

## Research Article

# Integrating the MCDM Method to Explore the Business Model Innovation in Taiwan: A Case Study in Affiliated Restaurants

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It is not easy for the hotel industry to develop a new business model. To find new consumers, Taiwan's hotel industry has learned from the successful experience of internal restaurants and set up affiliated restaurants. The innovative business model has become an important niche for grasping key technologies and expanding advantages in terms of food and beverage management outside the hotel building. Based on this, and on the application of resource theory, this research is based on the authors' previous research results which used resource-based theories as the basis to develop evaluation dimensions and criteria. This article continues this aspect and model, and merges MCDM models such as DEMATEL and DANP methods to formulate a research evaluation standard system for affiliated restaurants. According to the research results, there are four resource dimensions and eight measurement indicators for the development of key resources for affiliated restaurants; the importance of the four resources is in the following order: organizational ability, personal ability, tangible assets, and intangible assets, and the first two are the "causes" in the causal relationship. The important order of the eight measurement indicators is organizational resources, human resources, financial resources, physical resources, brand/business reputation resources, marketing resources, technical resources, and relationship resources; among them, human resources and financial resources are the most important factors which are the "causes" in the causal relationship. This study uses a multi-criteria decision-making model to explore the resource application, evaluation, and importance ranking of hotel development for affiliated restaurants, which provides a benchmark for the hotel industry to establish affiliated restaurants as an innovative business model. The study results can be referred to for the future and sustainable development of the hotel industry.

## 1. Introduction

Within a competitive environment, continuous innovation is an important factor for the sustainable operation of the business [1]. Innovation refers to a high-risk, innovative idea for owners, which is considered to have high-reward potential or extremely favorable commercial interest behaviors [2]. Therefore, enterprises must continuously innovate to maintain their competitive advantages, and innovation ability is the key factor for the success of enterprises [3]. Hospitality products are difficult to protect through patents and copyrights; therefore, continuous

product innovation is needed for hospitality firms to stay ahead of competitors [4].

The hotel industry mainly offers rooms and dining areas. However, as the number of people choosing food-away-from-home in Taiwan is quite large now, dining rooms have become important sources of revenue for Taiwan's hotel industry. The food and beverage are good in quality but high in price. Furthermore, some dining rooms have been in operation for a long time, whose primary consumers are turning older year by year. Hoping to find new consumers and increase the revenue, the hotel industry replicates the successful experience of internal dining rooms of hotels to

open affiliated restaurants and construct a new business model. Driven by department stores, cinemas, and other business districts, the inbound capacity and table turnover have improved, promoting the food and beverage industry's revenue to reach a new high [5]. Indeed, a good enterprise performance represents the abundance of revenue or resources, which means that performance is also a key to innovation [6]. A continuous innovation process helps restaurants heighten barriers to the establishment, keeping their portfolio ahead of the competition, which establishes a long-term competitive advantage [7]. Using market demands and grasping key technologies remains a key question for enterprises to expand their advantages [8].

The business model shows how different elements of a business fit together [9]. Business innovation is a complex and multifaceted phenomenon [10]. The business model needs to consider the rationality of cost and the acquisition of value benefits [11], and the innovation of business model has changed the industry outlook and redistributed industrial values [12–15]. The research of Chang, Chen, Wu, and Ke shows that, in the application of business model, there are nine main factors that affect the development of hotel sub-brands, the most important of which are channels, target customers, customer relationships, and key activities [16]. In recent years, Taiwanese hotels have set up sub-brands to open restaurants in limited locations like department stores, shopping centers, and others, driving a new trend in Taiwan's food and beverage industry. However, there are many requirements to meet before developing affiliated restaurants in tourist hotels, and affiliated restaurants have become a new issue in recent years. Past research cannot effectively explain how the hotel industry can use core resources and capabilities to achieve sustainable development with limited resources, which requires further in-depth discussion.

With the outbreak of the new crown epidemic (COVID-19) in 2020, the global epidemic has had a huge impact on the operation of the hospitality industry. Under the pressure of fierce competition, coupled with changes in consumer behavior affected by the epidemic, the competitive environment in the hotel industry has become increasingly severe. In order to create a competitive advantage, it is bound to provide services that are different from traditional ones, which is a challenge. In such a predicament, the competition among peers has intensified. The establishment of off-site restaurants in the hotel industry can be regarded as a new form of corporate organization. Therefore, it is necessary to deeply explore the causal relationship between the development of core resources and the impact indicators of affiliated restaurants, to form a tight business model, and to enhance or strengthen the overall synergy effect.

This study proposes a multi-criteria decision-making (MCDM) model to solve the problem of the key resources evaluation for the development of affiliated restaurants. Compared with statistical methods, MCDM only necessitates expert interview data from small-sized samples; it does not require the establishment of basic assumptions for criteria or variables. It manages to integrate survey data with expert assessment and provides decision-makers with

valid management information that facilitates their formulating of optimal strategies [17]. Therefore, in order to continue the research on affiliated restaurants, this study further analyzes the relationship between the four resources and eight indicators established by Chen, et al. [18] to complete the construction of an innovative business model. The main purposes of this study are as follows: Firstly, the present study applied DEMATEL to calculate the correlation between the evaluation criteria, so as to establish the multi-criteria decision analysis framework for affiliated restaurants. Secondly, this study introduced DANP to calculate the weight of criteria that influence each other and laid down a set of criteria used to evaluate affiliated restaurants.

## 2. Literature Review

**2.1. Affiliated Restaurants and Innovation.** With the change of times, people's lifestyle, and diversified eating habits, and the increase of people choosing food-away-from-home, the food and beverage industry is booming now. The food and beverage industry creates new brands in exhibition stores with growing revenue [5]. Opening affiliated restaurants in Taiwan's hotel industry is a new topic now. Old and well-established internal restaurants of hotels have joined the trend of setting up affiliated restaurants to attract young people, encouraging the food and beverage industry to adopt a new outlook and business model. Regent Taipei Hotel was the first to set up an affiliated restaurant. Followed by The Landis Taipei Hotel, Shangri-La's Far Eastern Plaza Hotel Taipei, Le Meridien Taipei, LDC Hotels and Resorts Group, Grand Han-Lai Hotel, Ambassador Hotel Taipei, Gloria Hotel Group, and other five-star hotels copied the successful cooking experience of internal restaurants to establish sub-brands in department stores and other locations using an innovative business model. Chang et al. define a sub-brand as: launching a new product in an existing market with a new brand. That is to say, on the premise of not violating the core concept and spirit of the main brand, a new brand and logo will be created for different consumer groups or different brand positioning [16].

Enterprises can use innovation to grasp the market [1]. Also, the innovation can either be a new product, a new method, a kind of potential to create a new business market, or a behavior pattern to change competitors or consumers [19]. To avoid the unmatching of products and services with market demands, enterprises need to develop new products and services [20]. According to Tidd, Bessant and Pavitt, innovation is redesigning or improving the products, services, and methods for an organization to survive or grow and create more different competitive advantages [21]. Process innovations increase profits for the organization through improved efficiencies and reducing costs [22]. Enterprises pursuing innovation can adapt to the changing environment by creating new products or services to satisfy market demands [23]. As a rising star springing up in the food and beverage industry, the affiliated restaurant provides an opportunity for consumers and enterprises to create unique competitive advantages based on innovation. At the

same time, being able to influence the food and beverage industry, innovation is a topic worthy of attention.

Therefore, Chen et al. adopted the resource-based theory to explore the core resources and impact indicators of the affiliated restaurant development for tourist hotels in Taiwan by using in-depth interviews and the Fuzzy Delphi Method. According to the results, there were four dimensions: “tangible assets,” “intangible assets,” “personal ability,” and “organizational ability,” and eight measurement indicators: “physical resources,” “financial resources,” “brand/business reputation resources,” “technical resources,” “relationship resources,” “marketing resources,” “human resources,” and “organizational resources” [18]. That article has great findings on the study of the affiliated restaurant research, but unfortunately it does not analyze the relationship between all core resources and indicators. Understanding the core resource dimensions and indicators is not enough. The analysis of the importance and causal relationship between indicators should be added to grasp the key to the competitive advantage of the business model.

**2.2. Business Model Innovation (BMI).** The business model is described as a process of changing the innovation into valuable products or services, during which the rationality of cost and the acquisition of value benefits must be considered [11]. As the business model aims to create more value for consumers, it is important to regard the business model as a system to emphasize profit and value [9]. From the perspective of strategy, Hill and Jones defined a business model as a collection of excellent profit-generating strategies for companies to pursue competitive advantages [24]. Maintaining and establishing competitive advantages for hotels within a fast-changing environment to meet market demands and pursue sustainable growth requires more attention from enterprises.

Ludeke-Freund et al. proposed that business model innovation is a means to alter and extend firms’ ability to act effectively and efficiently as with any type of innovation [25]. Enterprises should actively develop value activities to make a profit outweigh the cost through business models [11]. In recent years, the innovative business model created by Taiwan’s old and established hotels in food and beverage management is vital to the hotel industry. In addition, how to use market demands and master key technologies is also very important for enterprises to expand their advantages [8]. Geissdoerfer et al. advocated that the process of business model construction and modification is the business model innovation and forms a part of business strategy [26]. However, it is not easy for the hotel industry to develop a new business model, growing instability of the environment and constant transformation processes which dictate the new rules for the market participants require increased attention from scientists [27]. In this study, a new set of business model integrating Multiple Criteria Decision-Making is proposed to find out the relationship between all the considerations, calculate the weight of each factor, and analyze the key selection criteria. Also, the plans are ranked in order of

their merits according to the weights of various factors. The aim of this study is to improve the reliability and accuracy of the selection, which considers all factors to identify the best solution to an innovative business model for hotels to develop affiliated restaurants.

### 3. Methodology

Through a multi-criteria decision-making model, applying the results of Chen et al.’s research, the Decision-Making and Trial Evaluation Laboratory (DEMATEL) and the DEMATEL-based Analytic Network Process (DANP) method is mainly used for this study. The relevant research tools and steps are described as follows.

**3.1. Research Framework.** Based on the results of Chen et al. discussing the core resources for the development of affiliated restaurants [18], this study further merges MCDM models such as DEMATEL and DANP methods to formulate a research evaluation standard system for affiliated restaurants. The results of the previous study have concluded four resource dimensions, namely, tangible assets, intangible assets, personal ability, and organizational ability, and eight indicators, including physical resources, financial resources, brand/business reputation resources, technical resources, relationship resources, marketing resources, human resources, and organizational resources, as well as 31 evaluation factors. In the light of the four resource dimensions and eight indicators, this study presents a multi-criteria decision-making model of the DEMATEL-based ANP method (DANP). In this study, 2 professors who specialized in the related fields and 14 managers working in the affiliated restaurants with more than 6 years of experience in hospitality industry were invited to fill out the questionnaires; the effective recovery rate was 100%. The distribution status for their working tenure and experience is: 12.5% for less than 10 years, 50% for 11–15 years, 12.5% for 16–20 years, 19% for 21–25 years, and 6% for more than 26 years. Among these experts, there are 2 junior supervisors, 5 intermediate supervisors, 7 senior supervisors, and 2 scholars with catering backgrounds.

As mentioned above, this study adopts the multi-criteria decision-making model of DANP to understand the causality and relevance and analyze the weights and ranking of importance, thus providing a reference for relevant industries aimed at achieving sustainable operation to use resources when developing affiliated restaurants in a real sense.

**3.2. Key Resources and Impact Indicators for the Development of Affiliated Restaurants.** This study refers to the resources and indicators for developing affiliated restaurants summarized by Chen et al., divided into four resource dimensions, eight indicators, and 31 evaluation factors [18], as shown in Table 1. Based on four dimensions and eight indicators, this study presents a multi-criteria decision-making model of the DANP method.

TABLE 1: List of core resources, indicators, and evaluation factors of developing affiliated restaurants.

Goal	Dimensions	Indicators	Evaluation factors
Resources and indicators for the development of affiliated restaurants	Tangible assets	Physical resources	Area-effectiveness Perfect equipment sets Location/store base
			Planar configuration and thematic feature/design
		Financial resources	Sound financial structure Abundant investment funds
			Payback time-estimated investment costs and returns
	Intangible assets	Brand/business reputation resources	Registered trademark Customers' brand loyalty Client contract/cooperation contract-cooperative store Company's entire image/brand popularity
			License and technological exchange
			Product innovation and research and development ability
			Database—the establishment of consumers' database
		Technical resources	Patents—delicacies, equipment, and service workflow Horizontal alliances
			Client internalization—to internalize customers
			Stable supply chains Marketing and planning Brand development plan
			Information technology and multimedia Ability of familiarizing and discovering potential markets
	Personal ability	Human resources	Personnel allocation and training Special skills—license of chef, language ability, supervision Management ability/leadership Social networks/communication ability
			Organizational culture
			Administration and procurement
			Organization and memory learning
	Organizational ability	Organizational resources	Cross-organization cooperation networks Degree of profession for the organizational operation

Source: [18].

3.3. *Using Decision-Making Trial and Evaluation Laboratory (DEMATEL) to Discuss the Cause-and-Effect Relationships and Correlations of the Affiliated Restaurants' Core Resources and Impact Indicators.* This paper discusses the cause-and-effect relationships and correlations of the affiliated restaurants' core resources and impact indicators, and analyzes the procedures as follows:

#### Step 1. Defining elements and evaluation scales

In this paper, taking the aforementioned 16 experts as the object, conduct a survey for the opinion on the cause-and-effect relationships and correlations of the affiliated restaurants' core resources and impact indicators. There are five levels, 0, 1, 2, 3, and 4, which individually represents

“no impact (0),” “low impact (1),” “middle impact (2),” “high impact (3),” and “extremely high impact (4).”

Step 2. Establishing Matrix  $A$  for the average of experts' opinions

The number of evaluation items is set as  $n$ . The degree of mutual influence for each evaluation item judged by a large number of experts (assessors) in this field is collected and organized. Each expert's questionnaire represents the nonnegative result matrix,  $n \times n$ . All experts' opinions are added up and averaged out to establish matrix  $A$  for the average of experts' opinions, where  $A_{ij}$  denotes the degree of impact of Item  $i$  on Item  $j$ . The matrix diagonal means its degree of impact



on each item. Because there is no impact, the value of diagonal part is set as 0, as follows:

$$A = \begin{bmatrix} a_{11} & \dots & a_{1j} & \dots & a_{1n} \\ \vdots & & \vdots & & \vdots \\ a_{i1} & \dots & a_{ij} & \dots & a_{in} \\ \vdots & & \vdots & & \vdots \\ a_{n1} & \dots & a_{nj} & \dots & a_{nn} \end{bmatrix}. \quad (1)$$

**Step 3.** Building Matrix  $D$  for the normalization of the average of experts' opinions

After the column vectors and row vectors of Matrix  $A$  for the average of experts' opinions are added up, the maximum value is set as the normalization standard  $r$ . Next, all of the numbers of Matrix  $A$  for the average of experts' opinions separately multiply  $s = 1/r$ , denoted as  $D = s \cdot A$ , to obtain Matrix  $D$  for the normalization of the average of experts' opinions, whose matrix diagonal is 0. Also, the maximum value for the sum of columns and the sum of rows is 1. They can be represented in equations (2) and (3):

$$D = s \cdot A, \quad (2)$$

$$s = \max \left[ \frac{1}{\max_{1 \leq i \leq n} \sum_{j=1}^n |A_{ij}|}, \frac{1}{\max_{1 \leq j \leq n} \sum_{i=1}^n |A_{ij}|} \right]. \quad (3)$$

**Step 4.** Establishing the total influence-relation matrix  $T$

After normalizing the average of experts' opinions to obtain Matrix  $D$ ,  $\lim_{k \rightarrow \infty} D^k = 0$  (0 means zero matrix) is received, so it is formulated as  $T = D/I - D$ , where  $I$  is the unit matrix, and then the total influence-relation matrix  $T$  can be obtained, as shown in equation (4).

$$\begin{aligned} T &= \lim_{k \rightarrow \infty} (D + D^2 + D^3 + \dots + D^k), \\ &= \frac{D}{I - D}, \\ &= D(I - D)^{-1}. \end{aligned} \quad (4)$$

**Step 5.** Setting the threshold value and mapping the cause-and-effect graph

The total average of the total influence-relation matrix  $T$  is set as the threshold value  $\alpha$ . If the value of the total influence-relation matrix  $T$  is smaller than  $\alpha$ , it will be replaced by 0; otherwise, it will be kept. The dimensions/indicators of the relatively low impact in the total influence-relation matrix  $T$  can be removed to obtain a simplified total influence-relation matrix, the total influence-relation matrix  $T$  order to map the correlations in the cause-and-effect graph. In addition, the sum of each row and the sum of each column in the total influence-relation matrix  $T$  are added up to form

$d + r$  and  $d - r$ ;  $d + r$  is set as the horizontal axis and  $d - r$  is set as the vertical axis to map the cause-and-effect graph. With the help of the cause-and-effect graph, decision-makers can refer to the correlations, causes, and effects in the dimensions/indicators to plan and make proper decisions. The sum of each row and the sum of each column in the total influence-relation matrix  $T$  can be formulated as follows:

$$\begin{aligned} d &= (d_i)_{n \times 1} \\ &= \left[ \sum_{j=1}^n t_{ij} \right]_{n \times 1}, \end{aligned} \quad (5)$$

$$\begin{aligned} r &= (r_j)_{n \times 1} \\ &= (r_j)'_{1 \times n} \\ &= \left[ \sum_{i=1}^n t_{ij} \right]'_{1 \times n}. \end{aligned} \quad (6)$$

**3.4. Using DEMATEL-Based Analytic Network Process (DANP) to Construct Affiliated Restaurants' Core Resources and Impact Indicators and to Conduct the Analysis of Weights as Well as the Importance of Priority.** DANP (DEMATEL-based ANP) is a mixed MCDM model, combining Decision-Making Trial and Evaluation Laboratory (DEMATEL) with Analytic Network Process (ANP) [28]. Its procedures are analyzed and explained as follows:

**Step 1.** Establishing the unweighted supermatrix  $W$

This step is a key to combining DEMATEL with ANP to form DANP. Therefore, this paper especially transforms this step into a detailed computing process.

(1) Establishing the total influence-relation matrix  $T_C$  for the DEMATEL indicators

Based on equations (1) to (4) formulated by the method of DEMATEL, the total influence-relation matrix  $T_C$  for the received indicators is set as  $T_C$ , whose formula is as follows:

$$T_C = \begin{bmatrix} t_{11} & \dots & t_{1j} & \dots & t_{1n} \\ \vdots & & \vdots & & \vdots \\ t_{i1} & \dots & t_{ij} & \dots & t_{in} \\ \vdots & & \vdots & & \vdots \\ t_{n1} & \dots & t_{nj} & \dots & t_{nn} \end{bmatrix}, \text{ where } t_{ij} \text{ denotes the}$$

total influence value of Indicator  $i$  to Indicator  $j$ ,  $n$  and represents the total number of indicators.

(2) Establishing the normalized standard  $f_i$  of the total influence-relation matrix  $T_C$  for indicators

The normalized standard of the total influence-relation matrix  $T_C$  is set as  $f_i$ . The normalized standard  $f_i$  must follow the dimensions to conduct the calculation. It is supposed that Indicator 1 to Indicator 2 belong to the first dimension and Indicators 3 to 6 belong to the second dimension. The normalized standard  $f_i$  of the first two column numbers of Matrix  $T_C$  is the sum of first two column vectors of the total influence-relation

matrix  $T_C$  for indicators,  $n$  value (s) of  $f_i$  in total. The normalized standard  $f_i$  of the third to the sixth column numbers of Matrix  $T_C$  is the sum of the third to the sixth column vectors of the total influence-relation matrix  $T_C$  for indicators,  $n$  value (s) of  $f_i$  (s) in total. They are illustrated in equations (7) to (10):

$$T_C = \begin{bmatrix} t_{11} & \cdots & t_{1j} & \cdots & t_{1n} \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ t_{i1} & \cdots & t_{ij} & \cdots & t_{in} \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ t_{n1} & \cdots & t_{nj} & \cdots & t_{nn} \end{bmatrix}, \quad (7)$$

$$T_C[t_{ij}] = T_{ij}^C = \begin{bmatrix} t_{11}^C & \cdots & t_{1j}^C & \cdots & t_{1n}^C \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ t_{i1}^C & \cdots & t_{ij}^C & \cdots & t_{in}^C \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ t_{n1}^C & \cdots & t_{nj}^C & \cdots & t_{nn}^C \end{bmatrix}, \quad (8)$$

$$T_{ij}^C = \begin{bmatrix} t_{11}^C & \cdots & t_{1j}^C & \cdots & t_{1n}^C \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ t_{i1}^C & \cdots & t_{ij}^C & \cdots & t_{in}^C \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ t_{n1}^C & \cdots & t_{nj}^C & \cdots & t_{nn}^C \end{bmatrix}^{f_i = \sum_{j=1}^n t_{ij}^C}, \quad (9)$$

$$f_i = \sum_{j=1}^n t_{ij}^C, \quad (10)$$

- (3) Establishing the total influence-relation matrix  $T_C^*$  for the normalized indicators

The total influence-relation matrix  $T_C^*$  for the normalized indicators should be calculated based on the dimensions, following the assumption of the previous step. The computing method of the total influence-relation matrix  $T_C^*$  for the normalized indicators is to divide the values of Matrix  $T_C$  one by one by the normalized standard  $f_i$  of its row so as to obtain the total influence-relation matrix  $T_C^*$  for the normalized indicators, as shown in equation (11). The normalized standard  $f_i$  is formulated as (9) and (10).

$$T_C^* = \begin{bmatrix} \frac{t_{11}}{f_1} & \cdots & \frac{t_{1j}}{f_1} & \cdots & \frac{t_{1n}}{f_1} \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ \frac{t_{i1}}{f_i} & \cdots & \frac{t_{ij}}{f_i} & \cdots & \frac{t_{in}}{f_i} \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ \frac{t_{n1}}{f_n} & \cdots & \frac{t_{nj}}{f_n} & \cdots & \frac{t_{nn}}{f_n} \end{bmatrix} \quad (11)$$

$$= \begin{bmatrix} t_{11}^* & \cdots & t_{1j}^* & \cdots & t_{1n}^* \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ t_{i1}^* & \cdots & t_{ij}^* & \cdots & t_{in}^* \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ t_{n1}^* & \cdots & t_{nj}^* & \cdots & t_{nn}^* \end{bmatrix}.$$

- (4) Establishing the unweighted supermatrix  $W$

The total influence-relation matrix  $T_C^*$  for the normalized indicators is transposed to gain the unweighted supermatrix  $W$ , as indicated in equation (12).

$$W = (T_C^*)' = \begin{bmatrix} t_{11}^* & \cdots & t_{j1}^* & \cdots & t_{n1}^* \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ t_{i1}^* & \cdots & t_{ji}^* & \cdots & t_{ni}^* \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ t_{1n}^* & \cdots & t_{jn}^* & \cdots & t_{nn}^* \end{bmatrix} \quad (12)$$

$$= \begin{bmatrix} W_{11} & \cdots & W_{1j} & \cdots & W_{1n} \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ W_{i1} & \cdots & W_{ij} & \cdots & W_{in} \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ W_{n1} & \cdots & W_{nj} & \cdots & W_{nn} \end{bmatrix}.$$

- Step 2. Establishing the weighted supermatrix  $S$

The abovementioned total influence-relation matrix for the normalized indicators is transposed to gain the unweighted supermatrix  $W$ , and then the total influence-relation matrix for the dimensions received from DEMATEL establishes the weighted supermatrix  $S$ . The detailed computing process is explained as below:

- (1) Establishing the total influence-relation matrix  $T_D$  for the DEMATEL dimensions

The total influence-relation matrix  $T_D$  for the dimensions gained from (1) to (4) of DEMATEL is

formulated as follows:  $T_D = \begin{bmatrix} t_D^{11} & \dots & t_D^{1j} & \dots & t_D^{1n} \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ t_D^{i1} & \dots & t_D^{ij} & \dots & t_D^{in} \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ t_D^{n1} & \dots & t_D^{nj} & \dots & t_D^{nm} \end{bmatrix}$ ,

where  $t_D^{ij}$  denotes the total influence value of Dimension  $i$  to Dimension  $j$ ;  $n$  represents the number of dimensions.

- (2) Establishing the normalized standard  $v_i$  of the total influence-relation matrix  $T_D$  for dimensions

The normalized standard of the total influence-relation matrix  $T_D$  for dimensions is set as  $v_i$ . The normalized standard  $v_i$  is to add up the row vectors of Matrix  $T_D$  to gain  $n$  value (s) of  $v_i$  in total, as demonstrated in (13) and (14).

$$T_D = \begin{bmatrix} t_D^{11} & \dots & t_D^{1j} & \dots & t_D^{1n} \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ t_D^{i1} & \dots & t_D^{ij} & \dots & t_D^{in} \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ t_D^{n1} & \dots & t_D^{nj} & \dots & t_D^{nm} \end{bmatrix}, \quad (13)$$

$$v_i = \sum_{j=1}^n t_D^{ij}. \quad (14)$$

- (3) Establishing the total influence-relation matrix  $T_D^*$  for the normalized dimensions

The numbers of the total influence-relation matrix  $T_D^*$  for the normalized dimensions are gradually divided by the normalized standard  $v_i$  of its rows, so that the total influence-relation matrix  $T_D^*$  for the normalized dimensions can be established, as seen in equation (15). The normalized standard  $v_i$  is displayed in (13) and (14).

$$T_D^* = \begin{bmatrix} \frac{t_D^{11}}{v_1} & \dots & \frac{t_D^{1j}}{v_1} & \dots & \frac{t_D^{1n}}{v_1} \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ \frac{t_D^{i1}}{v_i} & \dots & \frac{t_D^{ij}}{v_i} & \dots & \frac{t_D^{in}}{v_i} \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ \frac{t_D^{n1}}{v_n} & \dots & \frac{t_D^{nj}}{v_n} & \dots & \frac{t_D^{nm}}{v_n} \end{bmatrix} \quad (15)$$

$$= \begin{bmatrix} t_{D_{11}}^* & \dots & t_{D_{1j}}^* & \dots & t_{D_{1n}}^* \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ t_{D_{i1}}^* & \dots & t_{D_{ij}}^* & \dots & t_{D_{in}}^* \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ t_{D_{n1}}^* & \dots & t_{D_{nj}}^* & \dots & t_{D_{nm}}^* \end{bmatrix}.$$

- (4) Establishing the weighted supermatrix  $S$

After the total influence-relation matrix  $T_D^*$  for the normalized dimensions is transposed as the weighting basis of the unweighted matrix  $W$ , the correspondent position after the transposition of  $T_D^*$  multiplies the unweighted matrix  $W$  to establish the weighted supermatrix  $S$ , as demonstrated in equation (16).

$$S = W \times (T_D^*)'$$

$$= \begin{bmatrix} S_{11} & \dots & S_{1j}S_{1j} & \dots & S_{1n} \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ S_{i1} & \dots & S_{ij} & \dots & S_{in} \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ S_{n1} & \dots & S_{nj} & \dots & S_{nm} \end{bmatrix}. \quad (16)$$

Step 3. Establishing the extreme supermatrix  $L$  and the weight of each indicator

By means of the characteristic showing that the sum of all column vectors for the weighted supermatrices is 1, the weighted supermatrices are multiplied by  $\lim_{t \rightarrow \infty} S^t$  plenty of times to achieve convergence and become stable. Thus, the extreme supermatrix  $L$  is resulted, and the importance priority for the weights of all indicators is also obtained. The establishment of the extreme supermatrix  $L$  is seen in equation (17).

$$\lim_{t \rightarrow \infty} S^t \quad (17)$$

The term weight in statistical methodology refers to the distribution frequency of a factor in the system, which is usually used to analyze the proportion [29]. As mentioned above, this study adopts the multi-criteria decision-making model of DANP to understand the causality and relevance, and analyze the weights and ranking of importance, thus providing a reference for relevant industries aimed at achieving sustainable operation to use resources when developing affiliated restaurants in a real sense.

## 4. Results

**4.1. DEMATEL Analysis.** This paper adopted the DEMATEL analysis. 16 effective questionnaires filled out by the experts were collected, and the DEMATEL method was applied to explore the cause-and-effect relationships and correlations of the affiliated restaurants' core resources as well as impact indicators. This paper referred to the DEMATEL expert questionnaire for core resources and impact indicators of affiliated restaurants' development based on the evaluation scale proposed by Lin and Wu [30]. The evaluation scale contains five levels, including "no impact (0)," "low impact (1)," "middle impact (2)," "high impact (3)," and "extremely high impact (4)."

The experts first judged and evaluated the degree of mutual influence among the projects, after which the data of the expert questionnaire were converted into a matrix, and

the total average value of each item in the questionnaire was calculated by the formula (1), thus creating a matrix of average expert opinions on dimensions and indicators of core resources and impact indicators for the development of affiliated restaurants.

Then, the relevance and impact between four dimensions and eight indicators were analyzed to find out the most influential indicator. In addition, the study explored the core resources through equations (2) to (4), and simplified the values less than the threshold of the total impact relationship matrix  $T$  to 0. We first obtained a simplified total influence relationship matrix of dimensions and indicators to draw the correlations in the causality diagram, as shown in Tables 2 and 3.

Next, equations (5) and (6) are used to compute the sum of columns and rows. Last, we can gain the result for the degree of correlation ( $d + r$ ) as well as the degree of cause ( $d - r$ ), and the computing lists of columns and rows for the total influence-relation matrices of the dimensions and indicators is sorted out, as shown in Tables 4 and 5.

According to Tables 4 and 5,  $d + r$  (degree of correlation) represents the vertical axis while  $d - r$  (degree of cause) represents the horizontal axis to map the dimension cause-and-effect graphs and indicator cause-and-effect graphs for the core resources and impact indicators of the affiliated restaurants' development, as illustrated in Figures 1 and 2, where  $d - r$  can analyze the cause and effect of the cause-and-effect relationship. In addition, according to Tables 2 and 3, the correlations between the core resources and impact indicators of the affiliated restaurants' development can be mapped.

To sum up the previous analysis, this paper uses the DEMATEL to explore the cause-and-effect relationships and correlations for the core resources and impact indicators of the affiliated restaurants' development, as explained as follows:

- (1) In the aspect of dimensions: According to the dimension cause-and-effect graph (Figure 1), only the value of  $d + r$  for "intangible assets" is larger than the average. Therefore, it can be learned that the indicators and dimensions for the core resources and impact indicators of the affiliated restaurants' development are more independent. Concerning the dimensions of "intangible assets" and "tangible assets," they tend to be easily affected because the value of  $d - r$  is smaller than 0, which represents "effect" in the cause-and-effect relationship. However, the dimensions of "personal ability" and "organizational ability" belong to the dimensions of cause because the degree of cause is larger than 0, which represents "cause" in the cause-and-effect relationship. Therefore, it is suggested that the owners who intend to develop affiliated restaurants should emphasize "personal ability" and "organizational ability."
- (2) In the aspect of indicators: According to the indicator cause-and-effect graph (Figure 2), "brand/business reputation resources," "organizational resources," "marketing resources," and "human

resources" are the indicators whose value of  $d + r$  is larger than the average, which means there are more correlations between each other. It is considered that "brand/business reputation resources," "organizational resources," and "physical resources" belong to the indicators which tend to be influenced. Although the degree of correlation for the indicators of "financial resources," "technical resources," and "relationship resources" is not above the average, the degree of cause is larger than 0; they belong to influential indicators. As for "marketing resources" and "Human resources," the degree of correlation is larger than the average and the degree of cause is larger than 0, which means that they are core indicators in the core resources and impact indicators for the affiliated restaurants' development. Hence, it is suggested that the owners who intend to develop affiliated restaurants can place more emphasis on "marketing resources" as well as "human resources," and then on "financial resources," "technical resources," and "relationship resources."

**4.2. DANP Weight Analysis.** Based on the total impact dimensions and indicators of core resources and impact indicators for the development of affiliated restaurants calculated by using the DEMATEL method, this study conducted a follow-up DANP weight analysis. Firstly, this study, referring to a matrix of average expert opinions on four dimensions and eight indicators, established a total influence relationship matrix of dimensions and indicators according to equation (4). Besides, the sum of the relevant values of each dimension was used as the positive planning benchmark, as shown in Tables 6 and 7.

According to Tables 6 and 7, this paper refers to equation (15) to individually divide the values of the total influence-relation matrices of dimensions and indicators by the values of the normalization standard of each row, so that the total influence-relation matrices of the normalization dimensions and indicators can be established. Next, this paper refers to equation (12) to separately transpose the total influence-relation matrices of the normalization dimensions and indicators, so that the unweighted super matrices will be received, as displayed in Tables 8 and 9.

In addition, this paper uses equation (17) to undertake the calculation of maximization in Table 8, and then the dimension weights of core resources and impact indicators for the affiliated restaurants' development, as revealed in Table 10.

According to the abovementioned, this paper applies equation (16) to multiply the unweighted supermatrices of the correspondent positions in Tables 8 and 9, so that the weighted supermatrices can be established. Last, equation (17) will be referred to help the weighted supermatrices multiply themselves by  $\lim_{t \rightarrow \infty} S^t$  many times to reach convergence, and then create the extreme supermatrices and also obtain weights for each indicator for importance priority, as shown in Table 11.



TABLE 2: List of simplified total influence relationship matrices of the dimensions.

The simplified total influence-relation matrices of the dimensions	Tangible assets	Intangible assets	Personal ability	Organizational ability
Tangible assets act	0.0000	2.6189	0.0000	0.0000
Intangible assets	2.6086	2.5829	2.5107	2.6312
Personal ability	0.0000	2.7103	0.0000	2.4926
Organizational ability	2.4775	2.7158	0.0000	0.0000

TABLE 3: List of simplified total influence-relation matrices of the indicators.

The simplified total influence-relation matrices of the indicators	Physical resources	Financial resources	Brand/business reputation resources	Technical resources	Relationship resources	Marketing resources	Human resources	Organizational resources
Physical resources	0.0000	0.0000	0.8754	0.0000	0.0000	0.7765	0.0000	0.7897
Financial resources	0.8017	0.0000	0.8976	0.0000	0.0000	0.8189	0.7824	0.8469
Brand/business reputation resources	0.0000	0.7946	0.7921	0.0000	0.0000	0.8356	0.7847	0.8442
Technical resources	0.0000	0.0000	0.8589	0.0000	0.0000	0.0000	0.0000	0.7926
Relationship resources	0.0000	0.0000	0.8254	0.0000	0.0000	0.0000	0.0000	0.0000
Marketing resources	0.7915	0.7935	0.9414	0.7756	0.0000	0.0000	0.0000	0.8379
Human resources	0.0000	0.7806	0.9345	0.7915	0.0000	0.8195	0.0000	0.8447
Organizational resources	0.7892	0.7970	0.9467	0.7771	0.0000	0.8334	0.8067	0.0000

TABLE 4: Computing list of columns and rows for the total influence-relation matrices of the dimensions.

Dimensions	Sum of rows	Ranking	Sum of columns	Ranking	$d+r$ (degree of correlation)	Ranking	$d-r$ (degree of cause)	Ranking
Tangible assets	9.4475	4	9.6947	3	19.1422	4	-0.2472	3
Intangible assets	10.3335	1	10.6279	1	20.9614	1	-0.2944	4
Personal ability	9.8365	3	9.4252	4	19.2617	3	0.4113	1
Organizational ability	9.8999	2	9.7695	2	19.6694	2	0.1303	2
Average					19.7587			

TABLE 5: Computing list of columns and rows for the total influence-relation matrices of the indicators.

Indicators	Sum of rows	Ranking	Sum of columns	Ranking	$d+r$ (degree of correlation)	Ranking	$d-r$ (degree of cause)	Ranking
Physical resources	5.9824	6	5.9836	6	11.9660	6	-0.0013	6
Financial resources	6.3171	4	6.0216	4	12.3386	5	0.2955	2
Brand/business reputation resources	6.3151	5	7.0720	1	13.3871	1	-0.7569	8
Technical resources	5.9329	7	5.9017	7	11.8346	7	0.0311	4
Relationship resources	5.6906	8	5.6769	8	11.3676	8	0.0137	5
Marketing resources	6.3815	2	6.3159	3	12.6975	3	0.0656	3
Human resources	6.3668	3	6.0129	5	12.3796	4	0.3539	1
Organizational resources	6.4405	1	6.4422	2	12.8827	2	-0.0017	7
Average					12.3567			

According to the analysis results of Tables 10 and 11, concerning the core resources and impact indicators for the development of affiliated restaurants, the importance priority of the dimensions is “intangible assets,” “organizational ability,” “tangible assets,” and “personal ability.” In addition, the results of Table 11 are shown in the radar analysis diagram (Figure 3), and it is found that the

weight priority of four impact indicators—“organizational resources,” “human resources,” “financial resources,” and “physical resources”—is relatively important. Thus, this paper conducts the analysis on the evaluation detailed items of the top four indicators, in order to provide the owners who intend to develop affiliated restaurants for further reference.

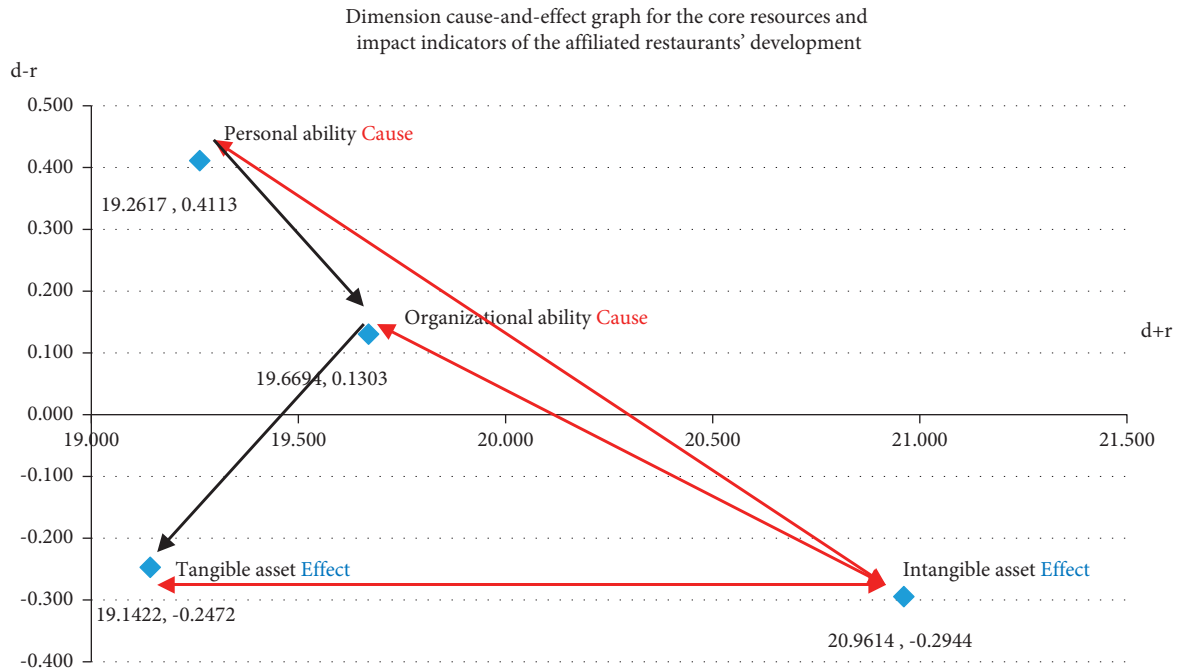


FIGURE 1: Dimension cause-and-effect graph.

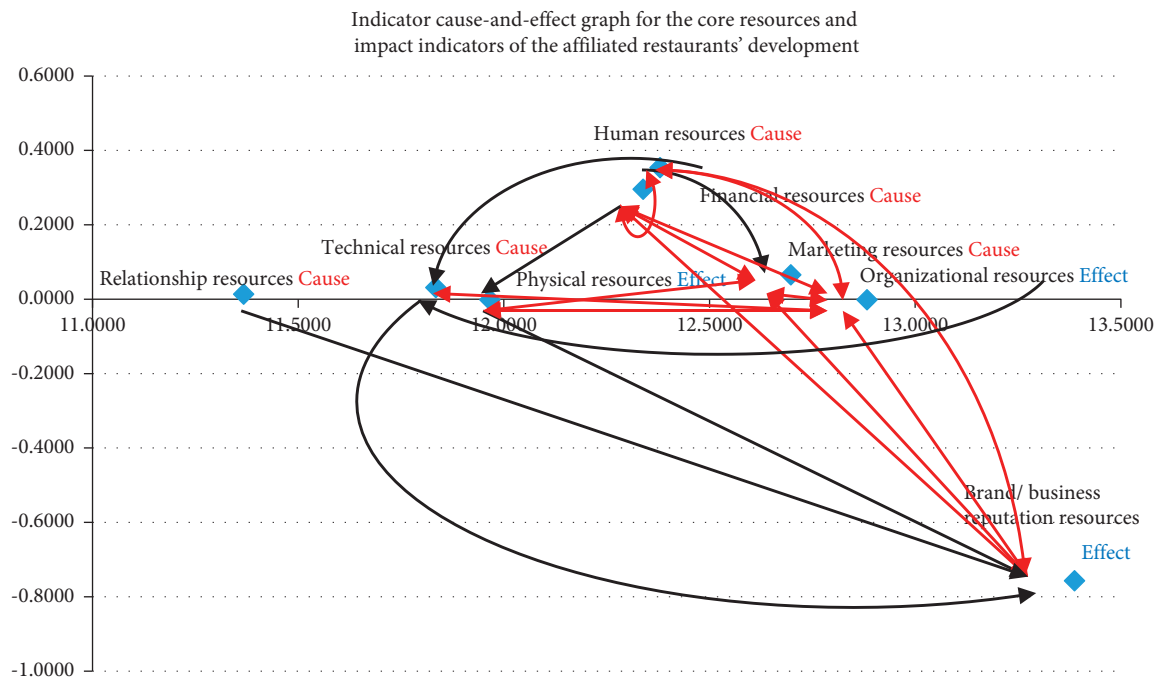


FIGURE 2: Indicator cause-and-effect graph.

TABLE 6: Normalization standard list for the total influence-relation matrices of the dimensions.

The total influence-relation matrices of the dimensions	Tangible assets	Intangible assets	Personal ability	Organizational ability	Normalization standard
Tangible assets	2.1559	2.6189	2.3026	2.3701	9.4475
Intangible assets	2.6086	2.5829	2.5107	2.6312	10.3335
Personal ability	2.4527	2.7103	2.1809	2.4926	9.8365
Organizational ability	2.4775	2.7158	2.4310	2.2756	9.8999

TABLE 7: Normalization standard list for the total influence-relation matrices of the indicators.

$f_i$	Physical resources	Financial resources	Normalization standard	Brand/ business reputation resources	Technical resources	Relationship resources	Marketing resources	Normalization standard	Human resources	Normalization standard	Organizational resources	Normalization standard
Physical resources	0.6347	0.7472	1.3819	0.8754	0.7261	0.6971	0.7765	3.0751	0.7356	0.7356	0.7897	0.7897
Financial resources	0.8017	0.6744	1.4761	0.8976	0.7643	0.7308	0.8189	3.2116	0.7824	0.7824	0.8469	0.8469
Brand/business reputation resources	0.7711	0.7946	1.5657	0.7921	0.7531	0.7397	0.8356	3.1205	0.7847	0.7847	0.8442	0.8442
Technical resources	0.7299	0.7344	1.4643	0.8589	0.6209	0.6781	0.7678	2.9257	0.7503	0.7503	0.7926	0.7926
Relationship resources	0.6956	0.6999	1.3955	0.8254	0.6930	0.5729	0.7492	2.8405	0.7042	0.7042	0.7505	0.7505
Marketing resources	0.7915	0.7935	1.5851	0.9414	0.7756	0.7568	0.7150	3.1888	0.7698	0.7698	0.8379	0.8379
Human resources	0.7699	0.7806	1.5505	0.9345	0.7915	0.7468	0.8195	3.2924	0.6791	0.6791	0.8447	0.8447
Organizational resources	0.7892	0.7970	1.5861	0.9467	0.7771	0.7547	0.8334	3.3119	0.8067	0.8067	0.7357	0.7357

TABLE 8: List for the unweighted supermatrices of the dimensions.

The unweighted supermatrices	Tangible assets	Intangible assets	Personal ability	Organizational ability
Tangible assets	0.2282	0.2524	0.2493	0.2503
Intangible assets	0.2772	0.2500	0.2755	0.2743
Personal ability	0.2437	0.2430	0.2217	0.2456
Organizational ability	0.2509	0.2546	0.2534	0.2299

TABLE 9: List for the unweighted supermatrices of the indicators.

The unweighted supermatrices	Physical resources	Financial resources	Brand/business reputation resources	Technical resources	Relationship resources	Marketing resources	Human resources	Organizational resources
Physical resources	0.4593	0.5431	0.4925	0.4985	0.4985	0.4994	0.4966	0.4975
Financial resources	0.5407	0.4569	0.5075	0.5015	0.5015	0.5006	0.5034	0.5025
Brand/business reputation resources	0.2847	0.2795	0.2538	0.2936	0.2906	0.2952	0.2838	0.2858
Technical resources	0.2361	0.2380	0.2413	0.2122	0.2440	0.2432	0.2404	0.2346
Relationship resources	0.2267	0.2276	0.2370	0.2318	0.2017	0.2373	0.2268	0.2279
Marketing resources	0.2525	0.2550	0.2678	0.2624	0.2638	0.2242	0.2489	0.2516
Human resources	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Organizational resources	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

TABLE 10: List for dimension weights.

Dimension weights	Tangible assets	Intangible assets	Personal ability	Organizational ability
Tangible assets	0.2452	0.2452	0.2452	0.2452
Intangible assets	0.2688	0.2688	0.2688	0.2688
Personal ability	0.2387	0.2387	0.2387	0.2387
Organizational ability	0.2473	0.2473	0.2473	0.2473

**4.2.1. Organizational resources.** “Organizational resources” is the most important core indicator. Its five items for evaluation are “organizational culture,” “administration and purchasing,” “organization and memory learning,” “cross-organization cooperation networks,” and “organizational creativity and operational specialization.” This paper discusses the results with experts of the industry and integrates their suggestions, in order to develop good organizational culture and administration purchasing system for the development of affiliated restaurants, establish organization and memory learning as well as cross-organization cooperation networks, and then enhance the operation team’s performance as well as their competitiveness by means of the organizational creativity and operational specialization. As a result, the abovementioned five evaluation factors all can be offered to the owners of the affiliated restaurants for reference when getting engaged into the organizational resource allocation.

**4.2.2. Human Resources.** This paper collects and sorts numerous experts’ and scholars’ researches as well as the industry experts’ suggestions, in order to confirm whether they conform to “human resource allocations and training,” “technical skills,” “management ability/leadership,” and “social networks/communication ability” listed in the evaluation detailed items for human resources of this paper,

all of which are the major evaluation detailed items and key points of the human resources which can help the owners for the development of the affiliated restaurants. Among them, the human resource allocations and training can help the organizational members carry out their duties and continue their learning; increase their technical skills and ability; and cultivate interpersonal exchange skills, communication ability, management ability, and leadership, in order to become the most powerful support to improve service quality and build a good organizational system.

**4.2.3. Financial and Physical Resources.** A sound financial structure, abundant investment funds, and complete corollary equipment are all taken into consideration for the development of affiliated restaurants. Meanwhile, the design of floor plan with theme features and the location of the business base are the main factors that are able to attract consumers’ attention. Besides, creativity and environmental protection are the keys of the plan design and theme features of Taiwanese restaurants, while location selection and the average sale per unit area are not only important parts for retail and service industries but also crucial elements for the development of affiliated restaurants. The abovementioned evaluation factors can be referred by the owners when they are considering the physical and financial resource allocations in the aspects of ideology and reality.



TABLE 11: List for indicator extreme supermatrices.

Dimensions	Evaluation indicators	Physical resources	Financial resources	Brand/business reputation resources	Technical resources	Relationship resources	Marketing resources	Human resources	Organizational resources	Priority
Tangible assets	Physical resources	0.1221	0.1221	0.1221	0.1221	0.1221	0.1221	0.1221	0.1221	4
	Financial resources	0.1231	0.1231	0.1231	0.1231	0.1231	0.1231	0.1231	0.1231	3
Intangible assets	Brand/business reputation resources	0.0762	0.0762	0.0762	0.0762	0.0762	0.0762	0.0762	0.0762	5
	Technical resources	0.0637	0.0637	0.0637	0.0637	0.0637	0.0637	0.0637	0.0637	7
	Relationship resources	0.0611	0.0611	0.0611	0.0611	0.0611	0.0611	0.0611	0.0611	8
	Marketing resources	0.0678	0.0678	0.0678	0.0678	0.0678	0.0678	0.0678	0.0678	6
Personal ability	Human resources	0.2387	0.2387	0.2387	0.2387	0.2387	0.2387	0.2387	0.2387	2
Organizational ability	Organizational resources	0.2473	0.2473	0.2473	0.2473	0.2473	0.2473	0.2473	0.2473	1

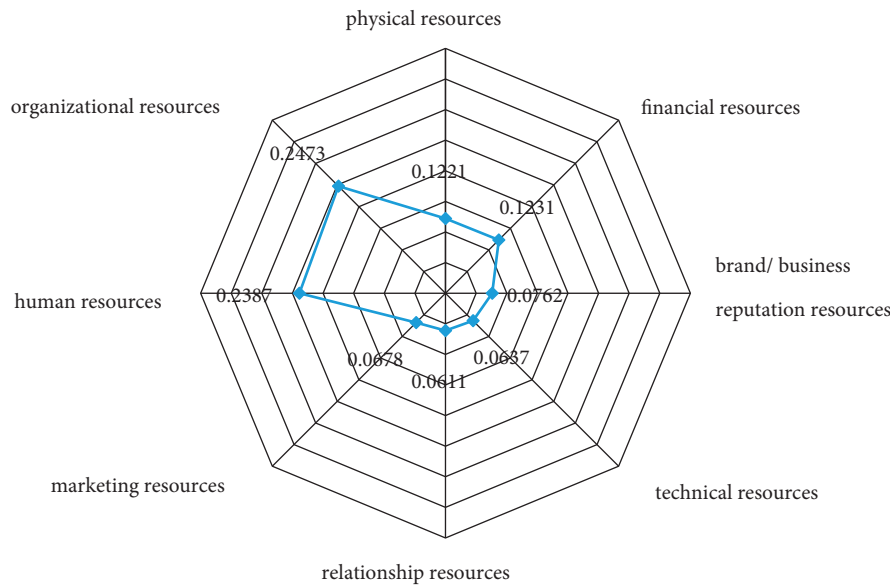


FIGURE 3: Radar analysis diagram of the core resources and impact indicators for the development of affiliated restaurants.

## 5. Conclusions and Suggestions

This study aims to explore the innovative business model of the hotel industry, which has a significant influence on the development of the hospitality industry. For Taiwan's tourist hotels, the average catering income is larger than the average rental income. Among the hotels of different levels and general hotels, the hotels with the highest incomes, such as Regent Taipei, all have affiliated restaurants, which is similar to this study's result. Human resources can have an indirect effect on restaurant business performance through the innovative acts [31]. Urbanization has a positive impact on hotel development, such as marketing, image, resources integration, and cooperation intensification [32], which is consistent with the importance of brands and the organizational resources that are emphasized by the major core resources on innovation as well as cross-organizational cooperation for the development of affiliated restaurants in this paper.

In this paper, there are two findings with management implications: one is teamwork which is emphasized in the practice of hotel management, verified by this paper, which discovers organizational resources and human resources as the crucial core resources for the development of affiliated restaurants; the other is the practice of core resource dimensions and indicators which really exist in the affiliated restaurants run by hotels in the practice of hotel business management. In terms of practical influence, in the four core resource dimensions (tangible assets, intangible assets, personal ability, and organizational ability) confirmed by the affiliated restaurants developed by hotels, it is found that both personal ability and organizational ability will affect the applications of tangible assets and intangible assets, personal ability in particular. Moreover, in view of the eight major resource indicators, human resources, financial resources, marketing resources, technical resources, and relationship resources will affect brand indicators, physical indicators,

and organizational indicators, in which human resources and financial resources have higher influence and the more influenced indicators are brand indicators.

To sum up, this paper not only conforms to the characteristic of labor intense for the tourism and hospitality industry confirming that human resources predominate the applications and development of other important resources but also discovers that large-medium hotels have more human resources and talents, most of which can use these resources to successfully develop their affiliated restaurants. However, for the hotel industry facing a shortage of talents and personnel, which is becoming more and more serious, there is no doubt that considering how to develop its business of affiliated restaurants and seeking for the sustainable development in the limited resources is an important basis for reference. For future research, (1) It is suggested that different types of affiliated restaurants can be discussed one by one, so as to more accurately confirm the core capabilities and indicators required by various types of restaurants. (2) Further research should be conducted on the major influential indicators, such as human resources, organizational resources, and factors with a high ranking of importance. Regarding research limitations, first, although there were 16 experts in this study, and they were from different universities and hotels, most of them were from northern Taiwan. They may not adequately represent the full spectrum of views held by individuals in different regions across Taiwan. The number and the regions of experts should be taken into consideration in further studies. Second, this study takes Taiwan as the scope of research, and the practices and considerations adopted probably differ from diverse countries.

## Data Availability

Data are available on request to the authors. The data source is obtained from the questionnaire analysis of the author's research.

## Conflicts of Interest

The authors declare that they have no conflicts of interest.

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