Expert Systems with Applications 38 (2011) 9674–9683

Contents lists available at ScienceDirect

Expert Systems with Applications

journal homepage: www.elsevier.com/locate/eswa

Applying the IPA and DEMATEL models to improve the order-winner criteria: A case study of Taiwan's network communication equipment manufacturing industry

Hsiu-Yuan Hu [a,b], Shao-I Chiu [c], Ching-Chan Cheng [d], Tieh-Min Yen [e,*]

[a] Department of Food Science, Taipei College of Maritime Technology, 212, Sec. 9, Yen Ping N. Rd., Taipei 111, Taiwan, ROC
[b] Da Chien Health Medical System, 6, Shin-Guang Street, Miaoli City, Taiwan, ROC
[c] The Center for General Education, Taipei College of Maritime Technology, 212, Sec. 9, Yen Ping N. Rd., Taipei 111, Taiwan, ROC
[d] Department of Restaurant Management, Taipei College of Maritime Technology, 212, Sec. 9, Yen Ping N. Rd., Taipei 111, Taiwan, ROC
[e] Department of Technology Management, Chung-Hua University, 707, Sec. 2, WuFu Rd., HsinChu 300, Taiwan, ROC

ARTICLE INFO

Keywords:
Importance–performance analysis (IPA)
Customer satisfaction
Multiple regression analysis
Gap analysis
Decision making trial and evaluation laboratory (DEMATEL)
Order-winner criteria

ABSTRACT

The purpose of this study is to use the gap-analysis method to calculate the performance of quality characteristics and apply the multiple regression analysis method to establish the overall level of satisfaction and implicit importance of quality characteristics. In addition we will use the decision making trial and evaluation laboratory (DEMATEL) method to analyze the cause-effect relationship and level of influence among different quality characteristics in order to make revisions to the traditional IPA model and find the core problems that are involved with winning orders. The methodology that we propose for this research not only makes revisions to the IPA model's method of directly using explicit information from customer responses, we also solved the influence of the cause-effect relationships of quality characteristics. For our research we analyzed the case of a company from Taiwan's network communication equipment manufacturing industry in order to make our corrections to the IPA model and gain the benefits of using the DEMATEL model. The findings of our research show that with the corrections to the IPA and the methodology of DEMATEL we can find and correct the core problems of the company that was analyzed, improve quality control and therefore improve the company's ability to win and be compatible for orders.

1. Introduction

The purpose of our research is to revise the IPA model, and find the core problems involved with a company's order-winning criteria. After Martilla and James (1977) first used the IPA method to develop a company's market strategy it quickly became the standard method used by companies of every industry. For example Lee, Cheng, and Yen (2009) used the IPA to research the ability of Taiwan's computer industry to win orders. Hu, Lee, and Yen (2009) used a modified version of the IPA to analyze the ability of Taiwan's air conditioner manufacturing industry to win orders. Matzler, Sauerwein, and Heischmidt (2003) used the IPA for the improvement and strategy of service quality of the banking industry. Aigbedo and Parameswaran (2004) used the IPA to analyze the improvement of service of campus restaurants. Zhang and Chow (2004) used the IPA to improve the service quality of tour guides. Levenburg and Magal (2005) used the IPA to analyze the establishment of business strategy and resource allocation in the electronics industry. Matzler, Rier, Hinterhuber, Renzl, and Stadler (2005) used the IPA in the research of modern management methods and trends in the tools industry. Huang, Wu, and Hsu (2006) used the IPA method to explore the level of satisfaction of long to medium distance travelers towards the service quality of the national freeways of Taiwan. Tonge and Moore (2007) used the IPA method and the gap-analysis method to estimate the perceived quality of visitors to the Marine–Park coast. Lee, Yen, and Tsai (2008a) employed IPA in supplier performance evaluation. Just like Martilla and James (1977) pointed out, the IPA method has many strong points; it is easy to apply, it has a lower cost, and it can provide better focus and strategic advice. For these reasons the IPA method has been commonly adopted and applied by businesses of all industries.

The basic concepts of the IPA method lie in using market surveys to understand the importance of the customer satisfaction level towards perceived quality characteristics and after determining the actual perceived satisfaction level establish a two-dimensional matrix of the level of importance and level of performance. Afterwards the quality characteristics are separated into four categories according to their level of importance and level of performance so that businesses can form market strategies according to these categories of quality characteristics. During the process of the development of the IPA methodology there were some scholars

* Corresponding author. Tel.: +886 3 4024298; fax: +886 3 4026145.
E-mail addresses: huyuan@mail.tcmt.edu.tw (H.-Y. Hu), schiu@mail.tcmt.edu.tw (S.-I. Chiu), m9019011@chu.edu.tw (C.-C. Cheng), ytm1129@ms48.hinet.net, ytm1129@kingsun.com.tw (T.-M. Yen).

0957-4174/$ - see front matter © 2011 Elsevier Ltd. All rights reserved.
doi:10.1016/j.eswa.2011.01.147

who used the IPA structure and its analysis methods to perform comparative research. For example Oh (2001) performed an analysis on past uses of the IPA method, exploring the concepts and the methods of the IPA. Not only did he strengthen the direction of future research, he also he came up with a ten point result for the benefits and reliability for using the IPA method. As for methodological comparison, in Bacon's (2003) research he used 15 data groups to compare the different types of IPA method, in doing so he found the most practical and effective methods. Fontenot, Henke, and Carson (2005) performed comparative research on the 4 methods most commonly used for researching the satisfaction level of customers and proved that when establishing priorities for a plan of action that a multivariate operation technique was the best choice.

In recent years there have been many scholars who have attempted to revise the traditional IPA method in order to make it even more rational. Using empirical study of the service quality of banks, Matzler et al. (2003) pointed out that the level of satisfaction of customers forms a linear structure of quality characteristics, and confirmed that the traditional IPA method can cause a business to make wrong decisions. Sampson and Showalter (1999) showed that the level of importance and the level of performance were negatively correlated. Therefore they believed that the level of importance was suitable to show estimation and that a linear function of the level of performance should be used instead. In the research of Yavas and Shemwell (2001) they used the difference in the level of performance with competitors multiplied by the relative level of importance to revise the IPA method, and used the medical industry to explain the implications of this method. The research performed by Tarrant and Smith (2002) on the customer satisfaction level towards outdoor recreation equipment quality characteristics used the average and standard variation to modify the IPA model in order to make up for and strengthen the shortcomings of the traditional average and estimate values.

Even though Scholars have provided us with many important contributions with their research of the IPA method the traditional IPA model still has many important assumptions that use the implicit data from customer reactions to directly estimate the level of importance and performance of quality characteristics and the variables in the relative independence between different quality characteristics. With these kind of assumptions when implicit data for quality characteristics are used and they are shown to have a cause-effect relationship the traditional IPA method is unable to correctly analyze the priority of the level of importance and performance. Therefore in our research we use gap analysis, multiple regression analysis, and DEMATEL to analyze the establishment of a company's market strategy and decision-making model. We use a case from Taiwan's network communication equipment manufacturing industry to explain our revisions to the IPA and DEMATEL models and the benefits of using this method to serve as a reference index for the improvement of industrial quality.

2. IPA model reviews

2.1. IPA models

Martilla and James (1977) believed that the organizational implementation market research used to understand the level of customer satisfaction towards quality characteristics usually faces the following main problems:

(1) During the research the implementation of surveys are only geared towards the acceptance level of one-way quality characteristics, either the level of importance or the level of performance.
(2) As for the finds of the research, it is hard to determine the coefficients to understand the practical importance and level of influence using statistical analysis.

Therefore he suggested a method for dealing with the problems in the level of importance and performance listed above. Through simple data processing an organization can analyze and understand the four different categories of quality characteristics, and simultaneously develop a strategy and plan of action for every quadrant. When applying the analysis of the level of importance and performance, questionnaires usually require the participants to answer the following two questions pertaining quality characteristics:

(1) What is the level of importance of this quality characteristic to you?
(2) What is the level of performance of the organization for this quality characteristic?

The importance/performance level analysis method uses the two kinds of data listed above to establish a two-dimensional matrix formed from two axes. The median of the central tendency of the level of importance and performance is used as the matrix' segmentation value, separating the quality characteristics into four quadrants. Of course some scholars use the average value to replace the median value when measuring the central tendency which then becomes the main statistic value in the importance/performance analysis method. The traditional importance/performance analysis method uses a two-dimensional graph model to display the status of the quality characteristics. This method allows for easy interpretation and the ability to make direct interpretations, which can be seen in Fig. 1. As for the explanation of the importance/performance analysis method matrix, the definitions of the 4 quadrants of the matrix are as follows:

(1) *Concentrate here:* Customers feel that the service or quality characteristic of the product is high, but the performance of the organization is low.
(2) *Keep up the good work:* Customers feel that the service or quality characteristic of the product is high, and the performance of the organization is also high.
(3) *Low priority:* The performance of the organization's product or service quality characteristic is low, and the importance perceived by the customer is also low.
(4) *Possible overkill:* The performance of the organization's product or service quality characteristic is high, but the importance perceived by the customer is low.

After Martilla and James (1977) shared their findings about the importance/performance analysis method many well-known scholars gradually proposed their own revised models. Yavas and Shemwell (2001) integrated the relative level of importance to

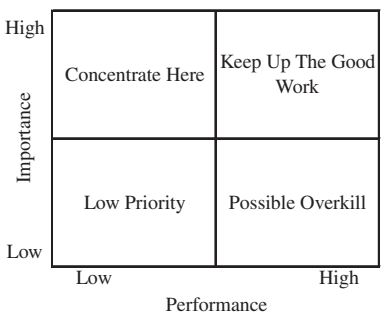

Fig. 1. The matrix chart of the level of importance and performance.