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Optimization of Lot Sizing Technique in Determining the Best Supplier of Local and Imported Beef Supply with Simple Additive Weighting (SAW) Method

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Abstract: It is important for companies engaged in the food processing industry to determine the right amount and time of ordering so that raw materials are available optimally. The purpose of this research is to measure lot sizing optimization in determining the best supplier of local and imported beef supplies using Simple Additive Weighting (SAW). The data used is local and imported beef raw material data at PT Uutbeef Indonesia Storage (Warehouse Storage) Cirebon Regency Jawabarat. The results of the study for Johndee and Amroon meat type products using the Lot For Lot (LOL) lot sizing technique obtained the lowest cost with the total cost generated was IDR 35,832,654,000 compared to using lot sizing Economic Order Quantity (EOQ), or Period Order Quantity (POQ). The results of the weighting of supplier criteria, the preference value of the maroon supplier obtained the best results for PT Sarana Inti with a value of 0.92 and for the preference of the johndee supplier obtained the best results, namely PT Sinar with the final result of 0.93. Therefore, Lot Sizing optimization can be used by companies to overcome problems regarding the quantity, time and cost of inventory, so as to reduce the excess raw materials that occur, ensure smooth production and increase the productivity and profitability of the company.

Keywords: Inventory planning; Lot sizing; SAW; Supplier

Introduction

Beef is a food with a high nutritional content to fulfill human essential amino acid needs. Beef is a better source of animal protein than plant protein. In addition, beef and its processed products are bioactive compounds such as vitamins, minerals, and fats that are good for health (Pogorzelska-Nowicka et al, 2018; Kadim et al, 2022). Beef raw materials are a very important requirement for the industry in the processing sector, given the importance of raw materials for the continuity of production, resulting in the company conducting alternative methods that produce the most effective efficiency (Gołaś, 2020). Therefore, it is important for companies engaged in the food processing industry to determine the right amount and time of ordering so that raw materials are optimally available according to production needs (Gholami & Mirzazadeh, 2018; Atnafu & Balda, 2018).

At PT UutBeef, beef raw materials are not only imported but also obtained from frozen beef suppliers in Cirebon city who have been working with the company since the company was founded. Beef received by the company is ordered with an order waiting time of one week. Due to the perishable characteristics of beef, the company requires special storage to keep the quality of raw materials well maintained. To maintain and extend the storage period of beef, the company provides cold

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storage with a temperature of -21°C in PT UutBeef's storage warehouse to increase the shelf life of beef for one month. PT UutBeef experiences an excess of raw materials every month, resulting in a buildup of raw materials which resulted in the waste of 70 kg of raw materials in 2023 (Company Data, 2024). The wasted raw materials are beef that has spoiled, so it cannot be used for production. Excess beef raw materials occur because the company purchases raw materials that exceed production needs even though the raw material stock is still available and able to meet production needs. The excess amount of orders and wasted beef raw materials results in the company's raw material inventory costs being said to be inefficient.

According to Soepriyadi et al (2022), inventory control is carried out by minimizing and determining the right order time in order to reduce the accumulation of raw materials in the storage warehouse and reduce the risk of wasted raw materials, so that the inventory costs incurred are more efficient. One of the inventory control methods that can be used for problems related to excessive procurement of raw materials is the Lot Sizzing Technique in the Material Requirement Planning (MRP) method. The MRP method is an inventory control system by determining the amount as needed and the right time to order raw materials to avoid excess inventory in the storage warehouse, thereby obtaining efficient inventory costs [5]. So the goal to be achieved in this study is to measure lot sizzing optimization (MRP) in Determining the Best Supplier of Local and Imported Beef Supply with the Simple Additive Weighting (SAW) Method.

Crystal Hi Protection stock had an excess of 300 rolls, which exceeded the predetermined safety stock amount of 300 rolls. In percentage terms, this excess reached 50%. The implementation of MRP helps organize the ordering schedule to suppliers so that it becomes more structured and scheduled. In addition, the quantity of materials ordered also does not exceed the actual needs (Nugroho et al., 2018). The highest assessment was given to the 2nd Supplier (PCM) with a weight of 0.9265. Therefore, the 2nd Supplier (PCM) is considered feasible or is the best alternative in the process of selecting the selected alternative. In research that has been done before, there are differences with the research to be done. In this study the authors will use the Lot Sizzing and SAW methods in determining inventory planning and the best supplier at the storage warehouse at PT UutBeef Cirebon Regency West Java (Hariansyah, 2020).

As market competition intensifies, businesses are required to work more efficiently. This demand has become more prominent due to the fact that market growth is much smaller than the total production capacity of the industry. The efficiency improvement that can be achieved is 15%, which is equivalent to a 15% reduction in production costs. If prices can be maintained, the business will gain an extra 15% increase in profits. However, in the interest of competition, at the same profit, the business can reduce prices by 10% - 15%. This illustration makes all parties involved realize the importance of inventory control (Hamining & Nurnajamuddin, 2007).

There are several previous studies that have become reference materials in the research to be carried out, which will then become a reference and comparison in conducting research. First research by (Nugroho et al., 2019), crystal Hi Protection stock had an excess of 300 rolls, which exceeded the predetermined safety stock of 300 rolls. In percentage, this excess reached 50%. The implementation of MRP helps organize the ordering schedule to suppliers so that it becomes more structured and scheduled. In addition, the quantity of materials ordered also does not exceed the actual needs. The second research conducted by (Hariansyah, 2020) the highest assessment is given to the 2nd Supplier (PCM) with a weight of 0.9265. Therefore, the 2nd Supplier (PCM) is considered feasible or is the best alternative in the process of selecting the selected alternative.

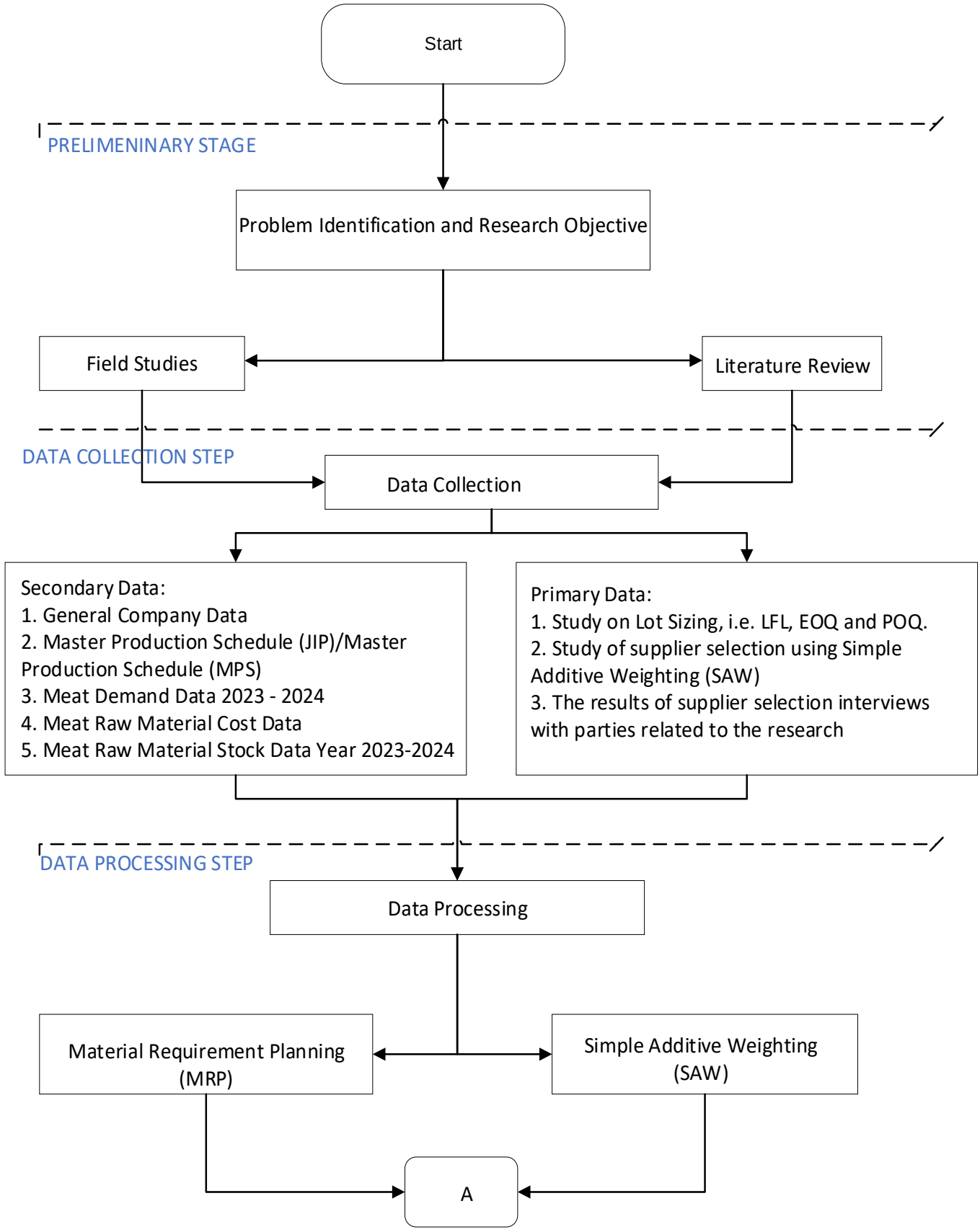
The third research conducted by (Waeni & Kartini, 2023), the hierarchy of problems is structured to assist in a decision-making process by taking into account all decision elements involved in the system. The purpose of this study is to determine the criteria for supplier selection, determine the priority of shallot suppliers, and determine the follow-up of all other shallot suppliers according to their performance. The method used in this research is AHP. The criteria used in supplier selection include pricing, quality, service and quantity. The results of the calculation, obtained shallot suppliers with the best value, namely Saniyah suppliers with a weight of 0.951. The next priority supplier is Karim with a weight of 0.337, then Amelia with a weight of 0.279.

In the research that has been done before, there are differences with the research that will be done. In this study the authors will use the Lot Sizzing and SAW methods in determining the best inventory planning and suppliers at the storage warehouse (storage) at CV.UUTBEEF Kab. Cirebon West Java.

Method

The research method is a process or description of the research to be carried out. In this research there are several important stages that must be carried out in supporting this research as shown in Figure 1.

A Problem Solving Framework 1



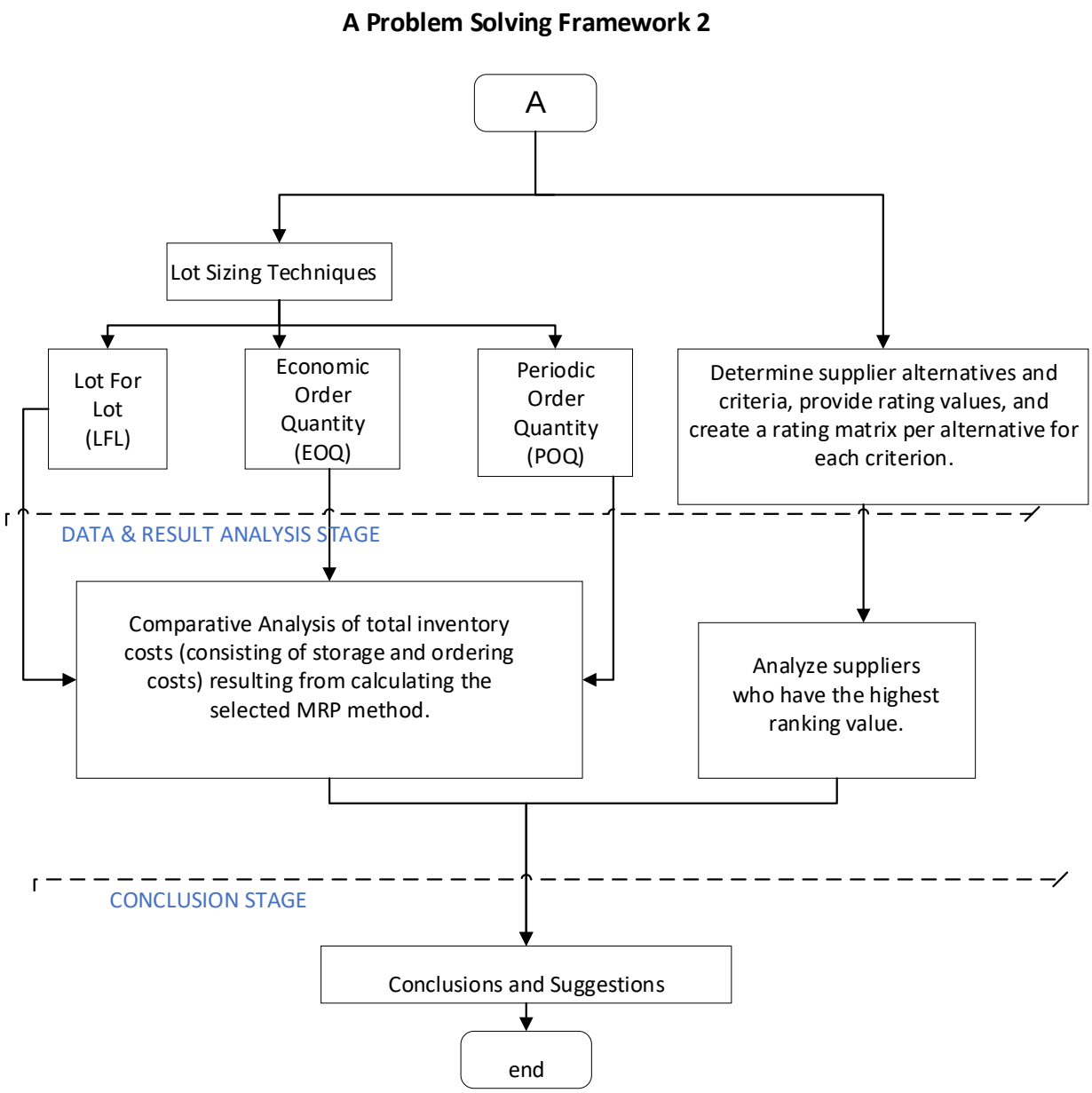


Figure 1. Flow chart of the research process

Based on Figure 1, the first stage is data collection. The data used in this study are beef raw material demand data for the 2023 period, beef Bill off Material (BOM) data, raw material costs, raw material stock for the last period, storage capacity and supplier data and data from interviews with the owner. The following data will be obtained and processed from the results of the study:

Master Production Schedule (MPS)

The data used to determine the Master Production Schedule (JIP)/Master Production Schedule (MPS) is historical data on demand for beef raw materials in 2023 which is then Forecasting for the following year. The plot of meat raw material demand data in 2023 will have a graph that fluctuates repeatedly, so it can be concluded that the type of data pattern is trend data and seasonal or seasonal, so forecasting that can be used is Moving Average and Single Exponential Smoothing. To find out the MAD, MSE and MAPE values that have the lowest error rate, calculations are carried out with the help of the POM QM application.

Product Structure / Bill of Materials (BOM)

BOM serves to calculate the need for meat raw materials for each storage (storage warehouse) in the production process.

Cost Data

The costs used in the total inventory cost calculation process include the price of raw materials per ton, the cost during the ordering process and the cost of storing materials in storage per ton.

According to Haming (2016), MRP is the right quantitative method to solve problems regarding the need for dependent raw materials in the processing industry including the optimal order quantity, total efficient inventory costs, and the right order time. The problems often faced by PT UUTBEEF are related to the supply of beef raw materials, such as determining the number of orders for raw materials to be ordered. The following MRP method calculation format is shown in

Table 1. MRP Raw Material Planning Format

DESCRIPTION	PERIOD									
	1	2	3	4	5	6	7	8	9	10
Gross Requirements (Kg)										
Scheduled Receipts										
Inventory on hand (kg)										
Net Requirements (Kg)										
Planned Orders Received (Kg)										
Planned Orders										

Source: Heizer & Barry (2011)

The Material Requirement Planning (MRP) method is carried out by determining lot sizing using the MRP method format table Lot for Lot (LFL) technique, Economic Order Quantity (EOQ) technique and Part Period Balancing (PPB) technique. To determine the best supplier, supplier selection is carried out using the Simple Additive Weighting method. The data collected from observations, interviews and observations in the field are then processed to obtain alternative supplier data, supplier criteria, weights for each supplier, provide rating values, preference weights (W), create a rating matrix per alternative on each criterion. The normalization of the decision matrix (X) is obtained using the formula:

Normalization Matrix (r).

$$r_{ij} = \frac{x_{ij}}{\max(x_{ij})} \text{ if j profit criteria}$$
$$= \frac{\min(x_{ij})}{x_{ij}} \text{ if j cost criteria} \quad (1)$$

Then from the calculation of matrix normalization that has been carried out, the results of the normalized performance rating value (rij) form a normalized matrix (R). The final result of the preference value (Pi &Vi) is obtained from the sum of the multiplication of the row elements of the normalized matrix (R) with the corresponding preference weights (W) matrix column elements (W). The calculation for each supplier is as follows:

$$V1 = \sum_{j-1}^{n} w_j r_{ij} \quad (2)$$

One of the methods in the decision support system is the SAW (Simple Additive Weighting) Method. The SAW method is often also known as the weighted sum method. The basic concept of the SAW method is to find the weighted sum of the performance ratings on each alternative on all attributes (Fishburn, 1967; MacCrimmon, 1968). The SAW method requires a normalization process of the decision matrix (X) to a scale that can be compared with all existing alternative ratings. This method is the most famous and most widely used method in dealing with Multiple Attribute Decision Making (MADM) situations. MADM itself is a method used to find the optimal alternative from a number of alternatives with certain criteria. This SAW method requires the decision maker to determine the weight for each attribute. The total score for alternatives is obtained by summing up all multiplication results between ratings (which can be compared across attributes) and weights for each attribute. The rating of each attribute must be dimension-free in the sense that it has passed the previous matrix normalization process.

SAW Completion Steps (Simple Additive Weighting) SAW Completion Steps are as follows: 1. Determine the criteria that will be used as a reference in decision making, namely Ci. 2. Determine the suitability rating of each alternative on each criterion. 3. Decide matrix based on the criteria (Ci), then normalize the matrix based on the equation adjusted to the type of attribute (profit attribute or cost attribute) so that a normalized matrix R is obtained. 4. The result is obtained from the ranking process, namely the summation of the multiplication of the normalized matrix R with the weight vector so that the largest value is selected as the best alternative (Ai) as a solution.

In this study, the assessment criteria determined by the company are 4 criteria, namely price, delivery, quantity and quality. Supplier selection based on price is seen from the total costs incurred by the company to buy these raw materials, the company chooses the lowest price to minimize costs incurred. For delivery criteria, it is seen from the number of shipments made by the supplier whether the delivery is on time according to the deadline given by the company or is delayed. Then the quantity criteria are determined based on the tonnage of shipments to the company whether it meets the demand or not. As for the quality supplier criteria, it is seen from the QC results carried out by the company to determine the level of water content in the raw material. The weighting value is determined based on the level of importance of each criterion. This weighting is seen from the criteria that have the most important importance. From the determined weighting, the order of weighting

from the highest to the lowest value is the quantity criteria, price criteria, quality criteria and delivery criteria. Then after that, the calculation is carried out on each criterion by giving a value to the criteria.

Result and Discussion

The first MRP process based on the LFL method is the order quantity according to demand. To find out the raw material requirements of Johndee and Amroon can be seen in tables 2 and 3.

Table 2. AMROON Lot For Lot (LFL) Calculation

Info	PD	PERIOD												Sum
		1	2	3	4	5	6	7	8	9	10	11	12	
GR		2745	2720	2695	2670	2645	2620	2594	2569	2544	2519	2494	2469	31284
SR		0	0	0	0	0	0	0	0	0	0	0	0	0
POH	7.851	5.106	2.386	0	0	0	0	0	0	0	0	0	0	7492
NR				309	2670	2645	2620	2594	2569	2544	2519	2494	2469	23433
PORc				309	2670	2645	2620	2594	2569	2544	2519	2494	2469	23433
POR			309	2670	2645	2620	2594	2569	2544	2519	2494	2469		23433

Tabel 3. Johndee Lot For Lot (LFL) Calculation

Info	PD	PERIOD												Sum
		1	2	3	4	5	6	7	8	9	10	11	12	
GR		28370	28110	27850	27590	27330	27070	26810	26550	26290	26030	25770	25510	323280
SR			0	0	0	0	0	0	0	0	0	0	0	0
POH	2.788	0	0	0	0	0	0	0	0	0	0	0	0	0
NR		25.582	28110	27850	27590	27330	27070	26810	26550	26290	26030	25770	25510	320492
PORc		25.582	28110	27850	27590	27330	27070	26810	26550	26290	26030	25770	25510	320.492
POR	25.582	28110	27850	27590	27330	27070	26810	26550	26290	26030	25770	25510		320.492

Table 2 and Table 3 show the results of calculations using the MRP method with the lot for lot technique, this method is carried out based on considerations to minimize storage costs, for the amount of raw material ordered is equal to the amount needed in each period, it is assumed that orders can be made in any amount. This technique aims to minimize storage costs so that the calculation of storage costs or project on hand (POH) is equal to zero. For the calculation of the EOQ method shown in table 4 and table 5 explain the results of the lot sizzing process with the EOQ method. The approach is carried out based on minimization of storage costs and message costs, then a fixed lot size calculation is carried out, based on calculations that have been made. In the POQ technique, an approach is taken based on the number of orders that are economical so that they can be used in the period that is the fulfillment of production needs, in the calculation of the POQ technique based on the EOQ method. By using the economic order that has been calculated, the order size that must be done and the interval period in 1 year or 12 periods will be obtained.

To determine table 2 and table 3: 1). Determine GR (Gross Requirement / Gross Needs). GR in the table is the need for Frozen Meat obtained from company data; 2). Determine SR (Schedule Receipt/Scheduled Receiver). Is data that is planned to come in a certain period because in this data there is no arrival schedule, so the SR value is equal to Zero (0); 3). Determine NR (net requirement / net requirement) To determine NR, the formula can be used:

$$NR1 = GRt - SRt - POHt\text{-}1 \quad (3)$$

However, if the calculation result of NRt = minus (-), then the result can be said to be 0.
Example:
NR3 = GR3 - SR3 - POH2
= 2695 - 0 - 2386
= 309

4). Determining POH (project on hand/availability) To determine POH using the formula:

$$POHt = POReceiptt + POHt\text{-}1 + SRt – GRt \quad (4)$$

Example:
POH1 = POReceipt1 + POH0 + SR1 - GR1
= 0 + 7851 + 0 - 2745
= 5106

5). PORc (Planned Order Receipts). Is a planned order of NR from the calculation results but for the EOQ method the PORc value is the value of the calculation of the economic amount in one order. Whereas in the POQ method the PORc value is the result of the calculation of the optimum number of orders; 6). POR (Planned Order Releases / Items already in stock). Items that must be available in the required period, because in this calculation the leadtime is 1 period, so to meet the needs

in the current period, the needs must be ordered in the previous 1 period. After knowing the net requirement (NR) of each material, the total cost is calculated, for the material cost of the lot for lot technique can be seen below:

Total Cost (AMROON):

= Material Cost + Order Cost + Storage Cost
= (IDR 630.000 x 23433) + (IDR 155.000 x 10) + (IDR 31500 x 7492)
= IDR 15.000.338.000

Total Cost (Johndee)

= Material Cost + Order Cost + Storage Cost
= (IDR 65.000 x 320.492) + (IDR 28.000 x 12) + (IDR 3250 x 0)
= IDR 20.832.316.000

The EOQ method is used to calculate raw material requirements if you already know the economic order quantity for each raw material. Below is an example of AMROON's EOQ calculation.

$$EOQ = \sqrt{\frac{2CS}{H}}$$

$$EOQ = \sqrt{\frac{2(155000\ x\ 2607)\ x\ \frac{31284}{12}}{31500}}$$

$$EOQ = \sqrt{66885688{,}57}$$
$$= 8178$$

From the results of the above calculations, it can be seen that the economic order of AMROON raw materials is 8178 for 1 order, from the results of this calculation it is then used to calculate the raw material requirements which can be seen in table 4.

Table 4. AMROON EOQ Method Calculation

Info	PD	PERIOD												Sum
		1	2	3	4	5	6	7	8	9	10	11	12	
GR		2745	2720	2695	2670	2645	2620	2594	2569	2544	2519	2494	2469	31284
SR		0	0	0	0	0	0	0	0	0	0	0	0	0
POH	7.851	5.106	2.386	0	5.508	2.863	243	0	5.634	3.115	621	0	5.709	31185
NR				309				2.351				1884		4544
PORc				8178				8178				8178		24534
POR			8178				8178				8178			24534

Table 5. Johndee EOQ Metode Calculation

Info	PD	PERIOD												Sum
		1	Sum	3	4	5	6	7	8	9	10	11	12	
GR		2837(	2811(	2785(	2759(	2733(	2707(	2681(	2655(	2629(	2603(	2577(	2551(	32328(
SR		(	(	(	(	(	(	(	(	(	(	(	(	(
POH	2.788		83.71	55.86	28.27	94	(	85.01	58.46	32.17	6.14	(	25.51(	37613
NR		25.58					26.12					19.62		7132(
PORc		11182					11182					11182		33548
POR	111828					11182					11182			33548

After knowing the net requirement (NR) of each material, the total cost is calculated.

Total Cost (AMROON):

= Material Cost + Order Cost + Storage Cost
= (IDR 630.000 x 24.534) + (IDR 155.000 x 3) + IDR 31.500 x 31.185)
= IDR 16.439.212.500,-

So, for the total cost of AMROON raw materials with the calculation of the EOQ method is IDR 16,439,212,500.

For Total Cost (Johndee):

= Material Cost + Order Cost + Storage Cost
= (IDR 65.000,00 x 335.484) + (IDR 28.000 x 3) + (IDR 3.250 x 376.134)
= IDR 23.028.979.500 ,-

So, for the total cost of Johndee's raw materials with the calculation of the EOQ method is IDR 23,028,979,500.

In the POQ method, the calculation results from the EOQ method become input from the POQ method, so that if the calculation has been carried out using the EOQ method, the raw material requirements can be calculated.

$$Order\ Quantity = \frac{\sum Net\ Needs}{EOQ}$$
$$= \frac{31284}{8178}$$
$$= 4$$

$$POQ\ Amroon = \frac{\sum Period}{Order\ Quantity}$$
$$= \frac{12}{4}$$
$$= 3$$

Below is an example of AMROON's POQ calculation:

The results of the POQ calculation above are an example of calculations for AMROON meat product raw materials with POQ results equal to 3 periods, meaning that in the process of calculating the value of PORc or the ordering process in 1 order must meet the needs for the next 3 periods, this calculation is used for table 6, namely the calculation of POQ techniques on AMROON raw materials. For a clearer calculation can be seen in Table 6.

Table 6. AMROON POQ Method Calculation

Info	PD	PERIOD												Sum
		1	2	3	4	5	6	7	8	9	10	11	12	
GR		2745	2720	2695	2670	2645	2620	2594	2569	2544	2519	2494	2469	31284
SR		0	0	0	0	0	0	0	0	0	0	0	0	0
POH	7.851	5.106	2.386	0	5.265	2.620	0	5.113	2.544	0	4.963	2.469	0	30466
NR				309			2.620			2.544			2.469	7942
PORc				7935			7.707			7482			2469	25593
POR			7935			7.707			7482			2469		25593

Table 7. Johndee POQ Metode Calculation

Info	PD	PERIOD												Sum
		1	2	3	4	5	6	7	8	9	10	11	12	
GR		28370	2811(	2785(	2759(	2733(	2707(	2681(	2655(	2629(	2603(	2577(	2551(	323280
SR		0	(	(	(	(	(	(	(	(	(	(	(	(
POH	2.788	0	83.81(	55.96(	28.37(	1.04(	81.73(	54.92(	28.37(	2.08(	79.65(	53.88(	28.37(	49818(
NR		25.582				26.29(				24.21(				76082
PORc		111920				107760				103600				323280
POR	111920				107760				103600					323280

After that, the cost calculation for each raw material is carried out. The calculation of raw material costs is as follows:

Total Cost (AMROON) = Material Cost + Order Cost + Storage Cost = (Rp.630,000.00 x 25593) + (Rp.155,000.00 x 4) + Rp 31500 x 30466) = Rp 16,124,240,466 ,-

So, for the total cost of AMROON raw materials with the calculation of the POQ method is IDR 16,124,240,466 ,-

Total Cost (Johndee) = Material Cost + Order Cost + Storage Cost = (Rp.65,000.00 x 323280) + (Rp 28000.00 x 3) + (Rp 3250 x 498180) = Rp 21,013,782,180

So, for the total cost of Jonhdee raw materials with the calculation of the POQ method is IDR 21,013,782,180.

The results of lot sizing can be summarized in table 6, table 8 and table 9

Table 8. Recap of raw material ordering lot sizing results

Material Name	Metode	ORDER												Order Frequency	Order Total (Ton)
		PD	1	2	3	4	5	6	7	8	9	10	11	12		
AMROON	LFL			309	2670	2645	2620	2594	2569	2544	2519	2494	2469		10	23433
	EOQ			8178				8178				8178			3	24534
	POQ			7935			7.707			7482			2469		4	23124
Johndee	LFL	25.582	28110	27850	27590	27330	27070	26810	26550	26290	26030	25770	25510		12	320.492
	EOQ	111828					111828					111828			3	335.484
	POQ	111920				107760				103600					3	323.280

Table 9. Recap of Raw Material Storage Calculation

Material Name	Metode	STORAGE												Storage Total (Ton)
		PD	1	2	3	4	5	6	7	8	9	10	11	12	
AMROON	LFL		5.106	2.386	0	0	0	0	0	0	0	0	0	0	7.492
	EOQ		5.106	2.386	0	5.508	2.863	243	0	5.634	3.115	621	0	5.709	31.185
	POQ		5.106	2.386	0	5.265	2.620	0	5.113	2.544	0	4.963	2.469	0	30.466
Johndee	LFL		0	0	0	0	0	0	0	0	0	0	0	0	0
	EOQ		0	83.718	55.868	28.278	948	0	85.018	58.468	32.178	6.148	0	25.510	376134
	POQ		0	83.810	55.960	28.370	1.040	81.730	54.920	28.370	2.080	79.650	53.880	28.370	498180

Table 10. Overall Cost Recap

Number	Lotting	Raw Material	Cost (IDR)	Total Cost (IDR)
1	LFL	AMROON	15.000.338.000	35.832.654.000
		Johndee	20.832.316.000	
2	EOQ	AMROON	16.439.212.500	39.468.192.000
		Johndee	23.028.979.500	
3	POQ	AMROON	16.124.240.466	37.138.022.646
		Johndee	21.013.782.180	

To determine the best supplier, supplier selection is carried out using the Simple Additive Weighting method, the data collected from observations, interviews and observations in the field are then processed to obtain alternative supplier data, supplier criteria and weights for each supplier.

Determining Supplier Alternatives

Table 11. Alternative Suppliers

Alternative	
P1	PT. Sarana Inti
P2	PT. AgroBoga
V1	PT. Sinar
V2	PT. Hijrah Gizi
V3	PT. Boga Citra
V4	CV. Barokah

Source: PT. UUTBEEF Cirebon tahun 2024

P : *Supplier AMROON*

V : *Supplier Johnde*

From the results of the calculation for amroon suppliers who have the highest total weight is PT Sarana Inti with a final result of 0.92. From the results of this assessment, the price criteria have the same value of 0.3 because the price criteria for these two suppliers are included in the good category.

As for the johndee raw material supplier which has the highest total weight is PT Sinar with a final result of 0.93 and the supplier whose value is almost the same is PT Boga Citra with a final weight of 0.92. From the results of this assessment, the quality criteria have the same value of 0.40 because the quality criteria for these two suppliers are included in the Very Good category.

This means that the best supplier for amroon raw materials is PT Sarana Inti and for jhondee raw materials is PT Sinar and the second alternative is PT Boga Citra.

Determining Criteria

Table 12. Supplier criteria

Code	Criteria	Category
C1	Price	Cost
C2	Shipping	Profit
C3	Quality	Profit
C4	Quantity	Profit

Source: Supply Departement PT. UUT BEEF tahun 2024

Rating value, preference weight (W)

Table 13. Preference weight values

Code	Criteria	Bobot
C1	Price	0.30
C2	Shipping	0.10
C3	Quality	0.40
C4	Quantity	0.20

Source: Supply Departement PT. UUT BEEF tahun 2024

Create a rating matrix per alternative on each criterion

Table 14. Terms of AMROON price assessment

Based on Price IDR /kg	Rating Scale	Value Price/kg Rating Scale Value
< 500.000,-	Very good	5
500.000 - 1.000.000	Good	4
1.000.000 - 1.500.000	Medium	3
1.500.000 - 2.000.000	Bad	2
> 2.000.000	Very Bad	1

Table 15. Johndee's pricing terms

Based on Price IDR /kg	Rating Scale	Value
< 50.000,-	Very good	5
50.000 - 100.000	Good	4
100.000 - 150.000	Medium	3
150.000 - 200.000	Bad	2
> 200.000	Very Bad	1

Delivery

Table 16. Terms of delivery assessment

Based on Delivery	Rating Scale	Value
Delivery on time (not late) and can fulfill the quantity ordered.	Very good	5
1 week late	Good	4
2 weeks late	Medium	3
More than 3 weeks late	Bad	2
Does not fulfill the quantity ordered	Very Bad	1

Quality

Table 17. Terms of quality assessment

By Quality	Rating Scale	Value
Humidity < 6%	Very good	5
7% Humidity	Good	4
8% Humidity	Medium	3
9% Humidity	Bad	2
Humidity > 10%	Very Bad	1

Quantity

Table 18. AMROON Quantity Assessment Conditions

Based on PO Quantity (Kg)	Rating Scale	Value
9500 < Tonase AMROON < 10.000	Very good	5
9000 < Tonase AMROON < 9500	Good	4
8500 < Tonase AMROON < 9000	Medium	3
8000 < Tonase AMROON < 8500	Bad	2
< 8000	Very Bad	1

Johndee

Table 19. Johndee quantity assessment conditions

Based on PO Quantity (Kg)	Rating Scale	Value
1000 - 1500	Very good	5
960 - 1000	Good	4
930 - 960	Medium	3
900 - 930	Bad	2
< 900	Very Bad	1

Normalize the decision matrix (X)

Calculation of supplier AMROON matrix normalization:

$$X\,\text{Amroon} = \begin{bmatrix} 4 & 5 & 3 & 5 \\ 4 & 3 & 3 & 4 \end{bmatrix}$$

Calculation of Johndee supplier matrix normalization:

$$X\,\text{Johndee} = \begin{bmatrix} 4 & 5 & 5 & 5 \\ 4 & 3 & 4 & 3 \\ 3 & 3 & 5 & 4 \\ 4 & 3 & 4 & 3 \end{bmatrix}$$

Then from the calculation of matrix normalization that has been carried out, the results of the normalized performance rating value (r_{ij}) form a normalized matrix (R) as follows:

Amroon: $R = \begin{bmatrix} 1 & 1 & 0{,}8 & 1 \\ 1 & 0{,}6 & 0{,}6 & 0{,}8 \end{bmatrix}$ and

Johndee: $R = \begin{bmatrix} 0{,}75 & 1 & 1 & 1 \\ 0{,}75 & 0{,}6 & 0{,}8 & 0{,}6 \\ 1 & 0{,}6 & 1 & 0{,}8 \\ 0{,}75 & 0{,}6 & 0{,}8 & 0{,}6 \end{bmatrix}$

The final results of the preference values (P_i) and (V_i) are obtained from the sum of the multiplication of the row elements of the normalized matrix (R) with the corresponding preference weights (W) matrix column elements (W). The calculation for each supplier is as follows:

$$V1 = \sum_{j-1}^{n} w_j r_{ij}$$

Criteria Weight = [0.30 ; 0.10 ; 0.40 ; 0.20]

Then Calculation of Pi (Amroon):

P1 Amroon = (0.30) (1.0) + (0.10) (1.0) + (0.40) (0.8) + (0,20) (1,0)
= 0,30 + 0,10 + 0,32 + 0,20 = 0,92

P2 Amroon = (0,30) (1,0) + (0,10) (0,6) + (0,40) (0,6) + (0,20) (0,8)
= 0,30 + 0,06 + 0,24 + 0,16 = 0,76

Calculation of Vi (Jhondee):

V1 Jhondee = (0.30) (0.75) + (0.10) (1.0) + (0.40) (1.0) + (0.20) (1.0)
= 0.23 + 0.10 + 0.40 + 0.20 = 0.93

V2 Jhondee = (0,30) (0,75) + (0,10) (0,60) + (0,40) (0,80) + (0,20) (0,60)
= 0,23 + 0,06 + 0,32 + 0,12 = 0,73

V3 Jhondee = (0,30) (1,0) + (0,10) (0,60) + (0,40) (1,0) + (0,20) (0,80)
= 0,30 + 0,06 + 0,40 + 0,16 = 0,92

V4 Jhondee = (0,30) (0,75) + (0,10) (0,60) + (0,40) (0,80) + (0,20) (0,60)
= 0,17 + 0,06 + 0,32 + 0,12 = 0,67

Performing Alternative Rating Matrix

Table 20 Rating Matrix Value

Alternatif	Criteria			
Johndee	C1	C2	C3	C4
P1	4	5	4	5
P2	4	3	3	4
V1	4	5	5	5
V2	4	3	4	3
V3	3	3	5	4
V4	4	3	4	3

Table 21 and Table 22 below show the final results of the calculation of the preference values of amroon and jhondee raw material suppliers from the calculation of matrix normalization.

Table 21. Final Results of Amroon Supplier Preference Values

Code	Alternative Name	Criteria				Result
		C1	C2	C3	C4	
P1	PT. Sarana Inti	0,3	0,1	0,32	0,2	0,92
P2	PT. AgroBoga	0,3	0,06	0,24	0,16	0,76

Table 21 is the final result of the calculation of the preference value of the amroon supplier, from 2 alternative suppliers and 4 assessment criteria, namely Price (C1), delivery (C2), Quality (C3) and Quantity (C4) the best result is PT Sarana Inti with a final result of 0.92.

Table 22. Final Results of Supplier johndee Preference Score

Code	Alternative Name	Criteria				Result
		C1	C2	C3	C4	
V1	PT Sinar	0,23	0,10	0,40	0,20	0,93
V2	PT Hijrah Gizi	0,23	0,06	0,32	0,12	0,73
V3	PT Boga Citra	0,30	0,06	0,40	0,16	0,92
V4	CV Barokah	0,17	0,06	0,32	0,12	0,67

Table 22 is the final result of the calculation of the preference value of the jhondee supplier, from 4 alternative suppliers and 4 assessment criteria, namely Price (C1), delivery (C2), Quality (C3) and Quantity (C4), the best result is PT Sinar with the final result of 0.93 and the second alternative whose final value is close to that obtained by PT Boga Citra with a final result of 0.92.

Conclusion

Inventory planning with lot sizzing techniques in MRP using three techniques, namely Lot For Lot (LFL), Economic Order Quantity (EOQ) and Period Order Quantity (POQ) obtained lot sizzing LFL method which has the minimum total cost of Rp 35,832,654,000. So, by using the MRP LFL technique, PT UUTBeef can minimize the inventory costs of johndee and amroon raw materials. And from the calculation results for amroon suppliers who have the highest total weight is PT Sarana Inti with a final result of 0.92. As for the johndee raw material supplier which has the highest total weight is PT Sinar with a final result of 0.93 and a supplier whose value is almost the same, namely PT Boga Citra with a final weight of 0.92. This means that the best supplier for amroon raw materials is PT Sarana Inti and for jhondee raw materials is PT Sinar and the second alternative is PT Boga Citra.

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Author Contributions

B.S.: Developing ideas, analyzing, writing, reviewing, responding to reviewers' comments; N.K., P.W.., H.G.: analyzing data, overseeing data collection, reviewing scripts, and writing.

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Conflicts of Interest

The authors declare no conflict of interest.

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