Beauty Clinic Selection Based on Service Quality Using AHP (Analytical Hierarchy Process) Method in Industrial Engineering Department

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Abstract. Economic growth, technology and social culture has driven changes in consumer behavior and needs that continue to grow, one of which is the need to continue to improve themselves. This is supported by the number of beauty clinics that stand. As a company engaged in the field of suits, beauty clinics must be able to make consumers feel satisfied with the services provided. This research helps consumers determine the beauty clinic services that consist of 3 alternatives, namely Erha Clinic, London Beauty Center and Natasha Skin Care. The method used in this study is the Analytical Hierarchy Process (AHP) method. The AHP method will break down complex multi-factor or multi-criteria problems into a hierarchy. Where with hierarchy, a complex problem can be broken down into groups which are then arranged into a hierarchical form so that the problem will appear more structured and systematic. This research will produce priority weight values for each beauty clinic, which based on the largest weight is an alternative beauty clinic with the best service quality.

1. Introduction
As economic, technological, and socio-cultural advances have driven changes in all aspects of consumer behavior and the fulfillment of evolving needs, this development has also touched on various aspects of human life, including influencing the need to improve themselves physically or wanting to look better and be attractive, especially in women. Prihatini & Mastawan states that physical beauty can make a woman feel fully confident in her environment, for that women do not only rely on physical beauty that is brought from birth, but need to be supported by doing the best care for themselves through the beauty care center which is there to always look beautiful and attractive. Physical beauty that according to some people is relative, it turns out that for most women is the first benchmark for others who want to know him, before finally getting to know his personality and intellectual.

More and more women are aware of the importance of care for themselves, has encouraged more and more beauty clinics that have sprung up by offering a variety of promising products and treatments. Beauty clinics in their services provide action services and sales of facial and body skin beauty products that have a high enough risk and are complex because they are related to health, so consumers need to make many considerations and choices [1].

The result of the process of determining the choice among several alternatives is called decision making. In the problem of decision making there are several methods that can be done, one of which is
Multiple Criteria Decision Making (MCDM). MCDM is used to choose the best alternative from a number of alternatives based on several predetermined criteria. The criteria in question can be in the form of measurements, rules or standards used in decision making [2].

In making a decision on beauty clinic services, one thing to consider is the quality of services. According to Parasuraman in Purnamawati service quality is defined as "How far is the difference between the reality and expectations of customers for the services they receive or receive". Meanwhile, according to Jasfar "what is meant by service quality is as consumers' responses to services consumed or felt".

According to Parasuraman in Jasfar there are five dimensions of service quality that are commonly used as a reference. The five dimensions are [3]:

- **Reliability**, is to provide the promised service accurately (reliably) and can be trusted (dependably), especially to provide services in a timely manner (on time), in a manner that is on schedule promised and without making mistakes every time.
- **Responsiveness**, is the willingness or desire of employees to help and provide services needed by consumers.
- **Assurance**, which includes knowledge, ability, friendly, polite and trustworthy nature of the contact of personnel to eliminate consumer doubt and feel free from danger and risk.
- **Empathy**, which includes the contact of personnel and companies to understand the needs and difficulties of consumers, good communication, personal attention, ease of communication and relationships.
- **Tangibles**, the availability of physical facilities, equipment, and means of communication and others that can and must be in the service process.

This research was conducted to select several beauty clinics based on the quality of their services according to consumers using the Analytical Hierarchy Process (FAHP) method.

### 2. Theoretical Background

#### 2.1. Sampling Method

Sampling is a very popular method of data collection because it utilizes such a large amount in saving time and money in data collection activities. Sampling is often compared to a census, which is a method of overall data collection in which all data sources are traced and every element of data needed is taken. The census method does produce more complete data but there are many obstacles encountered by using this method [4].

Non-probability sampling is a sampling technique where each population element to be drawn into a sample member is not based on the probabilities inherent in each element but based on the specific characteristics of each element. The model of this non-probabilistic sampling method is convenience sampling and purposive sampling [5].

- **Convenience Sampling**
  
  Convenience sampling is a sampling method in which the respondents are people who voluntarily offer themselves (conveniently available) with their respective reasons.

- **Purposive Sampling**

  Purposive sampling is a non-probability sampling method that uses certain people (specific target-group) as a source of data / information. The particular people referred to here are individuals or groups who because of their knowledge, experience, position and others make the individual or group need to be a source of information. This individual or special group is immediately recorded as a respondent without going through a random selection process. Purposive sampling can be divided into two forms, namely judgment sampling and quota sampling. Judgment sampling is the first type of purposive sampling, respondents are chosen...
Based on certain considerations, for example because of their ability or strengths among others in providing data and information that is specifically needed by researchers. Quota sampling is the second type of purposive sampling where certain groups are used as respondents (data/information sources) to fulfill a specified quota.

2.2. Questionnaire

Questionnaires are a means of collecting data in written questions made with columns where respondents will write down the answers according to the questions addressed to them. Compared to other data collection instruments, a questionnaire is a means that has an efficient mechanism if the researcher knows well what is needed and how to measure the desired variables.

2.3. Multi Criteria Decision Making (MCDM)

Multi Criteria Decision Making (MCDM) is a way of making decisions with the best alternatives from other alternatives based on the criteria listed. Criteria can be in the form of measures, rules or standards used in making decisions. Based on its function, MCDM is divided into 2, namely Multi Attribute Decision Making (MADM) and Multi Objective Decision Making (MODM). MADM is usually used to assess or select a number of alternatives, whereas MODM is used to solve problems in continuous space (as in mathematical programming) [6].

2.4. Analytic Hierarchy Process (AHP)

AHP is a decision support model developed by Thomas L. Saaty. AHP is an organized multicriteria procedure for sorting out and examining complex choices dependent on numerous models [10]. This decision support model will describe a complex multi-factor or multi-criteria problem into a hierarchy according to Saaty, hierarchy is defined as a representation of a complex problem in a multi-level structure where the first level is the goal, followed by the level of factors, criteria, sub criteria and so on down to the last level of alternatives. AHP can deal with subjective and quantitative elements from dynamic cycle for all intents and purposes, methodically and quickly [11]. With hierarchy, a complex problem can be broken down into groups which are then arranged into a hierarchical form so that the problem will appear more structured and systematic [7].

The stages of decision making in the AHP are basically as follows:

- Identify the problem and determine the desired solution
- Create a hierarchical structure that starts with general objectives, followed by criteria and alternative choices to be ranked.
- Form a pairwise comparison matrix that illustrates the relative contribution or influence of each element to each of the objectives or criteria level above it. Comparisons are made based on the choice or judgment of the decision maker by assessing the level of importance of an element compared to other elements.
- Test data normality by dividing the value of each element in the matrix by the total value of each column.
- Calculate the eigenvector value and test its consistency, if it is not consistent then data retrieval (preference) needs to be repeated. The eigenvector value in question is the maximum eigenvector value obtained using matlab or manually.
- Repeat steps 3, 4, and 5 for all levels of the hierarchy.
- Calculates the eigenvector of each paired comparison matrix. The eigenvector value is the weight of each element. This step is to synthesize choices in prioritizing elements at the lowest level of the hierarchy to the achievement of objectives.
- Test the consistency of the hierarchy. If it does not meet with CR <0, 100 then the assessment must be repeated.

In resolving AHP issues, there are several principles that need to be understood including [8]
• Decomposition
After the problem is defined, it is necessary to decomposition, which is to break the whole problem into its elements. If you want to get accurate results, the solution is also carried out on the elements until it is not possible to do further solutions so that some actions are obtained from the problem earlier. For this reason, the analysis process is called a hierarchy.

• Comparative Judgement
This principle means making judgments about the relative importance of two elements at a certain level in relation to the level above it. This assessment is the core of AHP, because it will affect the priority of the elements. The results of this assessment will be placed in the form of a matrix called a pairwise comparison matrix. In preparing the scale of interests using benchmarks that can be seen in Table 1.

Table 1. Basic comparison criteria

| Intensity | Definition                                |
|-----------|------------------------------------------|
| Importance|                                         |
| 1         | Both elements are equally important      |
| 3         | One element is slightly more important than the other |
| 4         | One element is more important than the other elements |
| 7         | One element is clearly more important than another element |
| 9         | One absolute element is more important than the other elements |
| 2,4,6,8   | The values between the two considerations are close together |

• Synthesis of Priority
From each pairwise comparison matrix then the eigen vector value is searched to get local priority. Because pairwise comparison matrices exist at each level, to get global priority, synthesis must be performed between local priority. The ordering of elements according to relative importance through synthesis procedures is called priority setting.

• Logical Consistency
Consistency has two meanings, first is that similar objects can be grouped according to uniformity and relevance. The second meaning is related to the level of relationship between objects based on certain criteria. The consistency indicator is measured through the Consistency Index (CI) which is formulated:

\[ Z_{\text{max}} = \frac{\sum_{i=1}^{n} \text{Vector Consistency}}{n} \]  

\[ \text{CI} = \frac{Z_{\text{max}} - n}{n-1} \]  

Information:

- \( n \) = Number of items compared
- \( Z_{\text{max}} \) = Average value calculated earlier

Random consistency index can be seen in Table 2.

Table 2. Random consistency index

| N  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|----|---|---|---|---|---|---|---|---|----|
| RI | 0 | 0.58 | 0.90 | 1.12 | 1.24 | 1.32 | 1.41 | 1.45 | 1.51 |

So the degree of inconsistency for pair comparison in the decision criteria matrix in the previous example is calculated by the ratio of CI to RI:

\[ \text{CR} = \frac{\text{CI}}{\text{Random Consistency Index}} \]  

Information:
CR = Consistency Ratio
CI = Consistency Index  
RI = Random Index  
In general, the degree of consistency is satisfactory if: CI / RI <0.10

3. Research Methodology  
The activity of selecting several beauty clinics based on the quality of service according to consumers using the Fuzzy Analytical Hierarchy Process (FAHP) method.

This type of research is descriptive research. Descriptive research is research conducted with the aim of describing systematically, factually and accurately about the facts and properties of a particular object or population. This descriptive research is in the form of survey research, namely research conducted to obtain facts from existing phenomena by seeking factual information to obtain truth. The criteria and sub-criteria for consideration in selecting a beauty clinic can be seen in Table 3.

| Criteria       | Sub-criteria                                      | Code |
|----------------|---------------------------------------------------|------|
| Reliability (R)| Worker ability                                    | R1   |
|                | Consistency in providing services                 | R2   |
|                | Satisfactory result                               | R3   |
|                | Providing comprehensive information and services  | R4   |
| Responsiveness (Rv)| There is a help center                          | Rv1  |
|                | Speed of customer service response                | Rv2  |
|                | Deft in serving customers                         | Rv3  |
|                | Focus on responding to customer needs             | Rv4  |
| Assurance (A)  | Clinical legality                                 | A1   |
|                | Guaranteed customer convenience                   | A2   |
|                | Product/service guarantee                         | A3   |
|                | Have a privacy policy                             | A4   |
| Emphaty (E)    | Affordable prices                                 | E1   |
|                | Giving discounts                                  | E2   |
|                | Providing consulting services                      | E3   |
|                | Able to accept criticism and suggestions          | E4   |
| Tangible (T)   | Have a product / service catalog                  | T1   |
|                | Full and modern equipment                         | T2   |
|                | Attractive clinical interior design               | T3   |
|                | Have a waiting room                               | T4   |

3.1. Hierarchy  
Hierarchy is a fundamental tool of the human mind. They involve identifying the elements of a problem, grouping the elements into homogeneous collections, and organizing these collections at different levels [9]. An alternative hierarchy for beauty clinics can be seen in Figure 1.
4. Result

4.1. Calculating the weight for each criteria and sub-criteria

The calculation using geometric mean for level 2 elements between reliability and responsiveness

The results of the calculation of the geometric mean for the calculation of paired weights between criteria can be seen in Table 4.

| Element       | Reliability | Responsiveness | Assurance | Empathy | Tangible |
|---------------|-------------|----------------|-----------|---------|----------|
| Reliability   | 1.0000      | 2.3038         | 1.0393    | 1.6110  | 4.0499   |
| Responsiveness| 0.4341      | 1.0000         | 0.6053    | 0.9611  | 1.9668   |
| Assurance     | 0.9622      | 1.6520         | 1.0000    | 2.2609  | 4.8120   |
| Empathy       | 0.6207      | 1.0405         | 0.4423    | 1.0000  | 1.7579   |
| Tangible      | 0.2469      | 0.5084         | 0.2078    | 0.5688  | 1.0000   |
| Total         | 3.2639      | 6.5047         | 3.2947    | 6.4018  | 13.5867  |

4.2. Calculation of Partial Weight

By dividing each number in each cell by the number of each column and producing a normalization matrix where the number in each column is one. For responsiveness: reliability Then we get the weight of each criterion by calculating the average of each row.

The average weighting for the level between criteria can be seen in Table 5.

| Element       | Reliability | Responsiveness | Assurance | Empathy | Tangible | Partial Weight |
|---------------|-------------|----------------|-----------|---------|----------|----------------|
| Reliability   | 0.3064      | 0.3542         | 0.3154    | 0.2517  | 0.2981   | 0.3051         |
| Responsiveness| 0.1330      | 0.1537         | 0.1837    | 0.1501  | 0.1448   | 0.1531         |
| Assurance     | 0.2948      | 0.2540         | 0.3035    | 0.3532  | 0.3542   | 0.3119         |
| Empathy       | 0.1902      | 0.1600         | 0.1342    | 0.1562  | 0.1294   | 0.1540         |
| Tangible      | 0.0757      | 0.0782         | 0.0631    | 0.0889  | 0.0736   | 0.0759         |
| Total         | 1           | 1              | 1         | 1       | 1        | 1              |
4.3. Calculation of Consistency Matrix

Matrix consistency calculations are performed to see the level of consistency of the respondents' answers. The degree of consistency is satisfactory if CI / RI < 0.10. The results of CR calculations at levels 2, 3 and 4 can be seen in Table 6.

| Level | Element     | CR Score | Explanation |
|-------|-------------|----------|-------------|
| 2     | Criteria    | 0.0076   | Consistent  |
|       | Reliability | 0.0004   | Consistent  |
|       | Responsiveness | 0.0010 | Consistent  |
|       | Assurance   | 0.0048   | Consistent  |
|       | Empathy     | 0.0011   | Consistent  |
|       | Tangible    | 0.0006   | Consistent  |
| 3     | R1          | 0.0120   | Consistent  |
|       | R2          | 0.0093   | Consistent  |
|       | R3          | 0.0048   | Consistent  |
|       | R4          | 0.0031   | Consistent  |
|       | Rv1         | 0.0023   | Consistent  |
|       | Rv2         | 0.0007   | Consistent  |
|       | Rv3         | 0.0001   | Consistent  |
|       | Rv4         | 0.0040   | Consistent  |
|       | A1          | 0.0003   | Consistent  |
|       | A2          | 0.0160   | Consistent  |
|       | A3          | 0.0075   | Consistent  |
|       | A4          | 0.0086   | Consistent  |
|       | E1          | 0.0062   | Consistent  |
|       | E2          | 0.0021   | Consistent  |
|       | E3          | 0.0030   | Consistent  |
|       | E4          | 0.0012   | Consistent  |
|       | T1          | 0.0019   | Consistent  |
|       | T2          | 0.0099   | Consistent  |
|       | T3          | 0.0001   | Consistent  |
|       | T4          | 0.0053   | Consistent  |

Priority weighting is calculated after all partial weight values have been calculated, the level 3 priority weight is added to the level 4 priority weight values in the column for each element. Calculation of priority weights starts from the lowest level and then continues to the next level. Priority Weight Calculation results can be seen in table 7.

| Partial weight | Priority Weight |
|----------------|-----------------|
| Level 2 | Level 3 | Level 4 | Level 4 | Level 3 | Level 4 |
| Erha Clinic | 0.4548 | 0.0491 | 0.1072 | 0.3051 |
| London Beauty Center | 0.2892 | 0.0312 | 0.0732 | 0.2748 |
| Natasha Skin Care | 0.2560 | 0.0276 | 0.0201 | 0.0276 | 0.0201 |
|   |   | Care | Erha Clinic | London Beauty Center | Natasha Skin Care |
|---|---|------|-------------|---------------------|--------------------|
| R3 | 0.2500 |      | 0.4341 | 0.2799 | 0.2860 | 0.0763 |
| R4 | 0.1565 |      | 0.3577 | 0.2911 | 0.3512 | 0.0478 |
| Rv1 | 0.2535 |      | 0.4833 | 0.2143 | 0.3024 | 0.0388 |
| Rv2 | 0.2463 |      | 0.4225 | 0.2865 | 0.2909 | 0.0377 |
| Responsiveness | 0.1531 |      | 0.2531 | 0.2891 | 0.2909 | 0.0344 |
| Rv3 | 0.2245 |      | 0.3655 | 0.3221 | 0.4578 | 0.0422 |
| Rv4 | 0.2757 |      | 0.5426 | 0.3221 | 0.3123 | 0.1058 |
| A1 | 0.3393 |      | 0.3005 | 0.2897 | 0.3526 | 0.0648 |
| Assuranc  e | 0.3119 |      | 0.3221 | 0.2749 | 0.3122 | 0.0731 |
| A3 | 0.2343 |      | 0.5426 | 0.2465 | 0.4413 | 0.0682 |
|      | Care  | Empathy | Tangible |
|------|-------|---------|----------|
|      | Erha Clinic | 0.3957  | 0.1540   |
|      | London Beauty Center | 0.1841  | 0.0759   |
|      | Natasha Skin Care | 0.4202  | 0.0759   |
| E1   | 0.2862 | 0.4941  | 0.3957   |
|      | Erha Clinic | 0.2949  | 0.3935   |
|      | London Beauty Center | 0.2110  | 0.2363   |
|      | Natasha Skin Care | 0.4202  | 0.3702   |
| E2   | 0.2246 | 0.4941  | 0.3957   |
|      | Erha Clinic | 0.2949  | 0.2363   |
|      | London Beauty Center | 0.2110  | 0.2363   |
|      | Natasha Skin Care | 0.4202  | 0.3702   |
| E3   | 0.2555 | 0.4941  | 0.3957   |
|      | Erha Clinic | 0.2949  | 0.2363   |
|      | London Beauty Center | 0.2110  | 0.2363   |
|      | Natasha Skin Care | 0.4202  | 0.3702   |
| E4   | 0.2336 | 0.4941  | 0.3957   |
|      | Erha Clinic | 0.2949  | 0.2363   |
|      | London Beauty Center | 0.2110  | 0.2363   |
|      | Natasha Skin Care | 0.4202  | 0.3702   |
| R1   | 0.3316 | 0.4308  | 0.3316   |
|      | Erha Clinic | 0.2983  | 0.2983   |
|      | London Beauty Center | 0.2736  | 0.2736   |
|      | Natasha Skin Care | 0.2956  | 0.2956   |
| R2   | 0.2416 | 0.4308  | 0.3316   |
|      | Erha Clinic | 0.2983  | 0.2983   |
|      | London Beauty Center | 0.2736  | 0.2736   |
|      | Natasha Skin Care | 0.2956  | 0.2956   |
| R3   | 0.2047 | 0.4308  | 0.3316   |
|      | Erha Clinic | 0.4264  | 0.2983   |
|      | London Beauty Center | 0.2610  | 0.2610   |
|      | Natasha Skin Care | 0.4407  | 0.4407   |
| R4   | 0.2221 | 0.4308  | 0.3316   |
|      | Erha Clinic | 0.4312  | 0.2983   |
|      | London Beauty Center | 0.2031  | 0.2031   |
|      | Natasha Skin Care | 0.3657  | 0.3657   |

After all the weight values for each level are obtained, then the alternative beauty clinic selection has the highest weight or percentage. The total weight can be calculated by adding up the priority level weights for level 4 for each alternative so that a total value is obtained that indicates the weight. The results of calculating the selection of alternative weights for beauty clinics can be seen in Table 8.
5. Discussion
Selection of alternative beauty clinic services by considering the 5 dimensions of service quality dimensions, namely Reliability, Responsiveness, Assurance, Empathy and Tangible. Whereas the sub-criteria consist of 20 sub-criteria.

Based on AHP priority weight calculation, Erha clinic has the biggest weight with a percentage of 39.95%, then followed by Natasha Skin Care with a percentage of 31.97% and London Beauty Center 28.09%.

6. Conclusion
Beauty clinic service evaluation criteria consist of 5 criteria based on the dimensions of service quality, namely reliability, responsiveness, assurance, empathy and tangible. Reliability criteria consist of 4 sub-criteria (the ability of workers, consistency in providing services, satisfactory results and Providing comprehensive information and services). Responsiveness criteria consist of 4 sub-criteria. For assurance consist of 4 sub-criteria (Clinical legality, Guaranteed customer convenience, Product/service guarantee, Have a privacy policy). Empathy criteria consist of 4 sub-criteria (Affordable prices, Giving discounts, Providing consulting services and Able to accept criticism and suggestions). And for tangible criteria also consist of 4 sub-criteria (Have a product / service catalog, Full and modern equipment, Attractive clinical interior design and Have a waiting room). Erha clinic occupies the first alternative position with a weight of 0.3995, then followed by Natasha Skin Care with a weight of 0.3197 and London Beauty Center with a weight of 0.2809.

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