Journal of Applied Sciences

ISSN 1812-5654

science alert

ANSInet
an open access publisher
http://ansinet.com

Journal of Applied Sciences 9 (1): 38-48, 2009
ISSN 1812-5654

Integrate Kano's Model and IPA to Improve Order-Winner Criteria: A Study of Computer Industry

[1]Yu-Cheng Lee, [2]Cheng-Chien Cheng and [2]Tieh-Min Yen
[1]Department of Technology Management,
[2]Graduate Institute of Technology Management, Chung-Hua University,
707, Section 2, WuFu Road, HsinChu, Taiwan 300, Republic of China

Abstract: The aim of study is to establish a new methodology of IPA to improve order- winner criteria and win orders. Importance-performance analysis (IPA) model has been widely used as the primary tool for market research and business improvement. However, traditional IPA model has important hidden assumption, that is performance and satisfaction have a linear relationship. Under these assumptions, if the quality characteristics cannot meet the above-mentioned assumption, the IPA model will not accurately analyze the importance and priority ranking for improvement, leading to wrongful decision making. This study puts forth a new decision making and analysis methodology that will, on one hand, exploit the Kano's Model to establish nonlinear relationship between quality characteristics and customer satisfaction, when quality characteristics are functional and dysfunctional. On the other hand, the analysis will adjust the importance of quality characteristics according to the effect of quality characteristic improvement on customer satisfaction. The modified IPA model takes the nonlinear relationship between quality characteristics and customer satisfaction into consideration, not only boosting effectiveness of the IPA model, but also retaining the simple decision making pattern of traditional IPA models. Finally, the study takes a case of industrial computers in Taiwan to address the application and effect of IPA methodology modified by Kano's model.

Key words: Importance-performance analysis, Kano's model, order-winner criteria, customer satisfaction

INTRODUCTION

Quality management systems developed in the 1980s used customer satisfaction as the primary measurement indicator for organization performance. The study of quality characteristics using importance and satisfaction blossomed. One of the main tools using in this study is Importance-Performance Analysis (IPA), because it can easily calculate and quickly determine the advantages and disadvantages directly from the organization's market information analysis. The fundamental concept of IPA is to appreciate the importance of customer cognition toward quality characteristics through market surveys used to measure their degree of satisfaction. A matrix of importance and performance is used for analysis. The quality characteristics are divided into four categories according to their importance and performance to facilitate employing a corresponding market strategy based on the classification of quality features. Since Martilla and James (1977) first used market strategy as developed and organized by IPA, the method has been widely applied to various industries for almost 30 years. For instance, the latest study Levenburg and Magal (2005) used IPA in formulating electronic commercial decision making and resource allocation. Zhang and Chow (2004) exploited IPA to improve tourism guide service quality. Matzler *et al.* (2003) used IPA to improve bank service quality and development strategy. Aigbedo and Parameswaran (2004) used IPA to improve school canteen service quality. Matzler *et al.* (2004b) used IPA in the automobile industry. Matzler *et al.* (2005) employed IPA to examine modern management methods and research tools. Huang *et al.* (2006) used IPA to investigate customer satisfaction service quality for middle and long-range highway journeys. Tonge and Moore (2007) used IPA and gap analysis to evaluate the sensed quality of visitors to a Marine-Park to conduct more effective management with environmental protection. Lee *et al.* (2008a) employed IPA in supplier performance evaluation. Lee *et al.* (2008b) used DEMATEL and IPA to improve organization performance

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

in computer industry. Lee *et al.* (2008c) modified IPA for quality improvement in air-conditioning service industry. As stressed by Martilla and James (1977), the several advantages enjoyed by IPA are low-cost, easy application and provides better focus and strategy recommendations. Hansen and Bush (1999) believed that IPA is a simple and effective tool that is most helpful in determining how limited resources can be most effectively utilized to achieve the greatest customer satisfaction. This is considered the primary reason why this method is so widely accepted and used.

Of course, some researchers have, during the IPA theory development process, invested themselves into the study of comparing the IPA structure with other models. For instance, Oh (2001) re-investigated the IPA concept and method. Bacon (2003) exploited 15 sets of information correlated with a few different kinds of IPA methods. He attempted to determine the most effective method. Fontenot *et al.* (2005) focused on the 4 most often seen models to study customer satisfaction to substantiate that it would be best to employ multivariate administration technology in establishing a priority ranking for the action plan.

In recent years many researchers have tried to modify the conventional IPA to render it more rational. In the study by Yavas and Shemwell (2001), the performance and competitor's difference were multiplied by the relative importance to modify the IPA model. The medical care industry was used for illustration. Tarrant and Smith (2002) used the average and standard error to modify the IPA model in view of customer satisfaction research on the quality features of outdoor recreational facilities. Although these researches have made significant contributions, they are still limited in the assumptions that the importance and performance of quality characteristics are independent in the conventional IPA model. Therefore, some researchers think there must be some relationship between the importance and performance of quality characteristics and take the customer satisfaction into consideration to induce the functional relationship between them. Matzler *et al.* (2004a), Oh (2001), Ryan and Huyton (2002) and Sampson Showalter (1999) have pointed out that importance and satisfaction for quality characteristics are related. As the performance of quality characteristics becomes better, the gap between importance and performance will be closer rapidly and nearly meets the customers' expectation. At this time, the improved quality characteristics are less important than that of others which their performances are relatively low (Sampson and Showalter, 1999; Matzler and Sauerwein, 2002). To address this situation, some adopted statistical inferences to evaluate the relative importance of quality characteristics. Matzler and Sauerwein (2002), for instance, derived it from multiple regression analysis and named it implicit importance. Sampson and Showalter (1999) examined the causality among quality characteristics using a Structural Equation Model (SEM) and applied some influence coefficients to the relative importance of quality characteristics. These creative studies have not only presented the correlation between the importance and performance of quality characteristics, but also established a linear relationship among importance, performance and satisfaction.

Kano *et al.* (1984) developed two-dimensional quality model with quality characteristics classified into attractive quality, one-dimensional quality, must-be-quality, indifference quality, reverse quality, attractive quality and must-be-quality given with non-linear features. Yang (2003) integrated Kano's two-dimensional quality model, crucial customer interview and IPA to improve electrical appliance maintenance service quality to enhance organizational competition. Besides modifying Kano's two-dimensional quality model, Yang (2005) integrated IPA to give the organization more valuable information for decision making. Other researchers resorted to the three-factor theory, the basic factors, performance factor and excitement factor to study the relevant customer satisfaction issues. Matzler and Sauerwein (2002) studied the service quality features of a medical care industry information department and developed an attribute methodology using the three-factor theory to define the service quality features. Matzler *et al.* (2004b) classified the three-factor theory attributes of quality characteristics regarding the incompatibility between quality characteristics and integral satisfaction in an automobile industry study. They accurately provided the needed information for management decision making. Anderson and Mittal (2000) discussed incompatibility and non-linearity characteristics that prominently enhanced customer value and customer satisfaction within a customer value-chain. From these studies it is known that certain quality characteristics have linear and non-linear impacts on the customer towards the quality sensed.

The above researchers have made many significant contributions in IPA methodology research, which not only have demonstrated the linear relationships between quality characteristics and satisfaction, but also confirmed quality characteristics still have nonlinear effects on customer satisfaction. However, when nonlinear effects exist, the IPA model will not accurately analyze the importance and priority ranking for improvement and leading to wrongful decision making. Thus the study aims

to put forth a new IPA decision making and analysis methodology, use Kano's model to establish a relationship between quality characteristics and customer satisfaction and amend the importance based on effect of quality characteristics improvement on satisfaction so as to establish a new IPA matrix. Finally the study focuses on a case study of order-winners for industrial computers in Taiwan to demonstrate applications and effects of the IPA model modified with Kano's model.

IPA was proposed by Martilla and James (1977) and used to develop effective market strategies. The IPA questionnaire design tended to invite the respondents to answer the following two questions related to quality characteristics: (1) How important is the quality characteristic for you? (2) How is the organization's performance with regard to this quality characteristic? With such simple data, the organizations could analyze and study four different types of quality characteristics and develop a strategy and action plans with regard to the quality characteristic in each quadrant. IPA constructs a two-dimensional matrix by collecting the above two responses. With regard to the central tendency of importance and performance, it divides the quality characteristics into four quadrants by treating the median as the matrix split value. Some researchers replaced the median with the means, which becomes the main statistics in the IPA. The traditional IPA model reveals the states of the quality characteristics using a two-dimensional graph used to explain and judge the strategies. IPA can be respectively defined four matrix quadrants: (1) Concentrate here: the customers suggest that the importance of the product or service quality characteristic is high; however, the organizational performance is low. (2) Keep up the good work: the customers suggest that the importance of the product or service quality characteristic is high and the organizational performance is also high. (3) Low priority: organizational performance on the product service quality characteristic is low and the customers' cognitive importance is also low. (4) Possible overkill: organizational performance on the product or service quality characteristic is high; however, the customers' cognitive importance is low.

As pointed out in the studies of Bacon (2003) and Eskildsen and Kristensen (2006), the primary purpose of IPA is to further chance for improvement regarding quality characteristics of product and service rendered by organization. Bacon (2003) and Martilla and James (1977) indicated that a manger can determine which ever quality characteristics must be retained, improved or reduced through the two-dimensional matrix of importance and performance.

The dynamic model put forth by Sampson and Showalter (1999) proved that organization performance change would concurrently affect the importance recognized by the customer and is mainly because the relevant coefficient of importance and performance is not zero. Based on such a perspective, when organization performance is enhanced, the gap between importance and performance will be quickly narrowed (Matzler and Sauerwein, 2002). This result provided evidence, saying that the importance and performance are not mutually independent variables. For this reason, Fontenot *et al.* (2005) made use of the gap analysis regarding importance and performance proposed by Parasuraman *et al.* (1985) to re-calculate organization performance.

Matzler and Sauerwein (2002) and Matzler *et al.* (2004b) indicated the IPA model has two types of measurements for the importance of quality characteristics. The first is customers disclose how important they think a given quality characteristic is, called the explicit importance. The second is how important that quality characteristic is for customers using the multiple regression equation, called the implicit importance. With performance as the independent variable and overall satisfaction as the dependent variable in the multiple regression equation, Matzler and Sauerwein (2002) proved that it is the implicit importance, not the customers' self presentation that serves as the satisfaction function of a quality characteristic. Therefore, the multiple regression equation is a better measurement of the customers' perception of the quality characteristics. The multiple regression equation with performances of quality characteristics (k) as the independent variables (X_i) and overall satisfaction as the dependent variable (Y) is shown as:

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

where, ϵ is an error and the regression coefficient β_i of the equation stands for the performance influence of the ith quality characteristic on overall satisfaction.

The model has made an important improvement and contribution in IPA development and inaugurated the quantification research of quality characteristics and customer satisfaction. This equation has demonstrated the linear relationships between quality characteristics and satisfaction.

Among studies with regard to nonlinear effect of quality characteristics on customer satisfaction, the most famous model is the two-dimensional model put forward by Kano *et al.* (1984) had quality characteristics classified into five categories according to comprehensiveness and

customer satisfaction. These characteristics were attractive quality and must-be quality and one dimensional quality, reverse quality and indifference quality. In the latest studies, many researchers have integrated Kano's two-dimensional quality model in IPA, for instances, Eskildsen and Kristensen (2006) integrated the loss function of Taguchi, two-dimensional quality model of Kano and regression analysis in IPA so as to enhance IPA model. Yang (2005) put forth the revised two-dimensional quality model by Kano and exploited IPA to collect more valuable decision making information on quality. Others adopted a three-factor theory: basic factor, performance factor and excitement factor, to provide insight into issues about satisfaction. Matzler *et al.* (2003) pointed out that convention IPA will lead to wrongful decision making as of impact from the three impact factors to customer satisfaction, which are basic factor, performance factor and excitement factor. Matzler *et al.* (2004a) made use of multi-regression analysis with dummu variable to prove that when quality features are found at different levels the incompatibility towards integral satisfaction does exist.

In order to discuss the linear and nonlinear effects of these factors, the study integrates the IPA analysis method of Kano's model as its basis, taking linear and nonlinear effects of quality characteristics into consideration and revising the importance of quality characteristics and priority of improvement to avoid wrong organizational decisions and make improvements on quality characteristics and allocation of resources more rational.

MATERIALS AND METHODS

With regard to the Kano-IPA model advanced by the study, the following aspects are discussed, respectively: (1) to analyze order-winners and qualifiers based on Kano's model for the purpose of understanding the quality characteristics of the model; (2) to establish a quantification evaluation model concerning the effects of quality characteristics on satisfaction with Kano's model; (3) to modify the traditional IPA with Kano's model.

Kano's model: In 1984 Dr. Kano used a two-dimensional model to know and utilize product features to meet customer needs and expectations (Kano *et al*., 1984; Lee *et al*., 2008d). This model was effective in assessing existing products and those to be developed, in order to meet customer needs and expectations and hence reach the company's goals. According to Kano's research, customers expected a product to satisfy three needs: a basic need, performance need and excitement need. The first need can be satisfied by the nature of a product, which means that this factor will make it unmarketable. That is to say, the basic quality characteristics can just stop complaints. This is because customers want other quality characteristics. Usually, satisfaction is positively related to these other quality characteristics. Moreover, some quality characteristics are beyond the clients' expectation and they can make customers very excited. These excitement characteristics are the source of a products' competitiveness and which a company can use to take a niche in the market. Matzler *et al*. (1996) deduced several good points from Kano's model: (1) it is better to know the customers' needs; (2) it prioritizes improvements; (3) it provides a valuable measurement in the process of developing a manufacturing system; (4) it helps a company to segregate the market; (5) it differentiates the market.

Kano recommended that when designing a product, a company should first discern the customers' needs and know what quality characteristics they value in order to best reach customers' expectations. To identify their perceptions and attitudes toward the quality characteristics of a product, a questionnaire should have positive and negative questions. To begin with, positive questions are raised to know how customers feel when a product contains all the essential quality characteristics and negative questions aims to understand how customers feel when a product does not contain all essential quality characteristics. Customers may answer: 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, which can show what quadrant into matrix a certain quality characteristic of the product should be placed. Next, the percentage of a quality characteristic in Kano's matrix should be determined and the one accounting for the majority is the right one (Matzler and Hinterhuber, 1998). In addition, Berger *et al*. (1993) proposed to take the satisfaction indicator, Better = (A+O)/(A+O+M+I) as the axis of ordinates and the dissatisfaction indicator, Worse = (O+M)/(A+O+M+I)×(-1) as the axis of abscissas, A then the attribution of quality characteristics can be determined by the matrix. There are five quality characteristics that will sway satisfaction according to Kano *et al*. (1984):

- **Must-be quality:** This is a very essential quality characteristic for customers. The customer will be very unsatisfied without it. In other words, if a quality characteristic is what they care about most, its existence will not make satisfaction better since it

is the basic feature in the customers' view. Thus, must-be quality can just avoid complaints. It is a definite competitive factor essential to customers when they select a product. That is, without must-be quality, it is highly unlikely to attract the clients' eyes

- **One-dimensional quality:** It is positively related with satisfaction degree. As the degree becomes higher, so will the satisfaction and vice versa. This quality is a definite competitive factor. Usually customers compare this quality in the products of different brands. When they find more of this characteristic in a certain brand, they will choose it for sure
- **Attractive quality:** This is the factor that most influences satisfaction among the quality characteristics. Customers may or may not know if they need it, but they will be very happy when they find it in a product. As a product has more of this quality, satisfaction will increase and vice versa. Yet, customers will not dislike a certain product without this quality
- **Indifferent quality:** It refers to a quality that is unable to sway satisfaction at all
- **Reverse quality**: It will arouse bad feelings in customers, so satisfaction comes without it

As for specific quality characteristics that cannot be categorized clearly, Lee and Newcomb (1997) have put forward two measurement indexes-category strength and total strength to assist the category work of quality characteristics. The definition of category strength is the gap between the highest percentage and the secondary percentage, with total strength being defined as the over-all percentages of attractive quality, one-dimensional quality and must-be quality. Lee and Newcomb (1997) defined the quality characteristics that cannot be categorized as combination. Reliability of Kano's questionnaires should be discussed after data collection. In general, the Q-rate is a measurement for an effective questionnaire, with 2% or below acceptable according to Matzler and Hinterhuber (1998).

Quantitative improvement model of customer satisfaction: Tan and Shen (2000) put forward a quantification model that uses the relationship between customer satisfaction and performance of product and service of Kano's model by employing an approximate method of parameter and equation in the study of Quality Function Deployment (QFD), of which the function relation can be expressed with s = f (k, p) and in this equation, *s* stands for customer satisfaction; k refers to the adjusted parameter based on Kano's quality characteristics category and *p* means the performance of product and service. Traditional linear assumptions of customer satisfaction believe if the performance of some product and service is better, the customer satisfaction will be higher; Kano's model supplies much more information for this. The model proposed by Kano *et al.* (1984) indicates the degree of effect for all quality characteristics that can exert an influence on customer satisfaction is different; additionally, not only the importance of different quality characteristics is different, but their effect means are also various. For example, when the completion degree of quality characteristics increases, the effect of attractive quality on satisfaction will be greater than that of one-dimensional quality, which means importance of attractive quality and its contribution to satisfaction are both greater than one-dimensional quality. As for attractive quality, when performance of the characteristic is improved, customer satisfaction will be enhanced consequently. So, we can get $\Delta s/s > \Delta p/p$ for attractive quality and in this relationship, s and p are customer satisfaction and quality performance respectively; Δs and Δp stand for change of customer satisfaction and quality performance separately. In a similar way, one-dimensional quality has the relationship of $\Delta s/s = \Delta p/p$ with customer satisfaction and relationship between must-be quality and customer satisfaction as $\Delta s/s < \Delta p/p$.

In order to simplify the relationship between satisfaction and performance improvement, Tan and Shen (2000) hypothesized that there was a linear relationship between $\Delta s/s$ and $\Delta p/p$. Next, they integrated the above three relationships into an equation, $\Delta\text{-}s/s = k(\Delta p/p)$, by using parameter k and in this equation, parameter k of attractive quality is greater than 1(k>1): parameter k of one dimensional quality is equal to 1(k = 1); parameter of must-be quality k is between 0 and 1($0<k<1$). And the equation can be further converted into a function relationship between satisfaction and performance, as Eq. (1):

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

In this Eq. c is a constant.

Set s_0 and p_0 as the customer satisfaction and performance of product and service, s_1 and p_1 as the target customer satisfaction and target performance of product and service, in addition, assume the change of satisfaction and performance will not change the category of quality characteristics in Kano's model and the constant, thus Eq. 2 can be used to express the improvement coefficient of customer satisfaction:

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

Tan and Shen (2000) suggested that *k* be set as 2, 1 and 1/2 in order, according to the category of attractive quality, one-dimensional quality and must-be quality to reflect the real relationships. Shahin (2004) suggested that k be set as 2, 1 and-1, respectively for attractive quality, one-dimensional quality and must-be quality in Kano's model and 0 for indifferent quality to conform to the calculation principle of the Risk Priority Number (RPN) in his research, proposing to integrate FMEA with Kano's model.

In the model put forward by Tan and Shen (2000) and the model of Shahin (2004), quantitative relationships between the completion of quality characteristics and customer satisfaction only involves the situation of quality characteristics with high completion; as for improvement efficiency of quality characteristics with low completion, the following relationships can be derived in accordance with the definition of Kano's Model: $\Delta s/s < \Delta p/p$ for attractive quality, $\Delta s/s = \Delta p/p$ for one-dimensional quality and $\Delta s/s > \Delta p/p$ for must-be quality; in other words, improvement of dissatisfaction on must-be quality will be greater than the increase of satisfaction on attractive and one-dimensional quality and improvement of dissatisfaction on one-dimensional quality will be greater than increase of satisfaction on attractive quality. Therefore, improvement priority should be M > O > A, which can also stand for importance of improvement. And this study adopted conception of Tan and Shen (2000) as well as Shahin (2004) based on the quantitative relationship between completion of quality characteristics and customer satisfaction. The study sets the performance perceived by customer p in an interval of (1, 9) and sets k as 2, 1, 1/2, 0 and 1 in terms of category of attractive quality, one-dimensional quality, must-be quality, indifferent quality and reverse quality in Kano's model. The improvement coefficient IR of A, O, M and R can be deduced by comparing the customer satisfaction before and after improvement of quality characteristics in conformity to Eq. 2 and IR can be the evaluation value for IPA importance adjustment when quality characteristics have asymmetric and nonlinear effects on customer satisfaction. Considering whether indifferent quality (I) exists or not, it will have no effect on customer satisfaction according to the definition of Kano's model, so, there is no need to calculate and discuss its improvement coefficient IR.

Kano-IPA model: As it has been proven, Kano's model can be used to handle linear and nonlinear effects of quality characteristics. The study integrates Kano's model to modify the decision making methodology of IPA. Firstly, the study will discuss the effect of asymmetric and nonlinear relationships on improving decision making by taking the case of order-winners and qualifiers. The traditional method for quality characteristic improvement is to look for the quality characteristics that need to be improved based on the IPA model directly and next to conduct the improvement work. However, it is inclined to make wrong improvement decisions when the quality characteristics have a nonlinear relationship with customer satisfaction. For instance: Since Brand Name is in the quadrant of Low priority (L) in the IPA matrix, an organization will not give priority to invest resources to improve the Brand Name, however, according to Kano's model, customers regard Brand Name as an Attractive quality (A) and if Brand Name is improved, customer satisfaction will present a nonlinear increase; that is to say, Brand Name is quite important to enhance customer satisfaction, thus the importance of customer self-statements should be corrected to reflect the real improvement priority, then the nonlinear effect must be taken into consideration when establishing an IPA matrix and importance of Brand Name should be raised to be located in the Concentrate here (C) area of the IPA matrix.

In terms of the method of Kano's model and Eq. 2, when improvement of some quality characteristic contributes to an increase of customer satisfaction, the improvement can stand for importance of the quality characteristics; in other words, the higher the improvement coefficient IR of customer satisfaction is, the greater the importance of the quality characteristics will be; vice versa. So, the study takes the improvement coefficient, IR, as the evaluation value for correcting customer self-stated importance when quality characteristics have a nonlinear effect.

Also, the study puts forth a combinative importance of (CI) I_{ci} by integrating Kano's model and IPA, which means to multiply customer self-statement importance I, with the improvement coefficient, IR, of Kano's model as Eq. 3:

$$I_{ci} = IR_i \times I_i \ (i = 1, 2, 3, ..., n) \quad (3)$$

Hansen and Bush (1999) have demonstrated that IPA is a simple and effective tool that is helpful in determining how limited resources can be most effectively utilized to achieve the greatest customer satisfaction. So, the study will replace the important coordinate axis of traditional IPA with I_{ci} to establish a Kano-IPA model. Evaluation on central tendency will use means and the two-dimensional matrix of importance and performance will have four

quadrants of which definitions and strategies will be same as those of traditional IPA brought up by Martilla and James (1977) to maintain the feature of easy interpretation and direct judgment for the strategy of an original model.

Case description: This study has resorted to manufacturing plants for industrial computer in Taiwan as its subject of study, while Kano-IPA model is used to analyze order-winners and qualifiers to improve customer satisfaction. This study has based itself on a large manufacturing plant of certain industrial computer in Taiwan and the operation of the company has lasted for 25 years, with 500 employees in 2008. The company holds about 20% market share for some product in Taiwan and has been awarded ISO 9001 quality management system certification as well as ISO 14001 environment management system. This company is listed on the stock market and its business has grown steadily. This study has conducted customer satisfaction survey in 2008 regarding customers that deal with it and developed questionnaire based on order-winners and qualifiers as well as based upon Kano-IPA model for analysis. As such, it is hoped to find the core problem and approach for improvement so as to enhance the competitiveness of the company.

Kano's model and IPA questionnaires : In 2008 this study surveyed counter-parties about their satisfaction with order winners and qualifiers at an industrial computer company FLYTECH in Taiwan. The quality characteristics were devised into functional and dysfunctional questions, in which the performance of each product/company characteristic is included. A scalogram with 9 satisfaction degrees by Slack (1994) was used to determine the customers' perception of this company's performance and importance. Fourteen quality characteristics are asked about using a scale in which 1= very unsatisfied to 9 = very satisfied and 1= very unimportant to 9 = very important, respectively. The 14 characteristics were determined using Hill (2000) and their effectiveness was approved using 20 customers and 15 senior officials. Griffin and Hauser (1993) held that in an interview with 20~30 customers 90~95% of the quality characteristics of homogeneous markets could be defined. The testers were existing counter-parties to whom a part of the 320 questionnaires were mailed. The rest were mailed to executives with the customer purchasing and QA departments. At the end of this activity, 192 effective questionnaires were collected, constituting a 60% recovery rate.

RESULTS AND DISCUSSION

Kano's model was used to analyze Order-winner criteria on the basis of all answers of customers and

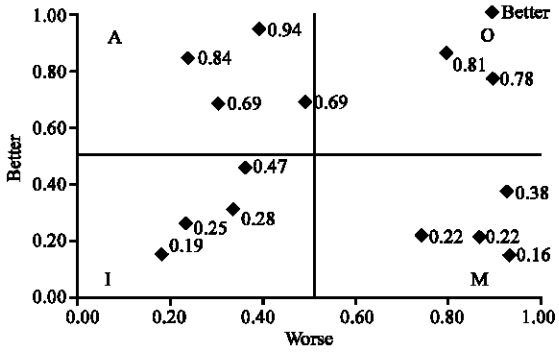

Fig. 1: Better-Worse diagram of Kano's model

classified and calculated the answers in conformity with Better-Worse Diagram of Berger *et al.* (1993), then shown and categorized the data in accordance to Kano's model in Table 1. In addition, the absolute value of the dissatisfaction degree was adopted for ease in diagram presentation, as in Fig. 1. In Fig. 1, the average of Better and Worse indicators are 0.49 and 0.53, respectively and the values divide the Better-Worse diagram into four area, reading as one-dimensional quality, attractive quality, indifferent quality and must-be quality. Such as Delivery speed (OW3), A, O, M, I and R of quality characteristics are 120, 60, 12, 0 and 0, respectively according to Kano's model and then the Better and Worse values can be figured out based on the formula of Berger *et al.* (1993). These are 0.94 and 0.38, as (0.38, 0.94) should be located in the attractive quality area in Fig. 1, Delivery speed (OW3) was categorized into attractive quality. From Fig. 1 and Table 1, it's easy to conclude that Delivery speed (OW3), Design (OW7), Design leadership (OW9) and Brand name (OW12) are Attractive Quality (A). Price (OW1) and Quality conformance (OW4) are One-Dimensional Quality (O). Delivery reliability (OW2), Distribution (OW8), Technical liaison and support (OW13) and After-Sales support (OW14) are belong to Must-Be Quality (M). Demand increases (OW5), Product range (OW6), Being an existing supplier (OW10) and Marketing and sales (OW11) are Indifferent Quality, (I). In this study, no Reverse Quality (R) is included in order-winner criteria and Q-Rate is 0% far smaller than 2%, so the analysis findings are acceptable.

In reference to importance and performance analysis of order-winner criteria, as in Table 2, the sequence of criteria of which performance mean values reach the satisfaction degree is: Distribution (OW8), Being an existing supplier (OW10) and Product range (OW6). And other criteria' performances are all acceptable, including Design (OW7), Design leadership (OW9), After-Sales support (OW14), Brand name (OW12), Marketing and sales (OW11) etc. In this study, the criterion with lowest performance mean value is Quality conformance (OW3).

Table 1: Analysis of Kano's model for order-winner criteria

Notation	Order-winner criteria	A	O	M	I	R	Worse	Better	Category
OW1	Price	36	120	30	6	0	0.78	0.81	O
OW2	Delivery reliability	18	54	120	0	0	0.91	0.38	M
OW3	Delivery speed	120	60	12	0	0	0.38	0.94	A
OW4	Quality conformance	24	126	42	0	0	0.88	0.78	O
OW5	Demand increases	48	42	24	78	0	0.34	0.47	I
OW6	Product range	18	30	12	132	0	0.22	0.25	I
OW7	Design	48	84	6	54	0	0.47	0.69	A
OW8	Distribution	24	18	120	30	0	0.72	0.22	M
OW9	Design leadership	84	48	6	54	0	0.28	0.69	A
OW10	Being an existing supplier	12	42	18	120	0	0.31	0.28	I
OW11	Marketing and sales	18	18	12	138	6	0.16	0.19	I
OW12	Brand name	126	36	6	24	0	0.22	0.84	A
OW13	Technical liaison and support	12	30	132	18	0	0.84	0.22	M
OW14	After-sales support	6	24	150	12	0	0.91	0.16	M

Table 2: Kano's model and IPA for order-winner criteria

Notation	Order-winner criteria	Category	Performance	Importance	Strategy
OW1	Price	O	5.91	7.66	C
OW2	Delivery reliability	M	5.93	7.46	C
OW3	Delivery speed	A	5.81	7.21	C
OW4	Quality conformance	O	5.02	7.70	C
OW5	Demand increases	I	5.60	6.91	L
OW6	Product range	I	7.04	6.74	P
OW7	Design	A	6.48	7.27	K
OW8	Distribution	M	7.14	7.13	P
OW9	Design leadership	A	6.29	6.88	P
OW10	Being an existing supplier	I	7.10	7.24	K
OW11	Marketing and sales	I	6.01	6.79	L
OW12	Brand name	A	6.06	6.85	L
OW13	Technical liaison and support	M	5.83	6.99	L
OW14	After-sales support	M	6.08	7.43	C

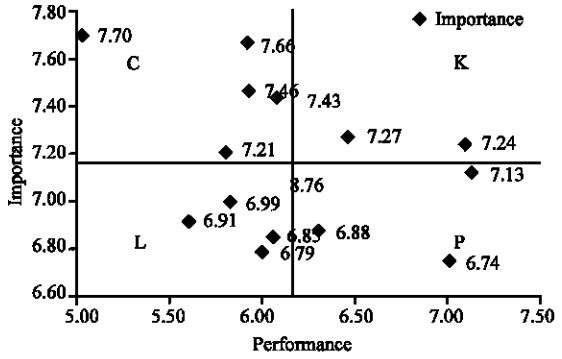

Fig. 2: Traditional IPA map of order-winner criteria

As Table 2 shows, importance mean values of all criteria are ranked in the degree of importance and the criterion with the highest importance mean value is Quality conformance (OW3). Based on the traditional IPA model, importance of order-winner criteria is set as the vertical axis and performance of order-winner criteria as the horizontal axis and marked coordinates of importance and performance in the IPA matrix and than classified the mean values into four kinds of strategy, as in Fig. 2. From Fig. 2, criteria of order-winner in the area of Keeping up good work (K) involving Design (OW7) and Being an existing supplier (OW10), criteria in the area of Concentrate here (C) are Price (OW1), Delivery reliability (OW2), Delivery speed (OW3), Quality conformance (OW4) and After-Sales support (OW12). Separately, criteria in the area Low priority (L) includes Demand increases (OW5), Marketing and sales (OW11), Brand name (OW12) and Technical liaison and support (OW13) and criteria in Possible overkill (P) contain Product range (OW6), Distribution (OW8) and Design leadership (OW9). Also, quality characteristics of order-winner based on Kano's model and four strategies based on IPA analysis in Table 1 were collected in Table 2.

In terms of Kano's model and IPA, Table 2 demonstrates that improvement strategy for criteria in Concentrate here (C) should be brought up immediately; however, these criteria belong to Must-Be Quality (M), One-Dimensional Quality (O) and Attractive Quality (A), respectively; that is to say, the criteria needed to be improved in the area of Concentrate here (C) will have different (linear and nonlinear) influences on customers. Additionally, Being an existing supplier (OW10) belongs to Indifferent Quality (I), whereas it is located in the quadrant of Keeping up the good work (K) in traditional IPA analysis, so a wrong decision is likely to be made if the traditional IPA analysis is referred to. Therefore, new decision making methods must consider the effects of improvement of order-winner criteria on customers. This means increasing the degree of satisfaction or decreasing the degree of dissatisfaction; this is the aspect that the traditional IPA model doesn't take into consideration.

Table 3: Kano-IPA table of order-winner criteria

Notation	Order-winner criteria	Quality attribute	$IR_{(e)}$	Performance	Combinative importance	Strategy
OW1	Price	O	1.30	5.91	9.94	C
OW2	Delivery reliability	M	1.12	5.93	8.37	L
OW3	Delivery speed	A	1.54	5.81	11.09	C
OW4	Quality conformance	O	1.53	5.02	11.81	C
OW7	Design	A	1.26	6.48	9.16	K
OW8	Distribution	M	1.00	7.14	7.12	P
OW9	Design leadership	A	1.20	6.29	8.23	P
OW12	Brand name	A	1.28	6.06	8.76	C
OW13	Technical liaison and support	M	1.10	5.83	7.66	L
OW14	After-sales support	M	1.11	6.08	8.22	L

In accordance to the methodology put forth by this study, the higher the improvement coefficient of customer satisfaction is, the higher the importance of quality characteristics will be; vice versa. So, the study takes the improvement coefficient, IR, as the evaluation value for correcting customer self-stated importance when quality characteristics have a nonlinear effect.

The improvement coefficient IR for Order-Winner Criteria was calculated in terms of Eq. 1 and 2 and the degree of change of existing performance being improved to the importance perceived by customers was taken as the calculation and comparison basis. Now, took the IR of delivery speed (OW3) in Table 3 as an example: Performance of Delivery speed (OW3) is 5.81, if it is supposed to improve it to 7.21, it should be categorized as an Attractive Quality (A) and its improvement coefficient IR should be $7.21^2/5.81^2 = 1.54$. IRs for other Order-Winner Criteria are shown in Table 3. According to Eq. 3, the ith combinative importance of quality characteristics is $I_{ci} = IR_i \times I_i$, so combinative importance of the above Delivery speed (OW3) should be $I_{c3} = 1.54 \times 7.21 = 11.09$; I_{ci} values of other criteria are shown in Table 3. In Table 3, a demand increases (OW5), Product range (OW6), being an existing supplier (OW10) and Marketing and sales (OW11) should belong to Indifferent Quality (I) according to the category of Kano's model, since no matter how much improvement is made for these criteria, they are of no help in order-winning, combinative importance of their improvement coefficient will not be discussed.

In reference to the Kano-IPA model, combinative importance, $I_{ci,}$ was set as the vertical axis and performance as horizontal axis to establish a matrix analysis chart. As Fig. 3 shows, the order-winner criteria in the quadrant of Keeping up the good work (K) is Design (OW7), criteria in the quadrant of Concentrate here (C) includes Price (OW1), Delivery speed (OW3), Quality conformance (OW4) and Brand name (OW12), criteria in Low priority (L) is Delivery reliability (OW2), After-Sales support (OW14) and Technical liaison and support (OW13) respectively and Order-winner criteria in the quadrant of Possible overkill (P) involves Distribution (OW8) and Design leadership (OW9).

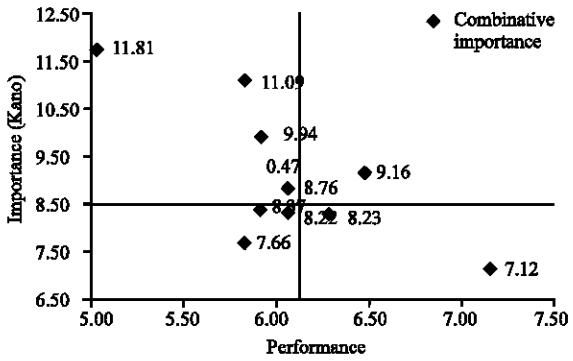

Fig. 3: Kano-IPA map of order-winner criteria

Regarding the analysis based on Table 3 and Fig. 3, Kano-IPA and a comparison with traditional IPA model are described as the following. Since order-winner criterion Delivery reliability (OW2) belongs to Must-Be Quality and its performance is in the range between acceptable and satisfaction, the improvement effect of Delivery reliability (OW2) will not be significant, so its importance should be adjusted and it should be moved from Concentrate here (C) to Low priority (L). As Brand name (OW12) is an Attractive Quality and its performance is between acceptable and satisfaction, its improvement effect will be significant when it is improved, so it is an important factor to enhance customer satisfaction and should be improved promptly, then Brand name (OW12) should be moved from Low priority (L) to Concentrate here (C) according to Kano-IPA analysis. After-Sales support (OW14) belongs to Must-Be quality and its performance is between acceptable and satisfaction, thus its improvement effect will not be great when it is improved, so its importance should be adjusted and it should be moved from Concentrate here (C) from Low priority (L).

The case company in the study mainly adopts the strategy of Design leadership (OW9), although it is superior in the design field, it always accepts many orders of high price and short delivery time at a time and its time for subsequent purchase and production is very limited due to much time having been spent on customized design, so the company often has to conducts purchase

and production urgently and performance of Quality conformance (OW4) declines accordingly, at the same time, its delivery speed is slow and committed delivery time cannot be fulfilled due to an increased rejection rate of quality; furthermore, the problems concerning technical support and after-sale services appear, one by one, due to bad quality of the products after delivery. These bad chain reactions can be verified according to performance shown in Table 2. In order to improve these problems, the case company used the Kano-IPA model to make decisions. Since, the company's Order-winner criteria that belonged to attractive quality and was located in the quadrant of Concentrate here (C) and Keeping up the good work (K) includes Delivery speed (OW3), Design (OW7) and Brand name (OW12), the company decided to adopt concerned improvement strategies and used differentiation competitive strategy to win orders and segment the markets, as well as to avoid the pressure of market price adjustment for Price (OW1) locating in Concentrate here (C). Moreover, since Quality conformance (OW4) is one-dimensional quality and its performance is low, customer satisfaction will be enhanced greatly when it is improved, thus the corresponding improvement strategy should be adopted immediately.

CONCLUSION

Traditionally study on customer satisfaction mainly is conducted by using questionnaires and all the researchers take the ranked quantitative data as measurement values for analysis and establish a two-dimensional matrix of importance and performance after calculating the mean values of importance and performance of quality characteristics to find investment of which quality characteristics should be reduced, which quality characteristics should be improved continuously and competitive advantage of which quality characteristics should be maintained in order to advance the competitive ability of an organization. Conventional IPA and subsequent relevant researches both have made a lot of contributions to this technology. However, the model still has some underlying problems that need to be studied and researched further; that is when quality characteristics have a nonlinear effect on satisfaction, a conventional IPA model can not analyze the importance and priority of improvement correctly, which can lead to wrong decisions. The study discussed Kano's model to understand the nonlinear effect of quality characteristics, categorized the order-winner criteria successfully and let us know the improvement effect of order-winner criteria more clearly. Whereas Kano's model didn't discuss improvement effect and priority of quality characteristics, the study combined Kano's model with IPA to put forth a more rational methodology at first, next discussed nonlinear relationship between quality characteristics and customer satisfaction by employing Kano's model and discovered the core problems and improvement items with Kano-IPA model.

The methodology established by the study integrates Kano's model with IPA, not only eliminating the underlying problem of a traditional model, but also solving the complicated problems in reality and finding the direction and market strategy for quality characteristics improvement. Finally the study took a real case of industrial computers in Taiwan to demonstrate that the Kano-IPA methodology can be used to evaluate the importance of order-winners more rationally and solve the complicated problems when some quality characteristics have nonlinear effects and the methodology can apply response information of customers fully with the fewest resources to focus on a few key factors for providing necessary information of decision making more effectively and correctly.

REFERENCES

Aigbedo, H. and R. Parameswaran, 2004. Importance-performance analysis for improving quality of campus food service. Int. J. Qual. Reliab. Manage., 21: 876-896.

Anderson, E.W. and V. Mittal, 2000. Strengthening the satisfaction-profit Chain. J. Service Res., 3: 107-120.

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.

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

Fontenot, G., L. Henke and K. Carson, 2005. Take action on customer satisfaction. Qual. Prog., 38: 40-47.

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

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, Y.C., C.H. Wu and C.J. Hsu, 2006. Using importance-performance analysis in evaluating Taiwan medium and long distance national highway passenger transportation service quality. J. Am. Acad. Business, 8: 98-104.

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

Lee, M.C. and J.F. Newcomb, 1997. Applying the Kano methodology to meet customer requirements: NASA's microgravity science program. Qual. Manage. J., 4: 95-110.

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

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., H.Y. Hu, T.M. Yen and C.H. Tsai, 2008d. 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.

Levenburg, N.M. and S.R. Magal, 2005. Applying importance-performance analysis to evaluate E-business strategies among small firms. E-Service J., 3: 29-48.

Martilla, J.A. and J.C. James, 1977. Importance-performance analysis. J. Marketing, 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. Marketing 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.

Matzler, K., M. Rier, H.H. Hinterhuber, B. Renzl and C. Stadler, 2005. Methods and concepts in management: Significance, satisfaction and suggestions for further research- perspectives from Germany, Austria and Switzerland. Strategic Change, 14: 1-13.

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

Parasuraman, A., V.A. Zeithaml and L.L. Berry, 1985. A conceptual model of service quality and its implications for future research. J. Marketing, 49: 41-50.

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. The 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.

Tarrant, M.A. and E.K. Smith, 2002. The use of a modified importance-performance framework to examine visitor satisfaction with attributes of outdoor recreation settings. Manag. Leisure, 7: 69-82.

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

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., 16: 1127-1137.

Yavas, U. and D.J. Shemwell, 2001. Modified importance-performance analysis: An application to hospitals. Int. J. Health Care Qual. Assurance, 14: 104-110.

Zhang, H.Q. and I. Chow, 2004. Application of importance-performance model in tour guides performance: Evidence from mainland Chinese outbound visitors in Hong Kong. Tourism Manage., 25: 81-91.