The Application of the Analytic Hierarchy Process (AHP) in Selecting Alcohol Suppliers: A Case Study of Miss and Kiss (Thailand) Co., Ltd.

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Abstract

The objective of this research study is to study the criteria. and selecting alcohol manufacturers suppliers, case study of MISS AND KISS (THAILAND) CO., LTD using Analytic Hierarchy Process AHP and using the Expert Choice program to calculate according to the factors used to select suppliers of alcohol manufacturers, namely price factors. Quality factors. Delivery factors. Trust factor. After that, create a questionnaire and execute it. Check consistency (IOC: Index of item objective congruence) of consistency with objectives. From 3 experts, the value was equal to 1, which means that the said factor can be used. And the results of the research found that the inconsistency ratio of all 4 factors was equal to 0.03 and when each factor was taken into consideration in looking for the inconsistency ratio of the three supplier companies, it was found that the price factor There is a non-conformity ratio value of 0.05. Quality factor There is an inconsistency ratio value of 0.03, a delivery factor, an inconsistency ratio value of 0.00, and a reliability factor. The inconsistency ratio was 0.03 when calculating the importance weights, and all 4 factors were within acceptable criteria. and found that the company with the highest importance weight value, number 1, is GREEN PHARMAHOL CO., LTD., with an importance weight value of 0.579 or 57.9%, number 2 is UNION CHEMICALS & EQUMPMENTS CO., LTD., with a value The importance weight is equal to 0.296 or 29.6% and the third place is FP PRODUCTS CO., LTD., the importance weight is equal to 0.125 or 12.5%.

Keywords: Suppliers, Analytic Hierarchy Process: AHP, Criteria for Selecting Manufacturers Suppliers, Decision, Expert Choice

1. Introduction

Humans have possessed knowledge of perfume-making for over 3,000 years. Ancient Mesopotamian inscriptions mention a woman named "Tapputi," who used flowers, herbs, and seeds mixed with water to distill fragrant liquids for use in royal palaces. By 2021, the global perfume industry had a compound annual growth rate (CAGR) of 6.1% between 2022 and 2027 (Teerapol Huakraton, 2022). Currently, the cosmetics and skincare industry ranks as the third most promising business sector, with Thailand's cosmetics market projected to grow by approximately 7.14% between 2019 and 2023.

The perfume distribution business has become increasingly competitive both domestically and internationally, particularly among entertainment professionals and individuals seeking to enhance confidence through fragrance (Thiraporn Sangpirun, 2015). This has led to the significant role of perfume-infused products in the cosmetics and skincare market, with trends indicating heightened intensity in the future. Additionally, alcohol is often added to maintain concentration levels and extend product shelf life.

Miss and Kiss (Thailand) Co., Ltd. has developed 19 new fragrances, resulting in increased production demands. However, the company lacks long-term contracts with alcohol suppliers, leading to insufficient alcohol supply for its growing production needs. The company aims to identify the best alcohol supplier from three current partners to establish a long-term contract for consistent alcohol production.

By applying the Analytic Hierarchy Process (AHP) for supplier selection, the company can identify the most suitable supplier. Consequently, the research team decided to study the application of AHP in selecting alcohol suppliers for Miss and Kiss (Thailand) Co., Ltd., enabling the company to secure a long-term contract with the optimal supplier.

1.1 Research Objective

1. To Study the Criteria for Selecting Alcohol Suppliers: A case study of Miss and Kiss (Thailand) Co., Ltd., located in Bang Khae District, Bangkok.

2. To Select Alcohol Suppliers Using the Analytic Hierarchy Process (AHP): This process involves employing the AHP methodology and the Expert Choice software for calculations. A case study of Miss and Kiss (Thailand) Co., Ltd., located in Bang Khae District, Bangkok.

1.2 Key informants

1. shareholders, 1 production manager, 1 accounting manager, and 1 quality controller, totaling 4 persons

2. experts (who considered the Item-Objective Congruence Index (IOC) assessment form. The IOC value must be greater than 0.5 to be used.

2. Methods

Analytic Hierarchy Process; AHP

The multi-criteria programming made through the use of the analytic hierarchy process is a technique for decision making in complex environments in which many variables or criteria are considered in the prioritization and selection of alternatives or projects.

AHP was developed in the 1970s by Thomas L. Saaty and has since been extensively studied, and is currently used in decision making for complex scenarios, where people work together to make decisions when human perceptions, judgments, and consequences have long-term repercussions (Bhushan & Rai, 2004).

The application of AHP begins with a problem being decomposed into a hierarchy of criteria so as to be more easily analyzed and compared in an independent manner (Exhibit 2). After this logical hierarchy is constructed, the decision makers can systematically assess the alternatives by making pair-wise comparisons for each of the chosen criteria. This comparison

may use concrete data from the alternatives or human judgments as a way to input subjacent information (Saaty, 2008).

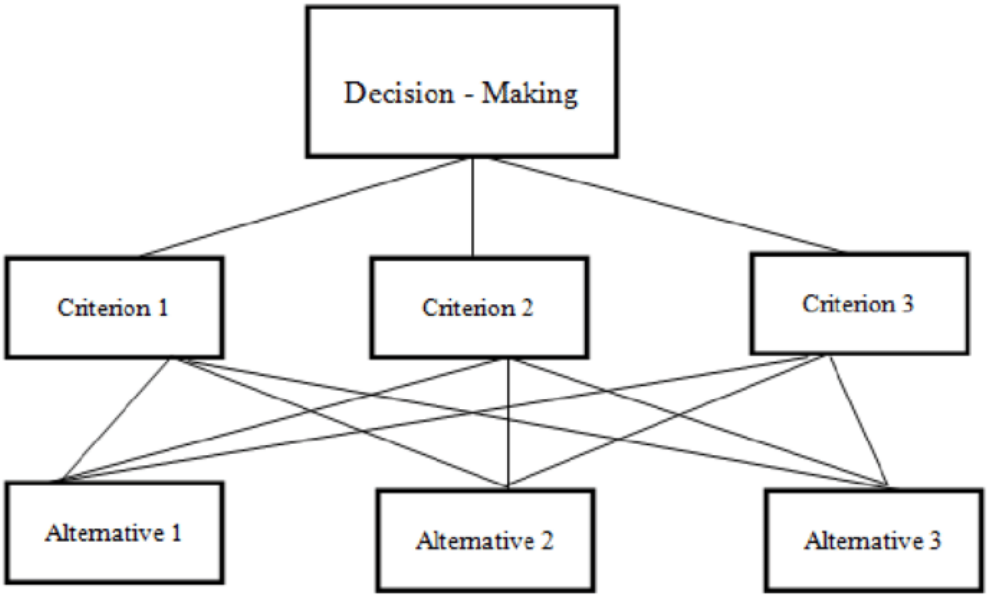

Figure 1: Example of a Hierarchy of Criteria/Objectives

AHP transforms the comparisons, which are most often empirical, into numerical values that are further processed and compared. The weight of each factor allows the assessment of each one of the elements inside the defined hierarchy. This capability of converting empirical data into mathematical models is the main distinctive contribution of the AHP technique when contrasted with other comparing techniques.

After all the comparisons have been made, and the relative weights between each of the criteria to be evaluated have been established, the numerical probability of each alternative is calculated. This probability determines the likelihood that the alternative has to fulfill the expected goal. The higher the probability, the better the chances the alternative has to satisfy the final goal of the portfolio.

The mathematical calculation involved in the AHP process may at first seem simple, but when dealing with more complex cases, the analyses and calculations become deeper and more exhaustive.

The Comparison Scale (SAATY scale)

The comparison between two elements using AHP can be done in different ways (Triantaphyllou & Mann, 1995). However, the relative importance scale between two alternatives as suggested by Saaty (SAATY, 2005) is the most widely used. Attributing values that vary from 1 to 9, the scale determines the relative importance of an alternative when compared with another alternative

Table 1: Saaty's Scale of Relative Importance

Scale	Numerical Rating	Reciprocal
Extremely Preferred	**9**	**1/9**
Very strong to extremely	8	1/8
Very strongly preferred	**7**	**1/7**
Strongly to very strongly	6	1/6
Strongly preferred	**5**	**1/5**
Moderately to strongly	4	1/4
Moderately preferred	**3**	**1/3**
Equally to moderately	2	1/2
Equally preferred	**1**	**1**

Source: (Saaty, 2005)

It is common to always use odd numbers from the table above to make sure there is a reasonable distinction among the measurement points. The use of even numbers should only be adopted if there is a need for negotiation between the evaluators. When a natural consensus cannot be reached, it raises the need to determine a middle point as the negotiated solution (compromise) (Saaty, 1980).

Table 2: Comparison Matrix (presuming that Criterion 1 dominates over Criterion 2)

	Criterion 1	Criterion 2
Criterion 1	1	Numerical Rating
Criterion 2	1/Numerical Rating (Reciprocal)	1

Evaluate alternatives

Once you have determined the weights of your criteria, the fourth step of the AHP is to rate the alternatives you are considering against the criteria.

This assessment is done in the same way that you assess the relative importance of your criteria, but this time it involves comparing a set of pairs of alternatives based on a question like this: “Based on Criteria A, to what extent do you think Alternative X is more popular than Alternative Y?”

These pairwise comparisons are made for every pair of alternatives on every criterion.

For each criterion, you answer these questions by choosing a 9-point scale that represents your level of liking, ranging from "like equally" (ratio = 1) to "like most" (ratio = 9). If you think one alternative is less popular than another on a criterion, use the reciprocal, such as from 1 ("dislike equally") to 1/9 ("dislike most").

Combine weights and scores to rank alternatives.

The final step of AHP is to combine the criterion weights from step 3 with the alternative scores from step 5 by multiplying and summing these scores to obtain a total score for each alternative, which can then be ranked.

Therefore, like most methods for multiple criteria decision analysis (MCDA), AHP is based on a weighted sum model, also known in the literature as a "multiple criterion model" or "multiple attribute model".

Conceptual Framework

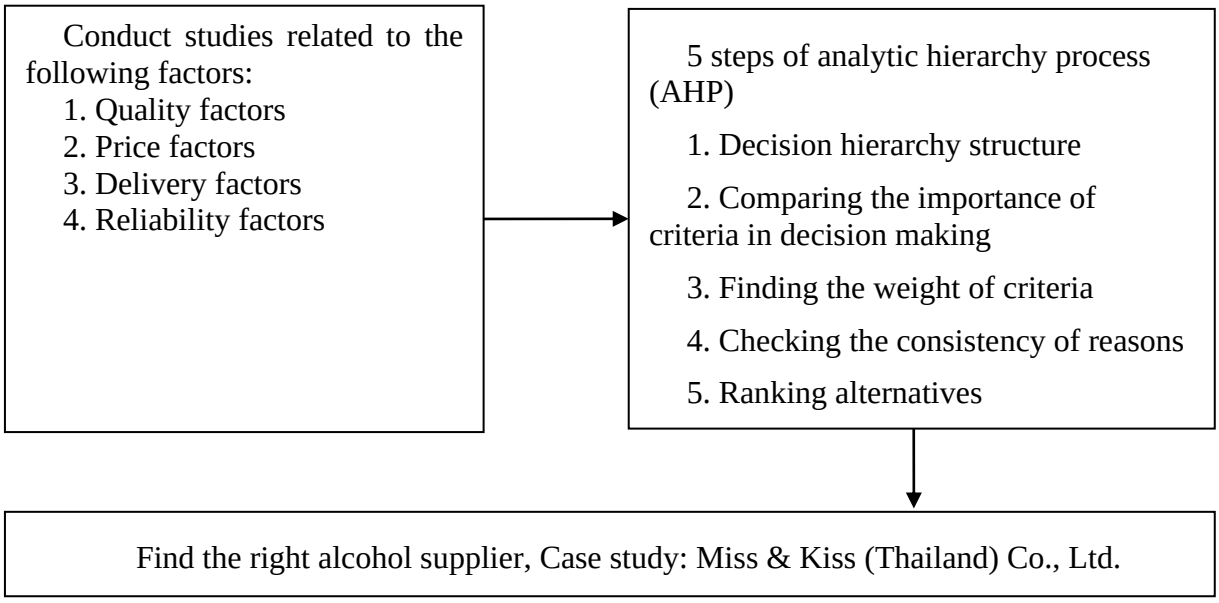

Figure 2: Conceptual Framework

Steps in the study

This research study has the following preparation methods and procedures:

1. Study theories and related research, including selection of alcohol suppliers, analytical hierarchy process (AHP) and use of the Expert Choice program.

2. Study both quantitative and qualitative factors affecting the decision to select an alcohol supplier.

3. Design a hierarchy structure for selecting an alcohol supplier, including designing a questionnaire that is appropriate and covers the content.

4. Analyze and collect data for comparison and to find the weight of each factor. In this step, opinions will be asked from executives, procurement staff and other relevant departments.

5. Evaluate the consistency of the decision in the order of alternative factors, including analyzing the sensitivity to changes in various main factors using the Expert Choice program.

6. Analyze and summarize the decision to select an alcohol supplier according to the guidelines of the analytical hierarchy process (AHP).

3. Results and Discussion

The results of the selection of alcohol suppliers for mixing perfumes, a case study of Miss & Kiss (Thailand) Co., Ltd., using the Analysis Hierarchy Process (AHP) and using the Expert Choice program to calculate the selection of alcohol suppliers for mixing perfumes, which the researcher is interested in are 3 alcohol companies. Each company has different advantages and disadvantages. Therefore, in order to make a decision to select alcohol production that meets the needs of Miss & Kiss (Thailand) Co., Ltd. the most, the researcher has used the Analysis Hierarchy Process (AHP) to help in the decision-making. From reviewing related theories, the decision criteria were set, namely, price factors, quality factors, delivery factors, and reliability factors. The study was then conducted according to the steps. Creating a hierarchy structure chart for the selection of alcohol suppliers according to Figure 2. Hierarchy structure to reduce decision importance. The factors obtained from the selection were used to create a hierarchy chart. Each level consists of a group of criteria:

Level 1 is the goal of the decision to select the alcohol supplier company.

Level 2 is the criteria of 4 factors selected from related research.

Level 3 is the choice of 3 alcohol supplier companies.

Create a matrix table showing the comparison of the factors used in the decision-making process.

Table 3: The matrix shows the comparison of the factors used in the decision pairs and the sum of each column of the matrix.

Factors	Price	Quality	Delivery	Reliability
Price	1or1.000	1 or 1.000	5 or 5.000	4 or 4.000
Quality	1 or 1.000	1 or 1.000	5 or 5.000	5 or 5.000
Delivery	1/5 or 0.200	1/5 or 0.200	1 or 1.000	2 or 2.000
Reliability	1/4 or 0.250	1/5 or 0.200	1/2 or 0.500	1 or 1.000
Total	2.450	2.400	11.500	12.000

The comparison scores from the two informants were added together and divided by two to find the importance weights in the Expert Choice program. The weighting table is a table that converts the decimal values from the matrix table showing the comparison of criteria used in the decision-making process.

Data analysis with Expert Choice

The result of the importance analysis of the factors by the Expert Choice program for all 4 factors has an overall inconsistency ratio of 0.03, which is in the acceptable range for the 4 factors, where the inconsistency ratio must be less than or equal to 0.09. The factors ranked from highest to lowest weight are: quality factor with a weight of 0.420, price factor with a weight of 0.401, delivery factor with a weight of 0.103, and reliability factor with a weight of 0.076.

Results of the weight analysis on the selection of alcohol manufacturers suppliers
Comparison of the weight of price importance

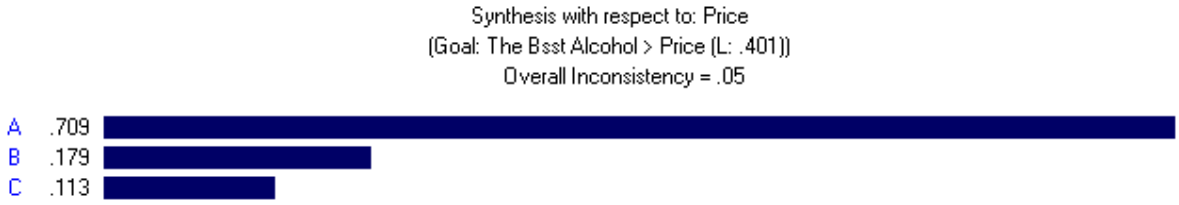

Figure 3: Price Importance Weight

The price factor has an overall inconsistency ratio of 0.05, which is acceptable for the 3 factors. The inconsistency ratio must be less than or equal to 0.05. The factors with the highest to lowest weights are as follows: Company A has a weight of 0.709, Company B has a weight of 0.179, and C has a weight of 0.113, as shown in Figure 3.

Compare the weights of quality importance

Figure 4: Comparison of quality importance weights.

The quality factor has an overall inconsistency ratio of 0.03, which is in the acceptable range for the 3 factors, where the inconsistency ratio must be less than or equal to 0.05. The factors ranked from the highest to the lowest weight are Company A with a weight of 0.481, Company B with a weight of 0.405, and C with a weight of 0.114, as shown in Figure 4.

Compare delivery importance weights

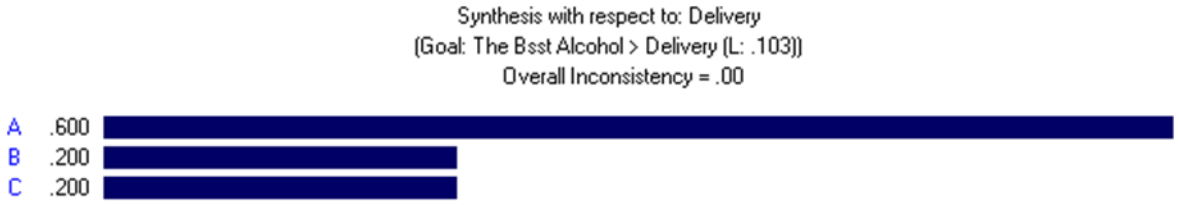

Figure 5: Delivery importance weight values

The delivery factor has an overall inconsistency ratio of 0.00, which is in the acceptable range for the 3 factors, where the inconsistency ratio must be less than or equal to 0.05, ranked from the most to the least weighted factors as follows: Company A has a weight of 0.600, while Company B and C both have equal weights of 0.200, as shown in Figure 5.

Compare credibility importance weights

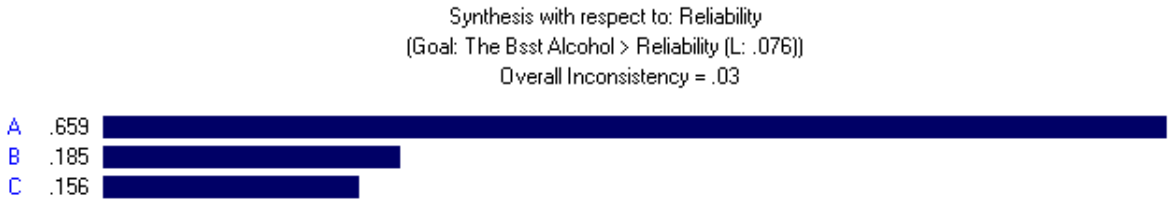

Figure 6: Importance weight of credibility.

The reliability factor has an overall inconsistency ratio of 0.03, which is in the acceptable range for the 3 factors, where the inconsistency ratio must be less than or equal to 0.05, with the factors ranked from the highest to the lowest weight as follows: Company A has a weight of 0.659, Company B has a weight of 0.185, and C has a weight of 0.156, as shown in Figure 6.

Table 4: shows the importance weight assessment and percentage importance of the alcohol supplier companies.

Selecting Suppliers of Alcohol for Perfumery	Price	Quality	Delivery	Reliability	Importance Weight	Percentage of importance	Grade
Eigenvector	0.401	0.420	0.103	0.076			
Firm A	0.709	0.481	0.600	0.659	0.579	57.9	1
Firm B	0.179	0.405	0.200	0.185	0.296	29.6	2
Firm C	0.113	0.114	0.200	0.156	0.125	12.5	3

When the information from the respondents is obtained, the information is entered into the Expert Choice program to find the importance weight of the factors. The results, arranged from the most important weight to the least, are as follows: 1st place, Company A has an

importance weight of 0.579 or 57.9%; 2nd place, Company B has an importance weight of 0.296 or 29.6%; and 3rd place, Company C has an importance weight of 0.125 or 12.5%.

4. Conclusion

The research prioritizes factors influencing the selection of alcohol suppliers. The study reveals that the most critical factor is quality, as the delivered alcohol must meet standards without significant deviations, such as the alcohol content, concentration, and color. The second most important factor is price, followed by delivery performance, aligning with the research of Supakarn Yodkham, Natthaphon Paisanvirojraks, and Jetsada Phochan (2022) on "Factors for Selecting Suppliers for Contract Manufacturers of Dietary Supplements in Thailand." Their findings indicated that price was the second most significant factor.

Additionally, the results correspond to the study by Warangkoon Isarangkoon Na Ayutthaya (2022), titled "A Study of Factor Prioritization in Renewable Energy Adoption by Food Manufacturing Industries Using the Analytical Hierarchy Process (AHP)." And Setthachotsombut et al, (2024). This study also identified quality as the most important factor, with delivery performance ranked third and reliability ranked fourth.

5. Acknowledgment

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References

Krittivakorn Thammasang, & Dr. Supachai Pathumna. (2022). Application of AHP with FSM and SAW methods for selecting farmers to supply raw materials for contract farming in the tapioca starch industry. *Journal of Research in Master of Engineering Program: Khon Kaen University.*

Setthachotsombut, N., Sommanawat, K., & Sua-iam, G. (2024). Logistics business management of providers in Thailand with smart logistics. *Journal of Open Innovation: Technology, Market, and Complexity, 10*(4), 1–11.

Supakarn Yodkham, Natthaphon Paisanvirojraks, & Jetsada Phochan. (2022). Factors in supplier selection for dietary supplement contract manufacturers in Thailand. *Journal of Industrial Technology and Engineering: Pibulsongkram Rajabhat University.*

Somkiat Khunlan, & Supachart Iamrattanakul. (2019). Application of AHP in selecting prosthetic and orthotic component manufacturers: A case study of a company producing assistive devices for persons with disabilities. *Journal of Multidisciplinary Research, Faculty of Business Administration: Kasetsart University.*

Sumana Arunudomchai, & Akaranan Phongsatornwiwat. (2021). Application of multi-criteria decision-making models for selecting packaging service providers: A case study of a consumer goods distribution company. *Journal of Logistics Management Research: National Institute of Development Administration.*

Theerapon Buakratok. (2022). Water and fragrance: Hygiene, sanctity, and current business trends. Retrieved from https://www.creativethailand.org/

Thiraphon Saengpirun. (2015). Thai tourists' satisfaction with homestay accommodations in Sena District, Phra Nakhon Si Ayutthaya Province. *Journal of Social Science Research and Academic, 10*(2), 67-80.

Warat Riwpitak. (2013). Decision-making in selecting textile chemical suppliers from Asian countries using the Analytical Hierarchy Process: A case study of VV Company. *Research Paper: Mae Fah Luang University.*

Warangkoon Isarangkoon Na Ayutthaya. (2022). A study of factor prioritization in renewable energy adoption by food manufacturing industries using the Analytical Hierarchy Process (AHP). *Faculty of Business Administration: Rajamangala University of Technology Thanyaburi.*

Warangkana Prachakasem, & Juthatip Leelathanapipat. (2021). Application of AHP theory in selecting furniture styles: A case study of convenience stores. *Thesis in Industrial Engineering, Faculty of Engineering: Panyapiwat Institute of Management.*