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Exploring the critical factors for improving customers' perceived food quality of casual-dining restaurants

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Abstract- This study intends to integrate IPGA with the DEMATEL model in order to determine food quality core factors demanding restaurants' most urgent improvement, as well as the highest effect for resource investment. It is hoped that such information can be provided as reference for casual-dining restaurants to develop food quality improvement and resource reallocation strategies under limited resources. 562 valid questionnaires were returned in Taipei City. The results showed that, from the perspective of customers, casual-dining restaurants should give priority to improving the quality dimensions of "hygiene" and "cooking." Among various quality dimensions, experts suggested that "cooking" is the core factor with the highest effect of resource investment affecting food quality, such as visual appeal, taste, and hygiene. Moreover, this study further analyzed and found that a total of 15 quality items are located in the area of "Concentrate here".

Index Terms- Food quality, Casual-dining restaurant, IPGA, DEMATEL

I. Introduction

Economic growth and increased national income have led to a rapid increase of demands for service industry markets, thus, increasing its competition. Jang, Ha, and Silkes (2009) indicated that the quality of a product is a key factor affecting consumers' decision-making for the service industry. Regarding the hospitality industry, food quality is ranked as one of the most important determinants of a customer's decision to return. This element is significantly more important than cleanliness, value, price, or convenience (Kim, Ng, and Kim, 2009). Casual-dining restaurants are important restaurant types. In the US, in 2010, the volume of business accounted for approximately 22% (USD$ 83 billion) of the overall restaurant industry (Darden, 2011). The majority of restaurants in Taiwan are casual dining, as most restaurants in this category are small businesses (USDA, 2012). The facts show that casual-dining restaurants are the most representative restaurant type in the restaurant industry in developed countries. Food quality was the most important reason for respondents to patronize a casual-dining restaurant (Mattila, 2001). As a result, food quality has a significant effect on the operation and sustainable development of casual-dining restaurants, and how to effectively and precisely assess their food quality has become an important research issue.

Lin, Chan, and Tsai (2009) integrated the concept of traditional IPA with that of quality gap, and developed Importance-Performance & Gap Analysis (IPGA) through function conversion. The IPGA model converted the axes of the traditional IPA matrix into relative importance (RI) and relative performance (RP). In addition to reflecting quality gap, IPGA can assist enterprises to develop strategies meeting customers' needs. Some scholars have used the IPGA model to investigate the service quality of different service industries (Tsai and Lin, 2010; Tsai, Chan, and Lin, 2011; Cheng, Chen, Hsu, and Hu, 2012). Cheng, Lin, Liu, Hu, and Lin (2011) used IPGA to investigate the food quality of fine-dining restaurants. The above show that IPGA is an effective research method used in the research field of quality management.

According to the resource-based view (RBV), as proposed by Wernerfelt (1984), a competitive advantage of a firm is the result of optimal resource allocation and combinations. Regarding casual-dining restaurants, the best approach to fulfill the resource investment utility of food quality under limited resources is to determine the dependent (cause-and-effect) relationships between the quality attributes of the highest efficiency and other quality attributes. When quality characteristics are shown to have a cause-effect relationship, the traditional IPA and IPGA model are unable to correctly analyze priority level of importance and performance (Hu, Chiu, Cheng, and Yen, 2011; Cheng et al., 2012). However, the methodology of the decision making trial and evaluation laboratory (DEMATEL) can change a complicated system into a causal relationship with a clear structure, and determine the core issues and improvement directions in a complicated system through interaction levels between quality characteristics (Cheng et al., 2012). Many scholars used DEMATEL to solve problems of different fields (Nanayo and Toshiaki, 2002; Tamura et al., 2006; Tseng, 2009; Hu et al., 2011). Tsai et al. (2011) and Cheng et al.

(2012) combined the perspectives of customers with those of experts and used a two-stage decision-making model integrating IPGA with DEMATEL to investigate the cause-and-effect relationships between improvement priorities and resource investments in service quality as important guidelines for service quality improvement strategies. Obviously, the decision-making model integrating IPGA with DEMATEL is an effective approach to develop quality improvement and resource investment strategies. Food quality improvement strategies of casual-dining restaurants also involve the issues of "quality gap" and "effective allocation of resources," which have never been discussed in previous studies. Therefore, the use of a quality improvement decision-making model integrating IPGA with DEMATEL in the investigation of quality improvement strategies for casual-dining restaurants is of significant practical contribution and value.

The purposes of this study are to use IPGA model to investigate the food quality of casual-dining restaurants and to understand the core factors for improving food quality, as well as their priority. In addition, this study interviewed restaurant chefs and scholars, and used DEMATEL to analyze the effect of resource investment and dependent relationships (cause-and-effect relationship) of various dimensions of food quality of casual-dining restaurants, as well as to identify critical quality attributes in order to improve overall food quality under resource-limited conditions. Based on the research results of IPGA and DEMATEL, this study intended to determine the critical factors affecting food quality that demand the most urgent improvements, and the highest effect of resource investment, and provide such information as reference for casual-dining restaurants to develop food quality improvements and resource reallocation strategies, in order to significantly improve the food quality of casual-dining restaurants.

II. Literature review

Food quality

Palmer (1985) suggested that food is a product constrained by culture, as it is the most fundamental and profound consumer culture affecting daily life. Compared with other products, it is harder to change the behavior consumption of food from among various consumer behaviors. From a commercial perspective, food quality is the phenomenon developed for commercial products based on perceptual/evaluative construe assessment on any factors concerning people, place, and time, which can affect expectation factors, as assessed by sensory perception (Cardello, 1995). Food quality refers to quality that is acceptable to both the producers and consumers, namely, it is producers' production of the quality most desirable to consumers at the most rational price under limited economic conditions (Cheng et al., 2011). With the development of economy, consumers' demand for quality of food has gradually increased. They not only intend to meet their physical needs, but also take food quality, health, and safety into account (Barbas, 2003; Henson, Majowicz, Masakure, Sockett, Jones, Hart, Carr, and Knowles, 2006). Therefore, food quality attributes have begun to attract the attention of consumers. Moreover, food quality becomes one of the most important factors affecting customer satisfaction (Pettijohn, Pettijohn, and Luke, 1997). Mattila (2001) confirmed that food quality is the most important reason for respondents to patronize a casual-dining restaurant. Kim et al. (2009) indicated that food quality is the strongest predictor of customer satisfaction, as well as revisit intention. Improvement of visual appeal, food taste, freshness, and nutritional content might help food service operators meet or exceed customer expectations and improve intention to return.

In terms of the evaluation indicators of food quality, Molnaar (1995) indicated that the characteristics of food quality evaluation include sensory attitude, chemical and physical aspects, microbiological hazard, texture damage, and the labeling of package and appearance. For the food quality of the meals provided by the army and public groups, consumers will consider the factors of taste, texture, and nutritional value (Cardello, Bell, and Matthew, 1996). Verbeke and Lopez (2005) used nine food attributes as evaluation indicators for preference and attitude, including price, color, appeal, taste, spiciness, convenience, leanness, safety, and healthiness, in order to analyze the attitude and behavior of Belgians and Belgian Spanish for ethnic food. Tsai et al. (2006) found that, the evaluation factors for food quality of fast food industry mainly include three dimensions, "freshness and hygiene," "menus and menu content," and "attractiveness of food," with a total of 16 items. Jang et al. (2009) developed 20 main attributes of Asian food, and used such attributes to determine 6 Asian foods as the new constructs of food attributes from the perspective of American consumers. Kim et al. (2009) used four items, taste of food, eye appeal of food, freshness of food, and overall quality of food, to assess the food quality of restaurants. Cheng et al. (2011) also summarized relevant previous studies to obtain five major dimensions, including appeal of food, taste, cooking, hygiene, and other factors, for 22 items in order to assess consumers' satisfaction with food quality of fine-dining restaurants. This study found that, such restaurants should give priority to the improvement of "hygiene" and "taste." Based on the above, this study suggested that the dimensions and items of the food quality assessment, as proposed by Cheng et al. (2011), are more specific and complete. Moreover, the empirical validity for restaurant food quality assessment is acceptable. Consequently, this study intended to use the food quality scale developed by Cheng et al. (2011) as the basis for the evaluation of food quality of casual-dining restaurants.

Importance-performance and gap analysis (IPGA)

Importance-Performance Analysis (IPA) is regarded by scholars and managers as an effective tool for improving service quality and customer satisfaction. Its analysis results can provide enterprises with relevant information for planning resource allocation. The IPA model, as proposed by Martilla and James (1977), is an analysis technique for determining whether to strengthen or adjust the resource allocation for analyzed strategies. The vertical and horizontal axes of a strategy matrix is constructed to denote respondents' perceived degrees of "importance" and "satisfaction." The overall average importance and satisfaction can be regarded as the intersecting point of two axes to facilitate the division of the coordinate matrix into four quadrants. Managers can understand enterprise performance based on IPA analysis, which facilitates the development of revitalization strategies in the future. Although the IPA model has been regarded as a convenient tool for assessing quality, it has several deficiencies in terms of practical application. For example, the IPA model can neither distinguish properties (Tarrant and Smith, 2002) in the same quadrant, nor integrate the concepts of quality gap (the difference between customers' expectations and perceptions) (Lin et al., 2009). Moreover, the assessment of means may easily lead to subjective conflict (Cheng et al., 2012).

IPGA was extended and developed from IPA as a model integrating the traditional IPA model with a resource reallocation analysis model for gap analysis (Importance-Performance and Gap Analysis; IPGA), as developed by Lin et al. (2009), and based on function conversion. IPGA converts the axes of traditional IPA matrix into relative importance (RI) and relative performance (RP). The vertical axis of the amended matrix is relative importance of the evaluated attributes, while the horizontal axis is the relative performance of the evaluated attributes. The resource allocation strategies, as denoted by the various quadrants of the IPGA model, are as shown in Figure 1 (Lin et al., 2009).

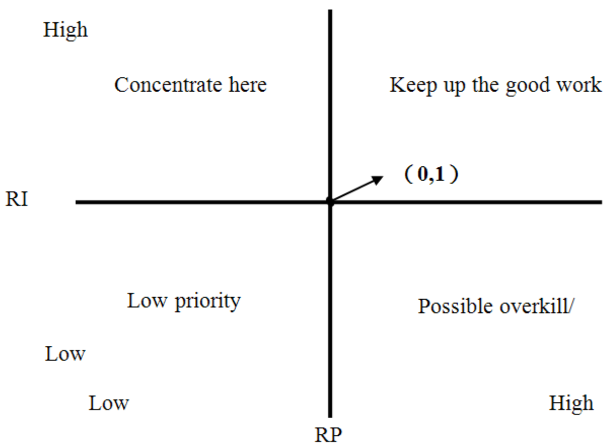

Figure 1 IPGA Model

Quadrant I: is the quadrant consisting of high relative performance and high relative importance, and is located in the upper right area of the two-dimensional matrix. It represents the situation where there is a positive gap between performance and importance in the evaluated attribute, and because the importance of evaluated attributes is higher than the average importance, it is necessary to "keep up the good work."

Quadrant II: is the quadrant consisting of low relative performance and high relative importance, and is located in the upper left area of the two-dimensional matrix. It presents the situation where there is a negative gap between performance and importance in the evaluated attribute, and because the importance of evaluated attributes is higher than the average level of importance, it is necessary to "concentrate here." Moreover, the larger the distance between the evaluated attributes and coordinate center (0, 1), the more urgent it is to make improvements.

Quadrant III: is the quadrant consisting of low relative performance and low relative importance, and is located in the lower left area of the two-dimensional matrix. It presents the situation where there is a negative gap between performance and importance in the evaluated attribute, and because the importance of evaluated attributes is lower than the average importance, the quadrant is the area of "low priority."

Quadrant IV: is the quadrant consisting of high relative performance and low relative importance, and is located in the lower right area of the two-dimensional matrix. It presents the situation where there is a positive gap between the performance and importance in the evaluated attribute. However, because the importance of evaluated attributes is lower than the average importance, this quadrant is the area of "possible overkill." Moreover, the larger the distance between the evaluated attribute and the coordinate center (0, 1), the higher the level of received resource transfer.

The analysis process of the IPGA model includes the following 6 steps (Lin et al., 2009; Tsai et al., 2012; Cheng et al., 2012):

Step 1: Collect information on users' perceived degree of importance and performance of quality attributes.

Step 2: Calculate the average importance ($\overline{I}_{.j}$) and average performance ($\overline{P}_{.j}$) perceived for each attribute, as well as the average importance ($\overline{I}$) and average performance ($\overline{P}$) of all the items.

Step 3: Use paired sample T test to understand whether there is a positive gap (i.e. performance larger than importance) or a negative gap (i.e. performance smaller than importance), or there is no gap (i.e. performance equals to importance) between users' expectation and actual perception of various attributes.

Step 4: Calculate the relative importance (RI) and relative performance (RP) of various quality attributes, respectively. Relative importance (RI) is the value of the importance of an assessment factor divided by the average importance of all the assessment factors. The formula is $\overline{I}_j / \overline{I}$. In addition, relative performance combines the concept of gap analysis model. The average performance of various attributes, as evaluated by respondents, is converted into perceived performance. In other words, after paired sample t-test is applied to perform gap analysis on the importance and performance of evaluated attributes, the formula was used to convert the values to obtain the RP values (as shown in Table 1) of various food quality attributes (as shown in Table 1).

Table 1 Relative performance (RP) calculation regulation table

Factor j's gap analysis result	Paired samples t-test	Factor j's RP value
$\overline{P}_j > \overline{I}_j$	Significant ($p \leq 0.05$)	$\overline{P}_j / \overline{P}$
$\overline{P}_j < \overline{I}_j$	Significant ($p \leq 0.05$)	$-(\overline{P}_j / \overline{P})^{-1}$
$\overline{P}_j > \overline{I}_j$ or $\overline{P}_j < \overline{I}_j$	Not significant ($p>0.05$)	0

Note: The average performance of Assessment factor j is $\overline{P}_j$, the importance is $\overline{I}_j$, and the average performance of all assessment factor is $\overline{P}$

Step 5: Draw the IPGA strategy matrix (as shown in Figure 1), where relative importance (RI) and relative performance (RP) are used as vertical axis and horizontal axis, respectively. The intersecting point of the horizontal and vertical axes is (0, 1). The resource allocation strategy and management definitions of various quadrants of IPGA strategy matrix are as follows:

Step 6: Determine the priority of resource allocation for attributes requiring improvement in quadrant II, namely, the larger the distance, the higher the priority for improvement. The formula is:

$$D_q(j) = \sqrt{[RP_j / \max_{r\in q}(|RP_{.r}|]^2 + [(RI_{.j} - 1) / \max_{r\in q}(|RI_{.r} - 1|)]^2} \quad (1)$$

Decision Making Trial and Evaluation Laboratory (DEMATEL)

The decision making trial and evaluation laboratory (DEMATEL) was developed by the Battelle Memorial Association in Geneva (Gabus and Fontela, 1973; Fontela and Gabus, 1976). At the time, the DEMATEL method was used to research complex, and difficult to solve, global problems, including ethnic issues, hunger, energy, environmental protection, etc. (Fontela and Gabus, 1976). The DEMATEL method takes complicated systems and directly compares the relative relationships between different quality characteristics, using a matrix to calculate all direct and indirect cause and effect relationships, as well as the level of influence between quality characteristics, especially through the use of a visual structure cause-effect diagram to determine the core questions of a complex system, thus, simplifying decision making (Cheng et al., 2012). Measurements are separated into four levels (0, 1, 2, 3), which are labeled ‘‘no influence’’, ‘‘low level of influence’’, ‘‘high level of influence’’, and ‘‘extremely high level of influence’’ (Lin and Wu, 2008). Recent studies have comprehensively used DEMATEL to solve the problems of different fields. For example, Nanayo and Toshiaki (2002) used amended DEMATEL to conduct an integrated assessment on a medical care system. Tamura et al. (2006) used DEMATEL to investigate the factors leading to customers' sense of insecurity regarding food and its improvement. Tseng (2009) combined the Fuzzy set theory with DEMATEL to evaluate the interrelationships of service quality evaluation criteria and to compare group perceptions for a cause-and-effect model regarding uncertainties. Hu et al. (2011) used DEMATEL to improve the order-winner criteria in the network communication equipment manufacturing industry. Tsai et al. (2011) used DEMATEL to determine the critical factors affecting customers' needs for quality of an online tax-filing system. Cheng et al. (2012) used DEMATEL to investigate the priority of improvements in the service quality of fine-dining restaurants. However, such a research method has never been used in previous studies to resolve issues concerning food quality improvement strategies and resource allocation of casual-dining restaurants.

This study adopted the explanation of the steps of DEMATEL, as described by Tsai et al. (2011) and Cheng et al. (2012), as follows:

Step 1: Build the initial average direct-relation matrix

Suppose *n* is the number of experts consulted, and *p* is the number of practices that each expert considers. The integer score x_{ij}^k refers to the degree that practice *i* affects practice *j* for the *k*-th expert. The *p×p* average matrix *A* is realized by averaging all expert scores, and can be represented mathematically by the following equation:

$$A = [a_{ij}]_{p\times p} = \left[\frac{1}{n}\sum_{k=1}^{n} x_{ij}^k\right]_{p\times p}$$

Step 2: Calculate the normalized direct-relation matrix

The normalized direct-relation matrix *Z* is obtained by normalizing the direct-relation matrix *A*, and can be represented mathematically by the following equation:

$$Z = \lambda^{-1}A, \text{ where } \lambda = \max(\max_{1\le i\le p}\sum_{j=1}^{p} a_{ij}, \max_{1\le j\le p}\sum_{i=1}^{p} a_{ij}) \quad (2)$$

Since the sum of each row *i* of matrix *A* represents the *direct effects* that practice *i* gives to the other practices, and the sum of each column *j* of matrix *A* represents the *direct effects* that practice *i* receives from the other practices; therefore, $\max(\max_{1\le i\le p}\sum_{j=1}^{p} a_{ij}, \max_{1\le j\le p}\sum_{i=1}^{p} a_{ij})$ represents the direct effects of the practice with the most directly given and received effects on others.

Step 3: Derive the total relation matrix

The *total relation effects* include both the *indirect effects* and *direct effects*. Since there is a continuous decrease of the *indirect effects* of problems along the powers of matrix *Z*, the total relation matrix, *T*, is defined as a *p×p* matrix, and *I* is the *p×p* identity matrix. The mathematical equation can be represented, as follows:

$$T = \lim_{k\to\infty}(Z + Z^2 + \Lambda + Z^k) = Z(I - Z)^{-1} \quad (3)$$

Step 4: Calculate the total effects and net effects.

Define *r* and *c'* as *p×1* vectors as the sum of rows and the sum of columns, respectively, of the total relation matrix *T*. The mathematical equations can be represented, as follows:

$$r = [r_i]_{p\times 1} = \left[\sum_{j=1}^{p} t_{ij}\right]_{p\times 1} \quad (4)$$

$$c = [c_j]_{1\times p} = \left[\sum_{i=1}^{p} t_{ij}\right]_{1\times p} \quad (5)$$

The sum r_i shows the *total given effects*, both directly and indirectly, that practice *i* has on the other practices. The sum c_j shows the *total received effects*, both directly and indirectly, that all the other practices have on practice *j*. Thus, the sum $(r_i + c_i)$ gives us an index representing the *total effects* (i.e. prominence) both given and received by practice *i*. In addition, the difference $(r_i - c_i)$ shows the net effects or the net contribution by practice i on the system. In other word, $(r_i - c_i)$ is defined as the cause and represents the level of influence and being influenced of this specific quality characteristic.

III. Methodology

Research Procedures for the Improvement of Food Quality of Casual-dining Restaurants

This study reformed the two-stage decision-making model integrating IPGA with DEMATEL, as proposed by Tsai et al. (2011), and used a questionnaire survey for customers' opinions and expert interviews to perform analyses. Firstly, this study conducted a questionnaire survey on customers to obtain information regarding the degree of importance and satisfaction with various food attributes, and calculated the RI and RP. IPGA was applied to determine the quality attributes (i.e. critical factors) requiring improvement. Secondly, After identifying the key factors of customer's perception, by applying IPGA, experts further analyze the critical factors of these practices, as based on their practical experiences and professional judgment, to achieve the cost effective target for resource allocation of food quality of casual-dining restaurants. Therefore, this study further used a DEMATEL questionnaire to investigate cause-and-effect relationships and total effects of various food quality attributes of casual-dining restaurants. Lastly, the analysis results of IPGA (perspective of customers) and DEMATEL (perspective of experts) questionnaires were integrated in order to determine critical food quality factors with the most urgent demand for improvement and for the highest effect of resource investment as reference for improving food quality strategies of casual-dining restaurants.

Measurement

The questionnaire used in this study was developed based on food quality, and the characteristics of food quality, of casual-dining restaurants. The content of the preliminary questionnaire included five major dimensions, visual appeal, taste, cooking, hygiene, and other factors, with 25 items totally. This study mainly investigated the importance and performance of various attributes of food quality, and used a 5-point Likert scale for measurement. The respondents completed the questionnaires anonymously. Before the formal questionnaires were distributed, 50 pre-test questionnaires were distributed to analyze reliability (Cronbach's α). The results showed that the reliability of various dimensions of the questionnaire was larger than 0.7, which suggested that there is internal consistency among the various dimensions (importance and performance). Moreover, regarding expert questionnaire, this study developed the DEMATEL expert questionnaire, as based on the five dimensions of restaurant food quality, and the measurement was separated into four levels (0, 1, 2, 3), labeled ''no influence,'' ''low level of influence,'' ''high level of influence,'' and ''extremely high level of influence.''

Research samples and data collection

The majority of restaurants in Taiwan are casual dining (USDA, 2012), which suggests that casual-dining restaurants play an important role in the hospitality industry in Taiwan. Taipei City is the largest international city in Taiwan, and in 2011, there were 16,764 restaurants, ranking it the highest in Taiwan (Financial Data Center, Ministry of Finance, Taiwan, 2012), thus, market competition in the hospitality industry will inevitably become more intense in Taipei City. In order to attract customers and maintain sustainable operation, operators in the hospitality industry must provide good food quality. Therefore, the priority of food quality evaluation and food quality resource investment has become an important research issue for casual-dining restaurants in Taipei City.

By customer questionnaire survey, this study selected the customers of 10 casual-dining restaurants in Taipei City as the subjects. A systematic sampling method was utilized to collect the questionnaires. Questionnaires were distributed to customers willing to participate in this research after their dining experience. The questionnaires were distributed once for every 10 customers dining in the restaurants. The questionnaires were distributed for 3 months, from January 1 to March 31, 2012, with 600 questionnaires distributed. After invalid questionnaires (e.g. incomplete questionnaires) were removed, 562 valid questionnaires were returned, for a valid return rate of 93.67%. In terms of expert questionnaire, this study interviewed 12 experts (6 executive chefs of restaurants and 6 scholars that had studied restaurant food quality in Taiwan) as the respondents to complete the DEMATEL questionnaires.

Data analysis methods

The data collected from the questionnaires were analyzed using SPSS version 12.0 for descriptive statistical analysis on the effective questionnaires. Second, this study then assessed the properties of measurement scales for convergent validity and discriminant validity, and constructed composite reliability by confirmatory factor analysis (CFA) using maximum likelihood to estimate parameters. Third, the allocated quadrant of restaurant food quality attributes, with the two dimensional matrix constructed by RI and RP through IPGA analysis, was examined to understand the strategy meaning of food quality attributes of casual-dining restaurants. Through expert questionnaire, this study analyzed the total effects and dependent (cause-effect) relationships among 5 dimensions of food quality of casual-dining restaurants by using the DEMATEL method.

IV. Results

Profile of the respondents

This study selected the customers of 10 casual-dining restaurants in Taipei City as the subjects, and successfully retrieved 562 valid samples. The sample structure distribution is as shown in Table 2. Most of the respondents are females (56.57%), aged 31-40 (34.16%), followed by 21-30 (32.74%), have junior college education (46.98%), are married (50.53%), have an average monthly income of NTD 20,001~40,000 (35.23%), followed by NTD 40,001~60,000 (32.38%), work in the service (34.52%) and manufacturing industries (23.49%), and have dined in restaurants twice or less (40.93%) or for 3~5 times (38.08%) within the past 3 months.

Table 2 Profile of the respondents

Characteristics	Items	Frequency	Percentage
Gender	Male	266	47.33%
	Female	296	52.67%
Age	Below 20	78	13.88%
	21-30	184	32.74%
	31-40	192	34.16%
	41-50	86	15.30%
	More than 51	22	3.91%
Education	Junior high or lower	57	10.14%
	Senior high or vocational school	152	27.05%
	University or college	264	46.98%
	Graduate school or above	89	15.84%
Marital status	Unmarried	278	49.47%
	Married	284	50.53%
Monthly income (NT$)	Below $20,000	54	9.61%
	$20,001-$40,000	198	35.23%
	$40,001-$60,000	182	32.38%
	More than $60,001	108	22.78%
Occupation	Student	60	10.68%
	Industrial and commercial industry	132	23.49%
	Service industry	194	34.52%
	Public sector	89	15.84%
	Housewives or retirees	67	11.92%
	Others	20	3.56%
Number of meals within three months	Below 2	230	40.93%
	3-5	214	38.08%
	6-8	86	15.30%
	More than 9	32	5.69%

Reliability and Validity Analysis

In accordance with accepted practice, this study assessed the properties of measurement scales for convergent validity, discriminant validity, and construct composite reliability (CR) (i.e. construct reliability). Table 3 lists standardized coefficient loadings of the confirmatory factor analysis (CFA) results, and construct CR and the average variance extracted (AVE) of food quality scales using customer satisfaction scores of casual-dining restaurants. The measurement model of this study provided a good overall fit with the data (GFI =0.94, AGFI=0.87, CFI=0.97, NFI=0.96, NNFI=0.97, IFI=0.97, $\chi^2/d.f$ =2.51, RMR=0.038, and RMSEA=0.057). Composite reliability (CR) for all dimensions of food quality scales was more than 0.8, respectively. In general, the measurement scales used in this study were found to be reliable. The average variance extracted (AVE) for all dimensions were more than 0.5, respectively, all exceeding the benchmark of 0.50 for convergent validity (Fornell and Larcker, 1981). Discriminant validity is established if the AVE is larger than the squared multiple correlation (SMC) coefficients between constructs (Fornell and Larcker, 1981). Our results demonstrate that the AVE values for all dimensions were more than SMC coefficients in Table 4. This result indicates sufficient discriminant validity of the five dimensions of restaurant food quality scales in this study.

Table 3 Construct reliability and validity analysis of food quality scales

Dimension	Items	Loading	CR	AVE
A.Visual appeal	1. Alternativeness of cuisine types	0.82	0.84	0.63
	2. Dish plating is beautiful and attractive	0.77		
	3. Dishes served are identical to those in the menu	0.82		
	4. Dishes on the menu are always available	0.79		
	5. Visual appearance meets the specific needs of customers, as possible	0.78		
B.Taste	1. Scent of dishes	0.82	0.84	0.64
	2. Dishes are delicate	0.81		
	3. Overall texture of dishes	0.79		
	4. Taste of dishes	0.81		
	5. The taste of dishes is unique	0.76		
C.Cooking	1. Temperature of cold and hot dishes (drinks)	0.75	0.84	0.65
	2. Color of dishes after cooking	0.84		
	3. Doneness of dishes	0.81		
	4. Tenderness of cooked food	0.81		
	5. Crispness and juiciness of fried food	0.81		
D.Hygiene	1. Hygiene of dishes	0.76	0.82	0.58
	2. Hygienic quality of tableware	0.77		
	3. Personal hygiene of staff	0.79		
	4. Cleanness of dining environment	0.78		
	5. Service process meets hygienic requirements	0.71		
E.Other	1. Freshness of food	0.74	0.82	0.60
	2. Nutritional balance of dishes	0.69		
	3. Side dishes are delicious	0.80		
	4. Alternativeness of seasonings	0.83		
	5. Meal size	0.79		

Table 4 Discriminant validity of the five dimensions of food quality scales

Dimensions	*Mean*	*S.D.*	A	B	C	D	E
A.Visual appeal	4.03	0.54	**0.63**[a]				
B.Taste	4.08	0.55	0.52	**0.64**[b]			
C.Cooking	4.07	0.55	0.36	0.51	**0.65**[c]		
D.Hygiene	4.50	0.50	0.02	0.01	0.07	**0.58**[d]	
E.Other	4.05	0.52	0.35	0.38	0.42	0.02	**0.60**[e]

[a,b,c,d,e,] represent AVE of each dimension. Other numbers represent SMC coefficients between dimensions

IPGA Analysis

The IPGA analysis quantified the importance and performance of various food quality attributes of restaurants. The coordinate axes of a traditional IPA matrix were converted into relative importance (RI) and relative performance (RP) to develop the IPGA strategy matrix (Lin et al., 2009). IPGA analysis results of food quality dimensions showed that (as shown in Table 5), the attributes located in quadrant II (Concentrate here) included cooking and hygiene. Those located in quadrant III included visual appeal, taste, and other factors. Therefore, priority should be given to the improvement of cooking and hygiene, followed by taste, visual appeal, and other factors.

Table 5 IPGA analysis of the dimensions of food quality scales of casual-dining restaurants

Dimensions	T-test (P-I)	RI	RP	Quadrant	$D_q(j)$
Visual appeal	-4.03*	0.985	-0.984	III	-
Taste	-4.12*	0.996	-0.975	III	--
Cooking	-6.19*	1.014	-0.993	II	1.081
Hygiene	-10.98*	1.026	-1.059	II	1.414
Other	-4.63*	0.980	-0.993	III	-

*p<0.05

After analysis of food quality through IPGA (as shown in Table 6), various items of food quality were located in quadrant II, including “dish plating is beautiful and attractive” and “dishes in the menu are always available” in the dimension of visual appeal, “dishes are delicate,” “overall texture of dishes” and “taste of dishes” in the dimension of taste, “temperature of cold and hot dishes (drinks),” “color of dishes after cooking,” “doneness of dishes,” and “tenderness of dishes” in the dimension of cooking, “hygiene of dishes,” “hygienic quality of tableware,” “personal hygiene of staff,” “cleanness of dining environment,” and “service process meets hygienic requirement” in the dimension of hygiene, and “freshness of food” in the dimension of other factors, with 15 items totally.

The items located in quadrant III were “alternativeness of cuisine types” and “dishes served are identical to those in the menu” in the dimension of visual appeal, “scent of dishes” and “the taste of dishes is unique” in the dimension of taste, “crispness and juiciness of fried food” in the dimension of cooking, and “nutritional balance of dishes,” “side dishes are delicious,” and “meal size” in the dimension of other factors, with 8 items totally. Only “visual appearance can meet the specific needs of customers as much as possible” in the dimension of visual appeal and “alternativeness of seasonings” in the dimension of other factors were located in quadrants III and IV.

Moreover, in quadrant II, the larger the value of $D_q(j)$, the higher the priority for improvement (Lin et al., 2009). This study further calculated the distance between various items and the coordinate center (0,1), and the order of the value of $D_q(j)$ from the largest to smallest was “freshness of food,” “personal hygiene of staff,” “hygienic quality of tableware,” “cleanness of dining environment,” “service process meets hygienic requirement,” “color of dishes after cooking,” “hygiene of dishes,” “doneness of dishes,” “temperature of cold and hot dishes (drinks),” “tenderness of cooked food,” “dish plating is beautiful and attractive,” “dishes in the menu are always available,” “dishes are delicate,” “taste of dishes,” and “overall texture of dishes.” The aforementioned order could be provided as reference for the priority improvements to be made to food quality of casual-dining restaurants.

Table 6 IPGA analysis of the items of food quality scales of casual-dining restaurants

Dimensions	Items	T-test (P-I)	RI	RP	Quadrant	Dq(j)	Rank
A.Visual appeal	A1	-2.02*	0.957	-0.986	III	--	--
	A2	-5.75*	1.011	-0.989	II	0.943	11
	A3	-5.07*	0.987	-0.986	III	--	--
	A4	-5.66*	1.008	-0.984	II	0.925	12
	A5	-1.11	0.959	0.000	Boundary	--	--
B.Taste	B1	-2.34*	0.987	-0.974	III	--	--
	B2	-5.45*	1.008	-0.977	II	0.919	13
	B3	-4.61*	1.001	-0.970	II	0.898	15
	B4	-4.14*	1.008	-0.965	II	0.908	14
	B5	-3.94*	0.973	-0.989	III	--	--
C.Cooking	C1	-6.25*	1.018	-0.989	II	0.989	9
	C2	-7.81*	1.020	-1.012	II	1.025	6
	C3	-6.74*	1.018	-0.996	II	0.995	8
	C4	-6.22*	1.015	-0.986	II	0.964	10
	C5	-5.31*	0.999	-0.984	III	--	--
D.Hygiene	D1	-10.98*	1.006	-1.081	II	1.008	7
	D2	-8.87*	1.032	-1.027	II	1.161	3
	D3	-12.87*	1.039	-1.078	II	1.286	2
	D4	-11.45*	1.029	-1.066	II	1.156	4
	D5	-9.73*	1.025	-1.044	II	1.097	5
E.Other	E1	-10.83*	1.048	-1.027	II	1.379	1
	E2	-3.97*	0.980	-0.982	III	--	--
	E3	-4.26*	0.978	-0.986	III	--	--
	E4	0.78	0.922	0.000	Boundary	--	--
	E5	-3.00*	0.971	-0.979	III	--	--

*p<0.05

DEMATEL analysis

This study used five dimensions of food quality to perform DEMATEL analysis in order to understand the dependent (cause-and-effect) relationships between the different dimensions of food quality of casual-dining restaurants. Using formulas (1)~(3), the direct-relation matrix is formed from the opinions of 12 experts, and after performing regularization and calculating a direct/indirect-relation matrix, used formulas (4) and (5) to calculate the r_i value of each column and the c_i value of each row. To simplify the relationship of various attributes, this study referred to Cheng et al. (2012) to use the maximum value of the diagonal (1.44) of the total relation matrix T as the threshold value, and deleted the values smaller than [1.44] in the total relation matrix T to re-obtain a new total relation matrix. This study also obtained the total effects $(r_i + c_i)$ and net effects $(r_i - c_i)$ by the new total relation matrix T, as shown in Table 7 and Figure 2. The results of DEMATEL analysis showed that there was a highly dependent relationship among visual appeal, taste, cooking, and hygiene of food quality. As shown in Table 7 and Figure 2, the dimension with both a high level of prominence (total effects) and cause (net effects) were "visual appeal" and "cooking," suggesting that these were core dimensions that influenced other dimensions of food quality of casual-dining restaurants. Among them, the total effect of resource investment in cooking (6.09) was the highest. The dimension with both a low level of prominence (total effects) and cause (net effects) were "hygiene" and "taste". Further analysis, as seen in Figure 2, showed that "cooking" and "visual appeal" would affect each other, "taste" would be affected by "visual appeal and cooking," and "hygiene" would be affected by "cooking." Since the total effect $(r_A + c_A = 0)$ and net effect $(r_A - c_A = 0)$ of "other factors" of food quality scales were very weak, "other factors" could be ignored and regarded as an independent factor.

Table 7 Total effects and net effects of the five dimensions of food quality scales of casual-dining restaurants

Dimensions	*total given effects* (r_i)	*total received effects* (c_i)	*total effects* $(r_i + c_i)$	*net effects* $(r_i - c_i)$
A: Visual appeal	2.95	1.57	**4.53**	**1.38**
B: Taste	0.00	3.02	**3.02**	**-3.02**
C: Cooking	4.59	1.51	**6.09**	**3.08**
D: Hygiene	0.00	1.44	**1.44**	**-1.44**
E: Other	0.00	0.00	**0.00**	**0.00**
Mean			3.02	0

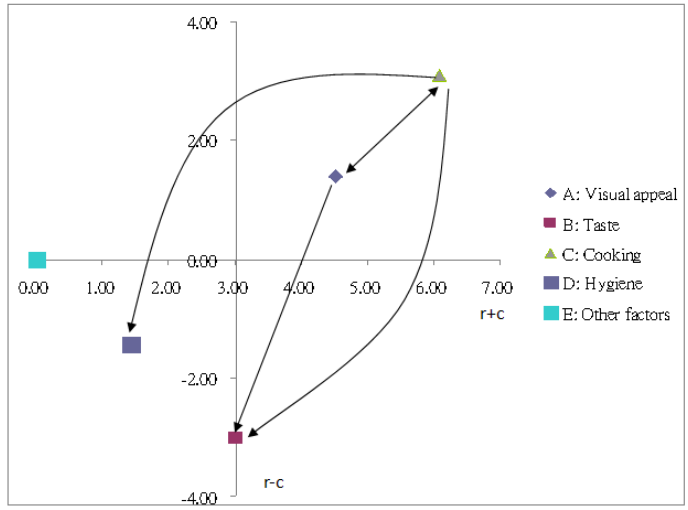

Figure 2 The DEMATEL analysis diagram

V. Discussion and Conclusions

The contribution of this study was the integration of the perspective of customers with that of experts to propose a two-stage decision-making procedure for food quality improvement strategies of casual-dining restaurants. Firstly, this study used the IPGA strategy matrix model to investigate the critical factors affecting food quality of restaurants, from the perspective of customers. Secondly, this study further used DEMATEL to determine the effect of resource investment and cause-and-effect relationships of various attributes of food quality in casual-dining restaurants, from the perspective of experts. Lastly, this study integrated the results of IPGA and DEMATEL to determine the critical food quality factors most in demand for urgent improvement and the highest effect for resource investment, and provide such information as reference for operators of casual-dining restaurants to develop food quality improvement strategies, as well as to determine the priority of resource allocation, thus, enabling food quality improvements for casual-dining restaurants to achieve the maximum effect.

In the IPGA model, the dimensions of cooking and hygiene were located in the area of "Concentrate here," which were factors of high relative importance but low relative performance from the perspective of customers, and were the food quality dimensions most in demand for urgent improvement. This research result is different from the IPGA result of food quality of fine-dining restaurants (Cheng et al., 2011): [hygiene and taste were the dimensions most in demand for urgent improvement], suggesting that the guidelines for food quality improvement strategies of fine-dining restaurants were significantly different from those of casual-dining restaurants. This study presumed that the characteristics and appeals of general casual-dining restaurants focused on low price, convenience, and large meal size. However, they tended to ignore hygiene and taste. Therefore, casual-dining restaurants should give priority to the improvement of cooking and hygiene to improve customers' satisfaction with food quality of casual-dining restaurants. Moreover, dimensions such as visual appeal, taste, and other factors, were in the area of Low priority, which were factors of low relative importance and low relative performance from the perspective of customers, and were the food quality dimensions less in demand for improvement. Thus, the operators of casual-dining restaurants do not have to excessively invest resources in improving food quality attributes, such as visual appeal, taste, and other factors, and can adequately allocate investment resources in visual appeal, taste, and other factors to the dimensions of "hygiene" and "cooking," to meet customers' needs for food quality of casual-dining restaurants. Furthermore, worthy of note, in the research results of IPGA, none of the food quality dimensions of casual-dining restaurants was located in the area of [Keep up the good work]. The investigation showed that, although the importance of some of the quality dimensions was higher than the average importance, there was no [positive gap (i.e. satisfaction—importance were both>0)] in the dimensions of food quality. Consequently, the food quality of casual-dining restaurants must be continuously improved to increase customers' satisfaction to a degree higher than importance, in order to develop substantial competitive advantage of food quality.

Among the 25 items of food quality, further IPGA analysis (perspective of customers) showed that a total of 15 items were located in the area of "Concentrate here," including 2 items in the dimension of visual appeal, 3 items in the dimension of taste, 4 items in the dimension of cooling, 5 items in the dimension of hygiene, and 1 factor in the dimension of other factors. From the perspective of customers, operators of casual-dining restaurants should give priority to the improvement of the 15 items mentioned above. The priority, from the highest to the lowest, was "freshness of food," "personal hygiene of staff," "hygienic quality of tableware," "cleanness of dining environment," "service process meets hygienic requirement," "color of dishes after cooking," "hygiene of dishes," "doneness of dishes," "temperature of cold and hot dishes (drinks)," "tenderness of cooked food," "dish plating is beautiful and attractive," "dishes in the menu are always available," "dishes are delicate," "taste of dishes," and "overall texture of dishes." Moreover, a total of 8 items were in the area of Low priority, including 2 items (alternativeness of cuisine types and dishes served are identical to those in the menu) in the dimension of visual appeal, 2 items (scent of dishes and the taste of dishes is unique) in the dimension of taste, 1 item (crispness and juiciness of fried food) in the dimension of cooking, and 3 items (nutritional balance, side dishes are delicious, and meal size) in the dimension of other factors. There was 1 item (visual appearance can meet the specific needs of customers as much as possible) in the dimension of visual appeal, and 1 item (alternativeness of seasonings) in the dimension of other factors, which were located on the boundary between low priority and possible overkill. This study suggested that operators of casual-dining restaurants should not excessively invest resources in the quality items on the boundary between "Low priority" area and "Low priority and Possible overkill" area.

However, the priority for quality improvement, as obtained from IPGA results mentioned above, was from the perspective of customers. In terms of the practical priority of quality improvement, there remains a need to consider the total effect of resource investment and cause-and-effect relationships, in order to obtain actual effect. Therefore, based on the results of the DEMATEL model, this study further found that, among the five dimensions of food quality of casual-dining restaurants, the dimension of the highest total effect of resource investment was "cooking." In addition, this critical quality factor had an effect on visual appeal, hygiene, and taste. Moreover, although the total effect of resource investment in "visual appeal" was not the highest, it would also affect "cooking" and "taste." The results of IPGA and DEMATEL (as shown in Table 8) showed that, casual-dining restaurants should give priority to the improvement of quality attributes of "hygiene" and "cooking," especially the items in the dimension of hygiene (including "personal hygiene of staff," "hygienic quality of tableware," "hygiene of dining environment," "service process meets hygienic requirement," and "cleanness of dishes," with 5 items totally), from the perspective of customers. However, "cooking" was the important factor of the highest effect of resource investment, which can affect food quality dimensions of "visual appeal, taste, and hygiene," from the perspective of experts. As a result, this study suggested that operators of restaurants should give top priority to "cooking," in order to achieve better effects in terms of food quality improvement measures. In terms of the improvement of cooking, as the quality of "cooking" (e.g. "temperature of cold and hot dishes (drinks)," "color of dishes after cooking," "doneness of dishes," and "tenderness of cooked dishes") is mainly subject to the professional capacity and skill of chefs, this study suggested that casual-dining restaurants can focus on finding excellent professional chefs to significantly improve the food quality of restaurants. DEMATEL analysis found that, the dependent relationship between "other factors" and the remaining four food quality dimensions were weak, and thus, was regarded as an independent factor, and could not achieve any specific effect.

Table 8 Integrated Strategies for Food Quality Improvement of Casual-dining Restaurants

Methods / Dimensions	IPGA strategy	DEMATEL strategy
Visual appeal	Low priority	Investment with high effect; Cause class
Taste	Low priority	Investment with low effect: Effect class
Cooking	Concentrate here	Investment with high effect; Cause class
Hygiene	Concentrate here	Investment with low effect: Effect class
Other factors	Low priority	Independent factor

VI. Recommendations

The IPGA model not only overcomes the deficiency of the subjective judgment of the traditional IPA, but also combines the concept of quality gap to fully reflect consumers' expectations, perceptions, and evaluations (Cheng et al., 2012). Moreover, the use of DEMATEL can help understand the effect of resource investment and cause-and-effect relationships among various food quality attributes, and such information can be provided as reference for restaurant operators' resource investment to achieve the objective of cost minimization. It has been verified that a decision-making model, integrating IPGA with DEMATEL for quality improvement, can be applied to the service quality improvement of IT and hospitality industries (Tsai et al., 2011; Cheng et al., 2012). However, as food quality improvement strategies of restaurants continue to involve issues concerning [quality gap] and "effective resource allocation," a decision-making model integrating IPGA with DEMATEL for quality improvement can combine the perspectives of customers and experts to effectively determine the critical factors most in demand for urgent improvement and of the highest effect of resource investment. The research results can be provided as reference for restaurant operators to develop more adequate guidelines for quality improvement strategies and resource allocation. The research results may have a considerable practical contribution and value to the food quality improvement strategies of casual-dining restaurants, which will be beneficial to the enhancement of casual-dining restaurants' competitiveness in the market, and thus, the development of sustainable operation. Owing to restrictive factors, such as cost and geography, the main research limitations of this study were that only customers in 10 casual-dining restaurants in Taipei City were selected as the subjects, and the opinions from customers in other areas or dining at restaurants of other price levels could not be reflected. Therefore, future researchers are advised to expand the research scope to restaurant customers in different areas and countries, or even use other research methods (e.g. Kano model, ANP), to investigate food quality improvement strategies for restaurants from different perspectives in order to effectively analyze factors affecting the food quality of restaurants.

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