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Amend Importance-Performance Analysis Method with Kano's Model and DEMATEL

[1,2]Hsiu-Yuan Hu, [3]Yu-Cheng Lee and [4]Tieh-Min Yen
[1]Department of Food Science, Taipei College of Maritime Technology, 212,
Yen Ping N. Road, Sec. 9, Taipei, Taiwan, Republic of China
[2]Teaching Director of Da Chien Health Medical System, 6 Shin-Guang Street,
Miaoli City, Taiwan, Republic of China
[3]Department of Technology Management, Chung-Hua University, 707, Sec. 2,
WuFu Road, HsinChu, Taiwan 300, Republic of China
[4]Graduate Institute of Technology Management, Chung-Hua University,
707, Sec. 2, WuFu Road, HsinChu, Taiwan 300, Republic of China

Abstract: The purpose of this study was to set up new decision making analysis methodology, KD-IPA, to assist enterprises in establishing market strategy to win orders. Traditional Importance-Performance Analysis (IPA) implies important assumptions: (1) performance and customer satisfaction is a linear relationship and (2) the variables are independent and have no causal relationship. If the quality characteristics do not meet the abovementioned assumptions, the traditional IPA will not be able to analyze the priority orders of importance and improvement accurately and results in wrong decision-making. Therefore, the study integrated Kano's Model and Decision Making Trial and Evaluation Laboratory (DEMATEL), to establish a new methodology KD-IPA. The KD-IPA considers the nonlinear impact of quality characteristics and the casual relationship between the quality characteristics, which not only increase the effectiveness and accuracy of IPA, but also maintain the ability to easily understand the decision making model of the traditional IPA. The study adopted Taiwan's air-conditioner technology industry as the study case to explain the application and effectiveness of KD-IPA methodology. In the case, the organization has decided to strengthen the order-winner criteria delivery speed and design for adopting differentiation strategy to segment the market. In addition, quality conformance has the greatest increased satisfaction effectiveness; therefore, it should be improved and used to increase the market competitiveness.

Key words: Importance-performance analysis, Kano's model, decision making trial and evaluation laboratory, order-winner criteria, customer satisfaction, decision making analysis

INTRODUCTION

Using customer satisfaction as the major measuring indicator for organizational performance is commonly seen in theoretical and empirical research since quality management systems came out in the 1980s. In this type of research, one of the major analysis tools is Importance-Performance Analysis (IPA), this method is not only easy to calculate, but the advantage and disadvantage of an organization can also be directly analyzed from the survey information of the organization. The basic concept of IPA is to use a market survey to understand the customer's cognition importance on the quality characteristics and after the customer has experienced the service, measure the actual satisfaction level for the quality characteristics, through establishing the two-dimensional matrix analysis of importance and performance to divide the quality characteristics into four categories according to its importance and performance and benefit the organization with adopting corresponded market strategy in accordance with the quality characteristics. The explanation for IPA matrix can be defined by the matrix's four quadrants:

- **Concentrate here:** The customers think the importance of the product or service quality characteristics is high, but the performance of the organization is low
- **Keep up the good work:** The customers think the importance of the product or service quality characteristics is high and the performance of the organization is also high

Corresponding Author: Tieh-Min Yen, Graduate Institute of Technology Management, Chung-Hua University, 707, Sec. 2, WuFu Road, HsinChu, Taiwan 300, Republic of China Tel: +886-3-4024298 Fax: +886-3-4026145

- **Low priority:** The performance of the organization's product or service quality characteristics is low and the importance of customer cognition is also low
- **Possible overkill:** The performance of the organization's product or service quality characteristics is high, but the importance of the customer cognition is low

In the research of Bacon (2003) and Eskildsen and Kristensen (2006), it is thought that the major purpose of IPA is to provide an opportunity for the organization's product and service to continue improving.

Since Martilla and James (1977) first adopted IPA to develop the market strategy of an organization, this method has been broadly adopted in various industries. For example: in recent researches, Lee *et al.* (2008d) applied the Taguchi Method, the amended IPA model, in the quality improvement of air-conditioner technology; Tonge and Moore (2007) adopted IPA and gap analysis to assess the visitor feelings regarding the quality of Marine-Park Coast and have more effective management for environmental protection and Lee *et al.* (2008b) adopted the IPA model in the supplier performance assessment, etc. Just as what Martilla and James (1977) stressed, the IPA model has several advantages, such as low cost, easy to apply and better focus and strategy recommendations, this is the major reason for this method to be broadly accepted and applied.

In recent years, many scholars have attempted to amend the traditional IPA model, to allow it to be more reasonable. In the innovative research of IPA methodology, many scholar researches pointed out that the importance and satisfaction of quality characteristics are correlated (Oh, 2001; Ryan and Huyton, 2002; Sampson and Showalter, 1999). The dynamic model presented by Sampson and Showalter (1999) has proven that when the organizational performance changes, the importance of customer cognition will also changes at the same time. The main reason for this is that the correlation coefficient of importance and performance is not zero. According to this point of view, when the performance of an organization increases, the gap of importance and performance will reduce rapidly. The research of Matzler and Sauerwein (2002) showed that the importance of quality characteristics will reduce along with the increasing performance, therefore, the problems induced by the dynamic evolution of importance and performance and the interaction and impact level between importance and performance are important study themes. Matzler and Sauerwein (2002) believed that self expressed customer importance cannot really express the relative importance of quality characteristics and prove that the self expressed customer importance is not really the satisfaction function of quality characteristics. The hidden importance is the satisfaction function of quality characteristics. This is derived by the multiple regression equation using the performance of k quality characteristics as the independent variable (X_i) and the overall satisfaction as the dependent variable (Y), the function relation can be shown as:

$$Y = \beta_0+\beta_1X_1+\beta_2X_2+...+\beta_kX_k+\varepsilon$$

where, ε is the error term.

Because the regression coefficient β_i refers to the impact level of ith performance of quality characteristics on the overall satisfaction, therefore, Matzler and Sauerwein (2002) and Matzler *et al.* (2004b) believe that the cognition importance measurement of a customer regarding quality characteristics is better off using the coefficient derived from the multiple regression equation. This model has provided significant improvement and contribution to the evolution process of the IPA model. It adopted the statistical method to derive the hidden importance of customer cognition, which is finding the real quality characteristic item that the customers care about and started the quantitative researches of performance of quality characteristics and customer satisfaction level. This type of innovated research not only explains that the importance and performance of quality characteristics are correlated, but also establishes importance as being the linear relationship of performance and satisfaction. However, nonlinear impact of quality characteristics on customer satisfaction is always exist which has been approved.

In the researches of quality characteristics' nonlinear impact for satisfaction level, the most famous model is the two-dimensional quality model presented by Kano *et al.* (1984), which divided quality characteristics into 5 categories according to the availability and customer satisfaction level, they respectively are attractive quality, must-be quality, one dimensional quality, reverse quality and indifference quality, where the attractive quality and must-be quality have nonlinear impact characteristics. Therefore, Yang (2003) integrated Kano's two-dimensional quality model, key customer interview and the quality of IPA improving household electrical appliances repair services and enhanced the organizational competitive ability. Yang (2005) amended Kano's two-dimensional quality model and at the same time integrated importance-satisfaction analysis method, to allow an organization to obtain more valuable information as a reference for quality decision making. Eskildsen and Kristensen (2006) integrated Taguchi's loss

function concept, Kano's model and regression analysis in the importance-performance analysis to strengthen the explanation ability of the importance-performance analysis model. In addition, there are a few customer satisfaction asymmetric effect researches of the three-factor theory: basic factor, performance factor and excitement factor in the quality characteristics, for example: Matzler and Sauerwein (2002) developed a methodology that defined the service quality characteristic three-factor theory attributes in the study of the service quality characteristics in the information department of the medical industry; the research of Matzler *et al.* (2003) believes that the organizational overall satisfaction level is the performance function of quality characteristics and the three customer satisfaction impact factors have different impacts for overall satisfaction; the research of Matzler *et al.* (2004a) used the multiple regression analysis of virtual variables to prove that quality characteristic asymmetry for overall satisfaction exists; the travel research of Deng (2007) in Taiwan's hot spring industry integrated the three-factor theory, partial correlation analysis and natural logarithmic transformation to amend the IPA model. Furthermore, in order to overcome the assumption problem limit of the traditional statistical method, in the travel research of Deng (2007) in Taiwan's hot spring industry, it used the BPNN model to establish the relationship of the performance of quality characteristics and the overall satisfaction and used its average weight to estimate the corresponding importance of quality characteristics and to amend the traditional IPA model. Although, from the above-mentioned researches, it can be seen that quality characteristics shall have the linear, asymmetry and nonlinear impact on customer satisfaction level and have significant contributions for the theory and application of IPA, however the impact researches of the causal relationships between quality characteristics have not yet been started.

To explore the impact of this type of problem, the purpose of this study is to present a new decision making analysis methodology KD-IPA, which integrate the Kano's Model and Decision Making Trial and Evaluation Laboratory (DEMATEL) into the IPA. KD-IPA considered the nonlinear impact of quality characteristics and the interaction level of the casual relationship between quality characteristics at the same time and re-amended the importance and improvement priority order of quality characteristics to avoid leading to wrong organizational decision making and to allow the improvement and market strategy to be more reasonable. Finally, take Taiwan's air-conditioning technology industry as the case study example to describe the application and effectiveness of KD-IPA methodology.

MATERIALS AND METHODS

The study combined the analysis results of Kano's model and DEMATEL to amend the traditional IPA model to find the core problem of an organization and allow the improvement and resource allocation of quality characteristics to be more reasonable and at the same time, accurately provide the required information for establishing market strategy and keep the organization from making wrong decisions which result in a large amount of loss. The KD-IPA model presented by the study has the following main issues being discussed:

- Using Kano's model to analyze the criteria of winning and filling the order to understand its quality attribute
- Using Kano's model to establish the quantitative evaluation model of the performance of quality characteristics for customer satisfaction
- Using DEMATEL to analyze the causal relationship and interaction level of the criteria of winning and filling the order
- Establishing the new decision making analysis methodology, KD-IPA model

Kano's model: Dr. Kano presented the product quality characteristics classification method in 1984. It used the relationship of the availability of quality characteristics and customer satisfaction to understand product quality attributes and satisfy customer requirements and expectations (Kano *et al.*, 1984). Dr. Kano suggested that the quality characteristics required and expected by customers shall be identified first, while design and planning the product and then the design can be added to the product to achieve the largest customer value. In order to understand the cognition and concept of customers on the product quality characteristics, the paired survey design method must be used to understand the customers' feelings while the quality characteristics are available or not available? (Lee *et al.*, 2008b). The customer emotion level can be classified as: I like it that way, it must be that way, i am neutral, i can live with it that way and i dislike it that way. From the answers of the customers, the attribute of a certain product quality characteristics can be understood according to matrix analysis method. According to the concept of Kano's model, the quality characteristics that impact customer satisfaction are divided into five categories:

- **Must-be quality, M:** Must-be quality is the product's basic required quality characteristics considered by the customers. If these needs are not satisfied, the

customers will be very dissatisfied. In other words, when the customers care about these products' basic quality characteristics, even if the needs are satisfied, the customers' satisfaction level still will not increase, because according to the customers' thought pattern, they think that satisfying the basic needs is a necessary factor. It can be seen that having the must-be quality will only allow the customers to not be dissatisfied with situation. Must-be quality is a clear market competitive factor; customers treat it as a necessary factor. Customers will not only clearly request it, but also will consider it as a basic necessity before selecting the product. If the product does not contain these criteria, the customer will not be interested in the product at all

- **One-dimensional quality, O:** The one dimensional quality's availability level is proportional to the customer satisfaction level, which means that the higher its availability level, the higher the customer satisfaction level; however, for the opposite, it will be lower. One dimensional quality is a clear market competitive factor. Usually, a customer will clearly request that quality characteristic and compare it. When the level of a product contains one-dimensional quality characteristics which are higher than other products, the customer will be happy to choose that product
- **Attractive quality, A:** Attractive quality has the biggest impact on customer satisfaction in the product quality characteristics. Usually, customers do not know or clearly express their needs regarding this. When the product has the attractive quality characteristics, the customers will feel very happy and the happiness will increase with the availability level. However, even if the product does not have the attractive quality characteristics, the customer will not be dissatisfied because of this
- **Indifferent quality, I:** Whether this quality characteristic is available or not will not make the customers feel satisfied or dissatisfied
- **Reverse quality, R:** When this quality characteristic is available, the customers will be dissatisfied; on the other hand, when the characteristic is not available, the customer will be satisfied

Kano's model used the plural to determine the quality attributes, when a specific quality characteristic cannot be clearly classified, Matzler *et al.* (1996) presented an effective and easy classification, the decision making order is M>O>A>I. Berger *et al.* (1993) presented a user satisfaction level index:

$$\text{Better} = (A+O)/(A+O+M+I)$$

as the vertical axis and dissatisfaction level index:

$$\text{Worse} = (O+M)/(A+O+M+I)\times(-1)$$

as, the horizontal axis and distinguished the attributes of quality characteristics through the matrix graphics.

Q-rate can be an effective measuring index for Kano's model survey, Matzler and Hinterhuber (1998) considered that it is acceptable for Q-rate to be smaller than or equal to 2%. Matzler *et al.* (1996) summarized Kano's two-dimensional quality model with the following advantages:

- Provides a better method to understand customer needs
- Provides clear improvement priority order
- Assists to provide a valuable balance model in the development manufacturing system stage
- Provides market segmentation method
- Provides market differentiation method. Therefore, the study used Kano's model to establish the quality attributes of winning orders to facilitate the establishment of a market strategy

Satisfaction improvement quantitative analysis model: Tan and Shen (2000) presented the quantitative model using customer satisfaction and the product and server performance relationship of Kano's model using a method similar to parameter and equation in the study of Quality Function Deployment (QFD). The function relationship can be shown with:

$$s = f(k, p)$$

where, s represents customer satisfaction, k represents the adjusted parameter of Kano's quality characteristics classification and p represents the performance of product and service.

It is shown in the model presented by Kano *et al.* (1984), for all of the quality characteristics that impact customer satisfaction, the impact levels are different. Not only the importance of quality characteristics is different, its impact method is also different. For example: when the availability of quality characteristics increases, attractive quality characteristics' impact on satisfaction will be bigger than one dimensional quality characteristics, which means that the importance of attractive quality and the contribution to satisfaction is bigger than one dimensional quality. Regarding the focus on attractive quality characteristics, when quality and service

performance improves, customer satisfaction will improve along with it. Therefore, for attractive quality, $\Delta s/s > \Delta p/p$; s and p, respectively are customer satisfaction and the performance standard of quality and service, Δs and Δp, respectively refer to the changes of customer satisfaction and the performance standard of quality and service. Likewise, one dimensional quality is $\Delta s/s = \Delta p/p$ and must-be quality is $\Delta s/s < \Delta p/p$.

In order to simplify the relationship of satisfaction and performance improvement rate, Tan and Shen (2000) assumed that $\Delta s/p$ and $\Delta p/p$ have a linear relationship and then used parameter k to integrate the above-mentioned three relationships into an equation:

$$\Delta s/s = k\,(\Delta p/p)$$

where, the parameter of attractive quality, $k>1$; the parameter of one dimensional quality, $k = 1$ and the parameter k of the must-be quality is between 0 and 1, which is $0<k<1$.

The equation can be further transferred to the function of the relationship of satisfaction and performance, shown as Eq. 1:

$$s = cp^k \quad (1)$$

where, C is the constant.

Set s_0 and p_0 as the customer satisfaction and performance standard of product and service, s_1 and p_1 as the target customer satisfaction and expected performance standard of product and service and assume that the changing of satisfaction and performance will not change the quality characteristics classification status and constant of Kano's model. Therefore, Eq. 1 is reasonable and acceptable. Because $s_0 = cp_0^k$ and $s_1 = cp_1^k$, so the ratio IR of customer satisfaction improvement can be shown as Eq. 2:

$$IR = \frac{s_1}{s_0} = \frac{cp_1^k}{cp_0^k} = \left(\frac{p_1}{p_0}\right)^k \quad (2)$$

Tan and Shen (2000) believed that k value shall be decided by the operator of QFD and suggests that k value can be set as 2, 1 and 1/2 to reflect the real relationship according to the classification of attractive quality, one dimensional quality and must-be quality in Kano's model. In the research of integrating FMEA and Kano's model presented by Shahin, the k value is set as 2, 1 and -1 according to the classification of attractive quality, one dimensional quality and must-be quality in Kano's model, 0 is set as the indifference quality to meet the calculation principle of RPN.

The study adopted the amended coefficient k and constant c and IR concept to process the research of amending the IPA model. In the model of Tan and Shen (2000) and Shahin (2004), the quantitative relationship of availability of quality characteristics and customer satisfaction, only high availability situations are considered and according to the definition of Kano's model, when quality characteristics process improvement efficiency in low availability situations, the attractive quality is $\Delta s/s < \Delta p/p$, one dimensional quality is $\Delta s/s = \Delta p/p$ and must-be quality is $\Delta s/s > \Delta p/p$. In other words, the dissatisfaction improvement range of must-be quality will increase more than the satisfaction of attractive quality and one dimensional quality and the dissatisfaction improvement range of one dimensional quality will increase more than the satisfaction of attractive quality. Therefore, the improvement priority order is M>O>A, this can also represent the importance level of improvement. Focusing on the quality characteristics availability of Kano's model and the quantitative relationship of customer satisfaction, the study integrates the formula of Tan and Shen (2000) and Shahin (2004) for partial adjustment and uses it as the assessment value for adjusting importance when quality characteristics have nonlinear impacts (Lee *et al*., 2008a). The study set the performance p of customer feelings in the interval of [1, 9], so k is classified according to the attractive quality, one dimensional quality, must-be quality, indifference quality and reverse quality and respectively set as 2, 1, 1/2, 0 and 1. According to Eq. 2, the quality characteristics before improvement are compared with the customer satisfaction after improvement, then IR of A, O, M and R can be introduced and used as the assessment value for adjusting IPA importance when quality characteristics have nonlinear impacts. However, according to the definition of Kano's model, indifferent quality (I), whether it is available or not, has no impact on customer satisfaction. Therefore the IR does not need to be calculated and discussed.

Although, Kano's model can solve the nonlinear problem, it still assumes that the quality characteristics are independent. Therefore, the study uses DEMATEL to explore the casual relationship between quality characteristics and to integrate Kano's model to amend IPA's decision making methodology.

Decision Making Trial and Evaluation Laboratory (DEMATEL): The Decision Making Trial and Evaluation Laboratory (DEMATEL) method was developed by the Battelle Memorial Institute in Geneva (Fontela and Gabus, 1974). At that time, the DEMATEL method was used to study the world's complicated problems, such as: Race,

hunger, environmental protection and energy, etc., (Fontela and Gabus, 1973). In recent years, many scholars have broadly applied the DEMATEL method to solve problems in different fields (Hajime *et al*., 2005; Kim, 2006; Wu and Lee, 2007; Lin and Wu, 2008). The purpose of DEMATEL is to use matrix calculation to obtain all the direct and indirect casual relationships and impact strength in a complicated and difficult system through directly comparing the interaction between quality characteristics, especially using a visual structural matrix and casual diagram to show the casual relationship and impact level between quality characteristics in a complicated system and assisting the establishment of decision making. The structure and calculation steps of DEMATEL will be described briefly as follows according to the research of Lee *et al*. (2008a, c).

Define quality characteristics and establish measurement scale: List and define the quality characteristics that impact a complicated system by using expert opinion method, assume there are n quality characteristics that impact the complicated system. Establish the measurement scale of the casual relationship and level between quality characteristics, the measurement scale is divided into 0, 1, 2 and 3, levels, which, respectively represent no impact, low impact, high impact and great impact (Lin and Wu, 2008). In addition, there are also measurement scales divided into 6 levels (Kim, 2006) and 11 levels (Huang *et al*., 2007).

Establish direct-relationship matrix: When there are n quality characteristics, compare the quality characteristics according to the impact relationship and level through surveying the expert's opinions, then the direct-relation matrix X of n×n can be obtained. In the direct-relation matrix, X, x_{ij} represents the level of quality characteristics i, impact quality characteristics j and the diagonal quality characteristics x_{ii} of the direct-relation matrix X is set as 0.

$$X = \begin{bmatrix} 0 & x_{12} & \cdots & x_{1n} \\ x_{21} & 0 & \cdots & x_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ x_{n1} & x_{n2} & \cdots & 0 \end{bmatrix} \quad (3)$$

Calculate normalized direct-relation matrix: The calculation of the normalized direct-relation matrix uses the row vector with the biggest sum as the normalized base. Set:

$$\lambda = \frac{1}{\underset{1 \le i \le n}{\text{Max}} \left(\sum_{j=1}^{n} x_{ij} \right)} \quad (4)$$

Then from the calculation of Eq. 4 and 5, multiply λ to direct-relation matrix X to receive normalized direct-relation matrix N.

$$N = \lambda X \quad (5)$$

Calculate direct/indirect relation matrix: Direct/indirect relation matrix T, which can also be called the total-relation matrix, can be obtained from Eq. 6:

$$T = \lim_{k \to \infty} \left(N + N^2 + \cdots + N^k \right) = N(I - N)^{-1} \quad (6)$$

where, I is the identity matrix.

Set t_{ij} as the quality characteristics of direct/indirect relation matrix T, i, j = 1,2, …,n. From Eq. 7 and 8, the sum of the rows and columns in Direct/indirect relation matrix T can be calculated and set D_i as the sum of the ith row, which means quality characteristic i is the reason to impact the sum of other quality characteristics, R_j as the sum of the jth column, which means quality characteristic i is the result and the sum being impacted by other quality characteristics. The D_i and R_j received from direct/indirect relation matrix T both include direct and indirect impacts.

$$D_i = \sum_{j=1}^{n} t_{ij} \quad (i = 1, 2, \cdots, n) \quad (7)$$

$$R_j = \sum_{i=1}^{n} t_{ij} \quad (j = 1, 2, \cdots, n) \quad (8)$$

Draw up causal diagram: Define (D_t+R_t) as the prominence and t = i = j = 1, 2, …, n, which means the total level of this quality characteristic impacts others and is impacted by others. According to this value, it can show the core level of quality characteristic t in all the problems; and $(D_t - R_t)$ is defined as a relation, which means that the difference level of this quality characteristic impacts others and is impacted by others. According to this value, it can show the attributed causal level of quality characteristic t in all the problems. If it is a positive value, then the quality characteristic is the reason type. If it is a negative value, then the quality characteristic is the result type. Therefore, the decision maker can find the core driving factor to solve the complicated system according to the casual relationship of quality characteristics and the interaction level of quality characteristics and according to the attributed type and impact level, plan a suitable decision to solve the problem.

Integrate the KD-IPA model of Kano's model and DEMATEL: First, take the criteria of winning and filling the orders as an example to explain the impact of nonlinear

relationship in improving decision making. When focusing on quality characteristics for improvement, the traditional method is to find the quality characteristic which is required to be improved according to the IPA model and process improvement work individually. However, when the quality characteristic has a nonlinear relationship, it is easy to result in making the wrong improvement decision. For example: when a brand name is located in the low priority order section of the IPA matrix, the decision of the organization will not devote any resources to process the improvement of the brand name. However, according to Kano's model, customers treat brand name as an attractive quality, which means if the brand name is improved, then the customer satisfaction will show a nonlinear enhancement, in other words, brand name is very important for the enhancement of customer satisfaction, therefore, the self expressed importance of customers shall be amended to truly respond the priority order of improvement, therefore, when establishing the IPA matrix, the asymmetric and nonlinear impact must be considered, the importance of brand name increased and made to land in the concentrate here section of the IPA matrix.

According to the method and Eq. 2 of Kano's model, when the improvement of quality characteristic contributes to the enhancement of customer satisfaction, it can represent the important level of the quality characteristic. In other words, the higher the improvement rate of customer satisfaction, the higher the importance of the quality characteristic; however, for the opposite, it will be lower. Therefore, the study uses IR as the assessment coefficient value to amend self expressed customer importance when the quality characteristic has nonlinear impact (Lee *et al*., 2009).

Follow by discussing the impact for establishing improvement decisions when there are causal relationships between quality characteristics. When there are causal relationships between quality characteristics, it means when focusing on a quality characteristic for improvement, at the same time it may impact the changes of other quality characteristics, therefore, it cannot accurately find the quality characteristic that requires improvement according to IPA matrix. For example: when the delivery speed is in the quadrant of keep up the good work and the demand increase, which impacts the delivery speed, is in concentrate here, the influential demand increase shall be improved immediately, therefore, in addition to improving the response ability of the demand increase, it can increase the performance of delivery speed at the same time, which has the same conclusion with directly finding the quality characteristics requiring improvement according to the IPA matrix. However, when demand increase is in the quadrant of possible overkill, if directly following the decision of the traditional IPA matrix, the resource devotion in the responding ability of demand increase is reduced, then the delivery speed will reduce and the competitive advantage will be lost. Therefore, when there are casual relationships between quality characteristics, directly following the traditional IPA matrix will result in making wrong decisions. Therefore, the quality characteristics with high impacts shall be considered before making the improvement decision and amending self expressed customer importance to truly respond the improvement decision and priority order.

According to the method of DEMATEL to calculate the relationship of D_i-R_i of quality characteristic i, it refers to the difference level of the quality characteristic impacting others and being impacted by others. According to the value, the attributed causal level of that quality characteristic i in all the problems that can be shown. If it is a positive value, then the quality characteristic is the reason type. If it is a negative value, then the quality characteristic is the result type. Therefore, according to this value, the impact level of the quality characteristic i in all problems can be shown and when the relationship of the quality characteristic $D_i-R_i>0$, it means that this quality characteristic has a bigger impact and the bigger the impact is, the higher the importance is, so it shall be considered first when processing improvement decision; if the relation of a quality characteristic $D_i-R_i<0$, it means the quality characteristic will be impacted by other characteristics, the bigger the impact is the lower the importance is and it shall not be a priority considering subject for improvement, therefore, the impact of the importance and causal relationship of IPA model shall be considered at the same time (Lee *et al*., 2008a).

The study presented the Combinative Importance (CI) I_{ci} of the integrated Kano's model and DEMATEL, which is to multiply the customer self expressed importance I with the quality characteristics $IR_{(i)}$ of Kano's model and then add impact D_i-R_i, therefore, the combinative importance of the *i*th quality characteristic is shown as Eq. 9.

$$I_{ci} = IR_{(i)} \times I_i + (D_i - R_i) \qquad (i = 1, 2, 3, \ldots, n) \qquad (9)$$

Hansen and Bush (1999) explained that IPA has been considered as a simple and effective tool. It is very useful for deciding how to most effectively use limited resources and achieve the greatest customer satisfaction. Therefore, the study transfers the importance coordinate axis of traditional importance-performance two-dimensional

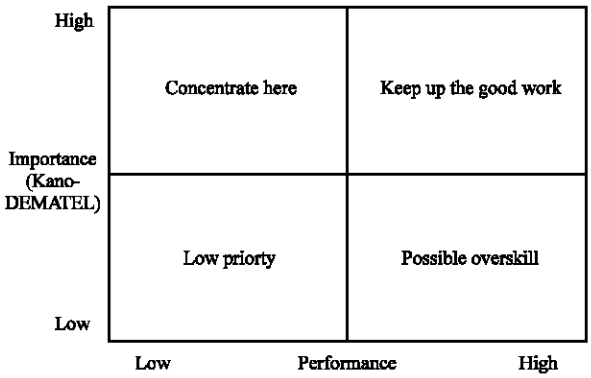

Fig. 1: Integrated KD-IPA model of Kano's model and DEMATEL

matrix into Combinative Importance (CI) I_{ci}, which is the KD-IPA model of integrating Kano's model and DEMATEL, shown as Fig. 1. The assessment of the concentration trend uses the mean to distinguish the four quadrants formed by the two-dimensional matrix of importance-performance, the definition and strategy of the four quadrants are the same as the traditional IPA method presented by Martilla and James (1977), which maintains the characteristics of the original model being easy to explain and the strategy can be read directly.

CASE STUDY AND DISCUSSION

This study uses Taiwan's air-conditioning technology manufacturer as the case study object and adopts the KD-IPA model to analyze the criteria of winning orders, providing references for market strategy and manufacturing strategy decision and improve customer satisfaction. The head office of the study case company, King Sun Group, is the leader of air-conditioning equipment manufacturer, the market share in Taiwan is about 30%, it has received the certification of ISO 9001 and the business performance continues to have a stable growth. The study focused on the customer group of the company for a survey in 2008 and developed the questionnaire with the criteria of winning orders. It used the KD-IPA model to analyze, find the core problem and improvement direction, provide references for market strategy and manufacturing strategy decision making and increase the company's competitiveness.

Kano's model and DEMATEL questionnaire establishment and survey: The study focuses on the customers who have transactions with the company to process an air-conditioning technology product satisfaction survey on the criteria of winning orders in 2008. The classification of quality characteristics adopted the pairing questionnaire of Kano's model. In addition, coping with the questions of the importance of quality characteristics and the performance of organization, adopts the 9-point scales of winning order criteria, Slack (1994) to understand the actual feelings of customers and further inspect the company's actual performance. The question items of the organization performance are classified as 1, very dissatisfied, to 9, very satisfied; the question items of the importance of quality characteristics are classified as 1, very unimportant, t 9, very important. The design of the questionnaire items refers to the 14 order winning criteria of Hill (2000) and it interviewed 20 customers and 10 company high level managers and considered the 14 order winning criteria to be able to be used for measuring the customer satisfaction level. Griffin and Hauser (1993) discovered that interviewing 20~30 customers can decide 90~95% of the quality characteristics for the same nature's market. The customer selection base is the customers with transactions with the company in 2007 and who have already completed the service. The questionnaires were sent by mail or fax to the project responsible personnel of the customer; 540 questionnaires were sent, 161 and 177 effective questionnaires were received, respectively from Kano's model and IPA, the effective questionnaire retrieval rate is 29.81 and 32.78%.

The questionnaire design of DEMATEL adopted the 14 order winning criteria of Hill (2000) as the base and 10 company high level managers adopted the expert opinions method to develop the direct-relation matrix of 14 order winning criteria. The measuring scale of direct-relationship adopted the 11 point scale of Huang *et al.* (2007), which uses 0 as No impact and 10 as significant impact. The company expects to use the received questionnaires to establish the characteristic classification of winning and meeting the order criteria through Kano's model and use DEMATEL to analyze the direct and indirect relationships of order winning criteria, find the core problem and improvement direction and then use the IPA model to analyze and accurately provide the required information for establishing market strategy.

Analysis result: According to traditional IPA analysis, as shown in Fig. 2 and Table 1, the order winning criteria that is in concentrate here, are the items required to be improved immediately, they respectively are price (OW1), quality conformance (OW4), delivery reliability (OW2), delivery speed (OW3) and after-sales support (OW14); the order winning criteria items that are in keep up the good work, respectively are design (OW7) and being an existing supplier (OW10), must continue to keep up its

competitive advantage; the order winning criteria items that are in possible overkill, are product range (OW6), distribution (OW8) and design leadership (OW9), they can reduce the devotion of resources. The order winning criteria items that are in low priority respectively are demand increases (OW5), marketing and sales (OW11).

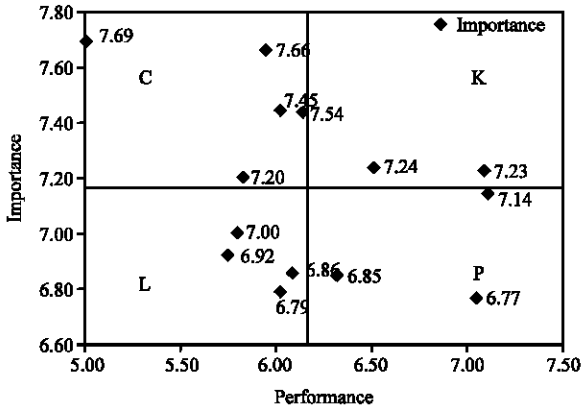

Fig. 2: Order winning criteria traditional IPA map

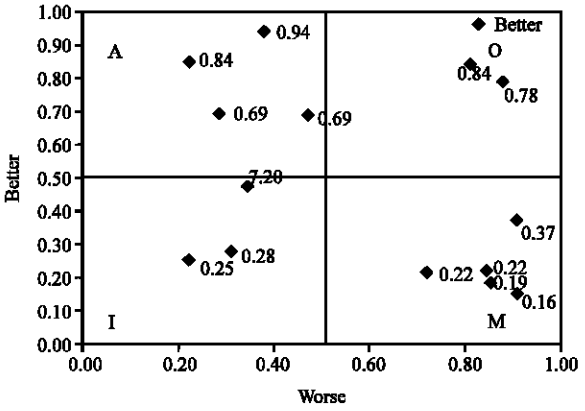

Fig. 3: Better-worse diagram of Kano's model

Analyze order winning criteria with Kano's model, summarize the survey result with Kano's model classification data as Table 2 and according to the analysis of the better-worse diagram (Berger *et al*., 1993), decide the quality attributes. It can be shown from Fig. 3 and Table 2, delivery speed, OW3, design, OW7, design leadership, OW9 and brand name, OW12 as the attractive quality; price, OW1 and quality conformance, OW4 as the one dimensional quality; delivery reliability, OW2, distribution, OW8, marketing and sales, OW11, technical liaison and support, OW13 and after-sales support, OW14 as the must-be quality and demand increases, OW5, product range, OW6 and being an existing supplier, OW10 as the indifference quality. In this research, there is no reverse quality for the criteria of order winning and filling and the Q-Rate is 0%, which means the analysis result is acceptable.

According to traditional IPA analysis, shown as Fig. 2, the criteria of order winning, which lands in the concentrate here, C section, shall present immediate improvement. However, according to the classification of Kano's model, these criteria of order winning respectively are attributed as must-be quality, one dimensional quality

Table 1: Order winning criteria traditional IPA analysis table

Notation	Order-winner criteria	Performance	Importance	Strategy
OW1	Price	5.94	7.66	C
OW2	Delivery reliability	6.02	7.45	C
OW3	Delivery speed	5.82	7.20	C
OW4	Quality conformance	5.01	7.69	C
OW5	Demand increases	5.75	6.92	L
OW6	Product range	7.04	6.77	P
OW7	Design	6.51	7.24	K
OW8	Distribution	7.10	7.14	P
OW9	Design leadership	6.32	6.85	P
OW10	Being an existing supplier	7.08	7.23	K
OW11	Marketing and sales	6.02	6.79	L
OW12	Brand name	6.08	6.86	L
OW13	Technical liaison and support	5.79	7.00	L
OW14	After-sales support	6.14	7.44	C

Table 2: Kano's model analysis table for criteria of order winning and filling

Notation	Order-winner criteria	A (%)	O (%)	M (%)	I (%)	R (%)	Total (%)	Attribute
OW1	Price	18.63	65.22	15.53	0.62	0.00	100.00	O
OW2	Delivery reliability	9.32	27.95	62.73	0.00	0.00	100.00	M
OW3	Delivery speed	62.11	31.68	6.21	0.00	0.00	100.00	A
OW4	Quality conformance	12.42	65.84	21.74	0.00	0.00	100.00	O
OW5	Demand increases	24.84	22.36	12.42	40.37	0.00	100.00	I
OW6	Product range	9.32	16.15	6.21	68.32	0.00	100.00	I
OW7	Design	24.84	44.10	3.11	27.95	0.00	100.00	A
OW8	Distribution	12.42	9.32	62.73	15.53	0.00	100.00	M
OW9	Design leadership	43.48	25.47	3.11	27.95	0.00	100.00	A
OW10	Being an existing supplier	6.21	21.74	9.32	62.73	0.00	100.00	I
OW11	Marketing and sales	9.32	9.32	75.78	5.59	0.00	100.00	M
OW12	Brand name	65.22	19.25	3.11	12.42	0.00	100.00	A
OW13	Technical liaison and support	6.21	15.53	68.94	9.32	0.00	100.00	M
OW14	After-Sales support	3.11	12.42	78.26	6.21	0.00	100.00	M

Table 3: Prominence and Relation coefficient table of criteria of order winning

Notation	Order-winner criteria	D	R	D+R	D−R
OW1	Price	0.17	1.25	1.42	-1.09
OW2	Delivery reliability	0.19	0.27	0.47	-0.08
OW3	Delivery speed	0.93	0.81	1.74	0.12
OW4	Quality conformance	1.11	0.79	1.90	0.32
OW5	Demand increases	0.41	0.00	0.41	0.41
OW6	Product range	0.40	0.33	0.73	0.07
OW7	Design	1.51	0.00	1.51	1.51
OW8	Distribution	0.23	0.00	0.23	0.23
OW9	Design leadership	0.91	0.18	1.09	0.73
OW10	Being an existing supplier	0.00	1.19	1.19	-1.19
OW11	Marketing and sales	0.00	1.13	1.13	-1.13
OW12	Brand name	0.24	0.53	0.77	-0.29
OW13	Technical liaison and support	0.17	0.05	0.22	0.12
OW14	After-sales support	0.27	0.00	0.27	0.27

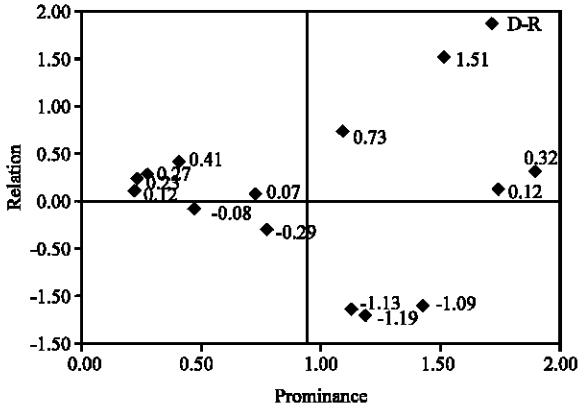

Fig. 4: Causal diagram of criteria of order winning

and attractive quality, this shows the same improved criteria of order winning which land in concentrate here, C section and will have different impacts on customers. In addition, being an existing supplier, OW10 is an indifference quality (I), however, according to the traditional IPA model analysis, it lands in keep up the good work, K section. If it is only analyzed according to the traditional IPA model, it will result in making the wrong decision. Therefore, the new decision making method must discuss the effectiveness of improving the criteria of order winning to customers, which is the level of increased satisfaction or reduced dissatisfaction. This is the issue that the traditional IPA model has not yet considered.

Process DEMATEL analysis with the criteria of order winning and understand the interaction and causal relationship of the criteria of order winning. According to Eq. 6, the direct/indirect relationship matrix can be obtained and can calculate various rows' D_i and various lines' R_i according to Eq. 7 and 8 and obtain Prominence (D_i+R_i) and Relationship (D_i-R_i), shown as Table 3.

Add Prominence (D_i+R_i) and Relation (D_i-R_i) and then divide the sum by the 14 criteria of order winning to obtain the mean as the concentrated trend assessment value in the casual diagram, the value can divide the diagram into four quadrants, shown as Fig. 4. According to the analysis of Fig. 4, in the criteria of order winning, those with high prominence and high relationship respectively are quality conformance, OW4, delivery speed, OW3, design, OW7 and design leadership, OW9, which means that this type of criteria of order winning is a core item of affecting other criteria; and those with high prominence and low relation, respectively are price, OW1, marketing and sales, OW11 and being an existing supplier, OW10, which means that these types of criteria of order winning are core items of being impacted by other criteria; the other criteria of order winning with low prominence, but high relationship, respectively are demand increases, OW5, product range, OW6, after-sales support, OW14, distribution, OW8, technical liaison and support, OW13 and those with low prominence and relation, respectively are delivery reliability, OW2 and brand name, OW12, the impact of their casual relationship can be ignored, which means they are treated as independent criteria.

Due to the complicated interaction of criteria of order winning, the impact level of the causal relationship is smaller than a certain value can be treated as having no causal relationship to simplify the analysis. The study set the threshold $\alpha = 0.1$ and at the same time set the impact coefficient of the criteria of order winning smaller than 0.1 ($t_{ij}<\alpha = 0.1$) as having no causal relationship, therefore; the causal relationship and impact level being processed by threshold $\alpha = 0.1$ can be established more clearly. Take quality conformance, OW4 as an example: when quality conformance, OW4 improves, at the same time, it will impact the changes of price, OW1, (the impact level is 0.26, delivery speed, OW3 (impact level is 0.17), being an existing supplier, OW10 (impact level is 0.27), marketing and sales, OW11 (impact level is 0.15) and brand name, OW12 (impact level is 0.16).

According to the traditional IPA analysis, when the criteria of order winning lands in the concentrate here, C section, those which shall present immediate improvements are price, OW1, delivery reliability, OW2, delivery speed, OW3, quality conformance, OW4 and after-sales support, OW14, however, in the analysis result of DEMATEL, these criteria of order winning have causal relationships and interaction, Lee *et al.* (2008b) considers that when the criteria of order winning has a causal relationship, the traditional IPA decision will result in the organization not achieving the expected effect even if it devotes many resources. Therefore, the causal relationship between the criteria of order winning must be considered.

Table 4: KD-IPA analysis table of criteria of order winning

Notation	Order-winner criteria	Quality attribute	$IR_{(i)}$	Relation (D-R)	Performance	Importance (I_{ci})	Strategy
OW1	Price	O	1.31	-1.09	5.94	8.98	L
OW2	Delivery reliability	M	1.19	-0.08	6.02	8.78	L
OW3	Delivery speed	A	1.53	0.12	5.82	11.11	C
OW4	Quality conformance	O	1.60	0.32	5.01	12.59	C
OW7	Design	A	1.12	1.51	6.51	9.61	K
OW8	Distribution	M	1.00	0.23	7.10	7.40	P
OW9	Design leadership	A	1.18	0.73	6.32	8.80	P
OW11	Marketing and sales	M	1.11	-1.13	6.02	6.38	L
OW12	Brand name	A	1.27	-0.29	6.08	8.42	L
OW13	Technical liaison and support	M	1.17	0.12	5.79	8.31	L
OW14	After-Sales support	M	1.17	0.27	6.14	8.96	P

KD-IPA model analysis and decision: According to Eq. 1 and 2 calculate the $IR_{(i)}$ of the criteria of order winning and use the existing performance improvement and customer cognition importance as the base of calculation and comparison. In Table 4, the calculation of $IR_{(i)}$ takes delivery speed, OW3 as the example: the performance of delivery speed, OW3 is 5.82 and attributed as an attractive quality, A. If the performance is wanted to be increased to 7.20, then the $IR_{(3)}$ is $7.20^2/5.82^2 = 1.53$, the $IR_{(i)}$ calculation results of other criteria of order winning are shown as Table 4. According to Eq. 9, the combinative importance of the ith quality characteristic is $I_{ci} = IR_{(i)} \times I_i + (D_i - R_i)$, the same as the earlier example: the combinative importance of delivery speed, OW3 is $I_{c3} = 1.53 \times 7.20 + 0.12 = 11.11$, the I_{ci} calculation results of other criteria of order winning are shown as Table 4. In Table 4, according to the classification of Kano's model, demand increase, OW5, product range, OW6 and being an existing supplier, OW10, are the indifference quality, I, because any improvement of this type of order criteria will not help in winning the customer's order. Therefore, the parts using improvement coefficient to amend the importance will not be explored.

According to the KD-IPA model; the matrix analysis diagram is established by using the combinative importance I_{ci} as the vertical axis and performance as the horizontal axis. According to Fig. 5, the criteria of order winning landing in keep up the good work, K, is design, OW7; the criteria of order winning landing in concentrate here, C, respectively are delivery speed, OW3 and quality conformance, OW4; the criteria of order winning landing in low priority (low priority, L), respectively are price, OW1, delivery reliability, OW2, marketing and sales, OW11, brand name, OW12 and technical liaison and support, OW13 and the criteria of order winning landing in possible overkill, P, are design leadership, OW9, distribution, OW8 and after-sales support, OW14.

It can be shown from Fig. 2 and 5, the analysis result of KD-IPA is significantly different from the traditional IPA. The criteria of order winning landing in concentrate here, C), shall immediately present improvements, they

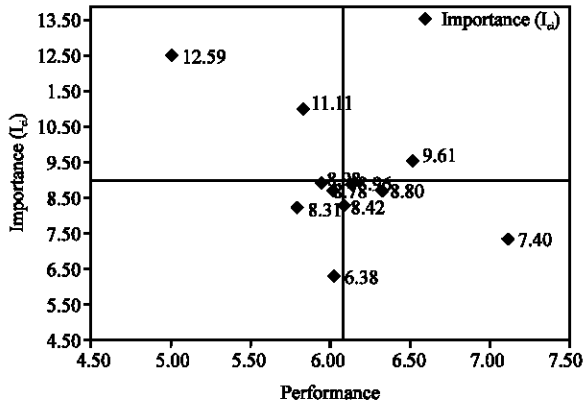

Fig. 5: KD-IPA diagram of criteria of order winning

respectively are delivery speed, OW3 and quality conformance, OW4; and price, OW1 and delivery reliability, OW2, have moved from concentrate here, C to low priority, L; after-sales support, OW14, has also moved from concentrate here, C to possible overkill, P. According to Table 4; Price, OW1, is a one dimensional quality, the IR = 1.31, but the relationship D-R= -1.09, which means price is greatly impacted from other criteria of order winning, through the improvement of other criteria, will be effective; delivery reliability, OW2, is a must-be quality, the IR = 1.19 and the relation D-R= -0.08, because the improvement effectiveness is not great and has a low relationship, therefore it lands in low priority, L) section; after-sales support, OW14, is a must-be quality, the IR = 1.17 and the relation D-R = 0.27, because the improvement effectiveness is not great and the relationship is low, therefore, it has moved out of the concentrate here, C section. Therefore, according to the analysis of KD-IPA, in addition to quality conformance, OW4, delivery speed, OW3, has become the high priority improvement subject.

Quality conformance, OW4, is a one dimensional quality, because it has the lowest performance, p = 5.01 and high customer cognition importance, I = 7.69, therefore the IR = 1.60 has great improvement effectiveness and at the same time, the relationship is

high, D-R = 0.32, therefore, the organization must place quality conformance, OW4, as the first priority improvement subject to rapidly increase customer satisfaction. Delivery speed, OW3, is an attractive quality due to its low performance, p = 5.82 and high customer cognition importance, I = 7.20, therefore, the IR = 1.58, which means the improvement effectiveness is great and at the same time, the relationship is high, D-R = 0.12, therefore the organization must place delivery speed, OW3. As the priority immediate improvement subject to rapidly increase customer satisfaction. In addition, according to the analysis of DEMATEL, processing improvement on quality conformance, OW4, can at the same time improve price, OW1, delivery speed, OW3, marketing and sales, OW11 and brand name, OW12. The impact levels, respectively are 0.26, 0.17, 0.15 and 0.16, which are the core driving factors in the system. In the same theory, process improvement on delivery speed, OW3 can at the same time improve price, OW1, quality conformance, OW4 and marketing and sales, OW11, the impact levels, respectively are 0.2, 0.17 and 0.22, which are the core driving factors in the system.

According to the analysis of KD-IPA, criteria of order winning which land in keep up the good work, K, is only design, OW7. The organization must keep or strengthen this competitive advantage, which has a significant different analysis result than the traditional IPA model. In addition to design, OW7, in the traditional IPA model analysis, because being an existing supplier, OW10, lands in keep up the good work, K section, it has a competitive advantage. However, according to the analysis of KD-IPA, being an existing supplier, OW10, IR = 1 and the relationship is very low, D-R = -1.19, therefore, for the customers, it has low importance and will land in possible overkill, P section, however, the study thinks that because being an existing supplier, OW10, is an indifference quality, it is not discussed in the KD-IPA. In addition, design, OW7, is an attractive quality, the R = 1.12, which means it has great improvement effectiveness and at the same time it has the highest relationship, D-R = 1.51, so it is a core driving factor in the system. According to the analysis of DEMATEL, by strengthening the ability of design, OW7, it can at the same time improve price, OW1, delivery speed, OW3, quality conformance, OW4, design leadership, OW9, marketing and sales, OW11 and brand name, OW12; the impact levels, respectively are 0.19, 0.18, 0.15, 0.22, 0.18, 0.29 and 0.17.

Finally, when making decisions according to the KD-IPA model, the company focused on the criteria of order winning which are attractive qualities and land in concentrate here, C and keep up the good work, K. They, respectively are delivery speed, OW3 and design, OW7. The organization has decided to improve and strengthen the criteria of the order for adopting differentiation strategy to segment the market. In addition, because quality conformance, OW4, is a one dimensional quality and has low performance, when increasing the quality conformance, it has the greatest increased satisfaction effectiveness; therefore, the strategy of concentrate here, C shall be used to increase the market competiveness.

CONCLUSIONS

Traditionally, the researches of customer satisfaction mainly use the questionnaire method for investigation. All researchers directly treat the quantitative scale data of the priority level as continuous for analysis. After calculating the mean of importance and performance, they establish the two-dimensional matrix of importance-performance and find out the quality characteristics required to reduce devotion and continue the improvement or keep the competitive advantage to increase the market competitive ability. The traditional IPA model and the relevant researches of the follow-up scholars all have significant contributions. However, these models still have some potential problems which require further study and discussion. These potential problems include: (1) the assumption of the linear relationship of performance and customer satisfaction and (2) The quality characteristics are independent variables and have no causal relationship impact. The study explores Kano's two-dimensional quality model and the nonlinear relationship of quality characteristics, which has successfully classified the criteria of order winning and filling and then further analyzes the improvement effectiveness of the criteria of order winning. However, Kano's model does not discuss the interaction between the criteria of order winning, therefore, the study adopts the DEMATEL method to consider the causal relationship between the criteria of order winning, integrates Kano's model, DEMATEL and IPA to establish the new decision making analysis methodology, KD-IPA and uses the KD-IPA methodology to find the organization core problems and improvement items.

The KD-IPA methodology established by the study, combined Kano's model and DEMATEL method at the same time, it not only eliminated the potential problems of the traditional IPA model, but also maintained IPA's easy to understand decision making model. This methodology can use the least resource devotion, focus on the core driving factor in the system and find the improvement direction and focus of the criteria of order winning. The study uses the case explanation and discussion of Taiwan's air-conditioning technology manufacturing

industry to prove the KD-IPA decision making analysis methodology established by the study using Kano's model and DEMATEL. Considering the impact of a nonlinear and causal relationship at the same time can more reasonably assess the importance of the criteria of order winning and use the least resource devotion to solve a complicated problem when there are causal relationships between the criteria of order winning. This not only uses the response information of customers completely, but also more effectively and accurately provides the organization with the required decision making information.

REFERENCES

Bacon, D.R., 2003. A comparison of approaches to importance-performance analysis. Int. J. Mar. Res., 45: 55-72.

Berger, C., R. Blauth, D. Boger, G. Burchill and W. DuMouchel *et al.*, 1993. Kano's methods for understanding customer-defined quality. Center Qual. Manage. J., 2: 3-36.

Deng, W.J., 2007. Using a revised importance-performance analysis approach: The case of Taiwanese hot springs tourism. Tourism Manage., 28: 1274-1284.

Eskildsen, J.K. and K. Kristensen, 2006. Enhancing importance-performance analysis. Int. J. Prod. Perf. Manage., 55: 40-60.

Fontela, E. and A. Gabus, 1973. News: Perceptions of the world and the DEMATEL project. Futures, 5: 421-429.

Fontela, E. and A. Gabus, 1974. DEMATEL: Progress achieved. Futures, 6: 361-363.

Griffin, A. and J.R. Hauser, 1993. The voice of customer. Market. Sci., 12: 1-27.

Hajime, Y., I. Kenichi and M. Hajime, 2005. An innovative product development process for resolving fundamental conflicts. J. Jap. Soc Precision Eng., 71: 216-222.

Hansen, E. and R.J. Bush, 1999. Understanding customer quality requirements: Model and application. Ind. Mar. Manage., 28: 119-130.

Hill, T., 2000. Manufacturing Strategy: Text and Cases. 3rd Edn., The McGraw-Hill Companies Inc., Palgrave, Basingstoke, ISBN-13: 978-0256106664.

Huang, C.Y., J.Z. Shyu and G.H. Tzeng, 2007. Reconfiguring the innovation policy portfolios for Taiwan's SIP mall industry. Technovation, 27: 744-765.

Kano, N., N. Seraku, F. Takanashi and S. Tsjui, 1984. Attractive quality and must-be quality. J. Jap. Soc. Qual. Control, 14: 39-48.

Kim, Y.H., 2006. Study on impact mechanism for beef cattle farming and importance of evaluating agricultural information in Korea using DEMATEL, PCA and AHP. Agric. Inform. Res., 15: 267-280.

Lee, Y.C., H.Y. Hu, T.M. Yen and C.H. Tsai, 2008a. Kano's model and decision making trial and evaluation laboratory applied to order-winners and qualifiers improvement: A study of computer industry. Inform. Technol. J., 7: 702-714.

Lee, Y.C., T.M. Yen and C.H. Tsai, 2008b. The study of an integrated rating system for supplier quality performance in the semiconductor industry. J. Applied Sci., 8: 453-461.

Lee, Y.C., T.M. Yen and C.H. Tsai, 2008c. Using importance-performance analysis and decision making trial and evaluation laboratory to enhance order-winner criteria: A study of computer industry. Inform. Technol. J., 7: 396-408.

Lee, Y.C., T.M. Yen and C.H. Tsai, 2008d. Modified IPA for quality improvement: Taguchi's signal-to-noise ratio approach. Total Qual. Manage. J., 20: 488-501.

Lee, Y.C., C.C. Cheng and T.M. Yen, 2009. Integrate Kano's model and IPA to improve order-winner criteria: A study of computer industry. J. Applied Sci., 9: 38-48.

Lin, C.J. and W.W. Wu, 2008. A causal analytical method for group decision-making under fuzzy environment. Expert Syst. Appli, 34: 205-213.

Martilla, J.A. and J.C. James, 1977. Importance-performance analysis. J. Market., 41: 77-79.

Matzler, K., H.H. Hinterhuber, F. Bailon and E. Sauerwein, 1996. How to delight your customers. J. Prod. Brand Manage., 5: 6-18.

Matzler, K. and H.H. Hinterhuber, 1998. How to make product development projects more successful by integrating Kano's Model into quality function deployment. Technovation, 18: 25-38.

Matzler, K. and E. Sauerwein, 2002. The Factor Structure of customer satisfaction: An empirical test of importance grid and the penalty-reward-contrast analysis. Int. J. Service Ind. Manage., 13: 314-332.

Matzler, K., E. Sauerwein and K.A. Heischmidt, 2003. Importance-performance analysis revisited: The role of factor structure of customer satisfaction. Service Ind. J., 23: 112-129.

Matzler, K., F. Bailom, H.H. Hinterhuber, B. Renzl and J. Pichler, 2004a. The asymmetric relationship between attribute-level performance and overall customer satisfaction: A reconsideration of the importance-performance analysis. Ind. Market. Manage., 33: 271-277.

Matzler, K., M. Fuchs and A.K. Schubert, 2004b. Employee satisfaction: Does Kano's model apply? Total Qual. Manage. Bus. Excell., 15: 1179-1198.

Oh, H., 2001. Revisiting importance-performance analysis. Tourism Manage., 22: 617-627.

Ryan, C. and J. Huyton, 2002. Tourists and aboriginal people. Ann. Tourism Res., 29: 631-647.

Sampson, S.E. and M.J. Showalter, 1999. The performance-importance response function: Observations and implications. Service Ind. J., 19: 1-25.

Shahin, A., 2004. Integration of FMEA and the kano model: An exploratory examination. Int. J. Qual. Reliab. Manage., 21: 731-746.

Slack, N., 1994. The importance-performance matrix as a determinant of improvement priority. J. Operat. Prod. Manage., 14: 59-75.

Tan, K.C. and X.X. Shen, 2000. Integrating kano's model in planning matrix of quality function deployment. Total Qual. Manage., 11: 1141-1151.

Tonge, J. and S.A. Moore, 2007. Importance-satisfaction analysis for marine-park hinterlands: A Western Australian case study. Tourism Manage., 28: 768-776.

Wu, W.W. and Y.T. Lee, 2007. Developing global managers' competencies using the fuzzy dematel method. Exp. Syst. Appli., 32: 499-507.

Yang, C.C., 2003. Establishment and applications of the integrated model of service quality measurement. Managing Service Qual., 13: 310-324.

Yang, C.C., 2005. The refined kano's model and its application. Total Qual. Manage. Business Excellence, 16: 1127-1137.