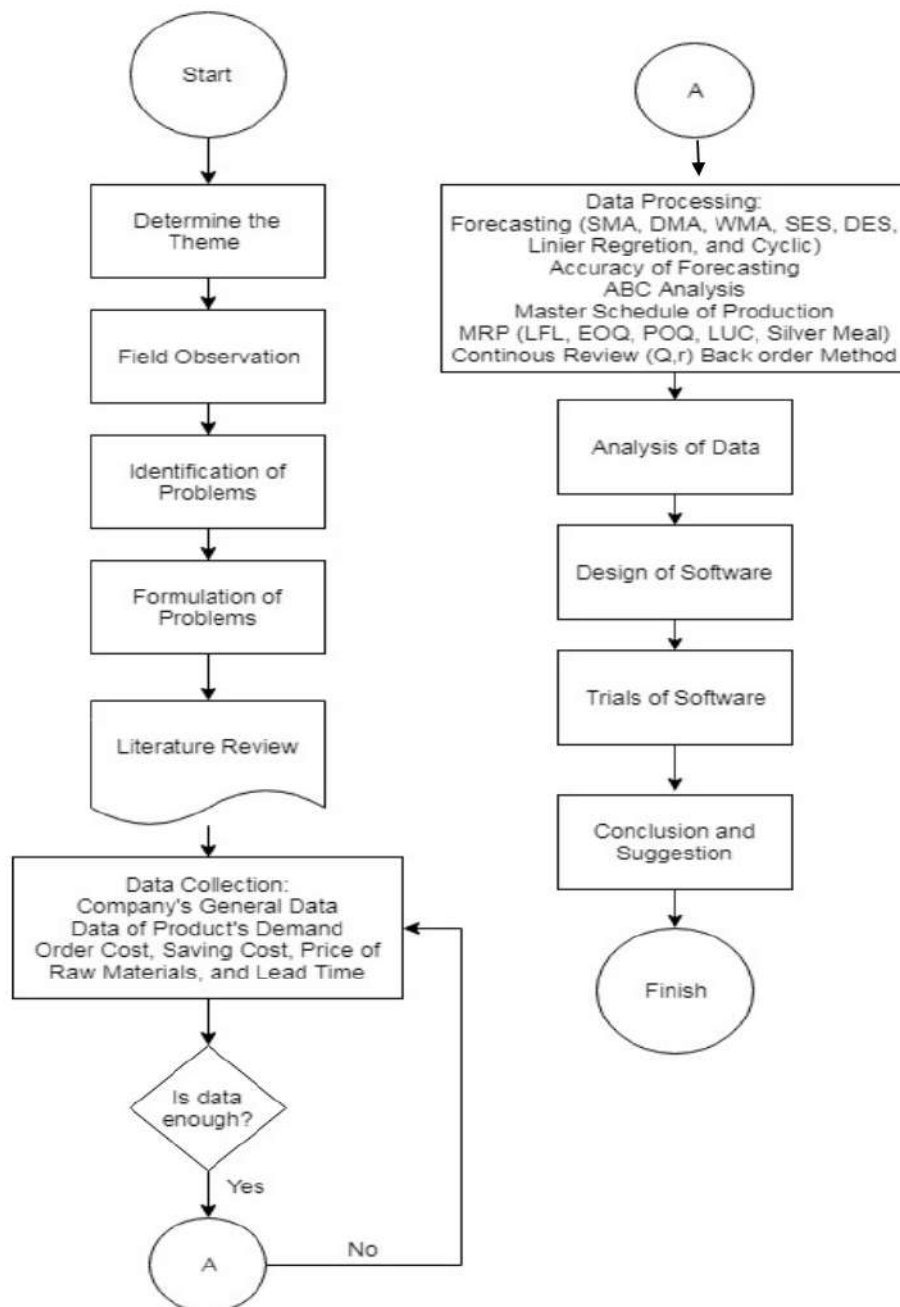
$$USL_j = 1 - USOR_j \dots\dots\dots(2h)$$

- 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.

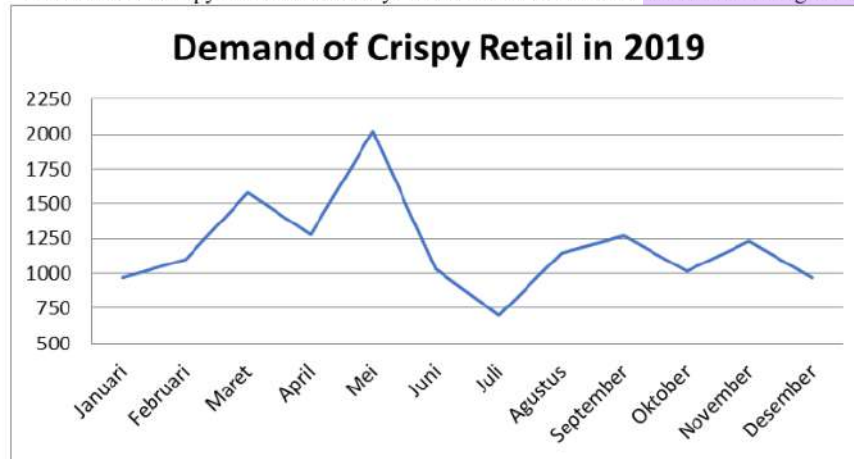


Figure 2. Demand of Crispy Retail Order cost, holding cost, purchase cost, and lead time can be seen in Table 1.

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

Raw Materials	Order Cost	Holding Cost	Purchase Cost	Lead Time
Wheat Flour	11 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	230.33	233.92
MSE	151735	161822	177075	199505	80336.8	100020
SDE	408.54	421.91	441.34	468.46	296.04	330.32

Method	SMA2	SMA3	SMA5	DMA2	WMA 3	SES0,1
MAPE(%)	25.55	28.11	30.97	32.59	<b>18.96</b>	20.22
Method	DES0,1	DES0,3	DES0,5	DES0,7	DES0,9	
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
Com 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
Continuous 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
Continuous 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.

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