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Decision Making Method for KT Kopi Café Location Selection Using Analytical Hierarchy Process Method

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Abstract— Decision Making in business location will have significant impact to long term profitability, survival and competitiveness of business. As important as it is, decision making also is challenging task as there will be criteria and alternatives complexity. This research will discuss about the application and implementation of Analytical Hierarchy Process Method in decision making for KT Kopi café location selection that currently located at North Sumatera. Currently the café location selection decision making is purely based on intuitive from management. In this research, the analysis and method used for decision making is Pairwise Comparison and Analytical Hierarchy process. The purpose is to recommend to KT Kopi of the methodological decision making process that based on criteria importance and weight. This decision making method will ensure that important criteria will be included and calculated in the decision making process. The research method using observation, literature study and interview with management to list the criteria that will contribute to the good café location selection decision making. Management is asked to give score of importance among three potential location based on eight criteria using pairwise comparison and afterward follows by the calculation of consistency ratio and calculation of rank using AHP. The result of the research shows that among three potential location A, B, and C, the location score using AHP and pairwise comparison for location A is 0.2673, location B is 0.3157 and location C is 0.4170. Therefore, based on each location's score with eight criteria (market proximity, customers access convenience, raw material suppliers' proximity, competition level, cost, labour potential, infrastructure & facilities), location C is the most preferred, following by location B then location A is the least preferred. The consistency ratio (CI/RI) value is 0.0337, which is less than 0.1, means the pairwise comparison data is consistent and can be used in AHP decision making analysis.

Keywords— *Decision Making, Weight, Criteria, Consistency Index, Pairwise Comparison, Analytical Hierarchy Process*

I. INTRODUCTION

A. Background

Decision making is one of important process for management. Wrong decision making will cause huge impact to company such as loss profit, increasing cost, loss of competition edge, ineffective operation and supply chain management. Thus, it is crucial for management to have good methodological and analytical decision-making process that consider and calculate the important criteria contribute to the decision making. Choosing the café location is one of the keys to profitability. According to (Diana et al., 2018) the selection of the right location for Micro, Small and Medium Enterprises will have positive impacts on the business development and profitability. The right location also will attract new customers, create strong presence, support effective and efficient operation and supply chain management, and also reduce cost. (Hanum et al., 2021) mentioned that accuracy in choosing location is one of the factors that determine the success of business and good location will provide primary service to customers. For a long time, location selection for the company is very essential decision to make since the location selection will contribute in significant cost and revenue factors (Heizer, Jay; Render, Barry; Munson, 2017; Krajewski, Mallhotra, & Ritzman, 2016). Research by (Fuad et al., 2012) indicated that competitive forces reflects the company's capability to earn above average profit compared to competitors due to several factors: number of competitors, suppliers bargaining power, customer bargaining power, the product substitute presence, entry barriers presence. Some factors to be considered in location selection are attractiveness of region, cost and availability of utilities, proximity to raw materials and customers, growth potential (Mulia, 2018).

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KT Kopi is one of the most famous traditional coffee businesses in Medan, originated from Pematang Siantar, established since 1925. The cafés location are in Medan, Padang Sidempuan, Pematang Siantar, Jakarta, Bali. The café location selection is from the management consideration based on the experience and intuitive. There is no methodological decision making process applied, therefore some cafés have a very good crowd while some are not much profitable. The management needs to have a decision making process that include and calculate criteria to recommend the best location alternative.

B. Problem Identification

Below the problem identification which based on the research background:

1. To have strong brand presence, efficient and effective supply chain, attract new customers, reduce cost and increase profit, the location selection is very crucial and important. The accuracy in selecting location is one of important factors for business success and customer service. Based on research by (Erbıyık et al., 2012) retail site location has vital importance to the success of management and one of the most important that affects the profitability and sales performance of the management
2. KT Kopi which the café location has spread across Indonesia, some café's location at main road, airport, tourist spot, shop, gas station and mall. Currently management decide the location based on intuitive and experience, resulted in inaccurate decision making. Thus, they need to have methodological and systematic decision making process based on criteria that are important and contribute to the decision.

C. Literature Study

Decision making involves generating, analysing and evaluating several alternatives and selecting the most preferred one that give most requirements. Optimization involves searching the best solution from a set of feasible solutions. Using the structured decision analysis process will improve decision making, not only it will help to decision maker to select the better option but also it will give more insight into the decision situation (Herrmann, 2015).

When a decision maker considers about multiple criteria it might be difficult to rank an alternative compared to other alternatives. If the decision maker had another objective that was more important it would be useful to determine how changing the value of the attributes will affect the objective and evaluate every alternative based on that objective, which will make simpler problem. In this aspect, the multi criteria decision making is useful.

Analytical Hierarchy Process (AHP), method developed by Thomas Saaty, is a method to rank decision alternatives and select the best alternative based on contributing criteria or objectives set by decision maker (Taylor, 2013). AHP is a mathematical process calculates a quantitative score to rank each alternative, based on how well the alternatives meet the decision maker's criteria. (Faulin et al, 2013) used AHP to select the most appropriate transportation route through a region based on economic, social and environment aspects.

In AHP the decision maker list down decision alternatives and criteria and determine how well each alternative scores on each criterion by using Pairwise Comparison method. In pairwise comparison the decision maker will make comparison between two alternatives (in a pair) based on a criterion and make preference between those two alternatives. This comparison is made using preference scale.

The standard preference scale used for AHP is shown in table 1.

Tabel 1. Pairwise Comparison Preference Scale

Preference Level	Numeric Value
Equally preferred	1
Equally to moderately preferred	2
Moderately preferred	3
Moderately to strongly preferred	4
Strongly preferred	5
Strongly to very strongly preferred	6
Very strongly preferred	7
Very strongly to extremely preferred	8
Extremely preferred	9

The AHP structure will have the objective as top of hierarchy, how the criteria contribute to objective as 2nd level and how each of alternative contribute to each of criteria as 3rd level.

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According to (Taylor, 2013) The AHP procedure steps are below:

1. Generate the pairwise comparison matrix for each alternative for each criterion
2. Synthesisation:
   a. Sum up the values in each column of the pairwise comparison matrix
   b. Divide each value in each column by corresponding column sum- these are the normalised matrix
   c. Average the values in each row of the normalised matrix – these will be the preference scores
   d. Combine the vectors of preference score for each criterion (step c) into one preference matrix that show the preference for each alternative for each criterion
3. Develop the pairwise comparison matrix for the criteria
4. Compute the normalized matrix
5. Develop the preference vector
6. Compute an overall score for each alternative
7. Rank the alternatives and choose the highest score as best alternative.

AHP is based on pairwise comparison that a decision maker will use to establish the ranking and importance between alternatives based on certain criteria. The normal procedure for establishing the pairwise comparison is by interview to get verbal preferences from decision maker using the preference scale in table 1. But sometimes a decision maker lost track when rank the importance and comparisons. However, AHP is based on these answers, thus, it is important to see if the data is valid and consistent. A consistency index measures the degree of inconsistency among the alternatives and criteria ranking in pairwise comparison. If CI=0 then the data is perfectly consistent. An acceptable consistency level is determined by comparing the CI to RI (Randow Index). The value of RI, depending on number of items, n, as table 2:

Tabel 2. Random Index Value

n	2	3	4	5	6	7	8	9	10
RI	0	0.58	0.9	1.12	1.24	1.32	1.41	1.45	1.51

The consistency level for pairwise comparison is calculated by computing the ratio of CI and RI, depending on n.

$$\frac{CI}{RI}, where\ RI\ value\ depends\ on\ n$$

If $\frac{CI}{RI} < 0.1$, then the data consistency is satisfactory. If $\frac{CI}{RI} > 0.1$ then the data is inconsistent, thus, the AHP results might not be accurate.

II. METHOD

This research is conducted using observation and face to face interview with management at KT Kopi, one of the most famous traditional coffee businesses in Medan, originated from Pematang Siantar, established since 1925. The cafés location are in Medan, Padang Sidempuan, Pematang Siantar, Jakarta, Bali. The research is based on the decision making problem that management faces when selecting the café location selection. Currently the management make decision based on intuitive and experience after they survey to the location. Although there are some criteria considered in the decision making process, there is no methodological decision making process applied, therefore some cafés have a very good crowd while some are not much profitable. The management needs to have a decision making process that include and calculate criteria that contribute to the location selection and recommend the best location alternative.

From the interview with KT Kopi management there are three potential café locations to be considered and eight criteria that contribute to the café location selection, such as market proximity, customers access convenience, raw material suppliers' proximity, competition level, cost, labour potential, infrastructure & facilities. The criteria are ranked by the weight (importance) and score is given to the potential location based on the criteria. These eight criteria are consistent with research by (Wibisono & Marella, 2020) list location characteristics, demography, cost, physical features, and competition as the important criteria for café location selection. Using the AHP and pairwise comparison method, ranking score is calculated and the best location recommendation is given based on the best score. The details of criteria considered in this research as below:

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Tabel 3. Criteria in Café Selection

No	Criteria	Details
1	market proximity	the distance (proximity) between café location to potential customers
2	customer buying power	customer purchase/ buying power based on income, education, and demographic
3	customer access convenience	the extent of customer easy to reach the location
4	raw material supplier proximity	the proximity between café location to raw material supplier
5	Competition level	nearby (surrounding competitor)
6	cost	rental, labor, transportation, renovation cost
7	labor potential	the access to reach potential employees/ talents needed for café operation
8	infrastructure & facilities	the availability of supporting infrastructure and facilities in or surround the location (parking space, etc)

The criteria are ranked according to the importance, and score is given to each location alternative based on the criteria. Using the pairwise comparison method, the rank is computed and analysed and the best location is recommended based on the best score.

III. RESULT AND DISCUSSION

Below is the calculation of the three locations preference and ranking based on eight criteria. Table 4 shows the importance rank for the eight criteria.

Table 4. Criteria Importance (Weight)

	Raw material Supplier Proximity	Market Proximity	Customer Buying Power	Cost	Competition Level	Infrastructure & Facilities	Labour Potential	Customer Access convenience
Raw Material Supplier Proximity	1	1/4	1/3	3	2	5	3	1/2
Market Proximity	4	1	2	7	5	9	8	3
Customer Buying Power	3	1/2	1	5	4	8	6	2
Cost	1/3	1/7	1/5	1	1/2	4	3	1/4
Competition	1/2	1/5	1/4	2	1	4	3	1/3

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Level								
Infrastructure & facilities	1/5	1/9	1/8	1/4	1/4	1	1/2	1/6
Labour Potential	1/3	1/8	1/6	1/3	1/3	2	1	1/5
Customer Access Convenience	2	1/3	1/2	4	3	6	5	1
SUM	11.37	2.66	4.58	22.58	16.08	39	29.5	7.45

Table 5. Pairwise Comparison Matrix for Café Selection Criteria

raw material supplier proximity	location A	Location B	Location C
location A	1	1/4	1/2
Location B	4	1	3
Location C	2	1/3	1
SUM	7	1.5833	4.5

market proximity	location A	Location B	Location C
location A	1	1/3	1/5
Location B	3	1	1/3
Location C	5	3	1
SUM	9	4.3333	1.5333

customer buying power	location A	Location B	Location C
location A	1	3	4
Location B	1/3	1	2
Location C	1/4	1/2	1
SUM	1.583333333	4.5	7

cost	location A	Location B	Location C
location A	1	2	1/3
Location B	1/2	1	1/4
Location C	3	4	1
SUM	4.5	7	1.5833

Competition level	location A	Location B	Location C
location A	1	1/3	1/2
Location B	3	1	5
Location C	2	1/5	1
SUM	6	1.5333	6.5

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infrastructure & facilities	location A	Location B	Location C
location A	1	4	5
Location B	1/4	1	3
Location C	1/5	1/3	1
SUM	1.45	5.333333333	9

labor potential	location A	Location B	Location C
location A	1	4	3
Location B	1/4	1	1/2
Location C	1/3	2	1
SUM	1.5833	7	4.5

customer access convenience	location A	Location B	Location C
location A	1	1/3	1/5
Location B	3	1	1/2
Location C	5	2	1
SUM	9	3.3333	1.7

Table 6. Preference Vector for Café Selection Criteria

	Preference Vector for Criteria
raw material supplier proximity	0.1011
market proximity	0.3363
customer buying power	0.2272
cost	0.0550
Competition level	0.0717
infrastructure & facilities	0.0223
labor potential	0.0325
customer access convenience	0.1540

Table 7. Consistency Index and Consistency Ratio

on time delivery	0.8552
raw material quality	2.8610
competitive price	1.9416
Raw Material Availability	0.4432
transportation cost	0.5943
Capacity for volume	0.1819
customer service (communication)	0.2637
lead time	1.3132

on time delivery	8.4574

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raw material quality	8.5081
competitive price	8.5469
Raw Material Availability	8.0602
transportation cost	8.2900
Capacity for volume	8.1627
customer service (communication)	8.1071
lead time	8.5295
average	8.3327

CI	0.0475

n	2	3	4	5	6	7	8	9	10
RI	0	0.58	0.9	1.12	1.24	1.32	1.41	1.45	1.51

CI/RI	**0.033712**

(Saaty, 1988) found that the measure by consistency ratio (CR) is by using consistency index (CI) divided by random consistency index (RI). If CR value <0.10 then the data is satisfactory. Based on the CI (Consistency Index) is 0.0475 with eight criteria (n=8) and three location alternatives (A, B, C), with value of consistency ratio (CI/RI) = 0.033712 (CI/RI <0.10), we can conclude that the data consistency is satisfactory and decision maker is consistent in making importance using pairwise comparison. Practical implication that the data that is collected by interviewing management for these three potential locations with eight criteria can be used in decision making using AHP.

Table 8 shows the preference vectors for café location alternatives. From table 8, the score and ranking for each location alternatives are calculated with the result shows in table 9.

Table 8. Preference Vectors for Café Location

Location	raw material supplier proximity	market proximity	customer buying power	cost	Competition level	infrastructure & facilities	labor potential	customer access convenience
A	0.1373	0.1062	0.6232	0.2395	0.1537	0.6651	0.6232	0.1096
B	0.6232	0.2605	0.2395	0.1373	0.6405	0.2311	0.1373	0.3092
C	0.2395	0.6333	0.1373	0.6232	0.2059	0.1038	0.2395	0.5813
Preference Vector for Criteria	**0.1011**	**0.3363**	**0.2272**	**0.0550**	**0.0717**	**0.0223**	**0.0325**	**0.1540**

Table 9. Café Location Rank Result

Location	score	Ranking
A	0.2673	3rd
B	0.3157	2nd
C	0.4170	1st

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Table 9 shows the location A score is 0.2673, location B is 0.3157 and location C is 0.4170. Therefore, based on each location's score with eight criteria (market proximity, customers access convenience, raw material suppliers' proximity, competition level, cost, labour potential, infrastructure & facilities), location C is the most preferred, following by location B then location A is the least preferred. The practical implication based on this research, for KT Kopi café location selection we can use these eight criteria with AHP and pairwise comparison that give the more analytical and methodological method for decision making process compared to current practice that management use based on intuitive and experience. The consistency index and ratio must be applied and calculated to ensure the importance rank data is valid and consistent.

IV. CONCLUSION

Location selection and decision making is one of crucial aspect in long term profitability, survival and competitiveness of business. Wrong decision making will cause huge impact in profit, cost, supply chain and operation management. Although the decision making process are crucial and important, it also gives complication as multicriteria and multi alternatives involved. In this research, from interview with management and literature study, there are eight criteria that contribute to café location selection such as market proximity, customers access convenience, raw material suppliers' proximity, competition level, cost, labour potential, infrastructure & facilities. Since KT Kopi has three potential location A, B, C, the score is given for each location based on eight criteria using pairwise comparison and the calculation of preference and rank using AHP. The pairwise data consistency is calculated using consistency index and consistency ratio with value of 0.0337 (less than 0,1) therefore the pairwise comparison data is satisfactory. The result shows the location A score is 0.2673, location B is 0.3157 and location C is 0.4170. Therefore, based on each location's score with eight criteria (market proximity, customers access convenience, raw material suppliers' proximity, competition level, cost, labour potential, infrastructure & facilities), location C is the most preferred, following by location B then location A is the least preferred. Since the research give recommendation based on mathematical and methodological tools for decision making, this will have positive implication to KT Kopi's café location selection. The research also has some limitations as the research is done specifically in café business and also the data is relied on the management interview and literature study which the score and rank relies on management judgement and opinion. The recommendation for next research is to analyse the interdependence of the criteria that contribute to the successful café location.

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