AHP METHOD FOR SUPPLIER SELECTION: CASE OF KNITPASSION GARMENT COMPANY

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ABSTRACT

Decision making is one of the important tasks in the field of economy, society, etc. of human. Decision making is the top priority, the process through which one optimal choice is made from several possible alternatives of solutions for a given situation. Decision making is often qualitative and quite cognitive biases, so this article desires to discover a quantitative analysis and evaluation technique as a decision-support model for contractor selection. The author has proposed a multi-criteria decision-making model, specifically the Analytic Hierarchy Process (AHP) to assess and select wool suppliers for Knitpassion Textile Company.

1. Introduction

Statistics show that export turnover of textiles and garments always accounts for the top three of the five key commodity groups (Figure 1), in the first four months, the third largest export commodity group in the whole country was US$8.65 billion, down by 8.8% (Thai & Kieu, 2020). Vietnam's textile and garment industry has for many years been one of the key export industries of Vietnam, with the development of technical technology, the skilled labor force has increasingly accounted for a large proportion and the incentives from state policies, the textile and garment industry has obtained encouraging and newly created results.

Knitpassion Company is a member of Lawsgroup (Hongkong), produces apparel in facilities set up in Vietnam. The company specialises in sweater processing for partners in the US and Europe; it is currently a partner of global brands such as GAP, UNIQLO, ANN, TALBOTS, etc. Over the past four decades Lawsgroup has pursued a quality policy, minimum costs, and lead-time guarantees, however, the COVID-2019 epidemic has affected most textile businesses.

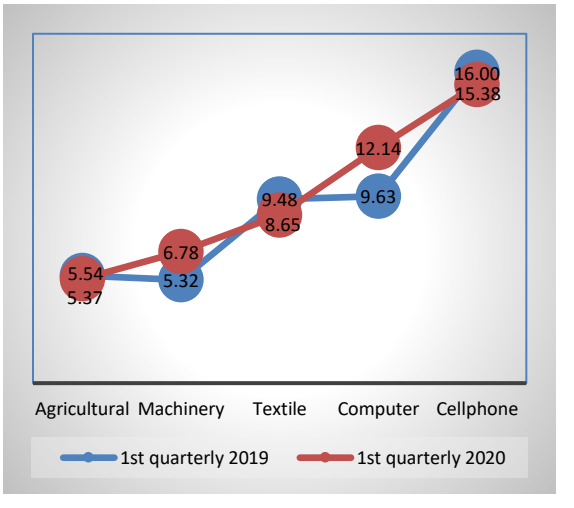

Figure 1. Export turnover of five key commodity groups, the unit is "billion USD" (Thai & Kieu, 2020)

According to Forbes Vietnam, 100% of garment manufacturing enterprises were affected by the Covid-19 epidemic, of which about 70% of businesses cut their staff in March and expected 80% of businesses to reduce the number labor in April and May (Chi, 2020). At Knitpassion, the number of workers was cut by 30% compared to weekdays. The reason for this reduction is that the EU and US partners have cut down the contract output, both the drop in contracts up to 70%. The contract issue is still maintained the business is nevertheless still very instable because the company has to import mainly textile fibers from China. At present, because the company has to comply with the commitment of the sales contract, the company has to import threads and wool from China to transshipment into Bangladesh, then import to the Vietnam factory, which leads to almost unprofitable. If the company hesitates, the order must be shipped by air to meet the delivery schedule as promised in the contract, the business may incur a loss. Currently, company materials such as buttons are purchased from Vietnamese partners, so the company is considering selecting new suppliers for yarns and wool. There are currently too many partners offering the company consequently requires the most suitable supplier.

In fact, in the business, when faced with the decision-making problem, decision-makers are mainly based on personal experience without grasping, or "leaving out" decision-making tools. Tarka (2018) conducted empirical research, the author observed 213 directors when making decisions, the results show that the vast majority are based on personal experience, which leads to "unreasonable results", experiences lead to biases and wrong decisions (Zeni et al., 2016). It has been well recognised that supplier selection has important strategic implications for organisations to understand their business needs and what they benefit they want to achieve by gaining from selecting suppliers competent in particular areas, rather than simply paying for what suppliers want to sell. The nature of supplier selection processes is generally complex, especially when the firm has a large variety of products and vendors (De Felice et al., 2015). Decision making is complicated because the diversity of quantitative and qualitative criteria assigns on evaluation and decision-making processes (Aouadni et al., 2019). Decision-maker is faced with both qualitative and quantitative factors. The factors suggested in the related literature can be classified into two categories: Mathematical programming models and weighting models (Huang & Hu, 2013). AHP - Analytic Hierarchy Process initially was proposed by Thomas L. Saaty in the 1970s, a technique for supplier selection from the view of organisations which calculate priorities from pairwise comparisons. AHP model is better than a mathematical programming model (Huang & Hu, 2013). AHP is a technique for making decisions (multi-decision tools) in complex environments using hierarchical analytical methods to select the best decisions (Longaray et al.,

2015). This method helps decision-makers organise important aspects of the problem into a hierarchical structure similar to a family tree, determine the weights of hierarchically non-structured or particular hierarchical level criteria in respect of those belonging to a higher level. Many companies still do not use Multi-Criteria Decision Making methods such as AHP when making multi-criteria decisions and prefer to decide intuitively (Ishizaka & Siraj, 2018; Asadabadi et al., 2019). However, the AHP method provides for this need of organisations because the determination of an appropriate supplier selection is a multicriteria decision-making problem essentially (Akcan et al., 2019).

2. Research Methodology

Interviews are one of the main instruments in this research. In order to determine the weights of the main criteria, the committee consisted of three experts from Lawsgroup with minimum of 10 years working experience; one is an operations manager, one is an industrial system engineering engineer (ISE), and another is purchasing manager. Experts were interviewed and the paired comparative evaluation applied to pairs of homogeneous criteria, eventually creating overall priorities for ranking options.

Research steps:

Step 1: Set up criteria

Research does not always involve collection of data from the participants, in order to select the appropriate criteria, we conducted a reference to secondary sources. Compared to secondary research, collecting and analysing primary data is not always feasible due to errors in data collection, subjective personal biases, and misinformation. The strength of secondary data analysis is the approach that we can utilise good collection of data already exists. In this spirit, the research methodology of this article was based on analysis of secondary data sources, using this reliable data source, experts had a visual reference of which criteria should be available. A lot of material needed to be gathered, however, a huge amount of data is flooded with exact information and fake information, trusted and unreliable statistics, useful and unusable instruction. Therefore, in this stage, we set out the following searching standards:

- *Database*: Web of Science (WoS-SSCI). Multi-disciplinary journal database produces high-quality research; all articles and reviews in such journals are subject to peer review.

- *Key term*: TITLE = "supplier selection"

- *Languages*: English.

- *Specific period*: 01/01/2016-20/7/2020

- *Excluded criteria*: Solely accept peer review article, excluding book chapter and proceeding.

The result was 213 articles with a relatively good citation index (Average citations per item is 14.44).

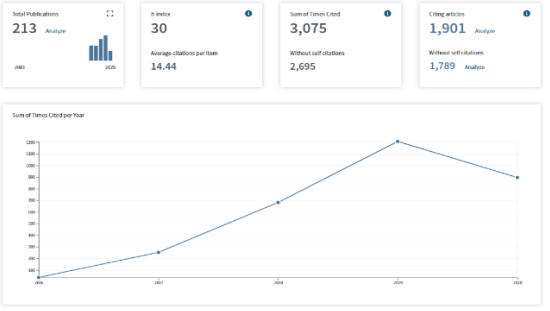

Figure 2. Web of Science analysis documents (Source: WoS)

Based on the average citations per year (ACY), from the results, we decided to choose the research results of the authors with the highest ACY index that is 30.6. Rezaei et al. (2016) point out supplier selection criteria are as follows: Cost of delivery, Lead time, Non-competitor on specialties, Production facilities and capacity, Quality, Compliance on certification, Sustainable performance.

The company currently has a supplier list set. The purpose is to eliminate suppliers who do not meet the criteria set out and select the most suitable supplier, using the Delphi method, the company conducts meetings and sets criteria. The experts will be independently surveyed, and then they will gather to agree on the criteria. The textile company proposes six items:

1. Quality (F1): Quality fabric (color, size, composition, etc.)

2. Cost (F2): Selling price

3. Distance (F3): The distance from the partner's warehouse to the delivery location

4. Technology (F4): The ability to modernise, dyeing, and weaving technologies.

5. Responsibility (F5): The ability to quickly respond to customer's orders.

6. Reputation (F6): Trademark of supplier.

Step 2: Determine evaluation criteria & priority level

We build a priority rating scale in pairs of criteria. The scale used for comparison in AHP allows the decision-maker to combine experience and knowledge intuitively and show how many times one factor dominates another.

The decision-maker can express the priority between each pair of elements verbally as equally important, nearly equally important, more important, much more important, extremely more important. The description will then be translated into numerical values of 1, 3, 5, 7, 9, which are intermediate values to compare pairs according to the qualitative judgment on the Satty scale (Table 1).

Table 1. Priority rating scale

Important level	**Explanation**	**Saaty value**
Equally important	The two factors are equally important	1
Nearly equally important	Support one element over another	3
More important	Strongly support one element over another	5
Much more important	This factor is a trend, prevailing over another	7
Extremely more important	This factor is extremely important to overwhelm the other factor, being the trend, is extremely dominant.	9

Step 3: Calculate weight for criteria

There are six factors that we set up the square matrix as in Table 2, in which the types of factors are designated as F = {F1, F2, F3, F4, F5, F6}. In this F matrix, each element represents pairs that compare with each other, the elements above and below the diagonal have reciprocal values, telling how many times this criterion is equal to the other criterion. Experts are asked to give their answers. For example: "Criteria F1 is nearly as important as F2 with a score of 3". When there is disagreement, the group will discuss and agree on the final decision. The results are shown in Table 2.

Table 2. Pair-wise comparison matrix [F]

F	F1	F2	F3	F4	F5	F6
F1	1	3	5	7	5	1
F2	1/3	1	3	5	3	1/3
F3	1/5	1/3	1	1	1	1/5
F4	1/7	1/5	1	1	1	1/7
F5	1/5	1/3	1	1	1	1/3
F6	1	3	5	7	3	1
TOTAL	**2.88**	**7.87**	**16.0**	**22.0**	**14.0**	**3.01**

Table 3- we have a 6 x 6 square matrix, weighting the criteria by taking the value of each cell divided by the total value. The calculation formula is described as follows:

$$W_{ij} = a_{ij} / \sum_{1}^{n} a_{ij}$$

The weight (Wij), presented in the cells of the tables (Table 3), is based on the importance of the i element to the j element, on the Saaty scale.

Table 3. Paired comparison matrix in % [X]

F	F1	F2	F3	F4	F5	F6	MEAN
F1	0.3477	0.3814	0.3125	0.3182	0.3571	0.3323	0.3415
F2	0.1159	0.1271	0.1875	0.2273	0.2143	0.1108	0.1638
F3	0.0695	0.0424	0.0625	0.0455	0.0714	0.0665	0.0596
F4	0.0497	0.0254	0.0625	0.0455	0.0714	0.0475	0.0503
F5	0.0695	0.0424	0.0625	0.0455	0.0714	0.1108	0.0670
F6	0.3477	0.3814	0.3125	0.3182	0.2143	0.3323	0.3177
TOTAL	**1**	**1**	**1**	**1**	**1**	**1**	**1**

Step 4: Consistency test

An analysis of the consistency of the translated pinions was performed, as the decision-makers may be uncertain or make negative judgments when comparing some of the elements.

*Priority vector [W] = [F] x [X]

We have: W**(**F1) = 2.1042; W(F2)= 0.9959; W(F3)= 0.3570; W(F4)= 0.2975; W(F5)= 0.3994; W(F6)= 1.9828

*The maximum eigenvector is calculated according to the equation:

λmax = $\lambda_{max} = \frac{1}{n}\sum_{i=1}^{n}\frac{(\mathbf{Aw})_i}{w_i}$. = 6.0569

The advantage of the AHP method is the use of a consistent index to assess the consistency of the answers of experts. In practical problems, it is not always possible to establish a bridging relation while comparing pairs. For example, F1 may be better than F2, F2 may be better than F3, but not necessarily F1 better than F3, which

demonstrates several methods such as ISM that are flawed when calculating based on bridging rules. Therefore we have to accept the practice of the problem, we call it inconsistency. Inconsistency is a fact that must be accepted but if the inconsistency is too much then we say the problem we are solving is the unreasonable problem. To check for inconsistencies in the evaluation, we use the CR-Consistency rate.

The consistency index is determined as follows: CR = CI / RI.

Therefore, CI = 6. 0569 - 6 / (6-1) = 0, 0114

Table 4. Random index table

n	1	2	3	4	5	6	…
RI	0	0	0.52	0.89	1.11	1.25	…

The result is CR = CI / RI = 0. 00114 / 1. 25 = 0. 0252 = 0. 9 % < 10 % (acceptable). In case of CR > 10% we must meet to revise the consistency of the factors was reasonable or not.

Step 5: Computation of individual scores for each supplier

For every single criterion, the six suppliers are compared using AHP, scores of each supplier for the criteria are computed individually.

There are 3 suppliers in all, we conduct the selection of suppliers based on the rule: If supplier S achieves the best condition i then S will get 3 points, points 2 and point 1 will be distributed to the remaining suppliers in descending levels respectively. Table 5 reveals individual scores of each supplier.

Table 5. Individual scores of each supplier.

Score Suppliers	S1	S2	S3
F1	1	2	3
F2	2	1	3
F3	3	1	2
F4	1	2	3
F5	2	1	3
F6	2	1	3
Σ (W x Score)	10.2289	8.5385	18.0534

3. Conclusion

In traditional applications, the company has to identify its customer's expectations and their relative importance (external variables) to identify which design characteristics (internal variables) should be allocated the most resources. The quality and reputation of the supplier is the concern of Knitpassion Company, followed by the price is also a concern when selecting suppliers. We also realise that the company doesn't pay much attention to the technology that its partners use. Finally, the research shows that in general S3 is the most optimal choice with total scores is approximate 18.

The process of selecting logistics providers is becoming increasingly important in today's complex environment. The selection process involves identifying quantitative and qualitative factors to choose the best supplier. The application of AHP established removing bias, unscientific, or possibly prejudiced in the judgment of an expert since the steps leading to the judgment are made explicit via relational assessment. AHP has attracted the attention of scholars in various fields because of its ability to provide support to different decision-makers, in areas ranging from business management to environmental studies and so on. Managers however rely on *intuition* to help them make decisions, thus, this study provides significant support to the management board when decision marker faces a situation with at least two alternatives of action with conflicting objectives.

The drawback of AHP is that it is difficult to compare criteria perfectly without consistency. The purpose of AHP is to make very relevant comparisons so that a perfect result of the AHP method is expected when there is no contradiction, without contradiction, AHP becomes simple. Therefore, AHP for more difficult problems with more criteria, this method is not optimal but needs to apply many methods together such as ISM, or TOPSIS.

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