

Implementation of Operational Competitiveness Rating Analysis (OCRA) and Rank Order Centroid (ROC) to Determination of Minimarket Location

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Abstract—Minimarket location placement is one of the main capital for the business to progress and develop. In determining the location of the minimarket, various considerations must be taken so that nothing is fatal to the sustainability of the business. The problem that occurs in the company in choosing the placement of minimarket locations, namely the various locations that are chosen, each location has its advantages and disadvantages, each of which can affect the analysis of results and takes a long time to make a decision. So that requires a system that can provide a solution to this problem. In this case the resulting system is a system that is useful for determining location placement for minimarkets using the ROC method as its weighting and the OCRA method as a decision generator. This system can provide a solution in determining the location of minimarkets, from various existing locations. The results of each alternative are more objective and definitive in determining the location of minimarkets in a computerized way. For this reason, it is necessary to have supporting criteria for using a decision support system. Determination of importance weight values on conflicting criteria is generated through a weighting method, namely ROC or Rank Order centroid. The OCRA method or Operational Competitiveness Rating Analysis is a method that can calculate and produce rankings efficiently so that the resulting decisions are accurate. The results obtained from the utilization of this system determine the location of minimarkets using the OCRA method and ROC weighting as well as various conflicting criteria determined by the company and development management in Lubuk Pakam resulting in the highest preference value of 0.673 as a location that is suitable for use as a minimarket.

Keywords: Placement; Minimarket Location; ROC Method; OCRA Method; DSS

1. INTRODUCTION

The trade sector in the Indonesian economy is expected to continue to grow and develop over time to accompany the changes in people's lives at this time. The higher a person's needs increase convenience in shopping, such as services and products with high quality. Minimarket as the fulfillment of these needs. The minimarket is a shopping place where to provide the needs we want we can choose it ourselves because there is no special sales assistant to serve consumers who come to shop for psychological needs products. Therefore, data processing for selecting minimarket location placements is very important in order to ease the task of company leaders in selecting minimarket location placements.

The modern market that is currently developing quite rapidly in Indonesia is the Minimarket. Minimarket itself can be interpreted as a supermarket that provides various kinds of needs such as basic needs, basic household needs, skin care as well as various kinds of snacks and other needs.

The process of making a decision on placing a potential minimarket location is not easy to choose among the many locations with the criteria met by the head of the agency and development management at the stage of determining the existing choices[1]. The decision to be chosen for the location of the minimarket does not only pay attention to the existing criteria. There are many supporting criteria for location selection in the process of placing minimarket locations with companies, such as Building Rent Costs, Level of Purchasing Power, Mileage with the same Business Competitor, Land Area, Number of Population, Population Economy, Strategic Location (Located around the center of trading activity or offices) and several other criteria. In other matters, the selection of a location determined by development management is only based on certain criteria, such as large land area, comfortable atmosphere and guaranteed public services and low prices. So we need a system that can provide decisions through the best alternative called SPK or Decision Support System [2], [3].

It is hoped that the minimarket location selection system requires not only criteria but must have the importance weight of each criterion in the form of numbers. In this system, some methods are applied to produce the best alternatives to provide solutions to various kinds of existing problems, including the OCRA, MAUT, COPRAS, MABAC, and ARAS methods. Of the different existing ways, this study uses ROC and OCRA. The Operational Comprehensive Rating Analysis (OCRA) method was first developed in 1994 by Parkan. The OCRA method is a stage in measuring the performance of an alternative, from the non-parametric model [4]. To produce an objective decision, we need a method that can produce criteria weights. The importance of each criterion is needed in DSS, usually by using the ROC method.

Several studies related to the similarity of methods, namely the ROC and OCRA methods such as in the application of ROC and SAW, Made Arya determines the location of the Stup in 2020[5]. This research is based on the relationship that determines the location of the Stup (Beehive). Decision Support System that applies the ROC and SAW methods. The ROC method is for weighting on criteria, the SAW method is for finding the sum of the weight values for each of the existing alternatives, and all attributes. Then Syamsuddin, et al in 2017 conducted research applying the Brown Gibson method for selecting minimarket branch locations[6]. This research is based on the fact that

location determination is still done manually in choosing certain alternative preferred locations by considering objective and subjective factors.

From the results of research on the placement of minimarket locations, it can provide convenience to management in the process of placing minimarket locations.

2. RESEARCH METHODOLOGY

2.1 Research Stages

The following are the stages of this research as follows:

- a. Identifying Problems
 This stage introduces the problems that arise and determines the problems to be resolved. The problem to be raised is the placement of minimarket locations.
- b. Literature Review
 At this stage, collect various references related to SPK in general and the ROC and OCRA methods or Operational Competitiveness Rating Analysis in particular and read related journals and references related to this research.
- c. Stages of Method Testing
 The method has a very important role in making research. The method applied in this study uses the calculation method OCRA or Operational Competitiveness Rating Analysis and the weighting method, namely ROC.
- d. Reporting Stages
 This stage is the final stage for making a report on the results of the overall performance of the existing research stages in minimarket location placement and the stage for providing input in the development of a future minimarket location placement system.

From the stages above, it can be explained more clearly based on Figure 1 below.

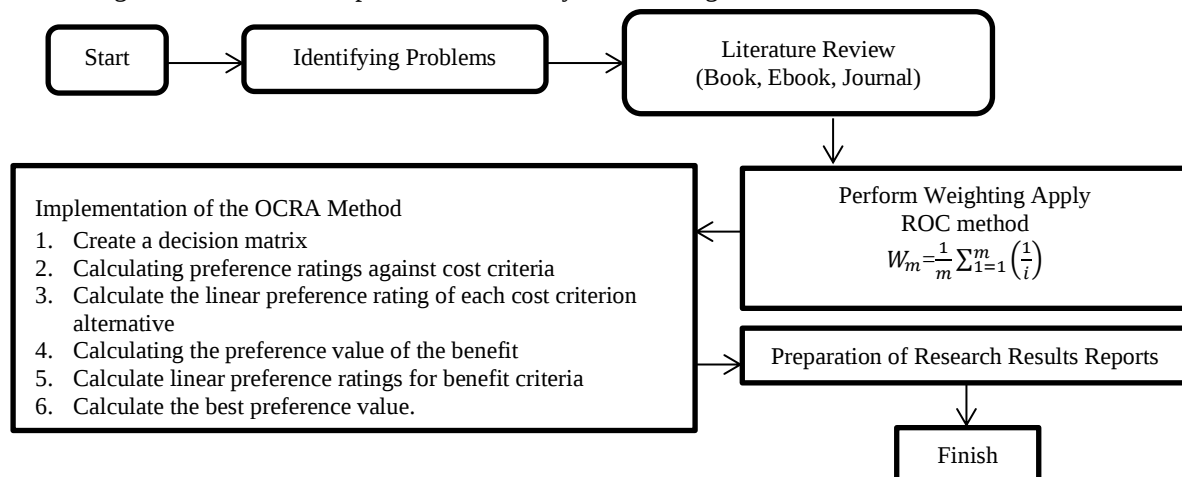


Figure 1. The research stages

2.2 Decision Support System

Decision support system (DSS) is a system that produces the best solution to an existing problem with the provision that it has some alternative certificate data, criteria and weights and requires a certain method included in the DSS method by following several existing stages so that from these stages the best decision is produced. through the best preference value as the best alternative. Multi Attribute Decision Making or decision making for many attributes and Multi Objective Decision Making or decision making for many purposes [7]–[11].

2.3 Location Determination

According to Heizer & Render (2015) Location is a driving force for increasing income, so location has an important place in the company's business strategy. Choosing a strategic location to have a good impact on the sustainability of the business, choosing the right location can provide various kinds of benefits for the business being run. Location selection is carried out when establishing a new business or company branch, expanding an existing business, or moving the company's location to another location. Location determination is in an important position due to the amount of operating costs and competition. Location selection aims to maximize company profits [12].

2.4 Rank Order Centroid (ROC) Method

The Rank Order Centroid (ROC) method can give/produce the weight of each attribute, from the value of this weight it can be seen how important these criteria are to a cashier's acceptance requirement. Determination of the weight of the ROC method is carried out to determine the priority of these criteria [13]–[16].

The formula of the ROC method is as follows:

$$W_m = \frac{1}{m} \sum_{i=1}^m \left(\frac{1}{i} \right) \quad (1)$$

The result of the total W_m , have value 1.

2.5 Operational Competitiveness Rating Analysis (OCRA) Method

The OCRA method or Operational Competitiveness Rating Analysis is a method for generating decisions from existing problems with certain data so that they can provide the best solution. The OCRA method discovered by Occhipinti and Colombini is usually used in repetitive work [4], [7], [17]–[21]. Several stages of the OCRA method are as follows:

1. In the first step, create the Xij decision matrix

$$X = [x_{ij}]_{m \times n} = \begin{bmatrix} x_{11} & x_{12} & \dots & x_{1n} \\ x_{21} & x_{22} & \dots & x_{2n} \\ \dots & \dots & \dots & \dots \\ x_{m1} & x_{m2} & \dots & x_{mn} \end{bmatrix} \quad i = 1, \dots, m \quad j = 1, 2, \dots, n \quad (2)$$

2. In the second step, preference ranking is related to cost criteria. Here, the value of each alternative against the criterion to be reduced is calculated only from the useful criteria not considered. For cost criteria use the formula below.

$$\bar{I}_i = \sum_{j=1}^g w_j \frac{\max(x_{ij})}{\min(x_{ij})} \quad (i=1, 2, \dots, m \quad j=1, 2, \dots, g) \quad (3)$$

3. In the third step, calculate the linear preference ranking for the cost criterion using the formula below.

$$\bar{I}_i = \bar{I}_i - \min(\bar{I}_i) \quad (5)$$

4. In the fourth step, preference ranking is related to benefit criteria. For benefit criteria, the alternative that has a higher value is preferred. The total performance rating of alternative i for the benefit criteria uses the formula below.

$$\bar{O}_i = \sum_{j=g+1}^n w_j \frac{x_{ij} - \min(x_{ij})}{\max(x_{ij}) - \min(x_{ij})} \quad (i=1, 2, \dots, m \quad j=g+1, g+2, \dots, n) \quad (6)$$

5. In the fifth step, calculating the linear preference rating for the benefit criteria is calculated by the formula.

$$\bar{O}_i = \bar{O}_i - \min(\bar{O}_i) \quad (7)$$

6. In the sixth step, determine the best preference for each alternative calculated using the formula below.

$$P_i = (\bar{I}_i + \bar{O}_i) - \min(\bar{I}_i + \bar{O}_i) \quad i = 1, 2, m \quad (8)$$

3. RESULT AND DISCUSSION

Location is an important factor in the real estate market. Location determination occupies an important position in the continuity of a business. Locations that are easily accessible by the community are easy to meet the daily needs of the community. Setting the distance between minimarkets is also very necessary so that they are not too close to one another. Heizer and Render (2015) state that choosing the right location can increase the income of the business, on the other hand, if you choose an inaccurate location, the income that the company gets can decrease.

3.1 Determination of Criteria and Weight

In this study using the ROC and OCRA methods, in selecting the placement of Minimarket Locations the OCRA method requires criteria and importance weights for a relative performance measurement approach based on a nonparametric model [22]. To produce objective research so that there are several criteria that are used as attribute requirements in table 1 below:

Table 1. Data of Criteria

Criteria	Description	Type of Criteria
C ₁	Mileage with the same business competitors (Mil)	Cost
C ₂	Building Rental Fees (Million/5 Years)	Cost
C ₃	Total population (People)	Cost
C ₄	Surface area (M ²)	Cost
C ₅	Located around the center of trade activity or offices	Benefit
C ₆	Population Economy	Benefit
C ₇	Purchasing Power Level	Benefit

From table 1 it can be explained from each criterion as follows.

- a. Determining the location of the minimarket needs paying attention to the distance traveled with the same business competitors so as not to create competition.

- b. Building rental fee is a fee that must be paid by the company to the person concerned, who is willing to lend/lease the building for the benefit of the company in accordance with the agreement that has been made.
- c. Total population is a factor that can influence the selection of minimarket locations. The more the population, the more likely consumers will shop to meet basic food needs.
- d. Land Area, in determining the location of minimarkets, land area is needed as a parking space for consumers' vehicles.
- e. Being around the center of trade activity or offices is the main factor, this proves that this location is able to attract consumers to come shopping.
- f. Economy The population is the level of welfare of the people in a certain area.
- g. The level of purchasing power is the market share which includes the ability of consumers or the public to buy the products offered.

3.2 Weight Calculation Applying ROC Method

Generating importance weights for each criterion in this study using the ROC method, calculated by the following equation:

$$W_1 = \frac{1 + \frac{1}{2} + \frac{1}{3} + \frac{1}{4} + \frac{1}{5} + \frac{1}{6} + \frac{1}{7}}{7} = 0,370$$

$$W_2 = \frac{0 + \frac{1}{2} + \frac{1}{3} + \frac{1}{4} + \frac{1}{5} + \frac{1}{6} + \frac{1}{7}}{7} = 0,187$$

$$W_3 = \frac{0 + 0 + \frac{1}{3} + \frac{1}{4} + \frac{1}{5} + \frac{1}{6} + \frac{1}{7}}{7} = 0,156$$

$$W_4 = \frac{0 + 0 + 0 + \frac{1}{4} + \frac{1}{5} + \frac{1}{6} + \frac{1}{7}}{7} = 0,109$$

$$W_5 = \frac{0 + 0 + 0 + 0 + \frac{1}{5} + \frac{1}{6} + \frac{1}{7}}{7} = 0,072$$

$$W_6 = \frac{0 + 0 + 0 + 0 + 0 + \frac{1}{6} + \frac{1}{7}}{7} = 0,042$$

$$W_7 = \frac{0 + 0 + 0 + 0 + 0 + 0 + \frac{1}{7}}{7} = 0,020$$

Based on the equation above, it produces a weight value in table 2 below:

Table 2. Criteria Weight

Criteria	Description	Weight
C ₁	Mileage with the same business competitors (Mil)	0,370
C ₂	Building Rental Fees (Million/5 Years)	0,187
C ₃	Total population (People)	0,156
C ₄	Surface area (M ²)	0,109
C ₅	Located around the center of trade activity or offices	0,072
C ₆	Population Economy	0,042
C ₇	Purchasing Power Level	0,020

For C₅, C₆ and C₇ are linguistic in nature, then they are weighted to make it easier in the calculation process, it can be seen in table 3 below:

Table 3. Weight for alternative assessment

Criteria	Description	Weight Value
C5	Strategic	2
	Not Strategic	1
C6	Very Good	4
	Good	3
	Enough	2
C7	High	3
	Medium	2
	Low	1

3.3 Determination of Alternative Data

The number of data samples in this study were 5 alternatives, which can be seen below:

Table 4. Alternative Location Data

Alternative	C ₁	C ₂	C ₃	C ₄	C ₅	C ₆	C ₇
Tj. Morawa (A ₁)	5	50	420	430	Not Strategic	Very Good	High
Lubuk Pakam (A ₂)	2	45	450	300	Strategic	Good	High
SM.Raja (A ₃)	4	30	620	500	Not Strategic	Enough	Low
Marindal (A ₄)	5	50	400	370	Strategic	Very Good	High
Medan Denai (A ₅)	2	30	510	480	Not Strategic	Good	Medium

So that the data can be processed according to the method that has been determined, the weighting process is carried out according to the data that has been determined, producing a match rating table like table 5 below:

Table 5. Match Rating Data

Alternative	C ₁	C ₂	C ₃	C ₄	C ₅	C ₆	C ₇
Tj. Morawa (A ₁)	5	50	420	430	1	4	3
Lubuk Pakam (A ₂)	2	45	450	300	2	3	3
SM.Raja (A ₃)	4	30	620	500	1	2	1
Marindal (A ₄)	5	50	400	370	2	4	3
Medan Denai (A ₅)	2	30	510	480	1	3	2

3.4 Application of the OCRA Method

The steps for determining minimarket locations using the OCRA method are as follows:

- a. Create a decision matrix x_{ij}

$$X_{ij} = \begin{vmatrix} 5 & 50 & 420 & 430 & 1 & 4 & 3 \\ 2 & 45 & 450 & 300 & 2 & 3 & 3 \\ 4 & 30 & 620 & 500 & 1 & 2 & 1 \\ 5 & 50 & 400 & 370 & 2 & 4 & 3 \\ 2 & 30 & 510 & 480 & 1 & 3 & 2 \end{vmatrix}$$

- b. Calculation of the preference level where only the performance value of the alternative for the cost criterion is calculated, using equation 2

$$\text{Max } C_1 = \{5; 2; 4; 5; 2\} = 5$$

$$\text{Min } C_1 = \{5; 2; 4; 5; 2\} = 2$$

$$\text{Max } C_2 = \{50; 45; 30; 50; 30\} = 50$$

$$\text{Min } C_2 = \{50; 45; 30; 50; 30\} = 30$$

$$\text{Max } C_3 = \{420; 450; 620; 400; 510\} = 620$$

$$\text{Min } C_3 = \{420; 450; 620; 400; 510\} = 400$$

$$\text{Max } C_4 = \{430; 300; 500; 370; 480\} = 500$$

$$\text{Min } C_4 = \{430; 300; 500; 370; 480\} = 300$$

$$\bar{I}_1 = \sum \left(0,370 \frac{5-5}{2} \right) + \left(0,187 \frac{50-50}{30} \right) + \left(0,156 \frac{620-420}{400} \right) + \left(0,109 \frac{500-430}{300} \right) = 0,103$$

$$\bar{I}_2 = \sum \left(0,370 \frac{5-2}{2} \right) + \left(0,187 \frac{50-45}{30} \right) + \left(0,156 \frac{620-450}{400} \right) + \left(0,109 \frac{500-300}{300} \right) = 0,725$$

$$\bar{I}_3 = \sum \left(0,370 \frac{5-4}{2} \right) + \left(0,187 \frac{50-30}{30} \right) + \left(0,156 \frac{620-620}{400} \right) + \left(0,109 \frac{500-500}{300} \right) = 0,310$$

$$\bar{I}_4 = \sum \left(0,370 \frac{5-5}{2} \right) + \left(0,187 \frac{50-50}{30} \right) + \left(0,156 \frac{620-400}{400} \right) + \left(0,109 \frac{500-370}{300} \right) = 0,133$$

$$\bar{I}_5 = \sum \left(0,370 \frac{5-2}{2} \right) + \left(0,187 \frac{50-30}{30} \right) + \left(0,156 \frac{620-510}{400} \right) + \left(0,109 \frac{500-480}{300} \right) = 0,730$$

From the calculation above it produces a value as in table 6 below:

Table 6. Minimum criterion preference rating (cost)

Alternative	$\bar{I}$
Tj. Morawa (A ₁)	0,103
Lubuk Pakam (A ₂)	0,725

Alternative	$\bar{I}$
SM.Raja (A_3)	0,310
Marindal (A_4)	0,133
Medan Denai (A_5)	0,730

- c. Calculate the linear preference rating of each alternative for the cost criteria, using equation 3.

$$\text{Min} = \{0,103; 0,725; 0,310; 0,133; 0,730\} = 0,103$$

$$\bar{I}_1 = 0,103 - 0,103 = 0,000$$

$$\bar{I}_2 = 0,725 - 0,103 = 0,622$$

$$\bar{I}_3 = 0,310 - 0,103 = 0,207$$

$$\bar{I}_4 = 0,133 - 0,103 = 0,030$$

$$\bar{I}_5 = 0,730 - 0,103 = 0,627$$

From the calculation above, it produces values like those in table 7 below:

Table 7. Minimum criterion linear preference rating (cost)

Alternative	$\bar{I}_i$
Tj. Morawa (A_1)	0,000
Lubuk Pakam (A_2)	0,622
SM.Raja (A_3)	0,207
Marindal (A_4)	0,030
Medan Denai (A_5)	0,627

- d. Calculating preference ratings where only the performance of alternatives for benefit criteria is counted, using equation 4.

$$\text{Max } C_5 = \{1; 2; 1; 2; 1\} = 2$$

$$\text{Min } C_5 = \{1; 2; 1; 2; 1\} = 1$$

$$\text{Max } C_6 = \{4; 3; 2; 4; 3\} = 4$$

$$\text{Min } C_6 = \{4; 3; 2; 4; 3\} = 2$$

$$\text{Max } C_7 = \{3; 3; 1; 3; 2\} = 3$$

$$\text{Min } C_7 = \{3; 3; 1; 3; 2\} = 1$$

$$\bar{O}_1 = \sum \left(0,072 \frac{1-1}{1} \right) + \left(0,042 \frac{4-2}{2} \right) + \left(0,020 \frac{3-1}{1} \right) = 0,082$$

$$\bar{O}_2 = \sum \left(0,072 \frac{2-1}{1} \right) + \left(0,042 \frac{3-2}{2} \right) + \left(0,020 \frac{3-1}{1} \right) = 0,133$$

$$\bar{O}_3 = \sum \left(0,072 \frac{1-1}{1} \right) + \left(0,042 \frac{2-2}{2} \right) + \left(0,020 \frac{1-1}{1} \right) = 0,000$$

$$\bar{O}_4 = \sum \left(0,072 \frac{2-1}{1} \right) + \left(0,042 \frac{4-2}{2} \right) + \left(0,020 \frac{3-1}{1} \right) = 0,118$$

$$\bar{O}_5 = \sum \left(0,072 \frac{1-1}{1} \right) + \left(0,042 \frac{3-2}{2} \right) + \left(0,020 \frac{2-1}{1} \right) = 0,062$$

From the calculation above it produces values like table 8 below:

Table 8. Maximum criterion preference ranking (benefit)

Alternative	$\bar{O}$
Tj. Morawa (A_1)	0,082
Lubuk Pakam (A_2)	0,133
SM.Raja (A_3)	0,000
Marindal (A_4)	0,118
Medan Denai (A_5)	0,062

- e. Calculating linear preference rankings is calculated for useful criteria, using equation 5.

$$\text{Min} = \{0,082; 0,133; 0,000; 0,118; 0,062\} = 0,000$$

$$\bar{O}_1 = 0,082 - 0,000 = 0,082$$

$$\bar{O}_2 = 0,133 - 0,000 = 0,133$$

$$\bar{O}_3 = 0,000 - 0,000 = 0,000$$

$$\bar{O}_4 = 0,118 - 0,000 = 0,118$$

$$\bar{O}_5 = 0,062 - 0,000 = 0,062$$

From the calculation above, it produces table 9 below:

Table 9. Maximum criterion linear preference ranking (benefit)

Alternative	$\bar{O}_i$
Tj. Morawa (A_1)	0,082
Lubuk Pakam (A_2)	0,133
SM.Raja (A_3)	0,000
Marindal (A_4)	0,118
Medan Denai (A_5)	0,062

f. Calculation of the preference value of the existing alternatives, as below:

Table 10. The total preference value for each alternative

Alternative	$\bar{I}_i$	$\bar{O}_i$	$\bar{I}_i + \bar{O}_i$	$\text{Min}(\bar{I}_i + \bar{O}_i)$	P_i
A_1	0,000	0,082	0,082	0,082	0,000
A_2	0,622	0,133	0,755		0,673
A_3	0,207	0,000	0,207		0,125
A_4	0,030	0,118	0,148		0,066
A_5	0,627	0,062	0,689		0,607

From table 10 it can be seen the ranking of the alternatives that have been generated

Table 11. Alternative Rank

Alternative	Description	P_i	Rank
A_1	Tj.Morawa	0,000	5
A_2	Lubuk Pakam	0,673	1
A_3	SM.Raja	0,125	3
A_4	Marindal	0,066	4
A_5	Medan Denai	0,607	2

Based on the alternative ranking table 11, where the method applied is OCRA and ROC. Then the resulting decision is A_2 as the best alternative, namely the Lubuk Pakam location with a preference value of 0.673.

4. CONCLUSION

This research was conducted by determining minimarkets, it can be concluded that the more factors that influence consideration in making decisions, the more difficult it is to determine a decision from this problem. The factors taken into consideration in selecting the location for minimarkets using the ROC and OCRA methods include building rental costs, level of purchasing power, mileage with the same business competitors, land area, population, population economy, strategic location (located around the center of trade or office activities) and many other criteria. The application of a minimarket location selection system uses ROC and OCRA from several existing criteria that have been set at 0.673, as a location that is suitable for making a minimarket. The process of placing minimarket locations by applying the ROC and OCRA methods starts with determining the weight criteria for each sub-criteria and this decision support system is able to display the largest total preference value as a matter to be considered in decision-making. It is hoped that this research can become a reference for further research and facilitate the process of selecting minimarket locations.

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