

Article

Establishing Competency Development Evaluation Systems and Talent Cultivation Strategies for the Service Industry Using the Hybrid MCDM Approach

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Abstract: Previously, coffee baristas only needed to learn basic coffee brewing skills. Today, in addition to coffee brewing skills, baristas also need to be able to identify the quality of coffee beans, select the appropriate way of roasting specific beans, and explain the growing regions and production processes for different coffees to customers. As coffee practitioners' competency gradually becomes specialized and complicated, understanding professional competency needs is critical to effectively cultivating a new generation of coffee practitioners. Further, without this understanding, it will be difficult to maintain the competitiveness of coffee industry practitioners in the third-wave coffee revolution. This study seeks to understand coffee consumers' service needs and coffee competency needs for the industry and to determine the driving forces of professional competency needs for the coffee (beverage) industry. In understanding coffee competency needs, we can analyze the status and gaps in coffee professionals' competency. Therefore, this study attempts to identify the professional competency needs of coffee industry practitioners (coffee operators and coffee workers) and consumers and introduces four major aspects (professional skills, professional knowledge, personal characteristics, and self-efficacy) to construct the competency needs and determine the network relation map (NRM). This research found that PK (professional knowledge) was the dominant aspect, and SE (self-efficacy) was the aspect being dominated. Moreover, the PK aspect affects the aspects of PS (professional skills), PC (personal characteristics), and SE (self-efficacy), and the PS aspect affects the aspects of PC and SE. Additionally, the PC aspect affects the SE aspect. Further, this study can aid various coffee service businesses in establishing competency development strategy maps and redefining coffee professionals' competency to achieve professional competency goals through staff selection and training and using their talents.



Citation: Lin, C.-L.; Kuo, C.-L. Establishing Competency Development Evaluation Systems and Talent Cultivation Strategies for the Service Industry Using the Hybrid MCDM Approach. *Sustainability* **2022**, *14*, 12280. <https://doi.org/10.3390/su141912280>

Academic Editors: Chrysanthi Charatsari and Evangelos D. Lioutas

Received: 24 April 2022

Accepted: 17 September 2022

Published: 27 September 2022

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Keywords: coffee practitioners; professional competence; competency development; DEMATEL; VIKOR

1. Introduction

With the continuous growth of the coffee-drinking population and the constant development of coffee roasting and extraction technology, coffee has been integrated into consumers' daily lives. Enjoying a cup of good coffee is not out of reach. The first wave of the coffee revolution sought to satisfy consumers' needs for low-cost, instant coffee. The second wave of the revolution emphasized on-site coffee brewed using hand punch coffee; the diversification of coffee production and coffee roasting technology is leading the third wave of the coffee revolution. Consumers are starting to enjoy premium coffee produced at particular farms and have begun to pay attention to coffee-producing areas and roasting methods. With the emergence of the third wave of the coffee revolution, customers are paying more and more attention to the quality of coffee, which affects the competency training and development of coffee practitioners. The demand for coffee-related technicians is increasing. The goal is to cultivate more outstanding coffee shop employees, and

coffee-related companies can also take this into consideration. It helps those companies to find talent and understand how they want to improve. This study looked for differences in implicit and explicit attitudes from the four facets of baristas, coffee roasters, and coffee tasters, and used this approach to subdivide their competency needs and identify obvious differences. After the four facets and competencies were analyzed for four coffee styles (international coffee chain, convenience store coffee, global brand coffee chain, domestic coffee chain), we will integrate these professional competencies and design a complete evaluation and training system.

Coffee practitioners need to handle customers' various needs and complaints, so strengthening the core competencies of public relations has become more critical for coffee practitioners. Therefore, a growing body of research has analyzed the role of public relations practitioners and conceptualizes the body of knowledge they need. These studies try to find critical competencies or behaviors for the public relations practitioners' role, but systematic studies of the core competencies are still lacking. Researchers have also tried to find the core competencies through in-depth interviews with the top 17 UK communicators. The study identified 10 behaviors or core competencies for senior communication practitioners in publicly held companies and 10 core competencies for the public sector's communication practitioners. The study analyzed core competencies and identified future research directions for the competency development of public relations practitioners [1]. The coffee service industry is part of the hospitality service industry, so coffee practitioners need to have professional knowledge and skills in hospitality service. Tourism studies and hospitality management internships have explored these cooperative education experiences to complement students' learning and enhance integrated competence and knowledge. Researchers analyzed the relationship between previous knowledge and internship experience and explored the internship's ability to increase students' new skills and enhance the link between academic theories and practical application. A study adopted mixed methods to evaluate the quantitative data from 339 questionnaire respondents and examine the qualitative outcomes of student focus groups. The study found that previous knowledge can prepare students for internships, and classroom discussion can aid their practical experiences. Moreover, the results pointed out that classroom education can increase new competencies and skills that they can use during their internship programs. The research results of the case study university also offered new information for further research [2].

In recent years, education-related topics in hospitality and tourism could be categorized into six groups (internationalization, industry experience, diversity education, online education, teaching methods with the emphasis on active and experiential learning, and leadership and human capital development). Moreover, a study has also discussed emerging development trends in the hospitality and tourism industries and explored how these trends influence the development of undergraduate students' cultural competency as well as hospitality and tourism Ph.D. programs. Therefore, the study offered new insights regarding hospitality and tourism education's current statuses and discussed developments trends for tourism and hospitality education-related research [3]. Practical internship experience can aid coffee practitioners in understanding the working environment and operation model for various coffee shops/coffee businesses. It can integrate theoretical knowledge and practical experience to solve the real problems of on-site coffee shops/coffee businesses. University–industry collaborations (UICs) have become more and more important for graduates' employability competencies. Another study explored teaching-focused UICs. The study adopted a three-staged mixed-methods approach to evaluate the critical factors that can influence employability competencies, based on the Indian Higher Education Institutes (HEIs). Researchers analyzed the Indian HEIs and their partners through 53 interviews and found critical factors that facilitate or hinder the development of teaching-focused UICs. The researchers gathered and tested these factors that influence the HEIs' propensity to form teaching-focused UICs. The study analyzed the impact on the employability competencies of graduates. The research suggested that the teaching-focused UICs partnering with HEIs can enhance the domain-specific employa-

bility competencies for UICs programs' graduates. Moreover, industrial embeddedness, academic embeddedness, discipline variety, and HEI's size can enhance UIC participation and industrial collaborations for teaching-focused universities [4].

Because coffee practitioners still lack a cultivation and training system for coffee professional competence, the quality of coffee employees today is uneven. This study analyzes the coffee service industry's professional competency needs and competency development status. It identifies four aspects (professional skills, professional knowledge, self-efficacy, and personal characteristics) of competency development based on expert interviews and a review of the literature. The study uses the DEMATEL (Decision-Making Trial and Evaluation Laboratory) approach to analyze professional competency and determine the driving forces of critical competency development. Moreover, the study also obtains the principal component based on a PCA (principal component analysis) approach and uses an ANP (analytic network process) approach to determine the components' weights. Then, a VIKOR (Vise kriterijumska Optimizacija I Kompromisno Resenje) approach is applied to professional competency development for the coffee service industry. This study surveys four styles of coffee service businesses (international coffee chain, convenience store coffee, global brand coffee chain, and domestic coffee chain). The results can aid stakeholders (service providers, industrial practitioners, and customers) in understanding competency development for coffee service businesses and by proposing competency development strategies for coffee service businesses through their competitive advantages of professional competency. The proposed model can aid stakeholders in identifying critical factors and determining suitable development strategies for coffee service businesses based on their competency development status using an NRM (network relation map) approach.

This study includes five sections. Section 2 discusses the service needs of coffee service businesses regarding professional competency development factors for the coffee service industry. Section 3 establishes an evaluation system of professional competency development for the coffee service industry. The study determines the critical influence factors for empirical cases for the coffee service industry using the hybrid MCDM technique in Section 4. This section also discusses the competency development force for the coffee service industry. It evaluates the advantages of professional competency for four styles of coffee service businesses using hybrid MCDM (multiple-criteria decision making) approaches. Finally, this study also provides some suggestions for future research in Section 5.

2. Literature Review

In the first wave of the coffee revolution during World War II, instant coffee and Robusta coffee beans prevailed. Even coffee beans of poor quality sold like hotcakes. They used low-grade coffee beans to reduce costs, resulting in a mass of low-quality coffee/fast food culture. Then, in 1966, the second wave of the coffee revolution began. The founder of Peet's coffee, promoting European deep-roasted and freshly ground beans for brewing and using high-altitude Arabica beans to enhance the flavor. Additionally, Peet's Coffee apprentices founded Starbucks and introduced Italian cappuccinos and lattes and initiated the globalization of coffee. With the beginning of the third wave of the coffee revolution in 2003, innovative civilians began seeking to counter the second wave of the coffee oligarch Starbucks. Using single-estate coffee beans and light roasts to identify the advantages of coffee beans, baristas form connections with consumers through the professional coffee brewing process. They teach consumers about coffee styles and how to taste coffee. There was no division of labor in early cafes. A counter was responsible for all competency projects. In the third wave of the coffee revolution, people have paid more and more attention to the quality of coffee, thus leading to "specialty coffee". To achieve the high quality of coffee beans and excellent sources of origin, there has been a specialization in the division of labor; the competency is divided into three areas: roasting, coffee tasting, and brewing. We have to determine their competency positioning and understand the difference and importance of attitude and knowledge.

2.1. Professional Skills (PS)

The competency study explored the hospitality industry's core competencies and collected 296 hospitality managers' samples in the Southeastern United States. The study determined six dimensions of core competencies (communication skills, leadership, food and beverage management skills, supervisory skills, interpersonal skills, and hospitality skills). Researchers noted that the six core competencies' importance showed significant differences between students and managers in the areas of leadership, interpersonal skills, and food and beverage management skills. The research results can provide useful insights for planning curriculum and can enhance the competencies and skills for future leaders [5]. Cultural understanding and cross-cultural competency can strengthen coffee practitioners' understanding of various customers' different service needs and increase practitioners' service quality and the teams' performance. Cross-cultural competency can increase team performance and improve multi-national hotel companies' organizational effectiveness. A study obtained 738 valid questionnaire samples based on the six multi-national hotel companies in Thailand. The researcher adopted the SEM (structural equation modeling) technique to analyze the relation structure between multi-cultural team performance and cross-cultural competency. The research found that intercultural competency has a direct and positive influence on multi-cultural team performance. In the study, the researcher offered practical management advice and cross-cultural theoretical recommendations for the hospitality industry and established an evaluation framework of intercultural competency through Thai multi-national hotels [6]. As a current trend in the tourism and hospitality industry, the service industry is shifting toward the service experience economy. The experience economy is growing globally, but very few talents can provide the expected "wow" experience to customers. The study tried to explore the employability skill needs in rural tourism and hospitality businesses and established an evaluation model for destinations' hospitality and tourism businesses. The researcher identified 14 essentials of employability skills for rural tourism and hospitality businesses through a literature review and determined the skills employers valued most in rural tourism and hospitality businesses. The study extended the existing competency framework and provided practical implications for rural hospitality and tourism businesses [7]. Soft skills were an essential part of the crucial competencies in research about management as it relates to competency. The study explored how managers teach soft skills on the job and provided faculty with the process for replicating the efforts of managers. The researcher adopted a grounded theory and established an evaluation framework based on the soft skills five-factor model. The study also analyzed the practical implications of soft skills and discussed how managers teach soft skills on the job [8].

2.2. Professional Knowledge (PK)

Professional knowledge competence can aid coffee practitioners in understanding relevant coffee professional knowledge to understand critical problems in the working field and find available solutions. Therefore, professional knowledge competence includes professional coffee knowledge (roasting, tasting, brewing, and service) and knowledge of the business operations and organization management. In the hospitality industry, the chef has the most challenging profession, and the chef needs both artistic innovation and scientific mastery. So, chefs require not only culinary skills but also managerial competence. A study explored chefs' perceptions of a successful career and how to develop competencies on the job. The study used a self-administered questionnaire that included 27 competency items based on Cyprus' professional chefs. Researchers found that culinary-specific technical competencies were critical, followed by management and leadership competencies. In contrast, the respondents considered conceptual (creative-adaptive) competencies less important [9]. A study of overseas dispatches explored how to reduce dispatch failure for international hotel companies. This study surveyed the competencies and skills of expatriation based on 66 representatives of the International Hotel & Restaurant Association. Researchers used an exploratory factor analysis to evaluate the critical factors of overseas

dispatches' competencies and skills. The research indicated that expatriate adjustment, global management skills, and personal competencies were essential factors in drafting successful overseas dispatches. Human resource development professionals should identify individual competencies for overseas dispatch work when evaluating high-potential expatriate managers. The proposed evaluation framework can also apply in educational programs to prepare students for work in international hospitality [10]. The competency approach has already become an evaluation tool in management competency development for hospitality and tourism organizations. So, some researchers have explored the relationship between professional competency, service performance, and customer satisfaction. Therefore, a previous study tried to establish an evaluation system of service-leadership competency for the hospitality and tourism industries. Researchers interpreted 100 behaviors in 20 competency areas and categories, for three competency styles (self-savvy, people savvy, and business savvy) through interviews with 110 industry managers. The study also proposed some practical suggestions for future research [11]. Another study explored the relationship between the finance discipline and hospitality education. Although academia seems to consider finance-related competencies necessary for hospitality education, the related literature remains inconclusive. Zopiatis et al. (2019) [12] tried to explore the value and potential role of finance-related courses in hospitality education to understand the conceptual capital issues in hospitality education. The study suggested that the finance discipline can enhance hospitality education through a meaningful connection between the two disciplines and offered practical suggestions for industry stakeholders and hospitality education researchers [12]. Learning contemporary knowledge and critical skills can aid the coffee practitioners in strengthening their initiative and self-management competency and then in building team organization and solving practical decision problems in the working field together.

2.3. Self Efficacy (SE)

A study found that practitioners who have passed professional skills certification feel more satisfied with their positions and report greater chances for promotion. Therefore, some studies noted that financial experts working in hotels have obtained a "Certified Hospitality Accountant Executive" (CHAE) designation. They believe that the CHAE designation has no real monetary value. However, compared to those without this certification, they are more likely to be promoted. The study interviewed professional hotel accounting supervisors who have this certification. Three-quarters said that the CHAE certificate demonstrates a person's professionalism, and two-thirds believed that the CHAE honorific attests to a person's technical expertise. This research found that people with a CHAE certificate were satisfied with their position and occupation [13]. The competency analysis identified tools for evaluating and grooming future organizational leaders. The study tried to explore the hospitality industry's leadership competency model based on 99 competencies or skills and determined eight overarching factors and 28 dimensions in the hospitality industry. The researchers assessed the importance of those competencies using a five-point scale based on the 137 industry leaders. They found that self-management competency was the most critical dimension, which included ethics and integrity, self-development, flexibility and adaptability, and time management. Competency in strategic positioning was the second most important dimension and included concern about the community, managing stakeholders, quality commitment, and awareness of customer needs. In addition to these factors, the respondents ranked interpersonal skills, leadership, and industry knowledge lower [14]. The competency approach can help identify professional competency and behaviors needed in the workforce for academic programs and hospitality organizations. A study explored the leadership competency model through the hospitality industry's director-level and frontline managers. Researchers adopted existing competency models to analyze 195 behaviors and determined 44 skills and 15 competencies using 30 senior hospitality leaders' opinions. The study reviewed relative importance and competency priority. It distilled these competencies into three style competencies (busi-

ness leadership competencies, people leadership competencies, and personal leadership competencies) through 98 director-level managers. The study also proposed practical and educational implications for future research [15]. Self-concept and self-efficacy can develop into sustainable behaviors for students. So, another study tried to enhance participatory ecological learning for students through mangrove forest ecotourism. Researchers explored the relationship between self-concept and self-efficacy and the students' sustainability by participatory ecological learning. The study used SEM for 128 participants through a PLS (partial least squares) analysis. The research found that self-concept had no significant effect on the students' behavior, but self-efficacy significantly impacted the students' sustainability behavior [16]. Therefore, self-concept and self-efficacy can develop coffee practitioners' self-learning and build sustainable professional competence development behaviors.

2.4. Personal Characteristics (PC)

A comparative competency study analyzed the hospitality unit leaders' competencies and determined the difference in critical skills, attributes, and abilities for different organizational contexts. Researchers compared two different hospitality segments (cruise ships and hotels). The study proposed a framework with four contextual dimensions (the external environment, organizational structure, task requirements, and staff composition) for the organizational context of ship and hotel leadership competencies. The research found that senior hotel and ship practitioners have the same core competencies, such as effective listening and a positive attitude. However, the organizational context still influences the relative importance of specific abilities, skills, and attributes in the different hospitality segments. The study also proposed some suggestions for researchers, practitioners, and educators [17]. The personality assessment plays a critical role in designing the training and development programs for first-line managers. A study adopted Cattell's 16PF5 to analyze the managerial and interpersonal competencies based on 70 hospitality students and 94 service sector managers in Hungary. The findings indicated that objectively assessed trainee personality profiles could help individuals and enterprises to develop management and training programs [18]. With global market growth and intercultural cooperation, postgraduates need intercultural competence and virtual teamwork experience. The study proposed the initiative based on three European institutions' academic teams. Researchers analyzed the virtual intercultural collaboration and surveyed the participating students' initiative over a two-year period. The research found that the participating students understood the importance of intercultural competence and virtual teamwork and discussed their viewpoints for the specific project's capacity in the relevant areas. The study also suggested that social media, teamwork, and intercultural interactions will become essential in the contemporary global work environment. Therefore, collaborative learning activities and inter-program teaching have become more critical for postgraduates in European higher education institutions [19].

This study establishes the evaluation model based on the four evaluation aspects (professional skills, professional knowledge, self-efficacy, and personal characteristics) and 16 criteria for professional competency development through expert interviews and literature reviews. Associated with the PS (professional skills) aspect, there are four evaluation criteria: coffee roasting skills (PS1), coffee tasting skills (PS2), coffee brewing skills (PS3), and customer service skills (PS4). Concerning the PK (professional knowledge) aspect, the four evaluation criteria are the identification of sources of raw materials (PK1), roasting parameter setting (PK2), grinding extraction knowledge (PK3), and hand modulation knowledge (PK4). Associated with the SE (self-efficacy) aspect, there are four evaluation criteria: responsibility and professionalism (SE1), workplace ethics and professional ethics (SE2), emotional control and resistance to stress (SE3), and crisis response and judgment ability (SE4). Concerning the PC (personal characteristics) aspect, there are four evaluation criteria: optimism and positive thinking (PC1), affinity and service enthusiasm (PC2), work performance and efficiency (PC3), and mutual assistance and teamwork (PC4). The four

aspects, their associated evaluation criteria, and their respective descriptions are shown in Table 1.

Table 1. The descriptions of professional competency development for the coffee service industry.

Aspects/Criteria	Descriptions
Professional skills (PS)	
Coffee roasting skills (PS1)	The development of coffee roasting skills can help coffee shop employees select and control the roasting degree of coffee.
Coffee tasting skills (PS2)	The development of coffee tasting skills helps to increase the ability of coffee shop employees to identify coffee production areas and coffee roasting degrees.
Coffee brewing skills (PS3)	The development of coffee brewing skills helps to improve the skills of coffee shop employees for coffee extraction, coffee brewing, and latte art.
Customer service skills (PS4)	The development of customer service skills helps to increase the ability of coffee shop employees to guide customers in selecting personally preferred coffee types.
Professional knowledge (PK)	
Identification of sources of raw materials (PK1)	The development of knowledge for identifying sources of raw materials can help coffee shop employees identify coffee production areas and coffee flavor characteristics.
Roasting parameter setting (PK2)	The development of knowledge of roasting parameter settings helps coffee shop employees understand roasting degree settings and roasting curve interpretation.
Grinding extraction knowledge (PK3)	Grinding and extracting knowledge can help coffee shop employees improve their understanding of coffee grinders and appropriate extraction rates.
Hand modulation knowledge (PK4)	Hand modulation knowledge helps to improve coffee shop employees' understanding of coffee brewing, coffee concentration, mixed modulation ration control, milk foam production, and latte art.
Self-efficacy (SE)	
Responsibility and professionalism (SE1)	The development of responsibility and professionalism help coffee shop employees to focus on service processes and improve service quality.
Workplace ethics and professional ethics (SE2)	The development of workplace ethics and professional ethics can ensure that coffee shop employees respect workplace ethics and value consumer drinking safety.
Emotional control and resistance to stress (SE3)	The development of emotional control and resistance to stress can ensure that coffee shop employees can adapt to personal emotions in all situations.
Crisis response and judgment ability (SE4)	The development of crisis response and judgment ability enables coffee shop employees to calmly judge and properly handle emergencies.
Personal characteristics (PC)	
Optimism and positive thinking (PC1)	Coffee practitioners who have positive thinking qualities can maintain positive emotions and be self-motivated at any time.
Affinity and service enthusiasm (PC2)	Coffee shop employees with affinities and service enthusiasm allow customers to feel like family and friends during the service process.
Work performance and efficiency (PC3)	Coffee practitioners have work efficiency to complete their assigned tasks within limited resources and timeliness.
Mutual assistance and teamwork (PC4)	Coffee practitioners' mutual assistance and teamwork can help reduce internal friction and improve team effectiveness.

3. Proposed Methods

This study interviewed stakeholders of professional competence development for coffee practitioners (coffee operators, coffee practitioners, and customers) for the surveys. The research generalizes four aspects (professional skills, professional knowledge, self-efficacy, and personal characteristics) and 16 criteria based on the stakeholders' interviews. Through the questionnaire survey, which was distributed on paper and online, the researcher evaluates satisfaction, importance, and aspects of the evaluation system by the various stakeholders (coffee operators, coffee practitioners, and customers). The survey data were collected from November 2020 to March 2021. At total of 150 samples were collected, of which there were 108 valid samples. The reliability of the satisfaction and importance were calculated with Cronbach's α . The satisfaction reliability result was 0.970, and the importance reliability result was 0.979. The reliability results of satisfaction and importance were higher than the suggested reliability level of 0.7. The evaluation system aspect's reliability was 0.932, indicating that the aspect had a high reliability.

3.1. DEMATEL

The DEMATEL approach can be applied in complex decision problems, such as in the following: user interface analyses through the DEMATEL technique [20]; the evaluation system of failure sorting [21]; Taiwan's SIP Mall industrial innovation policy portfolios using the DEMATEL technique [22]; the establishment of the science (technology) parks' value-created systems [23]; the establishment of the corporate social responsibility (CSR) selection model for international tourist hotels [24]; the establishment of improvement strategies for matrix organization performance using the DEMATEL approach [25]; the evaluation model of design delay using an ISA-IRM approach [26]; the causal model of supply chain collaboration based on the fuzzy DEMATEL approach [27]; the service position model of vehicle telematics systems (VTSs) [28]; the establishment of the service platforms selection approach of digital music using the MCDM technique [29]; the continuation of satisfaction with e-learning in higher education using the DEMATEL technique [30]; the package tour services evaluation model using an MCDM technique [31]; the establishment of the development strategies of sustainable industrial tourism using an IOA-NRM technique [32]; the establishment of the science and technology strategies using a SWOT NRM (network relation map) based on the mixed FMADM approach [33]; the determination of the key factors of outsourcing for complex product systems' R&D projects based on the ANP and grey-DEMATEL approach [34]; the creation of a service evaluation system of emerging culture festival events based on the MCDM technique [35]; the comparison of municipalities' environmental sustainability combining the approaches of DEMATEL and TOPSIS [36]; the creation of urban and rural tourism's environment sustentation strategies using an MCDM approach [37]; the application of green-strategic sourcing based on the gray DEMATEL-ANP [38]; the determination of common suited paths and urban sustainable development strategies based on various stakeholders' perspectives [39]; and the establishment of science parks' development strategies based on a hybrid MCDM approach [40]. The DEMATEL technique includes five steps: (1) analyze the original average matrix, (2) calculate the direct influence matrix, (3) calculate the indirect influence matrix, (4) evaluate the full influence matrix, and (5) determine the NRM (network relation map).

1. Analyze the original average matrix

Respondents evaluated the influence among the aspects according to scoring scales ranging from 0 to 4. "0" means no influence, and "4" means "extremely strong influence between aspect/criterion". Moreover, "1", "2", and "3" mean "low influence", "medium influence", and "high influence", respectively. The influence of the PS (professional skills) aspect on the aspect of PK (professional knowledge) is 3.065, which was interpreted as "high influence". Likewise, the influence of the aspect of SE (self-efficacy) on the aspect of PS (professional skills) is 2.333, again interpreted as "medium influence", as illustrated in Table 2.

Table 2. The original influence matrix.

Aspects	PS	PK	SE	PC	Total
Professional skills (PS)	0.000	3.065	2.426	2.093	7.583
Professional knowledge (PK)	3.130	0.000	2.370	2.120	7.620
Self-efficacy (SE)	2.333	2.352	0.000	2.556	7.241
Personal characteristics (PC)	2.046	2.056	2.722	0.000	6.824
Total	7.509	7.472	7.519	6.769	-

2. Calculate the direct influence matrix

The study evaluates the "original influence matrix (A)" by Equations (1) and (2) and considers the "direct influence matrix (D)" as illustrated in Table 3. The diagonal items of D are all 0, and the sum of a row is, at most, 1, as illustrated in Table 3. The degree of direct influence can be obtained by adding the columns and rows. The sum of the rows and

columns for professional skills (PS) and PK (professional knowledge) were 1.981, which is the most important influence aspect. On the other hand, the sum of the rows and columns for PC (personal characteristics) was 1.784, which is the least important influence aspect, as illustrated in Table 4.

$$D = sA, s > 0 \quad (1)$$

where

$$s = \min_{i,j} [1 / \max_{1 \leq i \leq n} \sum_{j=1}^n a_{ij}, 1 / \max_{1 \leq j \leq n} \sum_{i=1}^n a_{ij}], i, j = 1, 2, \dots, n \quad (2)$$

and $\lim_{m \rightarrow \infty} D^m = [0]_{n \times n}$, where $D = [x_{ij}]_{n \times n}$, when $0 < \sum_{j=1}^n x_{ij}, \sum_{i=1}^n x_{ij} \leq 1$ at least one $\sum_{j=1}^n x_{ij}$ or $\sum_{i=1}^n x_{ij}$ equal one, and only one row sum or column sum equal one. So, we can guarantee $\lim_{m \rightarrow \infty} D^{m-1} = [0]_{n \times n}$.

Table 3. The direct influence matrix (D).

Aspects	PS	PK	SE	PC	Total
Professional skills (PS)	0.000	0.402	0.318	0.275	0.995
Professional knowledge (PK)	0.411	0.000	0.311	0.278	1.000
Self-efficacy (SE)	0.306	0.309	0.000	0.335	0.950
Personal characteristics (PC)	0.269	0.270	0.357	0.000	0.896
Total	0.985	0.981	0.987	0.888	-

Table 4. The comparison analysis of direct influence matrix.

Aspects	Sum of Row	Sum of Column	Sum of Row and Column	Importance of Influence
Professional skills (PS)	0.995	0.985	1.981	1
Professional knowledge (PK)	1.000	0.981	1.981	1
Self-efficacy (SE)	0.950	0.987	1.937	3
Personal characteristics (PC)	0.896	0.888	1.784	4

3. Calculate the indirect influence matrix

The indirect influence matrix can be derived from Equation (3), as illustrated in Table 5.

$$ID = \sum_{i=2}^{\infty} D^i = D^2(I - D)^{-1} \quad (3)$$

Table 5. The indirect influence matrix (ID).

Aspects	PS	PK	SE	PC	Total
Professional skills (PS)	6.390	6.250	6.275	5.815	24.731
Professional knowledge (PK)	6.294	6.390	6.302	5.836	24.822
Self-efficacy (SE)	6.061	6.037	6.103	5.560	23.760
Personal characteristics (PC)	5.802	5.780	5.738	5.393	22.714
Total	24.548	24.457	24.418	22.604	-

4. Evaluate the full influence matrix

The T (full influence matrix) can be derived through Equations (4) or (5). The T consists of multiple elements, indicated by Equation (6) as illustrated in Table 6. $\{d_i\}$ is the sum vector of the row value. $\{r_j\}$ is the sum vector of the column value. We then let $i = j$, the sum vector of row value plus the column value, $\{d_i + r_i\}$, which means the T (full influence matrix). If the sum of row value plus the column value $\{d_i + r_i\}$ is higher, the aspect/criterion relationship is stronger. The sum of the row value minus the column value is $\{d_i - r_i\}$, which indicates the net influence relationship. If $d_i - r_i > 0$, it means the degree of influencing others is stronger than the degree of being influenced; otherwise, $d_i - r_i < 0$.

$$T = D + ID = \sum_{i=1}^{\infty} D^i \quad (4)$$

$$T = \sum_{i=2}^{\infty} D^i = D(I - D)^{-1} \quad (5)$$

$$T = [t_{ij}], \quad i, j \in \{1, 2, \dots, n\} \quad (6)$$

$$d = d_{n \times 1} = \left[\sum_{j=1}^n t_{ij} \right]_{n \times 1} = (d_1, \dots, d_i, \dots, d_n) \quad (7)$$

$$r = r_{n \times 1} = \left[\sum_{i=1}^n t_{ij} \right]'_{1 \times n} = (r_1, \dots, r_j, \dots, r_n) \quad (8)$$

Table 6. The full influence matrix.

Aspects	PS	PK	SE	PC	Total
Professional skills (PS)	6.390	6.652	6.593	6.090	25.726
Professional knowledge (PK)	6.705	6.390	6.613	6.114	25.822
Self-efficacy (SE)	6.367	6.346	6.103	5.895	24.710
Personal characteristics (PC)	6.071	6.050	6.095	5.393	23.610
Total	25.534	25.438	25.404	23.492	-

As illustrated in Table 7, the aspects of PS (professional skills) and PK (professional knowledge) have the highest degree of full influence ($d_1 + r_1 = d_2 + r_2 = 51.260$), and the PC (personal characteristics) aspect has the lowest degree of full influence ($d_4 + r_4 = 47.101$). The PK (professional knowledge) aspect also has the highest degree of net influence ($d_2 - r_2 = 0.384$). The order of other net influences is as follows: the PS (professional skills) aspect ($d_1 - r_1 = 0.192$), the PC (personal characteristics) aspect ($d_4 - r_4 = 0.118$), and finally, the SE (self-efficacy) aspect ($d_3 - r_3 = 0.693$).

Table 7. The degree of full influence.

Aspects	$\{d_i\}$	$\{r_i\}$	$\{d_i+r_i\}$	$\{d_i-r_i\}$
Professional skills (PS)	25.726	25.534	51.260	0.192
Professional knowledge (PK)	25.822	25.438	51.260	0.384
Self-efficacy (SE)	24.710	25.404	50.114	-0.693
Personal characteristics (PC)	23.610	23.492	47.101	0.118

5. Determine the NRM (network relation map)

The matrix's diagonal items are all 0. The matrix contains a strictly lower triangular matrix and a strictly upper triangular matrix. Moreover, while the strictly lower triangular matrix and the strictly upper are the same, their symbols are opposite. We can choose one of the strictly triangular matrices. The full influence matrix can be obtained by Equations (4) and (5) as shown in Table 6. The net influence matrix can be produced by Equation (9),

as shown in Table 8. The X and Y values can be obtained through the $(d + r)$ value and $(d - r)$ value as shown in Table 7. The NRM (network relation map) can draw as illustrated in Figure 1 and Table 8.

$$T_{net} = [t_{ij} - t_{ji}], \quad i, j \in \{1, 2, \dots, n\} \tag{9}$$

Table 8. The net influence matrix.

Aspects	PS	PK	SE	PC
Professional skills (PS)	-			
Professional knowledge (PK)	0.053	-		
Self-efficacy (SE)	-0.226	-0.267	-	
Personal characteristics (PC)	-0.019	-0.063	0.200	-

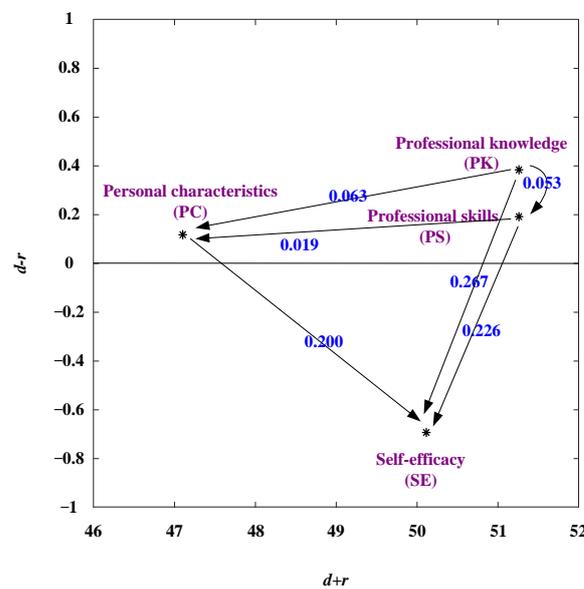


Figure 1. The NRM (network relation map) of competency development.

The aspects of PK (professional knowledge), PS (professional skills), and PC (personal characteristics) are the influencing aspects, and the aspect of SE (self-efficacy) is the influenced aspect. This study aims to assist coffee service providers and coffee practitioners in establishing an improved process and provides calculations of the net (to be received) influence matrix extracted from the full influence matrix, as shown in Table 8. This evaluation method can integrate the degree of influence of each aspect and gain the net influence relation among these four aspects. The PK (professional knowledge) aspect has a net influence on the aspects of PS (professional skills), PC (personal characteristics), and SE (self-efficacy). The PS (professional skills) aspect has a net influence on the PC (personal characteristics) aspect and SE (self-efficacy) aspect. The PC (personal characteristics) aspect has a net impact on SE (self-efficacy). So, the PK (professional knowledge) aspect can be enhanced first, followed by the PS (professional skills) and PC (personal characteristics) aspects. The aspect of SE (self-efficacy) is the least essential improvement item among all aspects, as shown in Figure 1 and Table 8.

3.2. PCA (Principal Component Analysis)

The original data of importance degree were analyzed through the PCA technique. The PCA technique can reduce the criteria number and satisfy the AHP/ANP hypothesis on criteria independence/dependence [41]. One component can be extracted: PSP1 (brewing and tasting skills, PSP1) and the square sum (84.098%). This study named the major component, as shown in Table 9. Coffee brewing skills (PS3), coffee tasting skills (PS2),

coffee roasting skills (PS1), and customer service skills (PS4) can be combined into the first major component PSP1 (brewing and tasting skills).

Table 9. The PCA analysis of PS (professional skills) aspect.

Aspects	Components	Criteria	Components	
			1	Community
Professional skills (PS)	Brewing and tasting skills (PSP1)	Coffee brewing skills (PS3)	0.941	0.885
		Coffee tasting skills (PS2)	0.924	0.855
		Coffee roasting skills (PS1)	0.921	0.848
		Customer service skills (PS4)	0.881	0.776
	Eigenvalue λ		3.364	
	% of Variance		84.098	
	Cumulative (%)		84.098	
	Cronbach's α		0.937	

3.3. Analytic Network Procedure (ANP)

The ANP technique can apply the decision problems of interrelationships and interdependence in the real world [42–45]. The complex decision problems can be separated into elements within a simplified hierarchical framework using the ANP technique [46–48]. The ANP technique has six steps: (1) analyze the decision problem and establish the evaluation of the framework, (2) design a questionnaire survey, (3) evaluate the aspects'/components' relative importance using the pair-wise comparisons to determine their weights under the consideration of dependence and feedback, (4) analyze the transposed and normalized full influence matrix, (5) analyze the weighted supermatrix, and (6) calculate the component weights [49–51].

1. Analyze the decision problem and establish the evaluation of the framework

The decision-maker can simplify a complex decision problem by determining the relation structure of the evaluation system. The decision-makers should consider all possible alternatives and establish the evaluation system's structure relationship through expert reviews and brainstorming. However, the evaluation system often includes many aspects/criteria, and these aspects/criteria influence each other. Thus, decision-makers can adopt the NRM (network relation map) approach to evaluate the network relation structure. This study determines the network relation map based on the NRM approach and utilizes the ANP approach to establish the relation weights of aspects/components.

2. Design questionnaire survey

According to the evaluation framework, the expert can judge the degree of the aspects'/criteria's relative importance. Hence, the study uses a questionnaire to evaluate the aspects'/criteria's relative importance.

3. Evaluate the aspects'/components' relative importance using pair-wise comparisons to evaluate the aspects'/components' weights under consideration of dependence and feedback. ANP procedures to obtain the weights are as follows: (1) Evaluate the aspects'/components' relative importance via pair-wise comparisons and obtain an $n \times n$ pair-wise comparison matrix, in which n means the number of components. (2) Calculate the logical judgment consistency by both the consistency index (C.I.) and the consistency ratio (C.R.). In general, C.I. and C.R. should be less than 0.1.

4. Analyze the transposed and normalized full influence matrix

The full influence matrix (T) can be derived by Equations (4) or (5). The d_i can be calculated by Equation (10) through the sum of the column of the full influence matrix (T). Then, the normalized full influence matrix (T_N) can be obtained through Equation (11), and the transposed and normalized full influence matrix (T_N^t) can be derived through

Equation (12). T_N^t is the transposed-normalized full influence matrix as illustrated in Table 10.

$$T = \begin{bmatrix} t_{11} & \dots & t_{1j} & \dots & t_{1n} \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ t_{i1} & \dots & t_{ij} & \dots & t_{in} \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ t_{n1} & \dots & t_{nj} & \dots & t_{nn} \end{bmatrix} \rightarrow \begin{aligned} d_1 &= \sum_{j=1}^n t_{1j} \\ d_i &= \sum_{j=1}^n t_{ij} \\ d_n &= \sum_{j=1}^n t_{nj} \end{aligned} \tag{10}$$

where $d_i = \sum_{j=1}^n t_{ij}, i = 1, 2, \dots, n$

$$T_N = \begin{bmatrix} t_{11}/d_1 & \dots & t_{1j}/d_1 & \dots & t_{1n}/d_1 \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ t_{i1}/d_i & \dots & t_{ij}/d_i & \dots & t_{in}/d_i \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ t_{n1}/d_n & \dots & t_{nj}/d_n & \dots & t_{nn}/d_n \end{bmatrix} = \begin{bmatrix} t_{11}^N & \dots & t_{1j}^N & \dots & t_{1n}^N \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ t_{i1}^N & \dots & t_{ij}^N & \dots & t_{in}^N \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ t_{n1}^N & \dots & t_{nj}^N & \dots & t_{nn}^N \end{bmatrix} \tag{11}$$

$$T_N^t = (T_N)' = \begin{bmatrix} t_{11}^N & \dots & t_{i1}^N & \dots & t_{n1}^N \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ t_{1j}^N & \dots & t_{ji}^N & \dots & t_{nj}^N \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ t_{1n}^N & \dots & t_{in}^N & \dots & t_{nn}^N \end{bmatrix} \tag{12}$$

Table 10. The transposed-normalized full influence matrix (T_N^t).

Aspects	PS	PK	SE	PC
Professional skills (PS)	0.248	0.260	0.258	0.257
Professional knowledge (PK)	0.259	0.247	0.257	0.256
Self-efficacy (SE)	0.256	0.256	0.247	0.258
Personal characteristics (PC)	0.237	0.237	0.239	0.228
Total	1.000	1.000	1.000	1.000

5. Analyze the weighted supermatrix

The W_p (un-weighted supermatrix) is illustrated in Equation (13), whereas the W_p is composed of many sub-matrices (W_{ij}). The researcher solves the relationship of dependency and feedback in the NRM (network relation map), and the ANP approach analyzes the sub-matrix's weight by the pair-wise comparison matrix, as illustrated in Equation (14). If only the single aspect of the component exists, the sub-matrix is the unit matrix (I). When the aspect includes more than one component, the sum of the component weight equals one. As illustrated in Table 10, the W_L (weighted supermatrix) can be calculated through multiplying the T_N^t (transposed-normalized full influence matrix) and the W_p , or it can be derived through Equation (15). Therefore, when there is more than one component in each

aspect, the W_L (weighted supermatrix) can be modified through Equations (15) and (16), as illustrated in Tables 11 and 12.

$$W_P = \begin{bmatrix} W_{11} & \dots & W_{1j} & \dots & W_{1m} \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ W_{i1} & \dots & W_{ij} & \dots & W_{im} \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ W_{m1} & \dots & W_{mj} & \dots & W_{mm} \end{bmatrix} \tag{13}$$

$$W_{ij} = \begin{bmatrix} w_{P_{11}} & \dots & w_{P_{1j}} & \dots & w_{P_{1m}} \\ \vdots & & \vdots & & \vdots \\ w_{P_{i1}} & \dots & w_{P_{ij}} & \dots & w_{P_{im}} \\ \vdots & & \vdots & & \vdots \\ w_{P_{m1}} & \dots & w_{P_{mj}} & \dots & w_{P_{mm}} \end{bmatrix} = 1 \quad i = 1, 2, \dots, m \quad j = 1, 2, \dots, m \tag{14}$$

here $\sum_{i=1}^m w_{P_{i1}} = \sum_{i=1}^m w_{P_{ij}} = \sum_{i=1}^m w_{P_{im}} = 1$

$$W_L = T_N^t \times W_P = \begin{bmatrix} t_{11}^N \times W_{11} & \dots & t_{i1}^N \times W_{1j} & \dots & t_{n1}^N \times W_{1m} \\ \vdots & & \vdots & & \vdots \\ t_{1j}^N \times W_{i1} & \dots & t_{ji}^N \times W_{ij} & \dots & t_{nj}^N \times W_{im} \\ \vdots & & \vdots & & \vdots \\ t_{1n}^N \times W_{m1} & \dots & t_{in}^N \times W_{mj} & \dots & t_{nn}^N \times W_{mm} \end{bmatrix} \tag{15}$$

$$t_{ji}^N \times W_{ij} = \begin{bmatrix} t_{11}^N \times w_{P_{11}} & \dots & t_{i1}^N \times w_{P_{1j}} & \dots & t_{n1}^N \times w_{P_{1m}} \\ \vdots & & \vdots & & \vdots \\ t_{1j}^N \times w_{P_{i1}} & \dots & t_{ji}^N \times w_{P_{ij}} & \dots & t_{nj}^N \times w_{P_{im}} \\ \vdots & & \vdots & & \vdots \\ t_{1n}^N \times w_{P_{m1}} & \dots & t_{in}^N \times w_{P_{mj}} & \dots & t_{nn}^N \times w_{P_{mm}} \end{bmatrix} \tag{16}$$

Table 11. Un-weighted supermatrix (W_p).

Aspects	Components	PSP1	PKP1	SEP1	PCP1
Professional skills (PS)	Brewing and tasting skills (PSP1)	1.000	1.000	1.000	1.000
Professional knowledge (PK)	Extraction and modulation knowledge (PKP1)	1.000	1.000	1.000	1.000
Self-efficacy (SE)	Emotional control and professionalism (SEP1)	1.000	1.000	1.000	1.000
Personal characteristics (PC)	Work performance and service enthusiasm (PCP1)	1.000	1.000	1.000	1.000
Total		4.000	4.000	4.000	4.000

Table 12. Weighted supermatrix.

Aspects	Components	PSP1	PKP1	SEP1	PCP1
Professional skills (PS)	Brewing and tasting skills (PSP1)	0.248	0.260	0.258	0.257
Professional knowledge (PK)	Extraction and modulation knowledge (PKP1)	0.259	0.247	0.257	0.256
Self-efficacy (SE)	Emotional control and professionalism (SEP1)	0.256	0.256	0.247	0.258
Personal characteristics (PC)	Work performance and service enthusiasm (PCP1)	0.237	0.237	0.239	0.228
Total		1.000	1.000	1.000	1.000

6. Analyze the weighted super-matrix

The super-matrix can be gained through $(W \times LW_L)^{2p+1}$ where p is determined by assumption. The ANP approach could determine the weight of the components and the reduced criteria are derived from the independent component obtained. The criteria weights can be established through the ANP approach. In the process of limitation, multiples of the super-matrix M for 45 squares and the component weights can be obtained as illustrated in Table 13.

Table 13. Limited super-matrix.

Aspects	Components	PSP1	PKP1	SCP1	PCP1
Professional skills (PS)	Brewing and tasting skills (PSP1)	0.256	0.256	0.256	0.256
Professional knowledge (PK)	Extraction and modulation knowledge (PKP1)	0.255	0.255	0.255	0.255
Self-efficacy (SE)	Emotional control and professionalism (SEP1)	0.254	0.254	0.254	0.254
Personal characteristics (PC)	Work performance and service enthusiasm (PCP1)	0.235	0.235	0.235	0.235
	Total	1.000	1.000	1.000	1.000

7. Calculate the component weights

As illustrated in Table 14, the parenthetic value means the weights of the aspects/components. The highest component weight, based on the PCA approach, is the PS (professional skills) aspect (0.256), followed by the aspects of PK (professional knowledge) (0.255), SE (self-efficacy) (0.254), and PC (personal characteristics) (0.235).

Table 14. The component weights.

Aspects	Components	Component Weights
Professional skills (PS)	Brewing and tasting skills (PSP1)	0.256
Professional knowledge (PK)	Extraction and modulation knowledge (PKP1)	0.255
Self-efficacy (SE)	Emotional control and professionalism (SEP1)	0.254
Personal characteristics (PC)	Work performance and service enthusiasm (PCP1)	0.235
	Total	1.000

3.4. VIKOR

The researcher can evaluate the positive ideal solution and the negative ideal solution for the existing coffee service businesses through the VIKOR approach. When calculating the distance between the ideal solution and the current service status, each criterion of the existing service system scores should be summarized. The gaps between the guests' highest level of satisfaction and lowest level of satisfaction with the existing coffee service businesses also analyze the values/utilities of the current coffee service businesses. Thus, the researcher can evaluate and improve the CEI (competency evaluation index) for the coffee service industry based on the VIKOR approach [51–58]. The VIKOR approach was started with the form of the L_p metric, which was used as an aggregating function in a compromise programming approach [59,60]. The VIKOR method provided a maximum group utility of the "majority" and a minimum individual regret of the "opponent". The compromise solutions could be the basis for negotiation, involving the decision-makers' preferences based on the aspects'/components' weights, as shown in Figure 2.

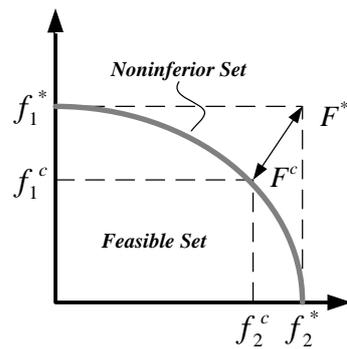


Figure 2. Ideal and compromise solutions.

In Figure 2, F^* is the ideal solution. f_1^* represents the ideal value (also called the aspired/desired level) of Factor 1. f_2^* represents the ideal value (the aspired/desired level) of Factor 2. The compromise solution, F^c , is a feasible solution that is “closest” to the ideal F^* . A compromise means an agreement established by mutual concessions. The VIKOR approach is presented with the following steps:

Step 1. Determines the best f_k^* value and the worst f_k^- value in aspect/component i .

$$f_k^* = \left\{ \left(\max_k f_{ik} \mid k \in I_1 \right), \left(\min_k f_{ik} \mid k \in I_2 \right); \text{ or setting the aspired level for } i \text{ criterion} \right\}, \forall k \tag{17}$$

$$f_k^- = \left\{ \left(\min_k f_{ik} \mid k \in I_1 \right), \left(\max_k f_{ik} \mid k \in I_2 \right); \text{ or setting the aspired level for } i \text{ criterion} \right\}, \forall k \tag{18}$$

where i is the criterion; k is the k th alternative; f_{ik} is the performance value of the i th criterion of k th alternative; I_1 is the cluster of utility-oriented criteria; I_2 is the cluster of the cost-oriented criteria; f_i^* is the positive-ideal solution; and f_i^- is the positive-ideal solution.

Step 2. Evaluates the values S_k and $Q_k, k = 1, 2, \dots, m$, using the relationships

$$\text{Let } r_{ik} \text{ be } r_{ik} = (|f_i^* - f_{ik}|) / (|f_i^* - f_i^-|). \tag{19}$$

$$d_k^p = \left\{ \sum_{i=1}^n [w_i (|f_i^* - f_{ik}|) / (|f_i^* - f_i^-|)]^p \right\}^{1/p} = \left\{ \sum_{i=1}^n [w_i r_{ik}]^p \right\}^{1/p}, \quad p \geq 1$$

$$S_k = d_k^{p=1} = \sum_{i=1}^n w_i r_{ik}, \quad \sum_{i=1}^n w_i = 1 \tag{20}$$

$$Q_k = d_k^{p=\infty} = \max_k \{r_{ik} \mid i = 1, 2, \dots, n\}, \tag{21}$$

where S_k shows the average gap for achieving the aspired/desired level. Q_k illustrates the maximal degree of regret for prior improvement of the gap aspect/component. w_i is the weight of aspect/component i and $i = 1, 2, \dots, n$, expresses the relative importance value of the criteria gained via the application of the ANP approach.

Step 3. Computes the index values $R_k, k = 1, 2, \dots, m$, using the relationship:

$$R_k = v(S_k - S^*) / (S^- - S^*) + (1 - v)(Q_k - Q^*) / (Q^- - Q^*) \tag{22}$$

$$S^* = \min_k S_k, \quad S^- = \max_k S_k$$

$$Q^* = \min_k Q_k, \quad Q^- = \max_k Q_k$$

where $S^* = \min_k S_k$ (showing the minimal average gap is the best, but we also can set $S^* = 0$), $S^- = \max_k S_k$ (we can set $S^- = 1$), $Q^* = \min_k Q_k$ (illustrating the minimal degree of regret is the best, but we also can set $Q^* = 0$), and $Q^- = \max_k Q_k$ (we can set $Q^- = 1$).

We also can re-write Equation (22) as: $R_k = vS_k + (1 - v)Q_k$.

Step 4. Rank the alternatives

When $0 \leq v \leq 1$ and when $v > 0.5$, this indicates S is emphasized more than Q in Equation (22), whereas when $v < 0.5$, this indicates Q is emphasized more than S in Equation (22). More specifically, when $v = 1$, it represents an alternative evaluation process that could use the strategy of maximum group utility; whereas when $v = 0$, it represents an alternative evaluation process that could adopt the strategy of minimum individual regret, which is obtained among the maximum individual regrets/gaps of lower-level dimensions of each project (or aspects/objectives). The weight (v) would affect the ranking order of the aspects/components and it is usually determined by the decision-makers. In this paper, R_k is applied to determine the CEI (competency evaluation index). R_k could also consider the index of the maximum group utility and the minimum individual regret of the “opponent”, where a smaller R_k is better and $0 \leq R_k \leq 1$.

4. The Analysis of Competency Development for Coffee Practitioners

This section includes four sub-sections. The first section presents a comparative analysis of competency development. The principal components of the four aspects adopt a PCA approach in the second section. The third section determines the evaluation and selects the competency development of coffee practitioners for the coffee service industry using the VIKOR approach. The improving paths of coffee service businesses are presented in the fourth section, and the discussion and suggestions are in the fifth section.

4.1. The Comparative Analysis of Competency Development for Coffee Practitioners

This study selects four service styles of coffee service businesses (international coffee chain, convenience store coffee, global brand coffee chain, domestic coffee chain) in Taiwan. The service styles of coffee service industry include two service styles (convenience store coffee and coffee chain). The coffee chain includes international coffee chain, global brand coffee chain, and domestic coffee chain. The study proposes the four aspects (professional skills, professional knowledge, self-efficacy, and personal characteristics) to evaluate the CEI (competency evaluation index) for the four service styles of the coffee service industry. It also compares the competitive advantages of the four competency evaluation indices (CEIs) for the four service styles of the coffee service industry. In the horizontal analysis, the coffee service businesses of global brand coffee chain (Style C) has a competitive advantage in the aspects of PS (professional skills), PK (professional knowledge), and SE (self-efficacy), and the domestic coffee chain (Style D) has a competitive advantage in the PC (personal characteristics) aspect. The convenience store coffee (Style B) has a competitive disadvantage in the aspects of PS, PK, SC, and PC, as illustrated as in Figure 3 and Table 15.

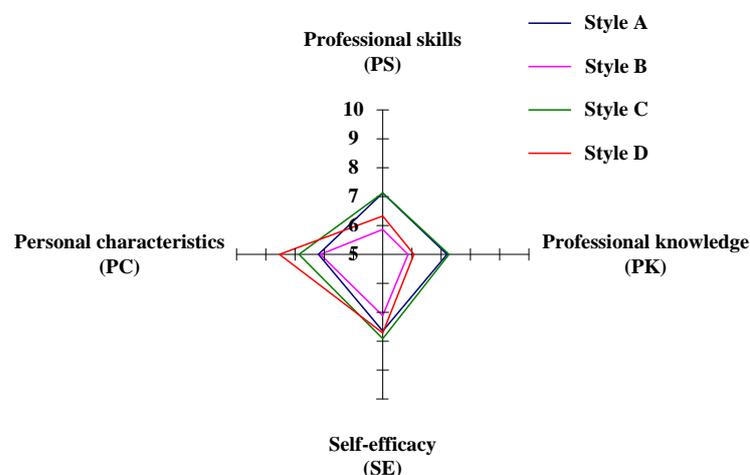


Figure 3. The CEI competitive radar map of competency development.

Table 15. The competency development of coffee service industry.

Aspects	International Coffee Chain	Convenience Store Coffee	Global Brand Coffee Chain	Domestic Coffee Chain
	(Style A)	(Style B)	(Style C)	(Style D)
Horizontal analysis				
Professional skills (PS)	7.120 (2)	5.875 (4)	7.137 (1)	6.300 (3)
Professional knowledge (PK)	7.170 (2)	5.875 (4)	7.265 (1)	6.050 (3)
Self-efficacy (SE)	7.660 (3)	7.125 (4)	7.917 (1)	7.750 (2)
Personal characteristics (PC)	7.230 (3)	7.156 (4)	7.897 (2)	8.550 (1)
Vertical analysis				
Professional skills (PS)	7.120 (4)	5.875 (3)	7.137 (4)	6.300 (3)
Professional knowledge (PK)	7.170 (3)	5.875 (3)	7.265 (3)	6.050 (4)
Self-efficacy (SE)	7.660 (1)	7.125 (2)	7.917 (1)	7.750 (2)
Personal characteristics (PC)	7.230 (2)	7.156 (1)	7.897 (2)	8.550 (1)

In the vertical analysis, the international coffee chain (Style A), convenience store coffee (Style B), and global brand coffee chain (Style C) have disadvantages/gaps in the PS (professional skills) aspect, and the convenience store coffee (Style B) and domestic coffee chain (Style D) have disadvantages/gaps in the IC (implicit capability) aspect. The international coffee chain (Style A) and global brand coffee chain (Style C) have advantages/competitiveness in the SE (self-efficacy) aspect. The convenience store coffee (Style B) and domestic coffee chain (Style D) have advantages/competitiveness in the PC (personal characteristics) aspect, as illustrated as in Figure 3 and Table 15.

In the PS (professional skills) aspect, the study provided four criteria (coffee roasting skills, coffee tasting skills, coffee brewing skills, and customer service skills) to evaluate the CEI (competency evaluation index) for the four service styles of coffee service businesses. In the horizontal analysis, the global brand coffee chain (Style C) has a competitive advantage in the criteria of PS1 (coffee roasting skills) and PS3 (coffee brewing skills) and the international coffee chain (Style A) has a competitive advantage in the criteria of PS2 (coffee tasting skills) and PS4 (customer service skills). The convenience store coffee (Style B) has a competitive disadvantage in the criteria of PS2 and PS4 and the domestic coffee chain (Style D) a competitive disadvantage in the criteria of PS1 (coffee roasting skills) and PS3 (coffee brewing skills), as illustrated as in Figure 4 and Table 16.

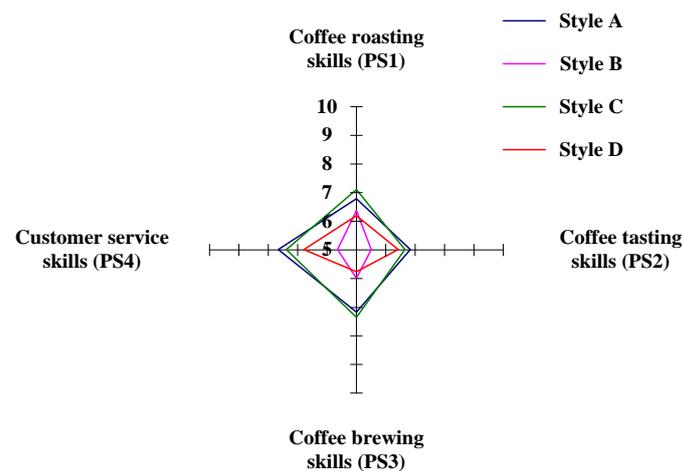
**Figure 4.** The competency development for PS (professional skills) aspect.

Table 16. The competency analysis for PS (professional skills) aspect.

Styles	International Coffee Chain	Convenience Store Coffee	Global Brand Coffee Chain	Domestic Coffee Chain
Criteria	(Style A)	(Style B)	(Style C)	(Style D)
Horizontal analysis				
Coffee roasting skills (PS1)	6.800 (2)	6.375 (3)	7.098 (1)	6.200 (4)
Coffee tasting skills (PS2)	6.840 (1)	5.500 (4)	6.667 (2)	6.400 (3)
Coffee brewing skills (PS3)	7.200 (2)	6.000 (3)	7.392 (1)	5.800 (4)
Customer service skills (PS4)	7.640 (1)	5.625 (4)	7.392 (2)	6.800 (3)
Vertical analysis				
Coffee roasting skills (PS1)	6.800 (4)	6.375 (1)	7.098 (3)	6.200 (3)
Coffee tasting skills (PS2)	6.840 (3)	5.500 (4)	6.667 (4)	6.400 (2)
Coffee brewing skills (PS3)	7.200 (2)	6.000 (2)	7.392 (1)	5.800 (4)
Customer service skills (PS4)	7.640 (1)	5.625 (3)	7.392 (1)	6.800 (1)

In the vertical analysis, the convenience store coffee (Style B) has a advantage/competitiveness in the criterion of PS1 (coffee roasting skills), and the international coffee chain (Style A) has a disadvantage/gap in the criterion of PS1. The convenience store coffee (Style B) and global brand coffee chain (Style C) have disadvantages/gaps in the criterion of PS2 (coffee tasting skills). The global brand coffee chain (Style C) has a advantage/competitiveness in the criterion of PS3 (coffee brewing skills) and the domestic coffee chain (Style D) has a disadvantage/gap in the criterion of PS3. The international coffee chain (Style A), global brand coffee chain (Style C), and domestic coffee chain (Style D) have advantages/competitiveness in the criterion of PS4 (customer service skills), as shown as in Figure 4 and Table 16.

In the PK (professional knowledge) aspect, the study provided four criteria (identification of sources of raw materials, roasting parameter setting, grinding extraction knowledge, and hand modulation knowledge) to evaluate the CEI (competency evaluation index) for the four coffee service businesses styles. In the horizontal analysis, the international coffee chain (Style A) has a competitive advantage in the criteria of PK2 (roasting parameter setting), PK3 (grinding extraction knowledge), and PK4 (hand modulation knowledge), and the global brand coffee chain (Style C) has a competitive advantage in the criterion of PK1 (identification of sources of raw materials). The convenience store coffee (Style B) has a competitive disadvantage in the criteria of PK1 (identification of sources of raw materials) and PK4 (hand modulation knowledge), and the domestic coffee chain (Style D) has a competitive disadvantage in the criteria of PK2 (roasting parameter setting) and PK3 (grinding extraction knowledge), as shown as in Figure 5 and Table 17.

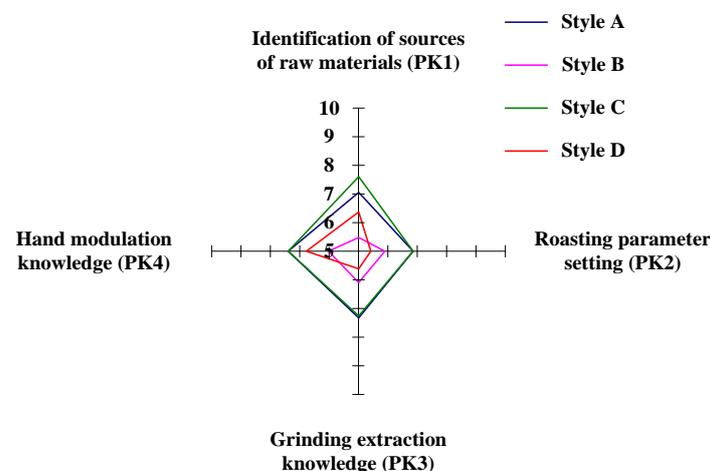
**Figure 5.** The competency development for PK (professional knowledge) aspect.

Table 17. The competency analysis for PK (professional knowledge) aspect.

Styles	International Coffee Chain	Convenience Store Coffee	Global Brand Coffee Chain	Domestic Coffee Chain
Criteria	(Style A)	(Style B)	(Style C)	(Style D)
Horizontal analysis				
Identification of sources of raw materials (PK1)	7.040 (2)	5.500 (4)	7.569 (1)	6.400 (3)
Roasting parameter setting (PK2)	6.880 (1)	5.875 (3)	6.824 (2)	5.400 (4)
Grinding extraction knowledge (PK3)	7.360 (1)	6.125 (3)	7.275 (2)	5.600 (4)
Hand modulation knowledge (PK4)	7.400 (1)	6.000 (4)	7.392 (2)	6.800 (3)
Vertical analysis				
Identification of sources of raw materials (PK1)	7.040 (3)	5.500 (4)	7.569 (1)	6.400 (2)
Roasting parameter setting (PK2)	6.880 (4)	5.875 (3)	6.824 (4)	5.400 (4)
Grinding extraction knowledge (PK3)	7.360 (2)	6.125 (1)	7.275 (3)	5.600 (3)
Hand modulation knowledge (PK4)	7.400 (1)	6.000 (2)	7.392 (2)	6.800 (1)

In the vertical analysis, the global brand coffee chain (Style C) has a advantage/competitiveness in the criterion of PK1 (identification of sources of raw materials) aspect, and the convenience store coffee (Style B) has a disadvantage/gap in the criterion of PK1 aspect. The international coffee chain (Style A), global brand coffee chain (Style C), and domestic coffee chain (Style D) have disadvantages/gaps in the criterion of PK2 (roasting parameter setting). The convenience store coffee (Style B) has a advantage/competitiveness in the PK3 (grinding extraction knowledge), and the international coffee chain (Style A) and domestic coffee chain (Style D) have advantages/competitiveness in the criterion of PK4 (hand modulation knowledge), as shown in Figure 5 and Table 17.

In the SE (self-efficacy) aspect, the study proposed four criteria (responsibility and professionalism, workplace ethics and professional ethics, emotional control and resistance to stress, and crisis response and judgment ability) to evaluate the CEI (competency evaluation index) for the four coffee service businesses styles. In the horizontal analysis, the global brand coffee chain (Style C) has a competitive advantage in the criteria of SE1 (responsibility and professionalism) and SE2 (workplace ethics and professional ethics), and the domestic coffee chain (Style D) has a competitive advantage in the SE3 (emotional control and resistance to stress) criterion and SE4 (crisis response and judgment ability) criterion. The convenience store coffee (Style B) has a competitive disadvantage in the SE1 (responsibility and professionalism), SE3 (emotional control and resistance to stress), and SE4 (crisis response and judgment ability) criteria, and the domestic coffee chain (Style D) has a competitive disadvantage in the SE2 (workplace ethics and professional ethics) criterion as shown as in Figure 6 and Table 18.

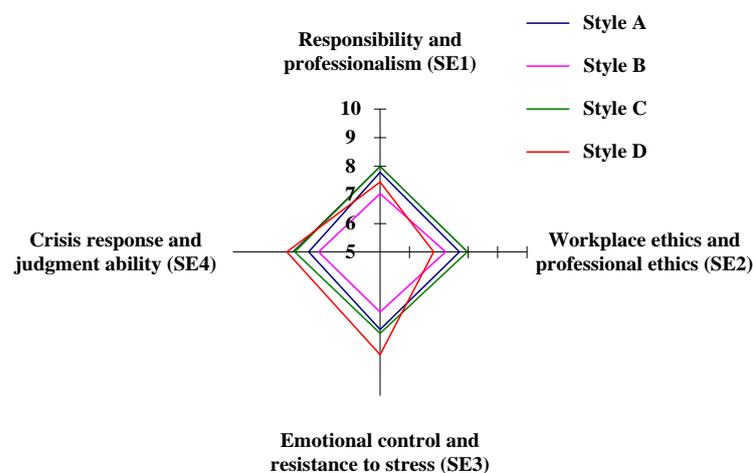
**Figure 6.** The competency development for SE (self-efficacy) aspect.

Table 18. The competency analysis for SE (self-efficacy) aspect.

Styles	International Coffee Chain	Convenience Store Coffee	Global Brand Coffee Chain	Domestic Coffee Chain
Criteria	(Style A)	(Style B)	(Style C)	(Style D)
Horizontal analysis				
Responsibility and professionalism (SE1)	7.760 (2)	7.000 (4)	7.941 (1)	7.400 (3)
Workplace ethics and professional ethics (SE2)	7.720 (2)	7.250 (3)	8.000 (1)	6.800 (4)
Emotional control and resistance to stress (SE3)	7.720 (3)	7.125 (4)	7.843 (2)	8.600 (1)
Crisis response and judgment ability (SE4)	7.440 (3)	7.125 (4)	7.882 (2)	8.200 (1)
Vertical analysis				
Responsibility and professionalism (SE1)	7.760 (1)	7.000 (4)	7.941 (2)	7.400 (3)
Workplace ethics and professional ethics (SE2)	7.720 (2)	7.250 (1)	8.000 (1)	6.800 (4)
Emotional control and resistance to stress (SE3)	7.720 (2)	7.125 (2)	7.843 (4)	8.600 (1)
Crisis response and judgment ability (SE4)	7.440 (4)	7.125 (2)	7.882 (3)	8.200 (2)

In the vertical analysis, the international coffee chain (Style A) has a advantage/competitiveness in the criterion of SE1 (responsibility and professionalism) and the convenience store coffee (Style B) has a disadvantage/gap in the criterion of SE1 (responsibility and professionalism). The convenience store coffee (Style B) and global brand coffee chain (Style C) have advantages/competitiveness in the criterion of SE2 (workplace ethics and professional ethics), and the domestic coffee chain (Style D) has a disadvantage/gap in the criterion of SE2 (workplace ethics and professional ethics). The domestic coffee chain (Style D) has a advantage/competitiveness in the criterion of SE3 (emotional control and resistance to stress), and the global brand coffee chain (Style C) has a disadvantage/gap in the SE3 criterion. The international coffee chain (Style A) has a disadvantage/gap in the criterion of SE4 (crisis response and judgment ability), as shown in Figure 6 and Table 18.

In the PC (personal characteristics) aspect, the study proposed four criteria (optimism and positive thinking, affinity and service enthusiasm, work performance and efficiency, mutual assistance and teamwork) to evaluate the CEI (competency evaluation index) for the four coffee service businesses styles. In the horizontal analysis, the domestic coffee chain (Style D) has a competitive advantage in the criteria of PC1 (optimism and positive thinking), PC2 (affinity and service enthusiasm), PC3 (work performance and efficiency), and PC4 (mutual assistance and teamwork). Convenience store coffee (Style B) has a competitive disadvantage in the criteria of PC1 (optimism and positive thinking) and PC2 (affinity and service enthusiasm), and the international coffee chain (Style A) has a competitive disadvantage in the criteria of PC3 and PC4, as illustrated as in Figure 7 and Table 19.

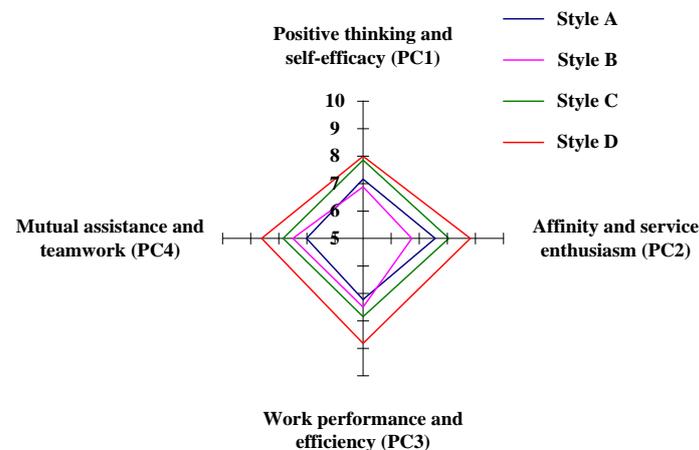
**Figure 7.** The competency development for PC (personal characteristics) aspect.

Table 19. The competency analysis for PC (personal characteristics) aspect.

Styles Criteria	International Coffee Chain	Convenience Store Coffee	Global Brand Coffee Chain	Domestic Coffee Chain
	(Style A)	(Style B)	(Style C)	(Style D)
Horizontal analysis				
Optimism and positive thinking (PC1)	7.120 (3)	6.875 (4)	7.843 (2)	8.000 (1)
Affinity and service enthusiasm (PC2)	7.600 (3)	6.750 (4)	8.039 (2)	8.800 (1)
Work performance and efficiency (PC3)	7.200 (4)	7.500 (3)	7.843 (2)	8.800 (1)
Mutual assistance and teamwork (PC4)	7.000 (4)	7.500 (3)	7.863 (2)	8.600 (1)
Vertical analysis				
Optimism and positive thinking (PC1)	7.120 (3)	6.875 (3)	7.843 (3)	8.000 (4)
Affinity and service enthusiasm (PC2)	7.600 (1)	6.750 (4)	8.039 (1)	8.800 (1)
Work performance and efficiency (PC3)	7.200 (2)	7.500 (1)	7.843 (3)	8.800 (1)
Mutual assistance and teamwork (PC4)	7.000 (4)	7.500 (1)	7.863 (2)	8.600 (3)

In the vertical analysis, the international coffee chain (Style A), global brand coffee chain (Style C), and domestic coffee chain (Style D) have advantages/competitiveness in the criterion of PC2 (affinity and service enthusiasm), and the convenience store coffee (Style B) and domestic coffee chain (Style D) have advantages/competitiveness in the criterion of PC3 (work performance and efficiency). The convenience store coffee (Style B) has an advantage/competitiveness in the criterion of PC4 (mutual assistance and teamwork). The global brand coffee chain (Style C) and domestic coffee chain (Style D) have disadvantages/gap in the criterion of PC1 (optimism and positive thinking). The convenience store coffee (Style B) has a disadvantage/gap in the PC2 criterion, and the global brand coffee chain (Style C) has a disadvantage/gap in the criterion of PC3 (work performance and efficiency). The international coffee chain (Style A) has a disadvantage/gap in the criterion of PC4 (mutual assistance and teamwork), as shown in Figure 7 and Table 19.

4.2. PCA (Principal Component Analysis)

The PCA approach is adopted to evaluate the component's number. If the eigenvalue is larger than one ($\lambda_i > 1$), the t th potential component is kept, otherwise, it is removed. Based on the PCA analysis, the aspect of personal characteristics (PC) accumulation loading is 88.88%, which can explain 88.88% of the aspect content. We can determine the accumulating loading threshold, for example, as 70%, and factor loading to determine the components' number. Only one component can be extracted from each CEI (competency evaluation index) aspect, as illustrated in Table 20. The four components can be named as follows: brewing and tasting skills (ECP1), extraction and modulation knowledge (ICP1), emotional control and professionalism (SEP1), and work performance and service enthusiasm (PCP1) for the CEI (competency evaluation index), as shown in Table 20.

Table 20. Component matrix after axis-spin.

Aspects	Components	Criteria	Components	
			1	Community
Professional skills (PS)	Brewing and tasting skills (PSP1)	Coffee brewing skills (PS3)	0.941	0.885
		Coffee tasting skills (PS2)	0.924	0.855
		Coffee roasting skills (PS1)	0.921	0.848
		Customer service skills (PS4)	0.881	0.776
	Eigenvalue λ	3.364		
	% of Variance	84.098		
	Cumulative (%)	84.098		
	Cronbach's α	0.937		

Table 20. Cont.

Aspects	Components	Criteria	Components	
			1	Community
Professional knowledge (PK)	Extraction and modulation knowledge (PKP1)	Grinding extraction knowledge (PK3)	0.965	0.932
		Hand modulation knowledge (PK4)	0.946	0.894
		Roasting parameter setting (PK2)	0.941	0.885
		Identification of sources of raw materials (PK1)	0.914	0.835
	Eigenvalue λ	3.546		
	% of Variance	88.651		
	Cumulative (%)	88.651		
	Cronbach's α	0.957		
Self-efficacy (SE)	Emotional control and professionalism (SEP1)	Emotional control and resistance to stress (SE3)	0.965	0.931
		Workplace ethics and professional ethics (SE2)	0.950	0.903
		Responsibility and professionalism (SE1)	0.917	0.840
		Crisis response and judgment ability (SE4)	0.908	0.825
	Eigenvalue λ	3.500		
	% of Variance	87.493		
	Cumulative (%)	87.493		
	Cronbach's α	0.952		
Personal characteristics (PC)	Work performance and service enthusiasm (PCP1)	Work performance and efficiency (PC3)	0.960	0.921
		Optimism and positive thinking (PC1)	0.958	0.919
		Mutual assistance and teamwork (PC4)	0.932	0.868
		Affinity and service enthusiasm (PC2)	0.920	0.847
	Eigenvalue λ	3.555		
	% of Variance	88.881		
	Cumulative (%)	88.881		
	Cronbach's α	0.958		

4.3. The Selection of Professionals Competency for Coffee Service Industry Based on the VIKOR Approach

1. Determines the best f_i^* value and the worst f_i^- value in aspect/component i . The value of the i th aspects/criteria goes from 0 to 10. In Equations (17) and (18), as illustrated in Table 21, k is the k th alternative of factor i ; f_{ik} is the performance value of the aspects/criteria i in alternative k ; f_i^* is the positive-ideal solution (setting the desired/aspired level by decision-making from customers' needs); and f_i^- is the negative-ideal solution (setting the worst value by decision-making from users). f_i^* is assumed to be 10 and f_i^- is assumed to be 0. This result can aid decision-makers in improving the satisfaction gap.

Table 21. The score of f_{ik} .

Aspects	Weight	International Coffee Chain	Convenience Store Coffee	Global Brand Coffee Chain	Domestic Coffee Chain	f_{vk}^*	f_{vk}^-
		(Style A)	(Style B)	(Style C)	(Style D)		
Professional skills (PS)	0.256	7.120	5.875	7.137	6.300	10	0
Professional knowledge (PK)	0.255	7.170	5.875	7.265	6.050	10	0
Self-efficacy (SE)	0.254	7.660	7.125	7.917	7.750	10	0
Personal characteristics (PC)	0.235	7.230	7.156	7.897	8.550	10	0

2. Computes the values S_{vk} and $Q_{vk}, k = 1, 2, \dots, m$ through the relationships weight.

In referring to Equations (20) and (21), w_i are the component weights, expressing the relative importance value of the components via the ANP approach. The lowest S_{vk} is 0.245 in Style C (international coffee chain) and the highest S_{vk} is 0.351 in Style B (convenience store coffee), as illustrated in Table 22. In addition, the lowest Q_{vk} is 0.286 in Style C (global brand coffee chain) and the highest Q_{vk} is 0.413 in Style B (convenience store coffee) among the CEI (competency evaluation index).

Table 22. The weighted value of the components of f_{vk} .

Aspects	Weight	International Coffee Chain	Convenience Store Coffee	Global Brand Coffee Chain	Domestic Coffee Chain
		(Style A)	(Style B)	(Style C)	(Style D)
Professional skills (PS)	0.256	0.288	0.413	0.286	0.370
Professional knowledge (PK)	0.255	0.283	0.413	0.274	0.395
Self-efficacy (SE)	0.254	0.234	0.288	0.208	0.225
Personal characteristics (PC)	0.235	0.277	0.284	0.210	0.145
S_{vk}		0.270	0.351	0.245	0.287
Q_{vk}		0.288	0.413	0.286	0.395

3. Computes the index values $R_{vk}, k = 1, 2, \dots, m$, using the following relationship

In referring to Equation (22), $\min_k S_{vk}$ has a maximum group utility (“majority” rule) and $\min_k Q_{vk}$ has a minimum individual regret of the “opponent”. R_{vk} is the indicator of the gap in the alternative k (the smaller, the better). The R_{vk} would decrease as v rises from 0 to 1, as shown in Table 23.

Table 23. Under different v for CEI (competency evaluation index).

v	International Coffee Chain	Convenience Store Coffee	Global Brand Coffee Chain	Domestic Coffee Chain
	(Style A)	(Style B)	(Style C)	(Style D)
0.00	0.288	0.413	0.286	0.395
0.10	0.286	0.406	0.282	0.384
0.20	0.284	0.400	0.278	0.373
0.30	0.283	0.394	0.274	0.362
0.40	0.281	0.388	0.270	0.352
0.50	0.279	0.382	0.266	0.341
0.60	0.277	0.375	0.262	0.330
0.70	0.276	0.369	0.258	0.319
0.80	0.274	0.363	0.254	0.308
0.90	0.272	0.357	0.249	0.297
1.00	0.270	0.351	0.245	0.287

4. Ranks the alternatives

In Table 24, the R_{vk} under different v is illustrated and R_{vk} (here $v = 0.5$) can apply to evaluate the CEI (competency evaluation index). The R_{vk} can also evaluate the index of the minimum individual regret and the maximum group utility of the “opponent”, in which R_{vk} means that smaller is better and $0 \leq R_{vk} \leq 1$. The researcher adopts $1 - R_{vk}$ for the system evaluation, in which $1 - R_{vk}$ means that bigger is better. When the v value of the CEI (competency evaluation index) is 0.5, then $V = R_{vk}$ and the CEI = $1 - R_{vk}$. Therefore, the CEI (competency evaluation index) of different alternatives can be obtained. Under $v = 0.0$, the lowest CEI (competency evaluation index) is 0.588, belonging to Style B (convenience store coffee), and the highest CEI (competency evaluation index) is 0.714, belonging to Style C (global brand coffee chain). In ranking the SDIs of three styles of coffee service businesses, Style C (global brand coffee chain) is better than other coffee service businesses, as illustrated in Table 24.

Table 24. The CEI (competency evaluation index) ($1 - R_{vk}$) under different v .

v	International Coffee Chain	Convenience Store Coffee	Global Brand Coffee Chain	Domestic Coffee Chain
	(Style A)	(Style B)	(Style C)	(Style D)
0.00	0.712	0.588	0.714	0.605
0.10	0.714	0.594	0.718	0.616
0.20	0.716	0.600	0.722	0.627
0.30	0.717	0.606	0.726	0.638
0.40	0.719	0.612	0.730	0.648
0.50	0.721	0.618	0.734	0.659
0.60	0.723	0.625	0.738	0.670
0.70	0.724	0.631	0.742	0.681
0.80	0.726	0.637	0.746	0.692
0.90	0.728	0.643	0.751	0.703
1.00	0.730	0.649	0.755	0.713

As illustrated in Table 25, under $v = 0.5$, the lowest CEI (competency evaluation index) is 0.618, which belongs to Style B (convenience store coffee), the highest CEI (competency evaluation index) is 0.734 and belongs to Style C (global brand coffee chain), and the ranking of the CEI (competency evaluation index) of coffee service businesses is $Style - C \supset Style - A \supset Style - D \supset Style - B$. The coffee service businesses of Style C (global brand coffee chain) are higher than other coffee service businesses. Under $v = 1.0$, the lowest CEI (competency evaluation index) is 0.649 and belongs to Style B (convenience store coffee), the highest SDI is 0.755, belonging to Style C (global brand coffee chain), and the ranking of the SDI of the coffee service businesses is $Style - C \supset Style - A \supset Style - D \supset Style - B$. The coffee service business of Style C (global brand coffee chain) is better than the other coffee service businesses, as shown in Table 25.

Table 25. The CEI (competency evaluation index) under $v = 0, 0.5$, and 1.0 .

		International Coffee Chain	Convenience Store Coffee	Global Brand Coffee Chain	Domestic Coffee Chain
		(Style A)	(Style B)	(Style C)	(Style D)
$v = 0.0$	R_{vk}	0.288	0.413	0.286	0.395
	CEI	0.712	0.588	0.714	0.605
	Rank	2	4	1	3
$v = 0.5$	R_{vk}	0.279	0.382	0.266	0.341
	CEI	0.721	0.618	0.734	0.659
	Rank	2	4	1	3
$v = 1.0$	R_{vk}	0.270	0.351	0.245	0.287
	CEI	0.730	0.649	0.755	0.713
	Rank	2	4	1	3

As illustrated in Table 25, Style C (global brand coffee chain) has the highest value in CEI (competency evaluation index), and Style B (convenience store coffee) has the lowest value in CEI (competency evaluation index). Therefore, there are still gaps among Style B (convenience store coffee), Style D (domestic coffee chain), Style A (international coffee chain), and Style C (global brand coffee chain) that can be enhanced with the four driving forces, as illustrated in Figure 3 and Table 15.

4.4. The Improving Paths Analysis for Different Coffee Service Businesses

This study proposes the analytic process of improving paths based on the rank of aspect satisfaction. The advantage aspect can improve the disadvantage aspect, so that higher satisfaction can improve lower satisfaction. In Style A (international coffee chain), the rank of aspect satisfaction for the coffee service businesses was SE (self-efficacy) > PC (personal characteristics) > PK (professional knowledge) > PS (professional skills),

as illustrated in Table 26. Then, the coffee service businesses of Style A (international coffee chain) can determine four improvement paths: two available improving paths ($PK(3) \rightarrow PS(4) \rightarrow SE(1) \{Y\}$; $PK(3) \rightarrow PS(4) \rightarrow PC(2) \rightarrow SE(1) \{Y\}$) and two unavailable improving paths ($PK(3) \rightarrow SE(1) \{N\}$; $PK(3) \rightarrow PC(2) \rightarrow SE(1) \{N\}$). In Style B (convenience store coffee), the rank of aspect satisfaction for the coffee service businesses was PC (personal characteristics) > SE (self-efficacy) > PK (professional knowledge) = PS (professional skills), as illustrated in Table 26. Then, the coffee service businesses of Style B (convenience store coffee) can determine four improvement paths: three available improving paths ($PK(3) \rightarrow PC(1) \rightarrow SE(2) \{Y\}$; $PK(3) \rightarrow PS(3) \rightarrow SE(2) \{Y\}$; $PK(3) \rightarrow PS(3) \rightarrow PC(1) \rightarrow SE(2) \{Y\}$) and one unavailable improving path ($PK(3) \rightarrow SE(2) \{N\}$).

Table 26. The advantageous and disadvantageous aspects/components and development paths of competency development for the coffee service industry.

	Advantageous and Disadvantageous Aspects/Components	Development Paths
International coffee chain (Style A)	Self-efficacy (SE) > Personal characteristics (PC) > Professional knowledge (PK) > Professional skills (PS)	1. $PK(3) \rightarrow SE(1) \{N\}$ 2. $PK(3) \rightarrow PC(2) \rightarrow SE(1) \{N\}$ 3. $PK(3) \rightarrow PS(4) \rightarrow SE(1) \{Y\}$ 4. $PK(3) \rightarrow PS(4) \rightarrow PC(2) \rightarrow SE(1) \{Y\}$
Convenience store coffee (Style B)	Personal characteristics (PC) > Self-efficacy (SE) > Professional knowledge (PK) = Professional skills (PS)	1. $PK(3) \rightarrow SE(2) \{N\}$ 2. $PK(3) \rightarrow PC(1) \rightarrow SE(2) \{Y\}$ 3. $PK(3) \rightarrow PS(3) \rightarrow SE(2) \{Y\}$ 4. $PK(3) \rightarrow PS(3) \rightarrow PC(1) \rightarrow SE(2) \{Y\}$
Global brand coffee chain (Style C)	Self-efficacy (SE) > Personal characteristics (PC) > Professional knowledge (PK) > Professional skills (PS)	1. $PK(3) \rightarrow SE(1) \{N\}$ 2. $PK(3) \rightarrow PC(2) \rightarrow SE(1) \{N\}$ 3. $PK(3) \rightarrow PS(4) \rightarrow SE(1) \{Y\}$ 4. $PK(3) \rightarrow PS(4) \rightarrow PC(2) \rightarrow SE(1) \{Y\}$
Domestic coffee chain (Style D)	Personal characteristics (PC) > Self-efficacy (SE) > Professional skills (PS) > Professional knowledge (PK)	$PK(4) \rightarrow SE(2) \{N\}$ $PK(4) \rightarrow PC(1) \rightarrow SE(2) \{Y\}$ $PK(4) \rightarrow PS(3) \rightarrow SE(2) \{N\}$ $PK(4) \rightarrow PS(3) \rightarrow PC(1) \rightarrow SE(2) \{Y\}$
	Common improving path	$PK \rightarrow PS \rightarrow PC \rightarrow SC$

In Style C (global brand coffee chain), the rank of aspect satisfaction for the coffee service businesses was SE (self-efficacy) > PC (personal characteristics) > PK (professional knowledge) > PS (professional skills), as illustrated in Table 26. Then, the coffee service businesses of Style C (global brand coffee chain) can determine four improvement paths: two available improving paths ($PK(3) \rightarrow PS(4) \rightarrow SE(1) \{Y\}$; $PK(3) \rightarrow PS(4) \rightarrow PC(2) \rightarrow SE(1) \{Y\}$) and two unavailable improving paths ($PK(3) \rightarrow SE(1) \{N\}$; $PK(3) \rightarrow PC(2) \rightarrow SE(1) \{N\}$). In Style D (domestic coffee chain), the rank of aspect satisfaction for the coffee service businesses was PC (personal characteristics) > SE (self-efficacy) > PS (professional skills) > PK (professional knowledge), as illustrated in Table 26. Then, the coffee service businesses of Style D (domestic coffee chain) can determine four improvement paths: two available improving paths ($PK(4) \rightarrow PC(1) \rightarrow SE(2) \{Y\}$; $PK(4) \rightarrow PS(3) \rightarrow PC(1) \rightarrow SE(2) \{Y\}$) and two unavailable improving paths ($PK(4) \rightarrow SE(2) \{N\}$; $PK(4) \rightarrow PS(3) \rightarrow SE(2) \{N\}$). So, the coffee service businesses can determine one common improving path ($PK \rightarrow PS \rightarrow PC \rightarrow SC$), as illustrated in Table 26.

Under $v = 0.0$, $R_{vk} = 0.288$ and the CEI = 0.712 of Style A (international coffee chain) coffee service businesses; $s = 0.413$ and the CEI = 0.588 of Style B (convenience store coffee) coffee service businesses; $R_{vk} = 0.286$ and the CEI = 0.714 of Style C (global brand coffee chain) coffee service businesses; and $R_{vk} = 0.395$ and the CEI = 0.605 of Style D (domestic coffee chain) coffee service businesses. The CEI rank of coffee service businesses is $Style - C \supset Style - A \supset Style - D \supset Style - B$. Under $v = 0.5$, $R_{vk} = 0.279$ and the CEI = 0.721 of Style A (international coffee chain) coffee service businesses; $R_{vk} = 0.382$ and

the CEI = 0.618 of Style B (convenience store coffee) coffee service businesses; $R_{vk} = 0.266$ and the CEI = 0.734 of Style C (global brand coffee chain) coffee service businesses; and $R_{vk} = 0.341$ and the CEI = 0.659 of Style D (domestic coffee chain) coffee service businesses. The CEI rank of coffee service businesses is $Style - C \supset Style - A \supset Style - D \supset Style - B$. Under $v = 1.0$, $R_{vk} = 0.270$ and the CEI = 0.730 of Style A (international coffee chain) coffee service businesses; $R_{vk} = 0.351$ and the CEI = 0.649 of Style B (convenience store coffee) coffee service businesses; $R_{vk} = 0.245$ and the CEI = 0.755 of Style C (global brand coffee chain) coffee service businesses; and $R_{vk} = 0.287$ and the CEI = 0.713 of Style D (domestic coffee chain) coffee service businesses. The CEI rank of coffee service businesses is $Style - C \supset Style - A \supset Style - D \supset Style - B$.

The decision-makers can adopt a ranking of under $v = 0.0$ under pessimistic conditions and a ranking of under $v = 1.0$ under optimistic conditions. This study considers that the ranking of the CEI can be evaluated in stable and steady states. This study determines the suitable CEI for the coffee service businesses $v = 0.5$, as illustrated in Table 26. Therefore, this study also compares the different v values. The CEI rank of coffee service businesses is $Style - C \supset Style - A \supset Style - D \supset Style - B$ for different v values. So, the CEI rank is the same under different v values. Coffee service businesses can use a robustness analysis to understand the PSI rank in the three states and determine the benchmarking coffee service businesses, as illustrated in Table 26.

Further, the service providers of coffee service businesses can analyze the advantageous aspects/components and disadvantageous aspects/components, as illustrated in Table 26 and then adopt the improvement paths, as shown in Table 26. In Style A (international coffee chain), the third improvement path (PK→PS→SE) and fourth improvement path (PK→PS→PC→SE) can apply. PK (professional knowledge) can improve PS (professional skills), and PS (professional skills) can improve SE (self-efficacy) in the third improvement path. Coffee practitioners can strengthen their coffee brewing skills through enhancing their knowledge of hand modulation. Moreover, the strength of the coffee practitioners' coffee brewing skills also improves their responsibility and professionalism. PK (professional knowledge) can enhance PS (professional skills), and PS (professional skills) can enhance PC (personal characteristics). Then, PC (personal characteristics) can enhance SE (self-efficacy) in the fourth improvement path. Coffee practitioners can increase their knowledge of roasting parameter settings to strengthen the quality of coffee roasting and improve their coffee roasting skills. Then, coffee practitioners can enhance their customer service skills and improve their work performance and efficiency. Furthermore, coffee practitioners with optimism and positive thinking can increase their emotional control and resistance to stress during specific events and in difficult conditions.

In Style B (convenience store coffee), the second improvement path (PK→PC→SE), the third improvement path (PK→PS→SE), and fourth improvement path (PK→PS→PC→SE) can apply. PK (professional knowledge) can improve PC (personal characteristics), and PC (personal characteristics) can improve SE (self-efficacy) in the second improvement path. Coffee practitioners can strengthen their affinity and service enthusiasm through training for customer service skills and establish their responsibility and professionalism by improving their mutual assistance and teamwork in the workplace. PK (professional knowledge) can improve PS (professional skills), and PS (professional skills) can improve SE (self-efficacy) in the third improvement path. Coffee practitioners can strengthen their grinding extraction knowledge to improve their coffee brewing skills. Furthermore, the coffee practitioners can also increase their diverse customer service skills to strengthen their crisis response and judgment ability. PK (professional knowledge) can enhance PS (professional skills), and PS (professional skills) can enhance PC (personal characteristics). Then, PC (personal characteristics) can enhance SE (self-efficacy) in the fourth improvement path. The coffee practitioners can learn how to identify sources of raw materials to enhance their coffee roasting skills and increase their work performance and efficiency by learning diverse customer service skills. Moreover, the coffee practitioners can also strengthen their emotional control and resistance to stress through optimism and positive thinking.

In Style C (global brand coffee chain), the third improvement path (PK→PS→SE) and fourth improvement path (PK→PS→PC→SE) can apply. PK (professional knowledge) can improve PS (professional skills), and PS (professional skills) can improve SE (self-efficacy) in the third improvement path. Coffee practitioners can strengthen their coffee roasting skills through enhancing their ability to identify the sources of raw materials. Moreover, the coffee practitioners who strengthen their customer service skills can also improve their emotional control and resistance to stress. PK (professional knowledge) can enhance PS (professional skills), and PS (professional skills) can enhance PC (personal characteristics). Then, PC (personal characteristics) can enhance SE (self-efficacy) in the fourth improvement path. The coffee practitioners can increase their knowledge of roasting parameter settings to strengthen their coffee roasting skills and save time learning coffee roasting skills. Moreover, the coffee practitioners who enhance their customer service skills also increase their work performance and efficiency and increase their crisis response and judgment ability.

In Style D (domestic coffee chain), the second improvement path (PK→PC→SE) and fourth improvement path (PK→PS→PC→SE) can apply. PK (professional knowledge) can improve PC (personal characteristics), and PC (personal characteristics) can improve SE (self-efficacy) in the second improvement path. Some coffee practitioners have strong learning motivation and capacity, and they also will put their time into developing professional knowledge and skills. So, the service providers of coffee service businesses can cultivate coffee practitioners with high work performance and efficiency by providing relevant courses for identifying the sources of raw materials and grinding extraction. These coffee practitioners also have a responsibility for training other coffee practitioners and paying attention to their customers' needs in their working environment.

PK (professional knowledge) can enhance PS (professional skills), and PS (professional skills) can enhance PC (personal characteristics). Then, PC (personal characteristics) can enhance SE (self-efficacy) in the fourth improvement path. The knowledge of identifying sources of raw materials can help coffee practitioners in strengthening their coffee roasting skills and coffee tasting skills. Additionally, coffee brewing skills and customer service skills can maintain the coffee practitioners' affinity and service enthusiasm and help coffee practitioners understand the customers' needs through communication. Coffee practitioners provide excellent service, and communicating with customers can reduce customer complaints. Similarly, the coffee practitioners can enhance their crisis response, and judgment can also reduce operational crises in the enterprise and increase their market competitive advantage.

5. Conclusions and Recommendations

SEM (structural equation modeling) can analyze the symmetry (two-way) of network relation structures. However, the SEM approach cannot evaluate the dominance relationship (one way) of network relation structures [61–63]. Therefore, the DEMATEL approach can solve the limitation of the SEM approach and can determine the dominance relationship (one way) for the network relation structure [31,37]. So, the proposed model integrates the four analytic processes (DEMATEL, PCA, ANP, and VIKOR approaches). The service providers and service practitioners of coffee service businesses can adopt the VIKOR approach to find their CEI (competency evaluation index) rank and determine their coffee service businesses' benchmarks. The service providers of coffee service businesses can evaluate the status of aspects and assess their development paths and usable improving paths. Based on the service competition analysis for coffee service businesses, the CEI (here $v = 0$, $v = 0.5$, and $v = 1.0$) could also be considered the index of the maximum group utility and the minimum individual regret of the "opponent". Style C (global brand coffee chain) coffee service businesses have the highest CEI (competency evaluation index), and Style B (convenience store coffee) coffee service businesses demonstrate the lowest CEI. The CEI rank of the coffee service business is $Style - C \supset Style - A \supset Style - D \supset Style - B$. From the results, Style C (global brand coffee chain) coffee service businesses have a competitive

advantage, and Style B (convenience store coffee) has a competitive disadvantage in the professional competency development. In the NRM analysis, the competency development could be developed by the aspect of PK (professional knowledge) because PK is the dominant aspect. For the competency development of coffee service businesses, the aspect of PS (professional skills) should be improved first, and then the PK (professional knowledge) aspect should be improved. The PS (professional skills) aspect can be improved by the PK (professional knowledge) aspect, whereas the PS aspect only can improve by itself.

The study proposes a model that modifies the ANP approach through the PCA approach and uses a modified VIKOR approach to improve the desired solution. Therefore, the VIKOR approach still has some limitations for v determination. This study compares the different v values and provides three specific states ($v = 0$, $v = 0.5$, and $v = 1.0$) for the robustness analysis of the CEI (competency evaluation index). These researchers can also determine their suited v values for different states. Decision-makers should evaluate the condition for the decision problem and then they can adopt a CEI value under $v = 0.0$ in a pessimistic state or a CEI value under $v = 1.0$ in an optimistic state. This study considers that the ranking of the CEI can be evaluated in stable and steady states. Therefore, this study determines the suitable CEI of the coffee service businesses is under $v = 0.5$. The suited v determination still exists as a limitation for different states. Future research should therefore consider how to determine the suited v values for different states.

Further, the study also provides the improvement paths based on the NRM (network relation map) approach. The Style A (international coffee chain) has two suited improvement paths (PK→PS→SE; PK→PS→PC→SE) based on the CEI rank. International coffee chain (Style A) has an advantage in the aspects of SE (self-efficacy) and PC (personal characteristics), but has a disadvantage in the aspects of PS (professional skills) and PK (professional knowledge). International coffee chains need to know how to ensure the service quality of their coffee service businesses; practitioners' competency is becoming more and more critical for the coffee service industry. Moreover, coffee service provider can strengthen practitioners' professional skills by enhancing their professional knowledge and improving their self-efficacy through professional skills. So, coffee service providers can maintain practitioners' knowledge of the widening sources of raw materials and roasting parameter settings to develop new blended coffee styles for satisfying diverse customers' needs. Therefore, coffee practitioners can also propose customized services for different customers using their coffee roasting and brewing skills. Moreover, international coffee chains often need to address variations in practitioners' competency and provide training for different service sites. So, coffee service providers should establish a competency evaluation system and education training system for practitioners to satisfy business volume growth and continuously increase coffee service sites.

Style B (convenience store coffee) coffee service businesses have three suitable improvement paths (PK→PC→SE; PK→PS→SE; PK→PS→PC→SE) based on the CEI rank. The convenience store coffee (Style B) has an advantage in the PC (personal characteristics) and SE (self-efficacy) aspects, but has a disadvantage in the PS (professional skills) and PK (professional knowledge) aspects. In the past, convenience stores often provided cheap canned coffee. Today, convenience stores have begun to offer hand-brewed, higher quality manor beans coffee to satisfy customers' diverse needs. Therefore, coffee service provider and practitioners understand the need for hand modulation knowledge and strengthening their ability to identify sources of raw materials. Although convenience stores still have differences in service style and service quality compared to international coffee chains, the customers' requirements of coffee quality are continually increasing and becoming more diverse. Convenience stores need to build standard service processes to reduce service mistakes and to understand customers' needs. Therefore, coffee service providers need to cultivate practitioners' coffee tasting skills and coffee roasting skills by offering professional training courses and establishing a dedicated unit. Furthermore, the professional training course can help service providers to select the suitable manor beans and determine the appropriate roasting parameters and grinding extraction rate. Moreover,

site-appropriate personnel also can collect the customers' comments and feedback for modifying and improving the production and service process.

Style C (global brand coffee chain) coffee service businesses have two suitable improvement paths ($PK \rightarrow PS \rightarrow SE$; $PK \rightarrow PS \rightarrow PC \rightarrow SE$) based on the CEI rank. The global brand coffee chain (Style C) has an advantage in the aspects of SE (self-efficacy) and PC (personal characteristics) but has a disadvantage in the aspects of PS (professional skills) and PK (professional knowledge). Global brand coffee chains own many brand coffee shops and coffee farms. So, the service operators of global brand coffee chains often adopt extensive planting and mass production to satisfy the coffee beans' quality and volume for their coffee shops. However, the service operators of global brand coffee chains also face coffee beans farm dispersion. Because these coffee bean farms may be located in different areas with different climates and planting environments, these coffee beans may need different roasting parameter settings or different coffee roasting skills. So, the service operators of global brand chains need to cultivate practitioners' knowledge of the identification of raw materials and their coffee roasting skills. Moreover, service operators can also strengthen their coffee tasting skills to modify the roasting parameter settings to satisfy their diverse customers' needs. Global brand chains' service operators can determine suitable coffee beans and adopt coffee roasting skills through their professional practitioners.

Style D (domestic coffee chain) coffee service businesses have two suitable improvement paths ($PK \rightarrow PC \rightarrow SE$; $PK \rightarrow PS \rightarrow PC \rightarrow SE$) based on the CEI rank. The domestic coffee chain (Style D) has an advantage in the PC (personal characteristics) aspect and SE (self-efficacy) aspects, but has a disadvantage in the PS (professional skills) aspect and PK (professional knowledge) aspect. The domestic coffee chain often faces the challenge of market competition and economies of scale. Due to the industry becoming quicker and more diverse, coffee service businesses need to satisfy different customer needs to keep sustainable development in a competitive market environment. Domestic coffee chains face bigger challenges of service and industrial transformation. Domestic coffee chain service providers attract new customers by providing higher quality manor beans coffee/meal service. Other service providers of domestic coffee chains offer valet roasting and manor beans ordering services. Therefore, the practitioners in domestic coffee chains need not only customer service skills and coffee roasting skills but also knowledge in identifying raw materials sources for satisfying guests' diverse needs. Moreover, some guests like to enjoy coffee roasting at home and hone their coffee tasting ability. So, the service providers of domestic coffee chains also share information on coffee roasting equipment, ordering coffee roasting equipment, and diverse manor beans. Some service providers of domestic coffee chains also provide courses in coffee roasting skills and coffee brewing skills to cultivate loyal customers of valet roasting and manor beans ordering services.

Author Contributions: Conceptualization: C.-L.L. and C.-L.K. Investigation, resources and data curation: C.-L.K. Methodology: C.-L.L. Writing—original draft preparation: C.-L.L. and C.-L.K. Writing—review and editing: C.-L.L. Supervision, project administration, and funding acquisition: C.-L.L. and C.-L.K. All authors have read and agreed to the published version of the manuscript.

Funding: This research and APC were funded by the Ministry of Science and Technology (MOST 111-2221-E-017-002-).

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Conflicts of Interest: The authors declare no conflict of interest.

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