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Applying Fuzzy AHP and TOPSIS Method to Identify Key Organizational Capabilities

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Abstract: Core competency is the basis of promoting a competitive advantage for any organization; this study aims to establish an objective and systematic assessment model for companies to identify their capabilities. This model will not only assist companies in understanding their own capabilities but will also allow them to compare their performance with that of main competitors to strengthen their competitiveness. The analysis process involved a combination of the fuzzy analytic hierarchy process, fuzzy linguistic value, and the ideal and anti-ideal concept. An objective and systematic model was first developed, which underwent empirical analysis using data from the top three home delivery companies in Taiwan. It was found that "Basic organizational competencies" and "Special competitive competencies" were the two key categories for the home delivery industry. Moreover, "Service price", "On-time delivery", and "Secure delivery" were found to be the three most important capabilities needed for home delivery companies. The results showed that the model is able to effectively assist organizations in constructing or assessing their organizational capabilities; in addition, organizations can adjust their service profiles to adapt to today's turbulent business environment and rapidly changing consumer demands.

Keywords: fuzzy analytic hierarchy process; TOPSIS; organizational capabilities; core competitiveness

1. Introduction

The upsurge in e-commerce resulted in the growth of the delivery industry, which changed consumer behavior and promoted many emerging business models. According to an e-commerce market research survey, Taiwan's e-commerce's turnover reached $6.28 billion in 2018, with a year-on-year increase of 12.4%, setting a new high over the years; the average annual growth rate was 8.1% in the past 8 years, which is better than overall retail growth (1.1%), and its proportion in the retail industry increased from 3.2% to 5.1%. It can be seen that the transfer of domestic consumption channels has promoted the growth of e-commerce [1]. The growth in e-commerce along with rapid economic development and changes in consumption patterns made it difficult for the traditional logistics industry business model to meet user needs, prompting logistics service providers to effectively enhance their competitiveness. For organizations, it is necessary to find a systematic method to help them effectively assess their current organizational capabilities, develop service profiles, and formulate competitive strategies to adapt to the turbulent business environment and rapidly changing consumer needs.

Several studies have used resource-based view (RBV) to determine vital organizational resources and capabilities and found that qualities such as "rare", "valuable", "irreplaceable", and "incapable of imitating" form the basis of a company's sustainable competitive advantage [2,3]. Moreover, it was found that competencies including organizational operations, know-how, experience, and implicit knowledge are important for companies to achieve success [4]. The company's core competitiveness

must have strategic value to guide it in achieving business goals and obtaining a competitive position in the market [5,6]. A business strategy should be based on the company's core competitiveness, which should be fully understood before making good use of external business opportunities and eliminating threats [5,7]. The core competency is the basis of promoting a competitive advantage for any organization; this study proposes an assessment model for home delivery companies to identify their capabilities and compare with their competitors to determine their core competitiveness, which can be used to further build better operational strategies to avoid a price war.

Many studies use different methods to discuss the issue of developing organizational capabilities or prioritizing business factors. For instance, Guenzi and Troilo [8] used a hierarchical value map to develop marketing capabilities, and Kumar and Kumar [9] evaluated the technological capability of a hospital through multiple regression analysis. Lemmetyinen and Go [10] used case studies to confirm key capabilities for managing tourism business networks. Erensal et al. [11] applied the fuzzy analytic hierarchy process (FAHP) to understand the relationship between the competitive advantage, competitive priority, and capability of an enterprise in the context of technology management. Kim et al. [12] used the analytic hierarchy process (AHP) to investigate the differences in perception among higher education stakeholders regarding the core competencies of tourism graduates. These studies show that organizations should strive to build their own capabilities to differentiate them from other companies, and multi-criteria decision-making methods are widely adopted. The AHP is an appropriate method that allows people to choose from multiple solutions to solve problems [13]. It eliminates the difficulty of weighted scoring in linear models or the difficulty of standard weighted point estimation and is more accurate than other scoring methods. Occasionally, a company assessment might use both qualitative and quantitative criteria; the AHP can be used to build a system evaluation structure that integrates all criteria with a consistent and simple operation.

Although the AHP/TOPSIS (Technique for Order Preference by Similarity to an Ideal Solution) and other multi-criteria decision-making methods have been developed for decades, there are still many scholars who use them as indicators or program selection tools, whether they are discussing environmental issues or related issues on organizational perspectives; e.g., Hidayanto et al. [14] used the fuzzy analytic network process (ANP) and Ahmadi [15] used the fuzzy AHP to evaluate the organization's readiness before implementing an enterprise resource planning (ERP) system; and Kilic et al. [16] used the fuzzy AHP to discuss ERP system selection. Alansari [17] proposed a modified fuzzy-AHP approach to analyze the factors influencing employees to bring their own device into an organization. Modak et al. [18] combined a balanced scorecard and fuzzy analytic hierarchy process to evaluate the performance of coal mining organizations in making outsourcing decisions.

Recently, there is still much research that adopts both the fuzzy AHP and fuzzy TOPSIS to prioritize business indicators or strategic factors, although these are not new methods and have been adopted for years. Keshavarz [19] used two fuzzy techniques to prioritize competencies for the coil industry in Iran; the result showed that process technology is more important than product technology and technology management. Rohani et al. [20] used the same tool to measure intellectual capital among companies. Other researchers applied both methods in discussing various business decisions or issues, such as entrepreneurship factors in the banking industry [21], customer relationship management (CRM) factors in the banking industry [22], service quality in banking industry [23], supply chain inventory coordination mechanisms and partnership factors [24], organization preferences for internet marketing channels [25], factors effective for marketing relationships [26], and technology transfer factors [27], and [28] applied FAHP to the evaluation of various dimensions of IT capabilities, data quality, database security and knowledge management system implementation. These studies show that the AHP and TOPSIS methods are very useful and reliable in ranking factors. However, the uncertain information in the decision-making process and the ambiguity of human perception make it difficult for decision makers to accurately assess and capture subjective feelings and object recognition; thus, the fuzzy set theory [29] can be used to assist in making objective and accurate decisions. Moreover, in order to ensure that the opinions or ideas of decision-makers can be expressed freely and adequately, the fuzzy

set theory with a natural language concept can be applied as well. Therefore, this study combines fuzzy set theory with a linguistic value to establish an evaluation model and help organizations identify their organizational capabilities and solve complex problems in a fuzzy environment.

The purpose of this research is to establish an objective and systematic hierarchy of organizational capabilities for home delivery companies. In addition, the analysis process integrates fuzzy sets, the AHP, linguistic values, and ideal and anti-ideal solutions (the main concept of TOPSIS) to help companies understand their capabilities and compare them with those of their major competitors to enhance their competitiveness. The research questions of this paper can be summarized as follows:

(1). What are the major organizational capabilities of the home delivery industry?
(2). Is there a systematic and objective method for organizations to easily identify organizational capabilities for continuous improvement or enhancing competitive advantages? An empirical study of applying the fuzzy AHP and an ideal and anti-ideal approach is conducted to demonstrate the effectiveness of the proposed method.
(3). What are the management implications of applying multi-criteria decision-making methods to identify organizational capabilities?

This article is organized as follows: first, the development of home delivery industry in Taiwan is introduced; then, the competency structures of home delivery companies are constructed using literature and expert review; next, the importance of each capability for home delivery companies is identified with the fuzzy AHP; thereafter, the competencies of each case company are evaluated and compared with those of other companies using the ideal and anti-ideal concept; and finally, the core competencies of each case company are formulated, and appropriate business strategy suggestions are provided based on the analysis.

2. Literature Review

2.1. Organizational Capability

Organization competency is a combination of organizational skills, assets, knowledge, operations, and procedures, which are the basis of organizational competitive capability and sustainable advantage [30–32]. Drejer [33] defined organization competencies as the interaction between technology and human resources practices. Organizational capabilities are unique organizational practices or abilities to make better use of internal resources to achieve goals and maintain a sustainable competitive advantage [31,34,35]. The internal tangible and intangible resources that support the organization's operations to achieve its goals and shape its competitiveness are all included in the scope of organizational capabilities.

The resource-based view (RBV) believes that organizational capabilities mean that organizations can make use of internal resources to create superior performance [36]. Enterprise resources that create sustainable a competitive advantage refer to unique resources that are valuable, rare, irreplaceable, and not easily imitated [2,37]. Furthermore, researchers define organizational capability as the ability of the organization to collect, manage and integrate internal resources to benefit the organization [38]. A capability is the capacity of a team to use resources owned by a firm, which are anything "tangible" such as capital resources and "intangible" such as employee capabilities, to perform some task or activity [37]. Capital resources include tangible resources, such as raw materials, equipment, and financial management, and intangible assets include employee experience and skills, the company image, processes, and operational knowledge [5].

Beginning in the 1990s, scholars have presented several views on business capability and considered business capability as a source of competitive advantage [39,40]. Capability is usually the result of a collective learning process and is represented by business activities and procedures; therefore, it involves collecting unique elements across functions, products, and the business. Prahalad and Hamel [41] defined organizational capability as the cumulative effect of overall learning, particularly

learning how to coordinate dispersed production technology and integrate multiple technologies, and is related to organizational operation and value delivery. Meanwhile, Winterschied [42] described enterprise capability as a combination of tangible/intangible assets and overall organization for a particular behavior that can be enforced. Capability can also be viewed as the integration of the experience and knowledge of the enterprise. It can reduce time and costs effectively when creating new strategic assets or expanding existing assets. In addition, capability advances strategic asset accumulation and help companies to fit and integrate strategic assets [43]. Marino [44] noted that enterprise capability includes factors of technology or knowledge, which are usually the results of the combination of technical ability and production technology. It is embedded in the enterprise operation processes and is difficult to imitate. Therefore, organizational capability can be regarded as cumulative energy generated from a learning process and an increase in new assets [45]. It can also develop a unique ability for enterprises to create a competitive advantage.

Henderson and Cockburn [46] divided organizational competencies into component capability and architectural capability. Component capabilities include resources, knowledge and skills, and technical systems; architectural capabilities include integration abilities, flexibility, implicit knowledge, organizational structure, composition abilities, management systems, values and norms, and intangible assets. Lado and Wilson [47] defined organizational capabilities as an organization being able to utilize company-specific resources to formulate competitive strategies. They further stated that organizational capabilities include all company-specific assets, culture, knowledge, skills, technology, processes, interpersonal relationships, and management capabilities embedded in the institution.

Erensal et al. [11] explained that companies applying adequate technologies in formulating strategies should consider the relationships between the three factors of competitive advantage, competitive priority, and organizational capabilities. They examined each dimension and the effects of each amongst each other. They utilized performance indicators to measure competitive advantage, such as the sales growth rate, profit, and return on investment. Competitive priority is measured by indicators such as cost, price, quality, flexibility, and time; organizational capability is measured by applying technology to products, processes, and management. Researchers argued that logistics service providers should possess both tangible resources (including equipment, plants, fleets, and facilities) and intangible resources (such as organizational processes, management, know-how, and reputation) to attain excellent performance [48,49]. Wong and Karia [50] pointed out that logistics service providers could build competitive advantages based on five resources: physical, knowledge, information, relationship and human resources. Lai [51] indicated that logistics service providers should have three major organizational capabilities, which are technology-enabled logistics services, value-added logistics services, and freight forwarding services.

2.2. Key Competencies of Home Delivery Companies

Based on literature that discusses organizational capabilities, such as Lado and Wilson [47], Henderson and Cockburn [46], and Lai [51], this article synthesized the competencies of home delivery companies. These are (1) basic organizational competencies, (2) special competitive competencies, (3) value-added competencies, and (4) management competencies.

2.2.1. Basic Organizational Competencies

Basic organizational competencies refer to the resources that a company owns and its ability to manage resources and facilities. These basic capabilities are needed for the company's survival; however, each company's practice is different, and the differences in these applications ultimately become the organization's key basic competencies. Based on previous literature, this study proposes six basic capabilities for the home delivery industry, which are (1) specific assets; (2) cost control, which refers to the ability to manage internal operating costs; (3) the number of warehouses, which includes the number of transshipment centers; (4) professional ethics, which are principles that govern the behaviors of employees in the business environment; (5) operating equipment, which refers to the amount of

mechanical equipment and number of transportation vehicles; and (6) human resources, which refers to employee characteristics including the ability to quickly respond to customers, friendly service attitude, and employee training and development.

2.2.2. Special Competitive Competencies

Special competitive competencies signify that a company has better or different capabilities than other companies. This study proposes nine special competitive capabilities for the home delivery industry including (1) on-time delivery, (2) service price, (3) secure delivery, (4) IT ability, (5) collaboration ability, (6) innovation ability, (7) a complete transportation network, (8) high-density service agents, and (9) unique services. On-time delivery refers to the ability to deliver goods in accordance with the agreed time. Consequently, service price is the competitive pricing of the services, and secure delivery refers to the ability to deliver goods with a low rate of damage or loss. IT ability means that the company is able to make use of information technology in providing better and efficient service process, electronic signatures, and digital documents. Furthermore, collaboration ability refers to the company's flexibility in dealing with the cross-filed sharing of services or technologies with companies in the same or different industry, or the sharing of ideas and talents to improve the efficiency of the organization. Innovation is the ability to design new or creative services that are different from those of other companies, and a complete transportation network is the provision of a delivery service in all regions. High-density service agents refer to convenient shipping services. Lastly, unique service refers to the ability to deliver special items, to deliver at a specified time, or to meet specific customer needs.

2.2.3. Value-Added Competencies

Value-added competencies mainly refer to the ability of an organization to accumulate intangible assets, including customer satisfaction, corporate identity, service convenience, and diversified services. Customer satisfaction refers to the provision of services from the perspective of consumers to earn praise or loyal customers, while corporate identity is the manner in which an enterprise presents itself to the public and how it is widely recognized. Service convenience refers to the frequency, timeliness, and methods of delivery, and diversified services include the storage and delivery of special goods that need specific temperatures, multiple payment mechanisms, etc.

2.2.4. Management Competencies

Management capability, that is, the output or performance of organizational governance, includes standard operating procedures and knowledge management applications to help employees improve their work efficiency and enhance their learning ability. A company with competent management has a well-defined vision and consistent overall corporate goals, which are clearly communicated to the employees. Consequently, this study proposes six management competencies that home delivery companies should possess: (1) standard operating procedures, (2) knowledge management, (3) clear objectives, (4) organizational culture, (5) education and training, and (6) strategic management.

3. Methodology

The methods adopted in this paper are introduced as follows.

3.1. Triangular Fuzzy Number (TFN)

A fuzzy number A in R (real line) is a TFN. The membership function of f_A: $R \rightarrow [0, 1]$ can be represented as:

$$f_A(x) = \begin{cases} (x-l)/(a-l), l \le x \le a \\ (x-u)/(a-u), a \le x \le u \\ 0, \text{ otherwise} \end{cases}$$

with $-\infty < l \leq a \leq u < \infty$, and the TFN A can be expressed by (l, a, u).

The maximum grade of $f_A(a) = 1$ means the maximum value of the evaluated data. The parameters l and u are used to present the lower and upper bounds of the fuzzy area of the evaluated data. The narrower the $[l, u]$ interval, the lower the ambiguity of the data. According to the extension rule proposed by Zadeh [29], if $A_1 = (l_1, a_1, u_1)$ and $A_2 = (l_2, a_2, u_2)$, then

$$A_1 \oplus A_2 = (l_1 + l_2,\ a_1 + a_2,\ u_1 + u_2) \tag{1}$$

$$k \otimes A_1 = (kl_1,\ ka_1,\ ku_1)\ k \geq 0,\ k \in R \tag{2}$$

$$A_1 \otimes A_2 \cong (l_1 l_2,\ a_1 a_2,\ u_1 u_2),\ \text{if}\ l_1 \geq 0,\ l_2 \geq 0 \tag{3}$$

3.2. Linguistic Value

The concept of linguistic values is to deal with ambiguous definitions or difficult descriptions that cannot be performed in general quantitative expressions [52]. The linguistic value will be characterized by the triangular fuzzy number defined on [0, 1] in this study. For instance, in L = {EG, G, M, B, EB}, the membership functions of the linguistic values are extremely bad (EB) = (0, 0, 0.2), bad(B) = (0, 0.2, 0.4), medium (M) = (0.3, 0.5, 0.7), good (G) = (0.6, 0.8, 1), and extremely good (EG) = (0.8, 1, 1).

The importance of the criteria can be determined by using pair-wise comparison matrices. Kahraman et al. [53] put forward a fuzzy scale to measure relative importance or weight in dealing with ambiguous issues. The conversion between the linguistic scale and the corresponding TFN scale is shown in Table 1.

Table 1. Linguistic scale conversion to the triangular fuzzy number (TFN) scale.

Importance Level	Triangular Fuzzy Scale	Triangular Fuzzy Reciprocal Scale
Just equal	(1, 1, 1)	(1, 1, 1)
Equally important	(1/2, 1, 3/2)	(2/3, 1, 2)
Weakly important	(1, 3/2, 2)	(1/2, 2/3, 1)
Strongly important	(3/2, 2, 5/2)	(2/5, 1/2, 2/3)
Very strongly important	(2, 5/2, 3)	(1/3, 2/5, 1/2)
Absolutely important	(5/2, 3, 7/2)	(2/7, 1/3, 2/5)

3.3. Ranking of TFN

This study adopted the graded mean integration representation to find the ideal and anti-ideal solutions because it solves some of the drawbacks of existing ranking methods, is easy to implement, and is powerful in problem solving. Through the method of the graded mean integration principle, the ranking of TFN $A_i = (l_i, a_i, u_i)$ can be obtained by Equation (4). $R(A_i)$ is the ordering of ith TFN.

$$R(A_i) = (l_i + a_i + u_i)/6,\ i = 1, 2, \ldots, n. \tag{4}$$

When A_i and A_j are both TFNs, then:

$$A_i > A_j \Leftrightarrow R(A_i) > R(A_j);$$

$$A_i = A_j \Leftrightarrow R(A_i) = R(A_j);$$

$$A_i < A_j \Leftrightarrow R(A_i) < R(A_j);$$

3.4. Distance between Two TFNs

The next step is to calculate the distance between two triangular fuzzy numbers. Chen and Hsieh [54] proposed the modified geometrical distance method to calculate the distance (d_p) between

two fuzzy numbers (A_i, A_k); it is denoted as $d_p = (A_i, A_k)$, and the value can be obtained by the following formula.

$$d_p(A_i, A_k) = \begin{cases} [0.25(|l_i - l_k|^p + |a_i - a_k|^p + |u_i - u_k|^p + |d_i - d_k|^p)]^{\frac{1}{p}}, \text{ for } 1 \le p \le \infty \\ \max\{|l_i - l_k|, |a_i - a_k|, |u_i - u_k|, |d_i - d_k|\}, \text{ for } p = \infty \end{cases}$$

When parameter p = 2, it meets to the concept of the classical distance, and this can be applied to two triangular fuzzy numbers. Thus, the distance between two TFNs $A_i = (l_i, a_i, u_i)$ and $A_k = (l_k, a_k, u_k)$ is denoted as $D(A_i, A_k)$ and can be calculated by the following equation:

$$D(A_i.A_k) = \left\{0.25[(l_i - l_k)^2 + 2(a_i - a_k)^2 + (u_i - u_k)^2\right\}^{1/2} \quad (5)$$

3.5. Ideal and Anti-Ideal Soultions

The ideal point represents the point where all conditions are optimized. It means the anchor point for human adaptability [55]. The ideal and anti-ideal concept is a useful technique in dealing with multiple criteria decision-making (MCDM) problems in the real world, which is the same as the concept of the TOPSIS method; the application here is summarized below.

Suppose that there are m alternatives and n criteria, x_i^k, $i = 1, 2, \ldots, n$; $k = 1, 2, \ldots, m$, is the semantic level assigned to alternative k regarding criteria i; and x_i^* and $x_i^{\sim}$ represent the ideal and anti-ideal values of criterion i, respectively, where:

(1) $x_i^* = \max_k\left\{x_i^k\right\}, x_i^{\sim} = \min_k\left\{x_i^k\right\}$ represents the positive criterion i;

(2) $x_i^* = \min_k\left\{x_i^k\right\}, x_i^{\sim} = \max_k\left\{x_i^k\right\}$, represents the negative criterion i

Therefore, assuming that $\lambda_i, i = 1, 2, \ldots, n$ is the integrated weight of criterion i, the D_k^* and $D_k^{\sim}$ are denoted as the distance of alternative k to the ideal and anti-ideal solutions, where $x^* = (x_1^*, x_2^*, \ldots, x_i^*, \ldots, x_n^*)$, $x^{\sim} = (x_1^{\sim}, x_2^{\sim}, \ldots, x_i^{\sim}, \ldots, x_n^{\sim})$.

$$D_k^* = \sqrt{\sum_{i=1}^{n} \lambda_i{}^2 D(x_i^*, x_i^k)^2} \quad (6)$$

$$D_k^{\sim} = \sqrt{\sum_{i=1}^{n} \lambda_i{}^2 D(x_i^{\sim}, x_i^k)^2} \quad (7)$$

In addition, $C_k^*, k = 1, 2, \ldots, m$, represents the relative approximation of the alternative k and the ideal solution.

$$C_k^* = \frac{D_k^{\sim}}{D_k^* + D_k^{\sim}} \quad (8)$$

where $0 \le C_k^* \le 1$; the alternative k is almost the ideal solution when C_k^* is close to 1.

4. Empirical Study

In order to illustrate the operation of this model, this study chose three major home delivery companies in Taiwan for the application of the model and to provide a reference for the home delivery industry. The analysis steps are presented in Figure 1 to, firstly, demonstrate the analysis flow.

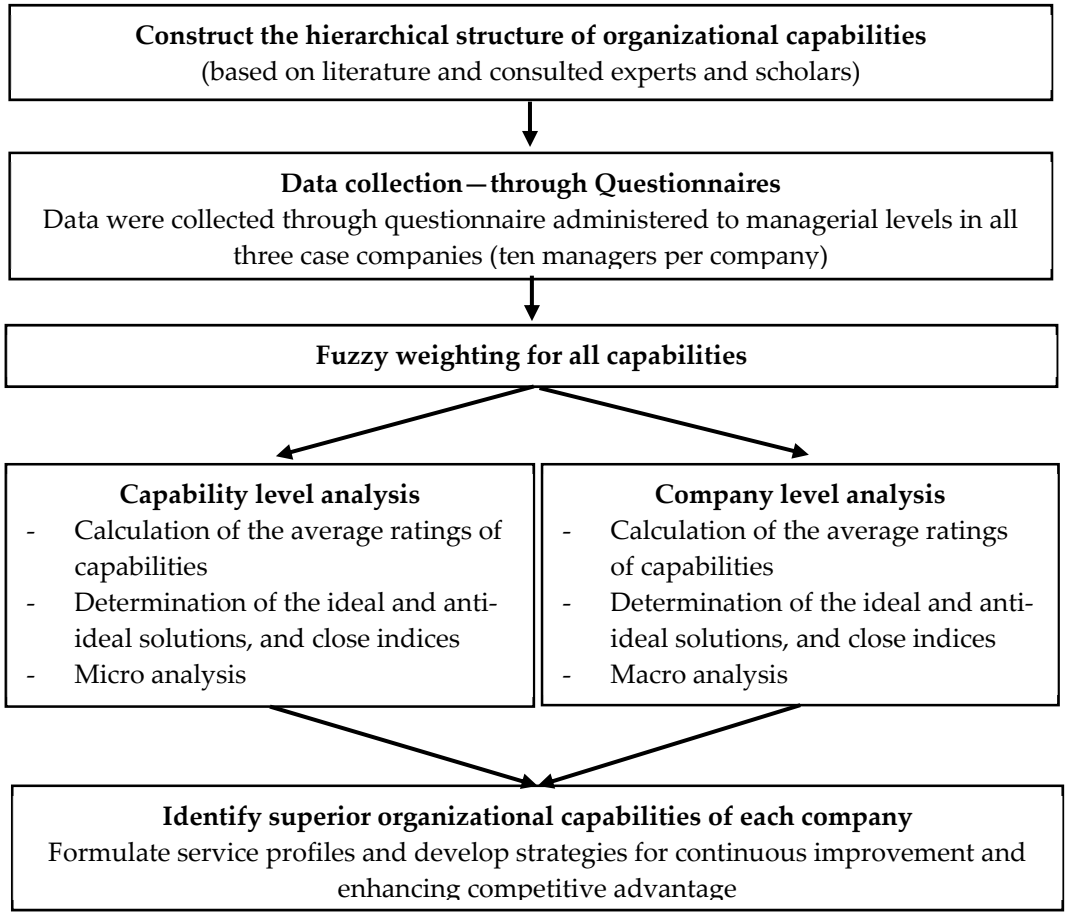

Figure 1. Flowchart of empirical study.

The current top three home delivery companies in Taiwan are Company T (denoted as CT), Company P (denoted as CP), and Company H (denoted as CH). Company T has a contract with a Japan transportation corporation, relies on 5655 convenience stores (statistics to December 2019) as a strong backup, and has become the leading brand home delivery company in Taiwan. Meanwhile, Company P runs a similar business model to Company T. Both expand the market actively and make great profits in the e-commerce channel. Due to the saturation of the cargo market, Company H has also entered the express delivery industry based on its logistics experience in recent years. The intense competition has led to a price war in the home delivery industry in Taiwan.

4.1. Constructing the Hierarchy of Organizational Capabilities and Questionnaire Design

We consulted two experts (two managers who have worked in the industry for more than 5 years) and two scholars (university professors who are teaching logistics-related courses and conducting research in this field) for the organizational competencies of the home delivery industry. Their opinions and suggestions helped us to construct the hierarchy of organizational capabilities and refine the questionnaire.

There are two sections in the questionnaire: the first one examines the importance of each capability within the industry, and the second one identifies the key capabilities for the company. The four categories of organizational competency based on previous literature were included in the questionnaire, which are (1) basic organizational competencies, (2) special competitive competencies, (3) value-added competencies, and (4) management competencies. The hierarchical structure of capabilities was adopted for managers to select the key competencies for their companies. The first level is the purpose of this study, and the second level enumerates four categories of organizational

capabilities. A total of twenty-five capabilities were illustrated in the third level derived from each category (as shown in Table 2).

Table 2. The hierarchical structure of organizational capability.

Purpose	Category	Capability
Key organizational capabilities	C_1 Basic organizational competencies	C_{11} Specific assets C_{12} Cost control C_{13} Number of warehouses C_{14} Professional ethics C_{15} Operation equipment C_{16} Human resource
	C_2 Special competitive competencies	C_{21} On-time delivery C_{22} Service price C_{23} Secure delivery C_{24} IT ability C_{25} Collaboration ability C_{26} Innovation ability C_{27} Complete transportation network C_{28} High-density service agents C_{29} Unique service
	C_3 Value-added competencies	C_{31} Customer satisfaction C_{32} Corporate identify C_{33} Service convenience C_{34} Diversified service
	C_4 Management competencies	C_{41} Standard operation process C_{42} Knowledge management C_{43} Clear objectives C_{44} Organizational culture C_{45} Education and training C_{46} Strategic management

4.2. Data Collection

Data were collected through a survey administered to managerial levels in all three companies to determine the importance of organizational capabilities and identify the perceived capabilities of their companies. A total of ten managers per company, which included operations managers and logistics managers, participated in the survey conducted in 2019.

4.3. Fuzzy Weighting for All Capabilities

In this study, we applied the concept proposed by Kahraman et al. [53] to measure the relative weight of each capability. Next, the method developed by Buckley and Uppuluri [56] was utilized to calculate the fuzzy weights of each fuzzy matrix with the geometric mean method.

The fuzzy weight and integrated weight are presented in Table 3. Given a positive reciprocal matrix $A = \left[a_{ij}\right]$, the geometric mean of each row was computed using:

$$r_i = \left(\prod_{j=1}^{m} a_{ij}\right)^{1/m}$$

where:

$$w_i = r_i \varnothing (r_1 \oplus r_2 \oplus \cdots \oplus r_m)$$

Table 3. The fuzzy weight and integrated weight of capabilities.

Category/ Capability	Fuzzy Weight	Integrated Weight	Capability	Fuzzy Weight	Integrated Weight
C_1	(0.170, 0.272, 0.433)	0.282	C_{26}	(0.015, 0.037, 0.098)	0.043
C_2	(0.199, 0.322, 0.490)	0.330	C_{27}	(0.015, 0.041, 0.112)	0.049
C_3	(0.156, 0.245, 0.388)	0.254	C_{28}	(0.013, 0.038, 0.103)	0.045
C_4	(0.111, 0.161, 0.261)	0.169	C_{29}	(0.012, 0.032, 0.087)	0.038
C_{11}	(0.021, 0.060, 0.156)	0.069	C_{31}	(0.009, 0.025, 0.069)	0.030
C_{12}	(0.020, 0.055, 0.146)	0.065	C_{32}	(0.009, 0.024, 0.067)	0.028
C_{13}	(0.013, 0.035, 0.092)	0.041	C_{33}	(0.008, 0.023, 0.067)	0.028
C_{14}	(0.015, 0.043, 0.118)	0.051	C_{34}	(0.009, 0.024, 0.068)	0.028
C_{15}	(0.014, 0.037, 0.107)	0.045	C_{41}	(0.008, 0.021, 0.059)	0.025
C_{16}	(0.016, 0.043, 0.116)	0.050	C_{42}	(0.007, 0.018, 0.051)	0.022
C_{21}	(0.023, 0.063, 0.162)	0.073	C_{43}	(0.021, 0.053, 0.136)	0.062
C_{22}	(0.024, 0.068, 0.175)	0.078	C_{44}	(0.016, 0.039, 0.102)	0.046
C_{23}	(0.023, 0.062, 0.150)	0.070	C_{45}	(0.016, 0.038, 0.104)	0.045
C_{24}	(0.018, 0.048, 0.124)	0.055	C_{46}	(0.014, 0.031, 0.087)	0.037
C_{25}	(0.017, 0.044, 0.109)	0.050			

4.4. Capability Level Analysis

4.4.1. Calculation of the Average Ratings of Capabilities

The present study used linguistic values to determine the company's strengths in various capabilities and converted the values to triangular fuzzy numbers (as defined in Section 3.2). The average rating of each capability was generated for each case company and is shown in the first three columns of Table 4.

4.4.2. Determination of the Ideal and Anti-Ideal Solutions, and Close Indices

The method introduced in Section 3.3 for ranking the TFNs for each capability in the case companies was applied, and the ideal and anti-ideal solutions were obtained, correspondingly. Hereafter, the distances between each capability of each case company and the ideal solution were calculated; the close indices are shown in the last three columns of Table 4. These results show that the various capabilities of each case company are close to the ideal values. A value of 1 indicates that the case company not only possesses this core capability but also performs better than its competitors.

Table 4. The average ratings, and the ideal and anti-ideal solutions by capability.

	CT	CP	CH	Ideal Solution	Anti-Ideal Solution	CT*	CP*	CH*
C_{11}	(0.575, 0.775, 0.925)	(0.450, 0.650, 0.850)	(0.260, 0.613, 0.813)	(0.575, 0.775, 0.925)	(0.260, 0.613, 0.813)	1.000	0.580	0.000
C_{12}	(0.575, 0.775, 0.925)	(0.600, 0.800, 1.000)	(0.332, 0.688, 0.888)	(0.600, 0.800, 1.000)	(0.332, 0.688, 0.888)	0.761	1.000	0.000
C_{13}	(0.425, 0625, 0.775)	(0.600, 0.800, 1.000)	(0.320, 0.613, 0.813)	(0.600, 0.800, 1.000)	(0.320, 0.613, 0.813)	0.230	1.000	0.000
C_{14}	(0.700, 0.900, 1.000)	(0.600, 0.800, 1.000)	(0.325, 0.750, 0.950)	(0.700, 0.900, 1.000)	(0.325, 0.750, 0.950)	1.000	0.606	0.000
C_{15}	(0.450, 0.650, 0.850)	(0.600, 0.800, 1.000)	(0.322, 0.625, 0.825)	(0.600, 0.800, 1.000)	(0.322, 0.625, 0.825)	0.310	1.000	0.000
C_{16}	(0.450, 0.650, 0.850)	(0.600, 0.800, 1.000)	(0.325, 0.625, 0.825)	(0.600, 0.800, 1.000)	(0.325, 0.625, 0.825)	0.306	1.000	0.000
C_{21}	(0.375, 0.575, 0.775)	(0.600, 0.800, 1.000)	(0.337, 0.588, 0.788)	(0.600, 0.800, 1.000)	(0.375, 0.575, 0.775)	0.000	1.000	0.089
C_{22}	(0.375, 0.575, 0.775)	(0.600, 0.800, 1.000)	(0.339, 0.588, 0.788)	(0.600, 0.800, 1.000)	(0.375, 0.575, 0.775)	0.000	1.000	0.085
C_{23}	(0.650, 0.850, 0.100)	(0.550, 0.750, 0.850)	(0.310, 0.700, 0.850)	(0.650, 0.850, 0.100)	(0.310, 0.700, 0.850)	1.000	0.433	0.000
C_{24}	(0.650, 0.850, 1.000)	(0.700, 0.900, 1.000)	(0.378, 0.775, 0.925)	(0.700, 0.900, 1.000)	(0.378, 0.775, 0.925)	0.777	1.000	0.000
C_{25}	(0.575, 0.775, 0.925)	(0.700, 0.900, 1.000)	(0.375, 0.738, 0.888)	(0.700, 0.900, 1.000)	(0.375, 0.738, 0.888)	0.478	1.000	0.000
C_{26}	(0.425, 0.625, 0.775)	(0.600, 0.800, 1.000)	(0.322, 0.613, 0.813)	(0.600, 0.800, 1.000)	(0.322, 0.613, 0.813)	0.228	1.000	0.000
C_{27}	(0.650, 0.850, 1.000)	(0.600, 0.800, 1.000)	(0.324, 0.725, 0.925)	(0.650, 0.850, 1.000)	(0.324, 0.725, 0.925)	1.000	0.611	0.000
C_{28}	(0.450, 0.650, 0.850)	(0.550, 0.750, 0.850)	(0.600, 0.800, 1.000)	(0.600, 0.800, 1.000)	(0.450, 0.650, 0.850)	0.000	0.419	1.000
C_{29}	(0.650, 0.850, 1.000)	(0.600, 0.800, 1.000)	(0.319, 0.725, 0.925)	(0.650, 0.850, 1.000)	(0.319, 0.725, 0.925)	1.000	0.615	0.000
C_{31}	(0.450, 0.650, 0.850)	(0.700, 0.900, 1.000)	(0.365, 0.675, 0.825)	(0.700, 0.900, 1.000)	(0.365, 0.675, 0.825)	0.173	1.000	0.000
C_{32}	(0.450, 0.650, 0.850)	(0.700, 0.900, 1.000)	(0.364, 0.675, 0.825)	(0.700, 0.900, 1.000)	(0.364, 0.675, 0.825)	0.173	1.000	0.000
C_{33}	(0.700, 0.900, 1.000)	(0.450, 0.650, 0.850)	(0.239, 0.675, 0.875)	(0.700, 0.900, 1.000)	(0.239, 0.675, 0.875)	1.000	0.145	0.190
C_{34}	(0.525, 0.725, 0.925)	(0.700, 0.900, 1.000)	(0.364, 0.713, 0.863)	(0.700, 0.900, 1.000)	(0.364, 0.713, 0.863)	0.357	1.000	0.000
C_{41}	(0.650, 0.850, 1.000)	(0.450, 0.650, 0.850)	(0.237, 0.650, 0.850)	(0.650, 0.850, 1.000)	(0.237, 0.650, 0.850)	1.000	0.306	0.000
C_{42}	(0.650, 0.850, 1.000)	(0.700, 0.900, 1.000)	(0.361, 0.750, 0.900)	(0.700, 0.900, 1.000)	(0.361, 0.750, 0.900)	0.608	1.000	0.000
C_{43}	(0.375, 0.575, 0.775)	(0.700, 0.900, 1.000)	(0.381, 0.638, 0.788)	(0.700, 0.900, 1.000)	(0.375, 0.575, 0.775)	0.000	1.000	0.144
C_{41}	(0.650, 0.850, 1.000)	(0.550, 0.750, 0.850)	(0.298, 0.700, 0.850)	(0.650, 0.850, 1.000)	(0.298, 0.700, 0.850)	1.000	0.444	0.000
C_{42}	(0.650, 0.850, 1.000)	(0.550, 0.750, 0.850)	(0.525, 0.725, 0.925)	(0.650, 0.850, 1.000)	(0.525, 0.725, 0.925)	1.000	0.000	0.274
C_{43}	(0.700, 0.900, 1.000)	(0.525, 0.725, 0.925)	(0.281, 0.713, 0.913)	(0.700, 0.900, 1.000)	(0.281, 0.713, 0.913)	1.000	0.360	0.000

4.5. Company Level Analysis

4.5.1. Determination of the Distance from Ideal and Anti-Ideal Solutions

The distance between each case company and the ideal (D_k^*)/anti-ideal solution ($D_k^{\sim}$) was also calculated, and the results are shown in Table 5.

Table 5. The distance from the ideal and anti-ideal solution.

	CT	CP	CH
D_k^* (ideal solution)	0.03865	0.02283	0.05206
$D_k^{\sim}$ (anti-ideal solution)	0.03483	0.04614	0.00807

4.5.2. Attainment of the Close Indices

The close index (C^*) for each case company was obtained using Equation (8) (Section 3.5), and the results are shown in Table 6. The managers were able to clearly identify their main competitors in the market and understand their own advantages and disadvantages in various organizational capabilities. Moreover, the managers were completely aware of their company's differences to competitors, reflected through the close index of each capability.

Table 6. The close indices of each case company and distances to the ideal solution.

	CT*	CP*	CH*
C_k^*	0.4740	**0.6690**	0.1342

4.6. Discussion

The assessment model presented in this article can help companies to obtain two types of information: one is a micro perspective, which is the internal inspection of organizational capabilities; and the other is a macro perspective, which is the external comparative analysis between a company and its competitors, and constitutes the key organizational capabilities of the industry. Based on this information, companies can formulate appropriate operational strategies to improve service quality or create new service projects to differentiate them from their competitors and to enhance competitiveness.

4.6.1. Micro Perspective

Based on the integrated weights shown in Table 3, the superior organizational capabilities of each case company are marked with an asterisk * and summarized in Table 7.

Company T outperformed the other two companies on 10 out of 25 organizational capabilities, while Company P showed better advantages on 12 capabilities. Large cargo transportation is the main business of Company H. As mentioned earlier, it has just entered the consumer home delivery industry and has been providing its services for a short time. Compared with the other two companies, having many service agents is its only advantage. On the contrary, both Company T and Company P use their own convenience stores as service networks without the need for service agents. In particular, Company T is the leading retailer of convenience stores with a strong network of 5565 stores and a dynamic group synergy; thus, it performed well on capabilities, such as "C_{27} Complete transportation network", "C_{33} Service convenience", and "C_{46} Strategic management".

Table 7. The superior organizational capabilities of each case company.

Category/Capability	Company T	Company P	Company H
C_1 Basic organizational competencies	2/6 = 0.33	4/6 = 0.67	0/6 = 0
C_{11} Specific assets	*		
C_{12} Cost control		*	
C_{13} Number of warehouses		*	
C_{14} Professional ethics	*		
C_{15} Operation equipment		*	
C_{16} Human resource		*	
C_2 Special competitive competencies	3/9 = 0.33	5/9 = 0.56	1/9 = 0.11
C_{21} On-time delivery		*	
C_{22} Service price		*	
C_{23} Secure delivery	*		
C_{24} IT ability		*	
C_{25} Collaboration ability		*	
C_{26} Innovation ability		*	
C_{27} Complete transportation network	*		
C_{28} High-density service agents			*
C_{29} Unique service	*		
C_3 Value-added competencies	1/4 = 0.25	3/4 = 0.75	0/4 = 0
C_{31} Customer satisfaction		*	
C_{32} Corporate identify		*	
C_{33} Service convenience	*		
C_{34} Diversified service		*	
C_4 Management competencies	4/6 = 0.67	2/6 = 0.33	0/6 = 0
C_{41} Standard operation process	*		
C_{42} Knowledge management		*	
C_{43} Clear objectives		*	
C_{44} Organizational culture	*		
C_{45} Education and training	*		
C_{46} Strategic management	*		

As for Company P, the analysis showed that it outperformed Company T in logistics-related capabilities, such as "C_{13} Number of warehouses", "C_{15} Operation equipment", "C_{12} Cost control", "C_{21} On-time delivery", "C_{22} Service price", and "C_{42} knowledge management". This is because it was originally a traditional logistics company. In addition, Company P took the lead in launching a loyalty reward program combined with mobile applications in 2016, marking a new era of big data applications. This increased its advantage in value-added capabilities, such as "C_{24} IT ability", "C_{25} Collaboration ability", "C_{26} Innovation ability", "C_{31} Customer satisfaction", and "C_{34} Diversified service". In recent years, Company P has developed rapidly to catch up with Company T. It is not only the second largest retailer of convenience stores with 3630 stores (statistics to 2019/12) but is also actively creating more innovative services.

4.6.2. Macro perspective

Table 6 shows the overall comparison of the three case companies. The results show that Company P has more capability advantages than the other two case companies and is the most competitive. Company T and Company P have strong rivalry. The top three important capabilities for the home delivery industry based on the integrated weight in Table 3 are "C_{22} Service price" (0.078), "C_{21} On-time delivery" (0.073), and "C_{23} Secure delivery" (0.07). All three capabilities belong under the category "C_2 Special competitive competencies". This implies that a company should possess unique competencies in order to hold the leading position in the industry.

However, the values shown in Table 6 are the weighted result of each capability. As the weight of each capability changes, the result will also change. Therefore, when managers reshape the company's business strategies based on the information obtained, it is suggested that the weights of various capabilities should be confirmed retrospectively to accurately grasp the strategy's advantages, disadvantages, and improvement priorities.

5. Conclusions

This study combined the fuzzy analytic hierarchy process and an ideal and anti-ideal approach, and illustrated, using practical data, that it can help the enterprise to identify organizational capabilities and determine its core competitiveness portfolio. Based on the limitation of internal resource allocation plans, managers can reformulate strategies to enhance their competitiveness. The empirical study provided twenty-five major capabilities for the home delivery industry and demonstrated the effectiveness of the organizational capability assessment model. The results showed that the "C_2 Special competitive competencies" and "C_1 Basic organizational competencies" were the two most important categories of organizational competency for the home delivery industry. The top five organizational capabilities were "C_{22} Service price," "C_{21} On-time delivery," "C_{23} Secure delivery," "C_{11} Specific assets", and "C_{12} Cost control". These are essential and critical capabilities to maintain competitiveness in the home delivery industry.

This method not only helps companies to identify their organizational capabilities from an objective perspective but also to compare them with their competitors to obtain insights for enhancing their competitive advantage. This paper verifies, again, that the integrated application of the multi-criteria decision-making method and fuzzy theory is an objective method that is suitable for alternative selection or criteria prioritization in a turbulent business environment. Moreover, the integrated method is recommended to apply to various business issues, for example, to gather key customer opinions for obtaining valuable ideas, thereby improving the company's service quality or helping to build a better service portfolio. Finally, this article uses existing methods for application analysis rather than the development of new methods. It is suggested that future research could take into account rough theory, the neural network concept, or other analysis techniques to improve information quality.

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