CHAPTER II

LITERATURE REVIEW

This chapter will explain about inductive and deductive study. Inductive study is a study from previous research. Meanwhile, deductive study is a study which explain about basic theory that supported this research. Deductive study itself derived from books, journals, and any other resources.

2.1 Inductive Study

A research about SWOT analysis has been conducted by Ahmed & Almarri (2006). This research performed SWOT analysis for Air China performance and its experience with quality. From their research, it can be concluded that Air China has tried to build strategy on genuine understanding of the customers' true needs. It identified key customer satisfaction drivers, then turned into a foundation to shape company development strategies and innovations.

Furthermore, SWOT analysis also performed in maritime industry by Arslan & Er (2008). The researchers perform SWOT analysis to identify and develop safer carriage of liquid chemicals. At the end, the researchers propose that the use of SWOT analysis is an acceptable basis for formulating strategy designed to minimize human error, accidents and incidents, and defects of shipboard operations.

A research was conducted by Ommani (2010). In his research, SWOT analysis is used to identify strategies for agricultural development, especially in farming systems, and they help the researchers or planners to manage and prioritize them for achieving food security. Based on the results of SWOT, strategies for farming system management were prioritized and they include: development of poor local market opportunities and

infrastructure, planting of crops with high economic values, development of governmental supports, preparing strategic plans for development of organic farming, considering the quality of crops, considering farm sustainability indexes, using sustainable water resources management and development of extension programs based on farmers' needs.

There is also SWOT analysis research by Yuan (2013) about construction waste management. This research was conducted in Shenzhen, China. In 2008, China proposed an investment plan to stimulate the development of national economy from 2008 to 2010. Majority of its investment plan was used for implementing construction projects, typically including development of infrastructure, railway, highway and road, airport, hydraulic engineering projects, and post-disaster rehabilitation. The bad effect of these projects are a large volume of construction waste generated throughout the country. So, this research aims at analyzing CWM at the regional level in China. A SWOT analysis is employed to achieve the purpose. This research resulting a basic principle which is maximizing strengths and opportunities, transforming weaknesses to strengths, and minimizing threats. According to that principle, then the strategy is establishing a mechanism for determining the responsibility of various government departments involved, promulgating detailed CWM regulations, investigating amounts of construction waste generated in Shenzhen and planning construction waste facilities properly, implementing CWM throughout the life cycle of construction projects, implementing a pilot program of applying recycled construction materials, establishing a construction waste research institute in Shenzhen, and raising CWM awareness via training and promotion activities.

Some researches about Fuzzy TOPSIS was conducted by Sun et al (2009). In their research, they evaluated the competitive advantages of shopping website using Fuzzy TOPSIS. The conclusion of this research is the security and trust are the most important factors for improving the competitive advantage of shopping website.

In a research conducted by Momeni et al (2011), the selection of maintenance strategies in Electerofan Company is studied. The evaluation of maintenance strategies for each piece of equipment is a multiple criterion decision-making (MCDM) problem. To deal

with the uncertain judgment of decision makers, a fuzzy TOPSIS method is applied as an evaluation tool, where uncertain and imprecise judgments of decision makers are translated into fuzzy numbers. A specific example of selection of maintenance strategies in this company with the application of the proposed fuzzy TOPSIS method is given, showing that the Preventive maintenance strategy is the most suitable for equipment.

Azizi et al (2015) conducted a Fuzzy TOPSIS research. This research presents another methodology to select the most suitable supplier in a supply chain system using Fuzzy Technique for Order Performance by Similarity to Ideal Solution (FTOPSIS). Triangular Fuzzy set is applied into the proposed model to handle the vagueness. In this FTOPSIS model, the results show that FTOPSIS is remarkably successful in determining the best supplier with stability in the ranking as it relates to the different criteria weights and multiple sub-criteria. The proposed methodology presents a comprehensive multi-criteria approach to find the best ranking among the alternative suppliers. The result shows that supplier A is the best supplier with the Closeness Coefficient of 0.5407. The FTOPSIS model proposed can be applied on other vague multiple criteria decision-making problem since it shows good result in the research. Future research may expand the work to another field of study or in a different type of industry.

A research was conducted by Safari et al (2012) namely Fuzzy multi-criteria decision making method for facility location selection. Facility location selection is a multi-criteria decision problem and has a strategic importance for many companies. The aim of this research is to propose a fuzzy approach for facility location selection. This paper is based on a fuzzy extension of the technique for order preference by similarity to ideal solution (TOPSIS) method. In this method, the ratings of various alternatives versus various subjective criteria and the weights of all criteria are assessed in linguistic variables represented by fuzzy numbers. Fuzzy numbers try to resolve the ambiguity of concepts that are associated with human being’s judgments. To determine the order of the alternatives, closeness coefficient is defined by calculating the distances to the fuzzy positive ideal solution (FPIS) and fuzzy negative ideal solution (FNIS). By using fuzzy TOPSIS,

uncertainty and vagueness from subjective perception and the experiences of decision maker can be effectively represented and reached to a more effective decision.

There is also a research which conducted by Abiddin et al. (2017). This study uses SWOT analysis to identify factors and formulate appropriate marketing strategies. The TOPSIS method is used to rank alternative marketing strategies. Based on SWOT analysis, there are four marketing strategies alternative. The first priority of marketing strategy is to expand the product marketing distribution network with a preference value of 0.497962. The second priority of marketing strategy is to focus on one of the NPK variants with a preference value of 0.488088. The priority marketing strategy of three is to improve the quality service with a preference value of 0.465217. And the fourth priority of marketing strategy is the use of marketing strategy with the value of preference 0.462249. Below is the table of research position:

Table 2.1 Research position

No	Researcher(s)	Title	Method(s)
1	Ahmed et al. (2004)	SWOT analysis for Air China performance and its experience with quality	SWOT
2	Arslan et al. (2008)	SWOT analysis for safer carriage of bulk liquid chemicals in tankers	SWOT
3	Ommani & Reza (2010)	Strengths, weaknesses, opportunities and threats (SWOT) analysis for farming system businesses management.	SWOT
4	Yuan & Hongping (2013)	A SWOT analysis of successful construction waste management	SWOT
5	Sun et al. (2009)	Using fuzzy TOPSIS method for evaluating the competitive advantages of shopping websites	Fuzzy TOPSIS
6	Momeni et al. (2011)	A Fuzzy TOPSIS-based approach to maintenance strategy selection: a case study	Fuzzy TOPSIS
7	Azizi et al. (2015)	A Fuzzy TOPSIS Model to Rank Automotive Suppliers	Fuzzy TOPSIS
8	Safari et al. (2012)	Fuzzy multi-criteria decision making method for facility location selection	Fuzzy TOPSIS
9	Abiddin et al. (2017)	*Pemilihan Strategi Pemasaran Dengan Metode* SWOT dan TOPSIS	SWOT and TOPSIS
10	Gumilang (2018)	Selection of Business Strategy using SWOT and Fuzzy TOPSIS	SWOT and Fuzzy TOPSIS

2.2 Deductive Study

2.2.1 SWOT Analysis

SWOT analysis is a method to identify an organization's or business' internal and external factors. SWOT itself is an acronym of strengths, weaknesses, opportunities and threats. It was developed to help companies define their strategies in the context of the ever emerging and competitive business environments (Nyarku et al., 2011). It determines what factor which supports the company in accomplishing its objectives, and what obstacles which must be overcome or minimized to achieve desired results.

There are several advantages of SWOT analysis, and it becomes the reason why the researcher performed this method. The first advantage is about its simplicity. It does not require special skill or training to perform this method, the knowledge about the object of research is more important. Therefore, anyone can perform this method as long as understand the step of SWOT and the object of research. The second advantage is by performing this method, it stimulates critical and reflective thinking. Company which performs SWOT will more aware and understand about anything that becomes their own strengths, weaknesses, opportunities, and threats. Alptekin (2013) stated that SWOT analysis is one of the most common used approaches of a firm as part of the strategic planning process. SWOT consists of internal factor and external factor.

Internal factor consists of Strength and Weakness, while external factor consists of Opportunity and Threat. Strength is something that becomes the advantage and value of the company compared to others such as a strong brand, good quality, strong balance sheet, strategic location, and so on. For example, Toyota's strength is strong brand name compared to other brands in Indonesia. Weakness is something that becomes disadvantage and makes the business cannot perform well such as lack of capital, weak brand image, lack of ability, etc. For example, Coca-cola's weakness is people's perception about Coca-cola as unhealthy drink. Opportunity is something from external which good for the business and it can be a competitive advantage if the company can develop it such as

suitable condition, new regulation, new market segment, etc. For example, new tourist destination can be an opportunity for hotel business. Threat is something from external which can threaten the business such as new strong competitor, unstable economic condition, tax increasing, etc. For example, global economic crisis can be a threat for many manufacturers.

Table 2.2 SWOT table

	Opportunities (external, positive)	**Threats** (external, negative)
Strengths (internal, positive)	**Strength-Opportunity strategies** Which of the company's strengths can be used to maximize the opportunities you identified?	**Strength-Threats strategies** How can you use the company's strengths to minimize the threats you identified?
Weaknesses (internal, negative)	**Weakness-Opportunity strategies** What action(s) can you take to minimize the company's weaknesses using the opportunities you identified?	**Weakness-Threats strategies** How can you minimize the company's weaknesses to avoid the threats you identified?

After the factors of Strength, Weakness, Opportunity, and Threat are obtained, researcher can make SO, WO, ST, or WT strategy. According to Figure 2.1, SO means strategy which derived from Strength and Opportunity. It could use strength to take advantage on opportunity to make a SO strategy. WO means strategy which derived from Weakness and Opportunity. Weakness could be overcome by taking advantage on opportunity. ST means strategy which derived from Strength and Threat. Use strength to avoid threat. WT means strategy which derived from Weakness and Threat. Minimize weakness and avoid threat.

2.2.2 IFE and EFE

Internal Factor Evaluation (IFE) and External Factor Evaluation (EFE) are used to evaluate all SWOT factors obtained. Therefore, these methods are used after all strengths, weaknesses, opportunities, and threats are obtained in SWOT analysis. As appears in its name, Internal Factor Evaluation (IFE) used to evaluate internal factors such as strength and weakness, while External Factor Evaluation (EFE) used to evaluate external factors

such as opportunity and threat. Even though both IFE and EFE has its own scope and different meaning of rating, but the step is identical. Below are several steps of IFE and EFE:

1. Making 2 tables, IFE and EFE table.
2. Filling IFE table with all internal factors, that is strength and weakness, while in EFE table, fill with external factors, that is opportunity and threat.
3. Providing weight for each factor, from 0 until 1. And the total weight for both IFE and EFE table must be 1.
4. Providing rating for each factor. But, to be noticed here is that IFE and EFE has different meaning of rating. In IFE, the ratings refer how strong or weak each factor is in a firm. The rating begins from 1 (Very Weak), 2 (Weak), 3 (Strong), 4 (Very Strong). Meanwhile in EFE, the ratings refer to how effectively company's current strategy responds to the opportunities and threats. The rating begins from 1 (Very Poor Response), 2 (Poor Response), 3 (Good Response), 4 (Very Good Response).

After the score of IFE and EFE are obtained, then those scores must be inputted into SWOT quadrant to find the suitable position for this company. Rangkuti (1997) explained about SWOT quadrant as seen below:

Figure 2.1 SWOT Diagram
Source: (Rangkuti, 1997)

Quadrant 1: This condition has many benefits. That company has opportunity and strength, so that can exploit available opportunity. Strategy which must be utilized in this condition is growth-oriented strategy.
Quadrant 2: Although this company faces the threat, but it still stays strong. Strategy which must be adopted is by using strength to exploit long-term opportunity by using diversification (product/market).
Quadrant 3: Company faces market opportunity which very wide, but in other side, they still facing some obstacle or internal weakness. Focused strategy of this company is to minimize internal problem, so it can be better in catching market opportunity.
Quadrant 4: This position is very unfavorable, that company can experience many threats and weaknesses.

2.2.3 Fuzzy Logic

The human language is filled with imprecision, subjectivities, and vagueness when used to judge, describe and communicate information. Expressions such as ‘‘not very clear”, ‘‘probably so”, and ‘‘very likely”, are used often in daily life, and more or less represent some degree of uncertainty of human thought. In view of this, Bellman & Zadeh (1970) introduced the fuzzy set theory to model human judgements. In that study, they noted that human thinking is mostly fuzzy, not definitive. Fuzzy set theory is a mathematical framework that is used to represent uncertainty, vagueness, inaccuracy, lack of information, and partial truth. Modeling using Fuzzy sets has proven to be an effective way for formulating decision problems, where the information available is subjective and imprecise. (Zimmermann, 1994)

Silva et al. (2014) stated fuzzy set theory is one of the concepts of science and engineering because it can manage imprecise or ambiguous information by manipulating mathematical terms. The notion of fuzzy sets is quite intuitive and transparent like captures the essence of how things are perceived and described in everyday life. The concept of a fuzzy set manages the representation of classes/categories that have boundaries with means characteristic of a functions in taking values of an ordered set of membership values.

To capture the vagueness and variations in the subjective ratings of a decision maker, a fuzzy number is used. A Fuzzy number is an expression of membership functions of a linguistic term and ascribe a rating set between the interval [0, 1] for subjective ratings. The two most popular fuzzy numbers are the trapezoidal and triangular fuzzy numbers. This research uses the Triangular Fuzzy Number (TFN). It is a fuzzy set theory which helps in the measurement of human subjective assessment uses the language or linguistics. It is appropriate for quantifying the vague information about most decision problems, e.g. the estimate of inventory level, lead times, product revenue, etc. The primary reason for using triangular fuzzy numbers can be stated as their intuitive and computational-efficient representation (Karsak, 2002). In its application, it is often convenient to work with triangular fuzzy numbers (TFNs) because of their computational simplicity, and they are useful in promoting representation and information processing in a fuzzy environment (Balli & Korukoglu, 2009).

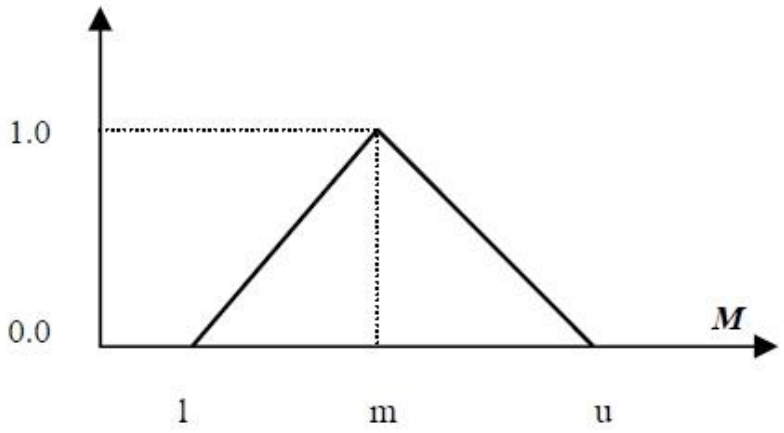

Figure 2.2 Triangular Fuzzy Number

Each membership function is defined in three parameters namely **l**, **m** and **u**. Where **l** is the lowest possible value, **m** is the possible value of the middle, and **u** is the possible value of the top interval decision maker or expert judgment. A triangular fuzzy number is represented as a triplet (l, m, u). The membership function of triangular fuzzy number is given as:

$$u(x/\tilde{M}) = \begin{cases} 0, & x < l, \\ (x-l)/(m-l), & l \le x \le m, \\ (u-x)/(u-m), & m \le x \le u, \\ 0, & x > u \end{cases}$$

In this research, five level scale fuzzy is applied to perform triangular fuzzy number. The triangular fuzzy number that used by researcher is shown in Figure 2.3 below:

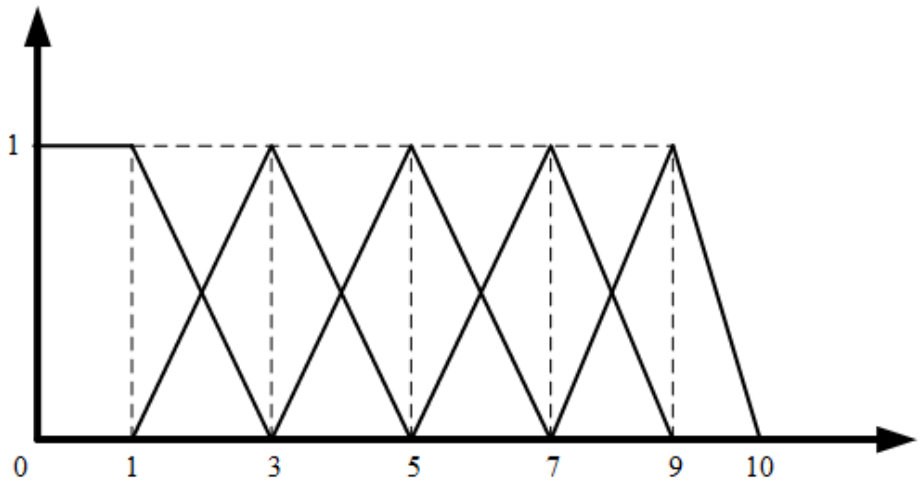

Figure 2.3 Membership function of triangular fuzzy number (TFN)

2.2.4 Linguistic Variable

Linguistic variable is a variable which represent numerical variable in the form of words or sentences. According to Zadeh (1975), it is very difficult for conventional quantification to reasonably express those situations that are overtly complex or hard to define, so the notion of a linguistic variable is necessary in such situations. These are then represented by triangular fuzzy numbers. Usually, conversion scales are used to transform linguistic terms into fuzzy numbers. In this research, linguistic variable will be used to assess the rating in Fuzzy TOPSIS and alternate with five basic linguistic terms which are “very poor”, “poor”,

"fair", "good", "very good" that refers to the five level scale fuzzy as shown in Table 2.3 Linguistic variable

Table 2.3 Linguistic variable

Linguistic Variable	Triangular Fuzzy Number
Very Poor	(0, 1, 3)
Poor	(1, 3, 5)
Fair	(3, 5, 7)
Good	(5, 7, 9)
Very Good	(7, 9, 10)

2.2.5 TOPSIS Method

Technique of Order Preference by Similarity to Ideal Solution or also known as TOPSIS is an MCDM method which proposed by Hwang & Yoon (1981). The basic concept of this method is the chosen alternative should have the shortest distance from the ideal solution and the farthest from the negative-ideal solution. Researcher performs this method to rank several strategies which have been obtained from SWOT result. Hung & Chen (2009) stated that the main advantages of this method are the following:

1. Simple, rational, comprehensible concept.
2. Intuitive and clear logic that represent the rationale of human choice.
3. Ease of computation and good computational efficiency.
4. A scalar value that accounts for both the best and worst alternatives ability to measure the relative performance for each alternative in a simple mathematical form.
5. Possibility for visualization.

There are several steps to perform TOPSIS method, which are:

1. Normalize Decision Matrix

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^2}} \quad (1)$$

where i indicates the alternatives, j denotes the selection criteria, and xij means the i alternative under the j criterion to be assessed.

2. Calculate the weighted normalized decision matrix

Weights of selection criteria, w = (w1, w2,…,wn), multiplied by the standardized appraisal matrix, may be expressed as:

$$v = \begin{bmatrix} v_{11} & v_{12} & \cdots & v_{1n} \\ v_{21} & v_{22} & \cdots & v_{2n} \\ \vdots & \vdots & \cdots & \vdots \\ v_{m1} & v_{m2} & \cdots & v_{nm} \end{bmatrix} = \begin{bmatrix} w_1 r_{11} & w_2 r_{12} & \cdots & w_n r_{1n} \\ w_1 r_{21} & w_2 r_{22} & \cdots & w_n r_{2n} \\ \vdots & \vdots & \cdots & \vdots \\ w_1 r_{m1} & w_2 r_{m2} & \cdots & w_n r_{mn} \end{bmatrix} \quad (2)$$

3. Determine the positive ideal and negative ideal solution

In this part, researcher needs to choose which value is A* and A- value from weighted normalized decision matrix.

$$A^* = \{v_1^*, v_2^*, \dots, v_j^*, \dots, v_n^*\} = \left\{\left(\max_i v_{ij} \mid j \in J\right) \mid i = 1, \dots, m\right\} \quad (3)$$

$$A^- = \{v_{\bar{1}}, v_{\bar{2}}, \dots, v_{\bar{j}}, \dots, v_{\bar{n}}\} = \left\{\left(\min_i v_{ij} \mid j \in J\right) \mid i = 1, \dots, m\right\} \quad (4)$$

4. Calculate the Euclidean distances of each alternative from the positive ideal solution and the negative ideal solution, respectively.

$$D_i^* = \sqrt{\sum_{j=1}^{n} (v_{ij} - v_j^*)^2}, i = 1,2, \dots, m, \quad (5)$$

$$D_i^- = \sqrt{\sum_{j=1}^{n}(v_{ij-}v_j^-)^2}\,, i = 1,2,\dots,m, \qquad (6)$$

5. Calculate the relative closeness of each alternative to the ideal solution. The relative closeness of the alternative Ai with respect to A* is defined as

$$RC_i = \frac{D_i^-}{D_i^* + D_i^-}\,, \quad i = 1,2,\dots,m \qquad (7)$$

According to RCi, larger index values indicate better performance of the alternatives.