

## A new hybrid MCDM model combining DANP with VIKOR to improve e-store business

Wan-Yu Chiu<sup>a</sup>, Gwo-Hshiung Tzeng<sup>b,c,\*</sup>, Han-Lin Li<sup>a</sup>

<sup>a</sup> Institute of Information Management, National Chiao Tung University, 1001 University Road, Hsinchu 30010, Taiwan

<sup>b</sup> Institute of Management of Technology, National Chiao Tung University, 1001 University Road, Hsinchu 30010, Taiwan

<sup>c</sup> Institute of Project Management, Kainan University, No. 1 Kainan Road, Luchu, Taoyuan 338, Taiwan

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### ABSTRACT

Many consumers today buy products and services from e-stores. Because e-store managers are responsible for allocating different resources, it is essential that they understand consumers' shopping behaviour to provide the best possible value for visitors to their websites. Therefore, the purpose of this article is to focus on assessing and improving strategies to reduce the gaps in customer satisfaction caused by interdependence and feedback problems among dimensions and criteria to achieve the aspiration level. We propose a new hybrid Multiple Attribute Decision Making (MADM) model, combining the Decision Making Trial and Evaluation Laboratory (DEMATEL), DEMATEL-based Analytic Network Process (DANP), and Višekriterijumsko Kompromisno Rangiranje (VIKOR) methods to solve these problems. Then, three real cases are used to illustrate how the proposed new hybrid Multiple Criteria Decision-Making (MCDM) model improves e-store business. These results can provide e-store managers with a knowledge-based understanding of how to create marketing strategies that reduce the performance gaps of dimensions and criteria to satisfy consumers' needs and encourage customers to purchase more.

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## 1. Introduction

It has become increasingly common for consumers to buy products and services from e-stores because these types of stores provide them with a convenient and fast shopping environment and high-quality products and services, saving them time and money. E-stores have become an important retailing channel, and many such stores have been established and are experiencing a continuous increase in sales. Therefore, this article focuses on the assessment, improvement, and setting of strategies to better meet customer needs. These needs are met by reducing performance gaps introduced by interdependence and feedback problems among dimensions and criteria, allowing the aspiration level to be achieved and promoting customer satisfaction to bring people real happiness. It is essential for e-store managers to know how to manage business and marketing strategies because the success of the store depends on excellent management and accurate marketing strategies.

\* Corresponding author at: Institute of Management of Technology, National Chiao Tung University, 1001 University Road, Hsinchu 30010, Taiwan.

E-mail addresses: [g8923224@yuntech.edu.tw](mailto:g8923224@yuntech.edu.tw) (W.-Y. Chiu), [ghtzeng@cc.nctu.edu.tw](mailto:ghtzeng@cc.nctu.edu.tw), [ghtzeng@mail.knu.edu.tw](mailto:ghtzeng@mail.knu.edu.tw) (G.-H. Tzeng).

Electronic commerce (EC) is defined as the process of buying, selling, or exchanging products, services, advertisements, and information via electronic communication technologies (the Internet and www, PDAs (Personal Digital Assistants), smartphones, and tablet computers). Those technologies facilitate the manufacturing of products and the provision of services to satisfy the wants and needs of consumers [4,51,66]. EC includes e-stores, and because shopping is a complex behaviour composed of rational choices, amusement, and social communication [87,90], understanding consumers' wants and needs is critical for the stores' successful management and development [27,90]. This understanding particularly applies to e-stores, in which consumers' shopping behaviour may be different from that in traditional brick-and-mortar stores [71,91]. Therefore, e-store management issues are a hot topic because such stores seek to extend their consideration sets and improve consumers' welfare, and the quality and quantity of individually customised interfaces can facilitate a better, more efficient purchase decision-making process [62,88].

Previous EC researchers have focused on the consumers' motivations [30,71], the shopping behaviour [39,81], the intelligent agents [43,86], the satisfaction-loyalty relationship [5,15,63], and the risk [10]. This research has focused on how to manage e-stores and create marketing strategies. Previous relation methods have focused on influence [38], assessment [13], ranking [37,92],

selection [18,36,47,49,60,72], and improvement [14,21,46,48,50,51,59,83,85]. Thus, this study seeks a new hybrid Multiple Attribute Decision Making (MADM) model combining the Decision Making Trial and Evaluation Laboratory (DEMATEL) technique to build an influential relationship among dimensions and criteria, DEMATEL-based ANP (DANP) to find the influential weights, and VIšekriterijumsko KOmpromisno Rangiranje (VIKOR) methods to assess performance, not only in ranking and selection but also in improving and creating e-store marketing strategies to reduce gaps in each dimension and criterion to promote the e-store environment and satisfy customers' needs. These processes can not only help e-store managers to understand customers' wants and needs, they can also assist them in improving their products and service to reduce performance gaps in customer satisfaction by building an effective e-store marketing strategy.

An empirical study of three e-stores – Yahoo, PChome, and Books aims to demonstrate the proposed new hybrid Multiple Criteria Decision-Making (MCDM) model for ranking and improvement. Because this study focuses on the effects of certain influential relationships among dimension and criteria in an e-store business and the creation of marketing strategies for the e-store manager, this study surveyed three e-stores to determine the best strategies for improving an e-store. From the survey results, we found that prioritising the customers' needs and giving them perfect post-purchase service can affect customers' purchase decisions, information searches, and evaluation of alternatives. Therefore, initial marketing strategies can include advertisements and light products to meet the customers' needs. Then, the e-store can create high-quality post-sales service programmes, offer fast delivery of products, provide complete packaging, communicate after the purchase, offer guarantees, and implement liberal returns policies to improve post-purchase service.

The remainder of this paper is organised as follows: Section 2 reviews the consumer decision-making process and evaluation framework, including e-store business criteria and performance. Section 3 provides a brief introduction of the DEMATEL technique, the DANP influential weights and the VIKOR method used to establish a new hybrid MCDM model to resolve problems of interdependence and feedback. An empirical study of Yahoo, PChome, and Books is presented in Section 4 to demonstrate the proposed model and, finally, conclusions and remarks are presented in Section 5.

## 2. Review of consumers' decision-making process and evaluation framework

An e-store markets and sells products or services offered by a company [54]. E-stores are becoming critically important to online retailers, and they have become important parts of retailer strategy [30]. Therefore, knowing the needs of customers and how to meet those needs is important. E-stores are a highly visible, well-received, and popular type of e-commerce [20,26] that sells products and services online [8,67]. E-stores are part of the e-commerce and retail channel, which includes online retailers, online stores, online shops, e-shops, and any virtual shopping websites that sell products or services from businesses to customers, such as Amazon [35,75,89]. Amazon.com was established in 1994 during an era of rapid growth for the Internet, which quickly became a key channel for the sale of products and services [2,40,77,78]. Consequently, e-store management is a key issue for the development of e-commerce.

The number of e-stores has grown quickly because they are convenient, eliminate sales pressure, and save time. The online retail sales of European e-stores increased 18% from 2009 to 2010 [9]. Forrester research forecasts that European online sales will have a compound annual growth rate of 12%, from €96.7 bn (£82.0 bn) in

2011 to €171.9 bn (£145.8 bn) in 2016 [22,32]. The UK Office for National Statistics reports that e-store sales increased by 13.1% in March 2011 [56]. Forrester research forecasts UK online sales will have compound annual growth rate of 11%, from £30.1 bn in 2011 to £51.0 bn in 2016, and the UK's proportion of online shoppers will increase from 75% of the population in 2011 to 85% in 2016. The proportion of online shoppers in Sweden will increase from 72% of the population in 2011 to 86% in 2016 [22,32]. In the US, Forrester research forecasts that online retail sales are expected to grow from US\$176.2 bn in 2010 to US\$278.9 bn in 2015, which is an increase of more than 10% [53]. Forrester research forecasts note that US online shoppers will have a compound annual growth rate of 15%, from 167 million people in 2012 to 192 million people in 2016, and it is predicted that each consumer's spending will grow by 44%, from US\$1207 in 2012 to US\$1738 in 2016. Therefore, the total sale value for e-stores will increase by 45%, from US\$226 bn in 2012 to US\$327 bn in 2016 [52,69]. All available reports indicate that sales by e-stores are growing rapidly in all areas.

Customer satisfaction has been considered most important issues for marketers and customer researchers [42,55,73]. Companies need to develop strategies that help company develop sustainable business practices [41]. E-store should to meet customers' needs [65] and increase customer satisfaction by creating customer value in consumer marketing [19,64]. Loyal customers that indulge in repeat purchases are the bedrock of any business [1]. Customer satisfaction is important mostly because of its indirect influence on the profitability of companies [3]; satisfied customers tend to make not only more purchases but also repeat purchases [7,74,76], and customer satisfaction has become a key element of many companies' business strategies [24]. Therefore, understanding the criteria that influence customer satisfaction is important not only to describe the actual situation but also to plan improvements, and actions [79].

Marketing activities should be designed to increase customer satisfaction [33]. Therefore, in this paper, we combined consumer behaviour and customer satisfaction to create dimensions and criteria that show the influence level, weighting, and performance among dimensions and criteria.

This study primarily examines consumers' criteria for the business-to-consumer electronic commerce (B2C e-commerce) of e-stores, focusing on consumer satisfaction. E-store buyer behaviour refers to consumer behaviour, and the steps in the consumers' decision-making process can be found in most textbooks and journals, some of which describe these steps as need recognition, information search, evaluation, purchase, and after-purchase evaluation [23,28,29,34,61,68,89]. Others propose that the steps are need recognition, information search, evaluation, purchase, and post-purchase behaviour [44,82]. In fact, according to e-store customers' behaviour, including blog writing, Facebook reviews, and tendency to repurchase, the main components of this process can be considered to be need recognition, information search, evaluation, purchase, and post-purchase behaviour. Based on these criteria, Bizrate.com and Alexa.com conducted surveys asking respondents to rate retailers on 14 e-store attributes, namely, product availability, ease of finding, overall look and design, clarity, number of reviews, brand, relative price, selection, variety of shipping options, shipping charges, charge statement, order tracking, on-time delivery, and expectations met [31]. A detailed description of these components is provided in Table 1. In summary, the intact criteria, which include five influential dimensions and fourteen criteria, need to be considered (see Table 1).

Having surveyed several Taiwan EC websites, Chang and Chen [12] found that, according to users, Yahoo.com, Yahoo auction, PChome.com, and Books.com were the four top online shopping sites [12]. Another study [80] found that the most popular website

**Table 1**  
Reorganisation of the current research. Source: Engel et al., [95], [68,31].

A.	Need recognition Product availability ( $a_1$ )	Products you want or need to be available
B.	Information search Ease of finding ( $b_1$ ) Overall look/design ( $b_2$ ) Clarity of product information ( $b_3$ )	How easily you were able to find information about the products How you feel about the overall look and design of the website How clear and understandable the information about the products is
C.	Evaluation of alternatives Number of Reviews ( $c_1$ )  Brand ( $c_2$ ) Prices relative ( $c_3$ )	How many reviews are there of other people's overall rating and experience of this purchase How much consumers trust the website's brand How the prices compare to other web-sites
D.	Choice/Purchase Selection ( $d_1$ ) Variety of shipping options ( $d_2$ ) Shipping charges ( $d_3$ ) Charges statement ( $d_4$ )	Types of products available The desired shipping options were available Cost of shipping/delivery Total purchase amount (including shipping/handling charges, etc.) displayed before order submission
E.	Post-purchase behaviour Order tracking ( $e_1$ ) On-time delivery ( $e_2$ ) Product expectations met ( $e_3$ )	Ability to track orders until delivered Products were in stock at time of expected delivery Correct products were delivered and everything worked as described/depicted

was Yahoo (45.1%), followed by PChome (7.8%), Books.com (6.8%), and Ezfly (5.3%), which accounted for 65% of all responses. An earlier study by Chang and Chen [11] found that the ten websites most often visited were Yahoo! (30.1%), Unimall (17.4%), PChome (9.9%), Etmall (9.4%), Books (6.7%), Payeasy (5.1%), Hermall (3.8%), Happybag (2.9%), Eztravel (2.5%) and era ticket (2.4%) [11]. Therefore, this study chooses the three most popular e-stores (i.e., Yahoo, PChome, and Books) to demonstrate the proposed method.

**3. Building a new hybrid MCDM model for e-store management**

This research uses the DEMATEL technique and combines a DANP with a VIKOR method to establish a new hybrid MCDM model to address the problems of interdependence and feedback among certain criteria and reduce the performance gap in each dimension and criterion. The DEMATEL technique is used to build an influential network relations map (INRM), and the DEMATEL-based Analytic Network Process (DANP) is expected to obtain the influential weights using the basic concept of Analytic Network Process (ANP) [70]. Then, the VIKOR method with influential weights (DANP) is used to integrate the performance gaps from criteria to dimensions and overall. Then, it is possible to determine how to improve business performance and reduce the gaps to achieve the aspiration level and satisfy the customers' needs based on INRM. The research processes are illustrated as Fig. 1.

**3.1. DANP (DEMATEL-based ANP)**

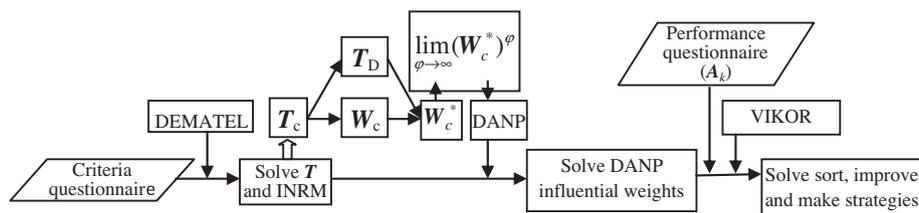
This study seeks to assess business performance, which usually consists of multiple dimensions and criteria and to determine the influential weights of those criteria. In a traditional ANP, normalisation is set by dividing each criterion in a column by a number of clusters so that each column achieves exact unity. This process

implicitly assumes that each cluster has the same weight. However, it is well-known that the effect of one cluster on the other clusters may be different in degree. Thus, the traditional ANP assumption that each cluster is of equal weight in obtaining a weighted supermatrix is not reasonable; consequently, the DANP influential weights can improve this shortcoming and obtain results based on the basic concept of the ANP from a total-influential matrix  $T_c$  and  $T_D$  by using the DEMATEL technique. Therefore, the DEMATEL technique is used to build an INRM for each criterion and dimension and also to improve the normalisation process of the traditional ANP. The DANP is an appropriate tool to include interaction and interdependence among the dimensions and criteria that appear in the cases of real world problems. According to the concrete characteristics of objective affairs, the methodology can verify the interdependence of variables and attributes, building a relationship that reflects those characteristics with an essential system and evolutionary trend [38,47,51,59,72,83,85,92]. This technique has been successfully applied to many situations, such as improving marketing, tourism policy, airline partner selection, information security risk control, and environment watershed plans [18,21,47,51,59].

The steps for building an INRM using the DEMATEL technique (steps 1–4) and finding the influential weights of a DANP based on a total-influential matrix (steps 5–9) are summarised below.

**3.1.1. DEMATEL technique for building an INRM**

**Step 1: Calculate the direct-influence matrix by scores.** An assessment of the relationship between each mutual influence criterion is made according to the opinions of knowledge-based experts, using a scale ranging from 0 to 4, with scores represented by natural language: 'absolutely no influence' (0), 'low influence' (1), 'medium influence' (2),



**Fig. 1.** Model procedure of the current research.

‘high influence’ (3), and ‘very high influence’ (4). The knowledge-based experts are required to indicate the direct influence by a pairwise comparison, and if they believe that criterion  $i$  has an effect and influence on criterion  $j$ , they should indicate this by  $g_c^{ij}$ . Thus, the matrix  $G = [g_c^{ij}]_{n \times n}$  of direct relationships can be obtained.

$$G = \begin{bmatrix} g_c^{11} & \dots & g_c^{1j} & \dots & g_c^{1n} \\ \vdots & & \vdots & & \vdots \\ g_c^{i1} & \dots & g_c^{ij} & \dots & g_c^{in} \\ \vdots & & \vdots & & \vdots \\ g_c^{n1} & \dots & g_c^{nj} & \dots & g_c^{nn} \end{bmatrix} \quad (1)$$

Step 2: **Normalise the direct-influence matrix  $G$ .** The normalised matrix  $X$  is acquired by using Eq. (2). Its diagonal is zero, and the maximum sum of rows or columns is one.

$$X = \nu G \quad (2)$$

where

$$\nu = \min_{ij} \left\{ \frac{1}{\max_i \sum_{j=1}^n g_c^{ij}}, \frac{1}{\max_j \sum_{i=1}^n g_c^{ij}} \right\}, \quad i, j \in \{1, 2, \dots, n\}$$

Step 3: **Attain a total-influential matrix  $T_c$ .** When the normalised direct-influential matrix  $X$  is obtained, the total-influential matrix  $T_c$  of the INRM can be obtained from Eq. (3), in which  $I$  denotes the identity matrix,

$$\begin{aligned} T_c &= X + X^2 + X^3 + \dots + X^\ell \\ &= X(I + X + X^2 + \dots + X^{\ell-1})(I - X)^{-1} \\ &= X(I - X^\ell)(I - X)^{-1} = X(I - X)^{-1}, \text{ when } \lim_{\ell \rightarrow \infty} X^\ell \\ &= [0]_{n \times n} \end{aligned} \quad (3)$$

where  $X = [x_c^{ij}]_{n \times n}$ ,  $0 \leq x_c^{ij} < 1$ ,  $0 < \sum_{j=1}^n x_c^{ij} \leq 1$ , and  $0 < \sum_{i=1}^n x_c^{ij} \leq 1$ , and at least one row or column of the summation (but not all) equals one; then,  $\lim_{\ell \rightarrow \infty} X^\ell = [0]_{n \times n}$  can be guaranteed.

Step 4: **Analyse the results.** At this stage, the row sums and the column sums of the matrix components are separately expressed as vector  $r = [\sum_{j=1}^n t_c^{ij}] = (r_1, \dots, r_i, \dots, r_n)'$  and vector  $s = [\sum_{i=1}^n t_c^{ij}] = (s_1, \dots, s_j, \dots, s_n)'$  by using Eqs. (4) and (5). Let  $i=j$  and  $ij \in \{1, 2, \dots, n\}$ ; the horizontal axis vector  $(r_i + s_i)$  is then defined by adding  $r_i$  to  $s_i$ , to illustrate the importance of the criterion. Similarly, the vertical axis vector  $(r_i - s_i)$  is defined by subtracting  $r_i$  from  $s_i$ , which may divide the criteria into a causal cluster and an affected cluster. In general, when  $(r_i - s_i)$  is positive, the criterion is part of the causal group; i.e., criterion  $i$  affects other criteria. By contrast, if  $(r_i - s_i)$  is negative, the criterion is part of the affected group; i.e., criterion  $i$  is influenced by other criteria. Therefore, a causal graph can be achieved by mapping the data set of  $(r_i + s_i, r_i - s_i)$ , the so-called INRM, to provide a valuable approach to decide how the preferred values in each dimension and criterion can be improved based on the INRM,

$$\begin{aligned} T_c &= [t_c^{ij}]_{n \times n}, i, j \in \{1, 2, \dots, n\} \\ r &= \left[ \sum_{j=1}^n t_c^{ij} \right]_{n \times 1} = [t_c^i]_{n \times 1} = (r_1, \dots, r_i, \dots, r_n)' \end{aligned} \quad (4)$$

$$s = \left[ \sum_{i=1}^n t_c^{ij} \right]_{1 \times n} = [t_c^j]_{n \times 1} = (s_1, \dots, s_j, \dots, s_n)' \quad (5)$$

where vector  $r$  and vector  $s$  express the sum of the rows and the sum of the columns from the total-influential matrix  $T_c = [t_c^{ij}]_{n \times n}$ , respectively, and the superscript ' denotes the transpose [17]. Two different total influence matrices are then applied. The first one,  $T_c = [t_c^{ij}]_{n \times n}$ , pertains to  $n$  criteria, while the second one,  $T_D = [t_D^{ij}]_{m \times m}$ , is devoted to  $m$  dimensions (clusters) from  $T_c$  (see Eq. (7)).

$$T_c = \begin{matrix} & \begin{matrix} D_1 & \dots & D_j & \dots & D_m \end{matrix} \\ \begin{matrix} D_1 \\ \vdots \\ D_i \\ \vdots \\ D_m \end{matrix} & \begin{bmatrix} c_{11} & \dots & c_{1j} & \dots & c_{1m} \\ \vdots & & \vdots & & \vdots \\ c_{i1} & \dots & c_{ij} & \dots & c_{im} \\ \vdots & & \vdots & & \vdots \\ c_{m1} & \dots & c_{mj} & \dots & c_{mm} \end{bmatrix} \end{matrix} \quad (6)$$

### 3.1.2. DANP for finding the influential weights in each criterion

Step 5: **Find the normalised total-influential matrix  $T_D^{nor}$ .** The total-influential matrix  $T_D$  needs to be normalised by dividing it by the following formula:

$$\begin{aligned} t_D^i &= \sum_{j=1}^m t_D^{ij} \\ T_D &= \begin{bmatrix} t_D^{11} & \dots & t_D^{1j} & \dots & t_D^{1m} \\ \vdots & & \vdots & & \vdots \\ t_D^{i1} & \dots & t_D^{ij} & \dots & t_D^{im} \\ \vdots & & \vdots & & \vdots \\ t_D^{m1} & \dots & t_D^{mj} & \dots & t_D^{mm} \end{bmatrix} \rightarrow \begin{matrix} \sum_{j=1}^m t_D^{1j} = t_D^1 \\ \vdots \\ \sum_{j=1}^m t_D^{ij} = t_D^i \\ \vdots \\ \sum_{j=1}^m t_D^{mj} = t_D^m \end{matrix} \end{aligned} \quad (7)$$

Thus, the total-influential matrix can be normalised and presented as  $T_D^{nor}$ . Then, the sum of each row can be defined as  $t_D^i = \sum_{j=1}^m t_D^{ij}$ , where  $i = 1, \dots, m$ , and  $T_D$  can be normalised by the rows of sums by dividing the elements in each row by the sum of the row to obtain as in Eq. (7). Therefore, a total-influential matrix  $T_D$  can be normalised and represented as  $T_D^{nor}$ .  $T_D^{nor} = [t_D^{ij}/t_D^i]_{m \times m}$ , as in Eq. (8). Then, each row of the normalised  $T_D^{nor}$  can be summed to equal one, so that  $\sum_{j=1}^m t_D^{nor,ij} = 1$ .

$$T_D^{nor} = \begin{bmatrix} t_D^{11}/t_D^1 & \dots & t_D^{1j}/t_D^1 & \dots & t_D^{1m}/t_D^1 \\ \vdots & & \vdots & & \vdots \\ t_D^{i1}/t_D^i & \dots & t_D^{ij}/t_D^i & \dots & t_D^{im}/t_D^i \\ \vdots & & \vdots & & \vdots \\ t_D^{m1}/t_D^m & \dots & t_D^{mj}/t_D^m & \dots & t_D^{mm}/t_D^m \end{bmatrix} = \begin{bmatrix} t_D^{nor,11} & \dots & t_D^{nor,1j} & \dots & t_D^{nor,1m} \\ \vdots & & \vdots & & \vdots \\ t_D^{nor,i1} & \dots & t_D^{nor,ij} & \dots & t_D^{nor,im} \\ \vdots & & \vdots & & \vdots \\ t_D^{nor,m1} & \dots & t_D^{nor,mj} & \dots & t_D^{nor,mm} \end{bmatrix} \quad (8)$$

Step 6: **Find the normalised matrix  $T_c^{nor}$  by dimensions and clusters.** Normalise  $T_c$  with the total degrees of effect and influence of the dimensions and clusters to obtain  $T_c^{nor}$ , as shown in Eq. (9).

$$\begin{matrix}
 & D_1 & \dots & D_j & \dots & D_m \\
 & C_{11} \dots C_{1n_1} & \dots & C_{j1} \dots C_{jn_j} & \dots & C_{m1} \dots C_{mn_m} \\
 C_{11} & & & & & \\
 C_{12} & & & & & \\
 D_1 & \vdots & & & & \\
 C_{1n_1} & \left[ \begin{array}{ccc} T_c^{nor_{11}} & \dots & T_c^{nor_{1j}} & \dots & T_c^{nor_{1m}} \\ \vdots & & \vdots & & \vdots \\ C_{i1} & T_c^{nor_{i1}} & \dots & T_c^{nor_{ij}} & \dots & T_c^{nor_{im}} \\ C_{i2} & \vdots & & \vdots & & \vdots \\ \vdots & & & & & \\ C_{m1} & T_c^{nor_{m1}} & \dots & T_c^{nor_{mj}} & \dots & T_c^{nor_{mm}} \\ C_{m2} & \vdots & & \vdots & & \vdots \\ \vdots & & & & & \\ C_{mn_m} & & & & & \end{array} \right] \\
 \end{matrix} \quad (9)$$

Step 7: **Build an unweighted supermatrix  $W_c$ .** Then, the total-influential matrix is normalised into a supermatrix according to the interdependence between the relationships of the dimensions and clusters to obtain an unweighted supermatrix,  $W_c$ , as shown in Eq. (10).

$$\begin{matrix}
 & D_1 & \dots & D_j & \dots & D_m \\
 & C_{11} \dots C_{1n_1} & \dots & C_{m1} \dots C_{mn_m} & \dots & C_{j1} \dots C_{jn_j} \\
 C_{11} & & & & & \\
 \vdots & & & & & \\
 D_1 & \left[ \begin{array}{ccc} W_c^{11} & \dots & W_c^{1j} & \dots & W_c^{1m} \\ \vdots & & \vdots & & \vdots \\ C_{i1} & W_c^{ij} & \dots & W_c^{ij} & \dots & W_c^{mj} \\ \vdots & & & & & \\ C_{m1} & W_c^{m1} & \dots & W_c^{mj} & \dots & W_c^{mm} \\ \vdots & & & & & \\ D_m & & & & & \\ C_{mn_m} & & & & & \end{array} \right] \\
 \end{matrix} \quad (10)$$

Unweighted supermatrix  $W_c$  is the matrix transposed from  $T_c^{nor}$  (basic concept from the ANP by Saaty [70], but different from the traditional ANP). If a blank or 0 is shown in the matrix, this means that the dimensions and criteria are independent.

Step 8: **Find the influential weights of the DANP.** The total-influential matrix  $T_c$  needs to be normalised by dividing the dimension and cluster (Eq. (9)), so  $T_c$  is normalised by summarising the row by dimensions and clusters to obtain  $T_c^{nor}$ . An unweighted super-matrix  $W_c$  can be obtained by transposing  $T_c^{nor}$ , i.e.,  $W_c = (T_c^{nor})'$ . Using (Eq. (11)), a weighted super-matrix  $W_c^*$  (improving the traditional ANP by using equal weights to make it appropriate for the real world) can be obtained by the product of  $T_D^{nor}$  and  $W_c$ , i.e.,  $W_c^* = T_D^{nor} W_c$  (Eq. (11)). This result demonstrates that these influential level values are the basis of normalisation to determine a weighted super-matrix.

$$W_c^* = T_D^{nor} W_c = \begin{bmatrix} t_D^{nor_{11}} \times W_c^{11} & \dots & t_D^{nor_{1j}} \times W_c^{1j} & \dots & t_D^{nor_{1m}} \times W_c^{1m} \\ \vdots & & \vdots & & \vdots \\ t_D^{nor_{ij}} \times W_c^{ij} & \dots & t_D^{nor_{ij}} \times W_c^{ij} & \dots & t_D^{nor_{mj}} \times W_c^{mj} \\ \vdots & & \vdots & & \vdots \\ t_D^{nor_{1m}} \times W_c^{1m} & \dots & t_D^{nor_{im}} \times W_c^{im} & \dots & t_D^{nor_{mm}} \times W_c^{mm} \end{bmatrix} \quad (11)$$

Step 9: **Obtain the DANP.** Limit the weighted super-matrix by raising it to a sufficiently large power  $\varphi$  until it converges and becomes a long-term stable super-matrix to obtain global priority vector, which defines the influential weights  $w = (w_1, \dots, w_j, \dots, w_n)$  from  $\lim_{\varphi \rightarrow \infty} (W_c^*)^\varphi$  for the criteria.

### 3.2. VIKOR method

The VIKOR method was developed for the multi-criteria optimisation of complex systems. It determines the compromise ranking list and the compromise solution, and the weight stability intervals for the preferred stability of the compromise solution can be obtained from the initial weights given by the AHP or ANP in the traditional method. This traditional method focuses on ranking and selection from a set of alternatives in cases of conflicting criteria. It introduces a multi-criteria ranking index based on the particular measure of “closeness” to the “ideal” solution [45,48,57,58,84]. This study focuses on improving this method to the aspiration level and knowing how to improve and create marketing strategies.

Assuming that each alternative is evaluated according to the function of each criterion, a compromise ranking can be obtained by comparing the measure of closeness to the ideal alternative in the traditional approach. The multi-criteria measure for compromise ranking is developed from the  $L_p$  – metric which plays an aggregating role in a compromise programming method [93,94].

The VIKOR was able to distinguish the three e-stores to determine their gaps. In a traditional VIKOR, the positive ideal point is set as the highest performance score among all alternatives (the larger is the better), i.e.;  $f_j^+ = \max\{f_{kj} | k = 1, 2, \dots, K\}$  in this case. Likewise, the negative ideal point is set as the lowest performance score among all alternatives, when smaller is worst; i.e.,  $f_j^- = \min\{f_{kj} | k = 1, 2, \dots, K\}$  in this case. However, in this study, a new technique for improving the VIKOR method is proposed and described as follows. The alternatives are denoted  $A_1, \dots, A_k, \dots, A_K$ ;  $w_j$  is set as the weight of the  $j$  – th criterion, expressing the relative influential weight of the criterion  $j$  by the DANP based on influential matrix  $T$  from the DEMATEL technique to make it applicable to the real-world situation, where  $j = 1, 2, \dots, n$ , and  $n$  is the number of criteria. The rating performance scores are normalised by the best value and the worst value for example, the scale performance scores from 0 (the worst value,  $f_j^- = 0$ ) to 10 (the best value, called the aspiration level,  $f_j^* = 10$ ), and the scores of the  $j$ -th criterion are denoted by  $f_{kj}$  for an alternative  $A_k$  as gap  $y_{kj}$ . The new VIKOR is more appropriate to the analysis of real-world situations. These models can be used to resolve other real business questions.

The new VIKOR method consists of the following:

#### Step 1: Finding the normalised gap.

$$y_{kj} = \left( |f_j^* - f_{kj}| \right) / \left( |f_j^* - f_j^-| \right) \quad (12)$$

where  $f_j^*$  is the best value ( $f_j^*$  is set as the aspiration level) and  $f_j^-$  is the worst value ( $f_j^-$  is set as the worst value or the so-called tolerable level) of all criterion functions  $j = 1, 2, \dots, n$ . These concepts are different from the traditional approach  $f_j^+ = \max_k f_{kj}$  and  $f_j^- = \min_k f_{kj}$ , in which higher-valued performance is better because they avoid “choose the best among

inferior choices, options, or alternatives (i.e., pick the best apple among a barrel of rotten apples)” problems. Thus, this performance definition differs from the traditional approach. It is more appropriate for the empirical business analysis of e-stores in the real world, to ascertain how the normalised scale of the gap,  $y_{kj}$ , can be reduced to zero (0) when the best value is set with no gap, the normalised scale of the gap  $y_{kj}$  is set to be one (1), and the worst value is set with the largest gap.

### Step 2: Computing the gap for minimal and the maximal gap for priority improvement.

The general form of  $L_p$ -metric can be written as follows:

$$L_k^p = \left\{ \sum_{j=1}^n [w_j \times y_{kj}]^p \right\}^{1/p}, \quad 1 \leq p \leq \infty; k = 1, 2, \dots, K. \quad (13)$$

In addition to applying the above form of  $L_p$  - metric, the VIKOR method also uses  $L_k^{p=1}$ , which is shown as the average gap  $E_k$  in Eq. (14), and  $L_k^{p=\infty}$ , which is shown as the maximal gap  $Q_k$ , to improve the priority in Eq. (15).

$$E_k = L_k^{p=1} = \sum_{j=1}^n w_j \times y_{kj}, \quad \forall k \quad (14)$$

$$Q_k = L_k^{p=\infty} = \max_j \{y_{kj} | j = 1, 2, \dots, n\}, \quad \forall k \quad (15)$$

How can the smaller average gap  $E_k$  be better? The average gap (called the group utility) is emphasised in the case of  $p = 1$ . The importance of individual regrets or gaps (maximum regrets or gaps should be improved by their priority in total and by each  $p$  dimension) rises as the value of parameter  $p$  increases when  $p = \infty$ . The compromise solution  $\min_k L_k^p$  will be chosen because its value is closest to the ideal or aspiration level. The usually applied expression  $E_k^* = \min_k E_k$  is therefore changed because the best gap  $E_k^*$  is zero (i.e.,  $E_k^* = 0$ ), and the commonly utilised expression  $E_k^- = \max_k E_k$  is changed because the worst value of  $E_k^-$  is one (i.e.,  $E_k^- = 1$ ). The expression  $Q_k^* = \min_k Q_k$  is similarly changed because the best gap  $Q_k^*$  is zero (i.e.,  $Q_k^* = 0$ ), and the expression  $Q_k^- = \max_k Q_k$  is changed because the worst value of  $Q_k^-$  is one (i.e.,  $Q_k^- = 1$ ).

### Step 3: Obtaining the comprehensive indicator $U_k$

Based on the above concepts, the comprehensive indicator  $U_k$  of the compromise VIKOR can be written as Eq. (16) from the traditional form

$$U_k = \alpha(E_k - E_k^*) / (E_k^- - E_k^*) + (1 - \alpha)(Q_k - Q_k^*) / (Q_k^- - Q_k^*) \quad (16)$$

Then, based on the concept above, the best situation, when  $E_k^* = 0$  and  $Q_k^* = 0$ , and the worst situation, when  $E_k^- = 1$  and  $Q_k^- = 1$ , can be rewritten as follows:

$$U_k = \alpha E_k + (1 - \alpha) Q_k \quad (17)$$

This paper seeks to combine the influential weights of the DANP with the VIKOR method to determine how to minimise the average gap (or regret) and prioritise improvement in the maximum gap overall and in each dimension based on the INRM by the DEMATEL technique. Thus, this study focuses on how to improve and reduce the performance gaps to achieve the aspiration level based on INRM.

## 4. Empirical case study of real e-stores

Because e-store commerce is growing fast, and the Internet is not limited by national boundaries, the competitive business environment makes it essential for e-store managers to know how to manage their e-stores and attract more consumers to browse, pur-

chase, and repurchase. Previous papers seldom address e-store management and marketing strategy problems.

We used two different questionnaires in this research. The first questionnaire for influential relationships among criteria was distributed to eight frequent shoppers who are e-store **experts** (the eight experts' group consensus of significant confidence in the questionnaires, which is 95.11%, is shown in Tables A1 and A2 of Appendix A). The questionnaires for influential relationships among dimensions and criteria were conducted on the basis of a face-to-face pairwise comparison to evaluate the effect and influence of the criteria, using a five-point scale ranging from four (extremely influential) to zero (completely non-influential).

The second questionnaire was the e-stores' performance questionnaire, which was distributed to 1,018 consumers who often purchase products from the three chosen e-stores (The reliability is 93.9%, and the validity is 92.9% (KMO test)). These questionnaires used an eleven-point scale ranging from zero (very poor performance) to ten (excellent performance), i.e., very dissatisfied or very bad  $\leftarrow 0, 1, 2, \dots, 9, 10 \rightarrow$  very satisfied or very good. It is hoped that this research can help e-store managers to improve and manage their stores more effectively to satisfy customers and promote higher rates of repurchase. The goal is to provide marketing strategies for managers to build an effective business by reducing or eradicating the gaps in e-store service and achieving aspiration levels.

### 4.1. Description of problem

In the e-era, the Internet has proved to be a particularly powerful channel for providing information to customers because it reduces buyers' costs and the time spent searching for the right product. Because e-stores are able to respond rapidly to changes in the marketplace, many prestigious companies have incorporated an e-store as a means of attracting customers who find it convenient to shop from their homes or places other than physical brick-and-mortar stores. Indeed, e-stores provide a diffuse and ubiquitous network of points of access. They are open 24 h a day and seven days a week, so customers can shop anywhere and at any time. In today's fiercely competitive electronic marketplace, e-stores are more anxious than ever to create a long-lasting relationship with their customers. Although all firms have the ability to establish and manage their own e-store sales channels, not all of them can successfully operate an e-commerce business. Therefore, e-store managers must know how to turn “lookers” into “buyers” and “purchases” into “repurchases.” A well-established brand name particularly helps to build trust with customers, which is essential for online sales [16].

The emergence of the e-store has led many organisations to rethink their business strategies to remain competitive. E-stores provide companies with the opportunity to reach new markets, new customers, and new information, improve customer services, distribute products more quickly, communicate more effectively, and increase profitability [2,25]. In other words, they provide companies with many competitive advantages. An effective e-store manager uses the Internet to enhance customer relations management (CRM) and attract potential customers [6]. This paper seeks to provide recommendations to the managers of three of the most popular e-store websites in Taiwan (i.e., Yahoo, PChome, and Books) that can help to improve their business and marketing strategy, increase the number of customers, increase the volume of business, and maximise profits.

### 4.2. Measuring the relationship among dimensions and criteria to build an INRM

The DEMATEL technique is used to model influential relationships among dimensions and criteria and to establish an INRM

for those dimensions and criteria using pair-wise comparisons (see Fig. 2). This technique can help to determine the levels of needs to improve them.

The shopping experts were asked to determine the influence of the relationships among the criteria. The average initial direct-relation  $14 \times 14$  matrix  $G$ , obtained using pair-wise comparisons in terms of influences and directions between criteria, is shown in Table 2.

As matrix  $G$  shows, the normalised direct-relation matrix  $X$  is calculated using Eqs. (1) and (2), as shown in Table 3. Then, the total-influential matrix  $T_c$  can be derived using Eqs. (3) and (7), as shown in Tables 4 and 5. Furthermore, by using Eqs. (4) and (5), the total-influence given and received according to each dimension and criterion can be summarised, as shown in Table 6. Thus, the INRM of the DEMATEL technique can be obtained as shown in Fig. 2 by using Table 6.

4.3. Influential weights of criteria in e-store management

Having determined the relationship structure of e-store business criteria, the DANP method was applied to obtain the influential weights of the criteria. Initially, the influence of the relationship among the criteria was compared based on the INRM. An unweighted supermatrix  $W_c$  can be obtained by transposing the normalised matrix  $T_c^{nor}$ , i.e.,  $W_c = (T_c^{nor})'$ , as shown in Table 7.

The influential weights  $W_c^*$  of DANP based on Eqs. (8)–(11) are shown in Table 8.

The influential weights of DANP can be obtained by limiting the power of the weighted super-matrix ( $\lim_{\phi \rightarrow \infty} (W_c^*)^\phi$ ) until it reaches a steady-state (see Table 9).

4.4. Using the method to evaluate e-store management performance and gaps

In Taiwan, 1018 customers who use e-stores were asked to evaluate their level of satisfaction with each criterion. The DANP method was used to obtain the influential weights of the dimensions and criteria to apply to a real case. The global influential weights and local influential weights of the dimensions and criteria were obtained based on the DANP technique (see Table 10), which

was followed by combining the DANP with the VIKOR method to obtain the average performance scores (satisfaction) of Yahoo ( $A_1$ ), PChome ( $A_2$ ), and Books ( $A_3$ ), which were 7.538, 7.470, and 7.601, respectively (as shown in Table 10).

4.5. Results and discussions

This study has three results. First, in the INRM, it can be easily understood from Fig 2 and Table 6 that five dimensions influence each other. For example, dimension A affects dimensions E, D, B, and C ( $A \rightarrow \{E D B C\}$ ); dimension E affects dimensions D, B, and C ( $E \rightarrow \{D B C\}$ ); dimension D affects dimensions B and C ( $D \rightarrow \{B C\}$ ); and dimension B affects dimension C ( $B \rightarrow \{C\}$ ). Understanding these influential relationships will enable managers to make decisions; for example, they should first improve A (need recognition), followed by E (post-purchase behaviour), D (choice/purchase), B (information search), and C (evaluation of alternatives).

Fig. 2 and Table 6 demonstrate that criterion  $e_1$  affects criteria  $e_2$  and  $e_3$  ( $e_1 \rightarrow \{e_2 e_3\}$ ), and criterion  $e_2$  affects criterion  $e_3$  ( $e_2 \rightarrow \{e_3\}$ ). In addition, criterion  $d_1$  affects criteria  $d_4$ ,  $d_3$ , and  $d_2$  ( $d_1 \rightarrow \{d_4 d_3 d_2\}$ ), criterion  $d_4$  affects criteria  $d_3$  and  $d_2$  ( $d_4 \rightarrow \{d_3 d_2\}$ ), and criterion  $d_3$  affects criterion  $d_2$  ( $d_3 \rightarrow \{d_2\}$ ). Criterion  $b_2$  affects criteria  $b_3$  and  $b_1$  ( $b_2 \rightarrow \{b_3 b_1\}$ ), and criterion  $b_3$  affects criterion  $b_1$  ( $b_3 \rightarrow \{b_1\}$ ). Criterion  $c_2$  affects criteria  $c_3$  and  $c_1$  ( $c_2 \rightarrow \{c_3 c_1\}$ ), and criterion  $c_3$  affects criterion  $c_1$  ( $c_3 \rightarrow \{c_1\}$ ).

These e-stores must improve their business strategies to meet consumers' needs, generate more purchases and repurchases, and devise the best marketing strategies with the most effective and efficient ways to achieve customer satisfaction. The e-store ranking further indicates the dimensions that need to be most improved: need recognition > post-purchase behaviour > choice/purchase > information search > evaluation of alternatives. This study demonstrates that the impact of need recognition and post-purchase on the intention to repurchase consists of product availability, order tracking, on-time delivery, and expectations met, supporting the results obtained by Gauri et al. [31]. Thus, this study has proved that DEMATEL can correctly indicate the effect of e-store criteria and identify those that need to be improved first.

Based on the result above, we can establish marketing strategies by using advertisements and light products to persuade customers

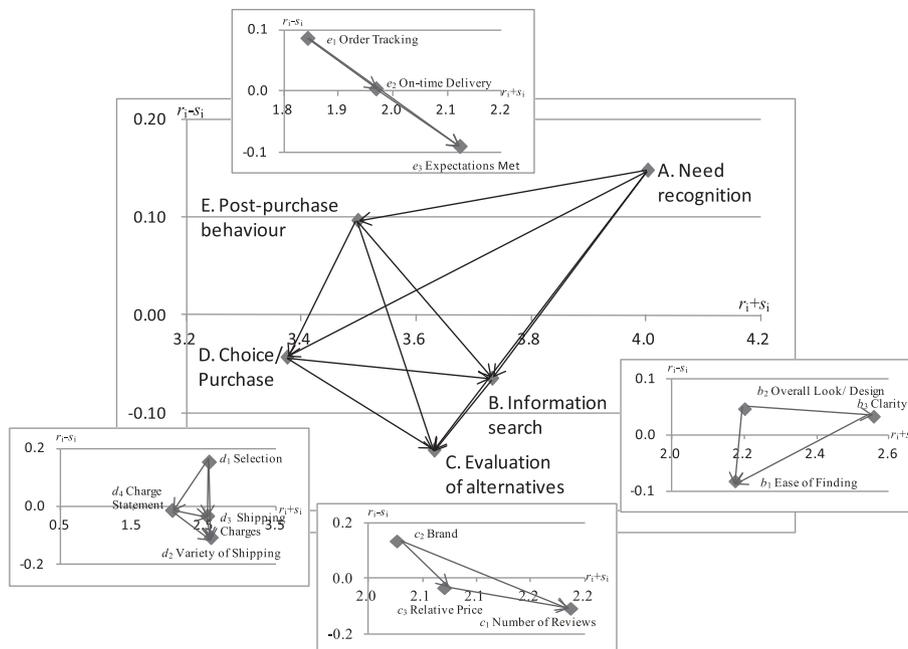


Fig. 2. Influential network relations map (INRM).

**Table 2**  
Initial influential matrix G.

Dimensions/criteria (G)		A. Need recognition			B. Information search			C. Alternatives evaluation			D. Choice/purchase				E. Post-purchase behaviour			Total
		$a_1$	$b_1$	$b_2$	$b_3$	$c_1$	$c_2$	$c_3$	$d_1$	$d_2$	$d_3$	$d_4$	$e_1$	$e_2$	$e_3$			
A. Need recognition	$a_1$ Product availability	0.000	2.125	1.875	3.000	3.375	1.250	3.250	2.125	2.250	2.375	2.000	1.375	1.875	2.875	29.750		
B. Information search	$b_1$ Ease of finding	1.875	0.000	2.625	2.625	1.875	1.375	1.375	2.500	1.375	1.125	1.500	1.375	1.250	2.000	22.875		
	$b_2$ Overall look/design	2.000	2.750	0.000	3.375	1.875	1.375	1.500	2.875	1.500	1.125	1.500	1.500	1.250	1.625	24.250		
	$b_3$ Clarity	3.125	3.625	3.125	0.000	1.875	1.375	1.750	3.250	2.000	1.500	1.625	1.375	1.250	2.625	28.500		
C. Evaluation of alternatives	$c_1$ Number of reviews	2.125	1.875	1.625	1.875	0.000	2.750	2.250	1.500	1.125	1.500	1.250	1.250	1.500	2.750	23.375		
	$c_2$ Brand	1.250	1.750	2.125	2.125	2.875	0.000	2.000	1.750	1.750	1.750	2.000	1.750	1.875	2.125	25.125		
	$c_3$ Relative price	3.125	1.250	1.250	2.000	2.500	1.375	0.000	1.500	1.375	2.500	1.250	1.250	1.500	2.625	23.500		
D. Choice/ Purchase	$d_1$ Selection	2.000	3.000	2.750	3.000	2.000	1.625	1.750	0.000	2.125	1.625	1.750	1.125	1.375	1.625	25.750		
	$d_2$ Variety of shipping	1.750	1.250	1.500	1.625	1.750	1.625	2.000	1.625	0.000	2.750	1.875	1.750	2.250	1.625	23.375		
	$d_3$ Shipping charges	2.000	1.125	1.250	1.625	1.500	2.250	3.000	1.250	2.875	0.000	1.375	1.875	2.125	1.625	23.875		
	$d_4$ Charge statement	1.750	1.375	1.125	1.625	1.250	1.625	1.500	1.500	1.625	1.625	0.000	1.375	1.125	1.375	18.875		
E. Post-purchase behaviour	$e_1$ Order tracking	1.250	1.125	1.375	1.500	1.625	1.625	1.250	1.250	3.125	2.250	1.250	0.000	3.500	2.125	23.250		
	$e_2$ On-time delivery	1.500	1.250	1.125	1.500	2.250	2.375	1.750	1.375	3.125	2.750	1.000	2.875	0.000	1.875	24.750		
	$e_3$ Met expectations	3.000	2.000	2.000	3.125	3.000	2.500	2.500	1.500	1.375	1.625	0.875	1.500	1.750	0.000	26.750		
	Total	26.750	24.500	23.750	29.000	27.750	23.125	25.875	24.000	25.625	24.500	19.250	20.375	22.625	26.875	-		

**Table 3**  
Normalised direct-relation X.

Dimensions/criteria (X)		A. Need recognition			B. Information search			C. Alternatives evaluation			D. Choice/purchase				E. Post-purchase behaviour		
		$a_1$	$b_1$	$b_2$	$b_3$	$c_1$	$c_2$	$c_3$	$d_1$	$d_2$	$d_3$	$d_4$	$e_1$	$e_2$	$e_3$		
$a_1$	Product availability	0.000	0.071	0.063	0.101	0.113	0.042	0.109	0.071	0.076	0.080	0.067	0.046	0.063	0.097		
$b_1$	Ease of finding	0.063	0.000	0.088	0.088	0.063	0.046	0.046	0.084	0.046	0.038	0.050	0.046	0.042	0.067		
$b_2$	Overall look/design	0.067	0.092	0.000	0.113	0.063	0.046	0.050	0.097	0.050	0.038	0.050	0.050	0.042	0.055		
$b_3$	Clarity	0.105	0.122	0.105	0.000	0.063	0.046	0.059	0.109	0.067	0.050	0.055	0.046	0.042	0.088		
$c_1$	Number of reviews	0.071	0.063	0.055	0.063	0.000	0.092	0.076	0.050	0.038	0.050	0.042	0.042	0.050	0.092		
$c_2$	Brand	0.042	0.059	0.071	0.071	0.097	0.000	0.067	0.059	0.059	0.059	0.067	0.059	0.063	0.071		
$c_3$	Relative price	0.105	0.042	0.042	0.067	0.084	0.046	0.000	0.050	0.046	0.084	0.042	0.042	0.050	0.088		
$d_1$	Selection	0.067	0.101	0.092	0.101	0.067	0.055	0.059	0.000	0.071	0.055	0.059	0.038	0.046	0.055		
$d_2$	Variety of shipping	0.059	0.042	0.050	0.055	0.059	0.055	0.067	0.055	0.000	0.092	0.063	0.059	0.076	0.055		
$d_3$	Shipping charges	0.067	0.038	0.042	0.055	0.050	0.076	0.101	0.042	0.097	0.000	0.046	0.063	0.071	0.055		
$d_4$	Charge statement	0.059	0.046	0.038	0.055	0.042	0.055	0.050	0.050	0.055	0.055	0.000	0.046	0.038	0.046		
$e_1$	Order tracking	0.042	0.038	0.046	0.050	0.055	0.055	0.042	0.042	0.105	0.076	0.042	0.000	0.118	0.071		
$e_2$	On-time delivery	0.050	0.042	0.038	0.050	0.076	0.080	0.059	0.046	0.105	0.092	0.034	0.097	0.000	0.063		
$e_3$	Met expectations	0.101	0.067	0.067	0.105	0.101	0.084	0.084	0.050	0.046	0.055	0.029	0.050	0.059	0.000		

**Table 4**  
Total-influential dimensions matrix  $T_D$ .

Dimensions	A. Need recognition	B. Information search	C. Evaluation of alternatives	D. Choice/purchase	E. Post-purchase behaviour	$r_i$
A. Need recognition	0.389	0.443	0.448	0.400	0.395	2.075
B. Information search	0.406	0.385	0.365	0.343	0.334	1.833
C. Alternatives evaluation	0.385	0.360	0.349	0.323	0.330	1.746
D. Choice/purchase	0.361	0.345	0.344	0.304	0.311	1.665
E. Post-purchase behaviour	0.386	0.365	0.377	0.339	0.330	1.797
$s_i$	1.927	1.898	1.884	1.708	1.700	–

**Table 5**  
Total-influential criteria matrix  $T_C$ .

Criteria	$a_1$	$b_1$	$b_2$	$b_3$	$c_1$	$c_2$	$c_3$	$d_1$	$d_2$	$d_3$	$d_4$	$e_1$	$e_2$	$e_3$	$r_i$
$a_1$ Product availability	0.389	0.422	0.403	0.505	0.500	0.372	0.472	0.412	0.427	0.421	0.339	0.333	0.377	0.476	0.389
$b_1$ Ease of finding	0.363	0.283	0.354	0.408	0.370	0.303	0.335	0.353	0.324	0.307	0.266	0.270	0.289	0.365	1.046
$b_2$ Overall look/design	0.385	0.385	0.290	0.448	0.388	0.317	0.355	0.380	0.344	0.323	0.279	0.286	0.303	0.373	1.123
$b_3$ Clarity	0.470	0.459	0.432	0.404	0.443	0.361	0.414	0.437	0.406	0.380	0.321	0.322	0.346	0.453	1.294
$c_1$ Number of reviews	0.377	0.345	0.328	0.391	0.321	0.350	0.370	0.325	0.323	0.325	0.263	0.272	0.303	0.395	1.041
$c_2$ Brand	0.367	0.356	0.357	0.415	0.424	0.281	0.376	0.348	0.358	0.349	0.297	0.301	0.329	0.392	1.082
$c_3$ Relative price	0.411	0.328	0.318	0.398	0.401	0.313	0.305	0.327	0.335	0.360	0.265	0.275	0.307	0.395	1.019
$d_1$ Selection	0.401	0.407	0.388	0.455	0.409	0.340	0.379	0.306	0.378	0.353	0.299	0.289	0.321	0.389	1.336
$d_2$ Variety of shipping	0.361	0.320	0.318	0.377	0.370	0.316	0.359	0.324	0.287	0.362	0.279	0.287	0.326	0.357	1.252
$d_3$ Shipping charges	0.375	0.322	0.316	0.384	0.370	0.339	0.395	0.319	0.382	0.285	0.269	0.296	0.328	0.365	1.255
$d_4$ Charge statement	0.307	0.275	0.260	0.320	0.299	0.267	0.290	0.273	0.286	0.279	0.181	0.233	0.245	0.295	1.018
$e_1$ Order tracking	0.343	0.313	0.312	0.370	0.364	0.316	0.334	0.310	0.383	0.349	0.258	0.233	0.363	0.369	0.965
$e_2$ On-time delivery	0.368	0.333	0.321	0.389	0.401	0.353	0.367	0.330	0.399	0.378	0.265	0.334	0.272	0.381	0.987
$e_3$ Met expectations	0.448	0.391	0.380	0.476	0.459	0.381	0.420	0.367	0.371	0.370	0.283	0.313	0.348	0.357	1.017
$s_i$	0.389	1.127	1.076	1.260	1.146	0.945	1.051	1.222	1.332	1.280	1.028	0.879	0.983	1.107	

**Table 6**  
Sum of influences given and received on dimensions and criteria.

Dimensions/criteria	$r_i$	$s_i$	$r_i + s_i$	$r_i - s_i$
A. Need recognition	2.075	1.927	4.002	0.148
$a_1$ Product availability	0.389	0.389	0.778	0.000
B. Information search	1.833	1.898	3.731	–0.064
$b_1$ Ease of finding	1.046	1.127	2.173	–0.081
$b_2$ Overall look/design	1.123	1.076	2.199	0.047
$b_3$ Clarity	1.294	1.260	2.555	0.034
C. Evaluation of alternatives	1.746	1.884	3.630	–0.138
$c_1$ Number of reviews	1.041	1.146	2.187	–0.105
$c_2$ Brand	1.082	0.945	2.026	0.137
$c_3$ Relative price	1.019	1.051	2.070	–0.031
D. Choice/purchase	1.665	1.708	3.374	–0.043
$d_1$ Selection	1.336	1.222	2.558	0.114
$d_2$ Variety of shipping	1.252	1.332	2.584	–0.080
$d_3$ Shipping charges	1.255	1.280	2.535	–0.025
$d_4$ Charge statement	1.018	1.028	2.047	–0.010
E. Post-purchase behaviour	1.797	1.700	3.497	0.097
$e_1$ Order tracking	0.965	0.879	1.844	0.086
$e_2$ On-time delivery	0.987	0.983	1.970	0.004
$e_3$ Met expectations	1.017	1.107	2.123	–0.090

to buy products to improve the dimension “need recognition (A)”. For the dimension “post-purchase behaviour (E)”, e-stores can create high-quality post-sales service programmes and offer fast delivery of products to improve the “order tracking ( $e_1$ )” and “on-time delivery ( $e_2$ )” criteria, and they can provide complete packaging, add service speed, give reassuring communication after the purchase, offer guarantees, and implement liberal returns policies to improve “expectations met ( $e_3$ )”. To improve the dimension of “choice/purchase (D)”, e-stores can provide an assortment of merchandise, an interface that is easy to access and navigate, and a satisfactory number of alternatives to improve network crowding; they can offer various methods of payment and provide a clean bill of sale to improve “charge statement ( $d_4$ )”; clear shipping prices can improve “shipping charges ( $d_3$ )”; and convenience and easy transactions can improve the “variety of shipping ( $d_2$ )”. In

the “information search (B)” dimension, e-stores can enhance the appearance and design of their websites, use attractive animated graphics, provide the expected value of additional information, and offer a variety of categories to improve the “overall look and design ( $b_2$ )”, “clarity ( $b_3$ )”, and “ease of finding ( $b_1$ )”. To facilitate “evaluation of alternatives (C)”, e-stores can provide former customers’ experience, namely word-of-mouth (chat rooms and blog) and services offered to improve the image of the “brand ( $c_2$ )”; they can display other e-store references or relative prices to improve “relative price ( $c_3$ )”; and they can correct any unfavourable perception to improve the “number of reviews ( $c_1$ )” (see Fig. 2).

In addition to the summary above, new e-store managers can refer to the INRM of the DEMATEL technique to prioritise the improvement of dimensions and criteria and creating marketing strategies for their e-store business.

The second results were influential weights. As seen in Table 9, the highest relative weights were “clarity  $b_3$ ” and “number of reviews  $c_1$ ”, assessed at 0.084 and 0.080, respectively. This result shows that an e-store’s “clarity” of information about products and customer’s rating of the e-store as having a good “number of reviews” have the greatest relative influence of all criteria. Thus, it is extremely important to deliver clear and careful information to customers on an e-store website because this parameter can contribute to positive reviews. The lowest priority was “charge statement  $d_4$  (0.056)”. This result shows that an e-store’s clear display of price, quantity, shipping fee, and total fee makes “charge statement” the least influential criterion. “Need recognition (A)” was the most influential dimension within an e-store business. Fig. 2 and Table 9 illustrate the priority of criterion improvement from top to bottom, where improvement of the most influential criteria would provide the best effect. The priority of dimensions and criteria for improvement should be considered in entire systems (based on Fig. 2) to reduce gaps and meet customers’ needs. It is possible that improving different criteria will strongly influence the results directly and indirectly.

The third result (see Table 10), which ranked three e-stores’ performances, determined that Books surpassed Yahoo, which

**Table 7**  
Unweighted supermatrix  $W_c$ .

Unweighted		$a_1$	$b_1$	$b_2$	$b_3$	$c_1$	$c_2$	$c_3$	$d_1$	$d_2$	$d_3$	$d_4$	$e_1$	$e_2$	$e_3$
A. Need recognition	$a_1$ Product availability	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
B. Information search	$b_1$ Ease of finding	0.317	0.271	0.343	0.354	0.324	0.316	0.314	0.325	0.315	0.315	0.321	0.315	0.319	0.314
	$b_2$ Overall look/design	0.303	0.339	0.258	0.334	0.309	0.316	0.305	0.310	0.313	0.310	0.304	0.314	0.308	0.305
	$b_3$ Clarity	0.380	0.390	0.399	0.312	0.368	0.368	0.381	0.364	0.372	0.376	0.374	0.372	0.373	0.382
C. Evaluation of alternatives	$c_1$ Number of reviews	0.372	0.368	0.366	0.364	0.308	0.392	0.394	0.362	0.354	0.335	0.349	0.359	0.358	0.364
	$c_2$ Brand	0.277	0.300	0.299	0.297	0.337	0.260	0.307	0.301	0.302	0.307	0.312	0.311	0.315	0.302
	$c_3$ Relative price	0.351	0.332	0.335	0.340	0.355	0.348	0.299	0.336	0.344	0.358	0.339	0.330	0.327	0.333
D. Choice/purchase	$d_1$ Selection	0.258	0.282	0.287	0.283	0.263	0.257	0.254	0.229	0.259	0.254	0.268	0.239	0.240	0.264
	$d_2$ Variety of shipping	0.267	0.259	0.259	0.263	0.261	0.265	0.260	0.283	0.229	0.304	0.281	0.295	0.291	0.267
	$d_3$ Shipping charges	0.263	0.246	0.243	0.246	0.263	0.258	0.280	0.264	0.289	0.227	0.274	0.268	0.276	0.266
	$d_4$ Charge statement	0.212	0.213	0.210	0.208	0.212	0.220	0.206	0.224	0.223	0.215	0.178	0.199	0.193	0.204
E. Post-purchase behaviour	$e_1$ Order tracking	0.281	0.292	0.298	0.287	0.281	0.294	0.281	0.289	0.296	0.299	0.301	0.241	0.338	0.307
	$e_2$ On-time delivery	0.318	0.313	0.315	0.309	0.312	0.322	0.314	0.321	0.336	0.331	0.317	0.377	0.276	0.342
	$e_3$ Met expectations	0.401	0.395	0.387	0.404	0.407	0.384	0.405	0.389	0.368	0.369	0.382	0.382	0.386	0.351

**Table 8**  
The weighted supermatrix  $W_c^*$ , produced by weighting the unweighted supermatrix  $W_c$ .

Weighted		$a_1$	$b_1$	$b_2$	$b_3$	$c_1$	$c_2$	$c_3$	$d_1$	$d_2$	$d_3$	$d_4$	$e_1$	$e_2$	$e_3$
A. Need recognition	$a_1$ Product availability	0.067	0.081	0.081	0.081	0.080	0.080	0.080	0.079	0.079	0.079	0.079	0.078	0.078	0.078
B. Information search	$b_1$ Ease of finding	0.072	0.062	0.079	0.081	0.073	0.071	0.071	0.074	0.071	0.071	0.072	0.070	0.070	0.069
	$b_2$ Overall look/design	0.069	0.078	0.059	0.077	0.069	0.071	0.069	0.070	0.071	0.070	0.069	0.069	0.068	0.068
	$b_3$ Clarity	0.086	0.089	0.091	0.071	0.083	0.083	0.086	0.082	0.084	0.085	0.084	0.082	0.082	0.084
C. Evaluation of alternatives	$c_1$ Number of reviews	0.086	0.080	0.080	0.079	0.067	0.086	0.086	0.082	0.080	0.076	0.079	0.082	0.082	0.083
	$c_2$ Brand	0.064	0.066	0.065	0.065	0.074	0.057	0.067	0.068	0.068	0.069	0.071	0.071	0.072	0.069
	$c_3$ Relative price	0.081	0.072	0.073	0.074	0.078	0.076	0.066	0.076	0.078	0.081	0.077	0.075	0.075	0.076
D. Choice/purchase	$d_1$ Selection	0.070	0.077	0.078	0.077	0.071	0.069	0.068	0.061	0.069	0.067	0.071	0.065	0.066	0.072
	$d_2$ Variety of shipping	0.073	0.071	0.071	0.072	0.070	0.071	0.070	0.075	0.061	0.081	0.074	0.081	0.079	0.073
	$d_3$ Shipping charges	0.072	0.067	0.067	0.067	0.071	0.069	0.075	0.070	0.077	0.060	0.073	0.073	0.075	0.073
	$d_4$ Charge statement	0.058	0.058	0.057	0.057	0.057	0.059	0.055	0.059	0.059	0.057	0.047	0.054	0.053	0.056
E. Post-purchase behaviour	$e_1$ Order tracking	0.057	0.058	0.059	0.057	0.058	0.061	0.058	0.059	0.060	0.061	0.061	0.048	0.068	0.061
	$e_2$ On-time delivery	0.064	0.062	0.063	0.062	0.065	0.067	0.065	0.065	0.069	0.068	0.065	0.075	0.055	0.068
	$e_3$ Met expectations	0.081	0.079	0.077	0.080	0.084	0.080	0.084	0.080	0.075	0.075	0.078	0.077	0.077	0.070

**Table 9**  
Influential weights by stable matrix of DANP when power  $\lim_{\rho \rightarrow \infty} (W_c^*)^\rho$ .

Criteria	$a_1$	$b_1$	$b_2$	$b_3$	$c_1$	$c_2$	$c_3$	$d_1$	$d_2$	$d_3$	$d_4$	$e_1$	$e_2$	$e_3$
Weights (DANP)	0.079	0.072	0.070	0.084	0.080	0.067	0.076	0.070	0.073	0.071	0.056	0.059	0.065	0.078

surpassed PChome (Books ( $A_3$ )) > Yahoo ( $A_1$ ) > PChome ( $A_2$ )). The integration of the performance index scores of Yahoo in the DANP further demonstrated that the dimension of the “need recognition” gap is 0.279 and the gap for the “Shipping Charges” criterion is 0.290 constituting the largest gaps, which the Yahoo e-store should improve as a priority. The integration of the performance index scores of PChome in the DANP showed that the gap of the “need recognition” dimension is 0.274, and the gap of the “Overall Look/Design” criterion is 0.289 constituting the largest gaps, which the PChome e-store should improve as a priority. The integration of the performance index scores of Books in the DANP showed that gap of the “need recognition” dimension is 0.296 and the gap of the “Relative Price” criterion is 0.307 consti-

tuting the largest gaps, which the Books e-store should improve as a priority. Thus, the priority for Yahoo, PChome, and Books is to enhance their product variety to satisfy their customers’ needs.

The e-store strategies were defined by using the data in Table 10 (shown in Table 11). This process demonstrated that the priorities of each e-store’s strategy were dissimilar. The results indicated that Yahoo, PChome, and Books needed to enhance their product availability. Therefore, Yahoo, PChome, and Books should all strengthen their efforts to develop and comply with their customers’ need for products and goods or extend their products and goods category to satisfy their customers. Additionally, providing the best service to customers at the post-purchase stage is an

**Table 10**  
Performance values combined with the influential weights of the criteria according to the DANP.

Alternatives			Yahoo (A <sub>1</sub> )		Pchome (A <sub>2</sub> )		Books (A <sub>3</sub> )		
	Local weight (based on DANP)	Global weight (DANP)	aspiration value	Performance (A <sub>1</sub> )	Gap (VIKOR)	Performance (A <sub>2</sub> )	Gap (VIKOR)	Performance (A <sub>3</sub> )	Gap (VIKOR)
<b>A.Need recognition</b>	<b>0.079</b>			<b>7.212</b>	<b>(0.279)</b>	<b>7.261</b>	<b>(0.274)</b>	<b>7.040</b>	<b>(0.296)</b>
<i>a</i> <sub>1</sub> Product Availability	1.000	0.079	10.000	7.212	(0.279)	7.261	(0.274)	7.040	(0.296)
<b>B.Information search</b>	<b>0.226</b>			<b>7.336</b>	<b>(0.266)</b>	<b>7.341</b>	<b>(0.266)</b>	<b>7.605</b>	<b>(0.239)</b>
<i>b</i> <sub>1</sub> Ease of Finding	0.318	0.072	10.000	7.586	(0.241)	7.481	(0.252)	7.484	(0.252)
<i>b</i> <sub>2</sub> Overall Look/ Design	0.310	0.070	10.000	7.133	(0.287)	7.108	(0.289)	7.668	(0.233)
<i>b</i> <sub>3</sub> Clarity	0.372	0.084	10.000	7.292	(0.271)	7.417	(0.258)	7.656	(0.234)
<b>C.Evaluation of alternatives</b>	<b>0.223</b>			<b>7.584</b>	<b>(0.242)</b>	<b>7.510</b>	<b>(0.249)</b>	<b>7.491</b>	<b>(0.251)</b>
<i>c</i> <sub>1</sub> Number of Reviews	0.359	0.080	10.000	7.735	(0.226)	7.511	(0.249)	7.508	(0.249)
<i>c</i> <sub>2</sub> Brand	0.300	0.067	10.000	7.644	(0.236)	7.628	(0.237)	8.114	(0.189)
<i>c</i> <sub>3</sub> Relative Price	0.341	0.076	10.000	7.373	(0.263)	7.405	(0.259)	6.927	(0.307)
<b>D.Choice/ Purchase</b>	<b>0.270</b>			<b>7.759</b>	<b>(0.224)</b>	<b>7.550</b>	<b>(0.245)</b>	<b>7.710</b>	<b>(0.229)</b>
<i>d</i> <sub>1</sub> Selection	0.259	0.070	10.000	7.983	(0.202)	7.687	(0.231)	7.892	(0.211)
<i>d</i> <sub>2</sub> Variety of Shipping	0.270	0.073	10.000	7.776	(0.222)	7.511	(0.249)	7.666	(0.233)
<i>d</i> <sub>3</sub> Shipping Charges	0.263	0.071	10.000	7.104	(0.290)	7.188	(0.281)	7.255	(0.274)
<i>d</i> <sub>4</sub> Charge Statement	0.208	0.056	10.000	8.285	(0.171)	7.889	(0.211)	8.115	(0.188)
<b>E.Post-purchase behaviour</b>	<b>0.202</b>			<b>7.544</b>	<b>(0.246)</b>	<b>7.546</b>	<b>(0.245)</b>	<b>7.791</b>	<b>(0.221)</b>
<i>e</i> <sub>1</sub> Order Tracking	0.292	0.059	10.000	7.605	(0.240)	7.484	(0.252)	7.626	(0.237)
<i>e</i> <sub>2</sub> On-time Delivery	0.322	0.065	10.000	7.610	(0.239)	7.582	(0.242)	7.746	(0.225)
<i>e</i> <sub>3</sub> Met Expectations	0.386	0.078	10.000	7.442	(0.256)	7.564	(0.244)	7.953	(0.205)
<b>Total</b>	<b>1.000</b>	<b>1.000</b>	-	<b>7.538(2)</b>	<b>0.246(2)</b>	<b>7.470(3)</b>	<b>0.253(3)</b>	<b>7.601(1)</b>	<b>0.240(1)</b>

essential dimension because this consideration primarily determines the consumers' choice of e-store.

According to the DANP based on the basic concept of ANP, the data in Table 9 were designed and obtained to calculate a weighted and unweighted super-matrix to determine the influential weights based on the total-influential normalised matrix. Table 10 shows the e-store criteria weighted super-matrix indices, as well as the performance gaps of Books, Yahoo, and Pchome. Each row represents the weight of each criterion (Table 9). Therefore, in this paper, based on the results previously provided, the influential weights of the criteria and index were created using the DEMATEL technique and the DANP in conjunction with VIKOR for performance evaluation.

The e-store strategy, which emphasises the e-store business goal of satisfying customers' needs, is shown in Table 11. The results of this research indicate that no e-store business strategy is the same; consequently, managers of e-stores must use this method to determine their customers' wants and needs to define the gap and improve it to achieve the ideal solution or aspiration level.

## 5. Conclusion and remarks

This study can help e-store managers to reflect on the improvement of marketing strategies, service re-engineering, and management redesign. The influential weight questionnaire from experts and the performance questionnaires from 1,018 e-store consumers are more relevant than other traditional evaluation techniques in the real world.

E-stores can offer products and services at a reduced cost at any time and in any place, making good e-store management essential in the business field. This research used the DEMATEL technique in conjunction with a DANP to produce an INRM and influential weights of criteria, and it used a VIKOR to ascertain the gaps in the three chosen e-stores and discover how to improve them. The traditional e-store approach is to rank the alternatives and only use the best, whereas this current study not only selects the best but also analyses which gaps in the dimensions and criteria should be improved first. An important topic for future research is how to formulate strategies to improve and reduce the gaps to

**Table 11**  
E-stores' priority strategies for improvement.

e-Store	Strategies
Yahoo	The priority index for improving the dimensions includes need recognition, information search, post-purchase behaviour, evaluation of alternatives, and choice/purchase The priority index for improving the criteria includes shipping charges, overall look and design, product availability, clarity, relative price, expectations met, ease of finding, order tracking, on-time delivery, brand, number of reviews, variety of shipping, selection, and charge statement
Pchome	The priority index for improving the dimensions includes need recognition, information search, the evaluation of alternatives, post-purchase behaviour, and choice/purchase The priority index for improving the criteria includes overall look and design, shipping charges, product availability, relative price, clarity, ease of finding, order tracking, number of reviews, variety of shipping, expectations met, on-time delivery, brand, selection, and charge statement
Books	The priority index for improving the dimensions includes need recognition, the evaluation of alternatives, information search, choice/purchase, and post-purchase behaviour The priority index for improving the criteria includes relative price, product availability, shipping charges, ease of finding, number of reviews, order tracking, clarity, variety of shipping, overall look and design, on-time delivery, selection, met expectation, brand, and charge statement

**Table A1**  
Group consensuses of the seven respondents on the degree of influence among the criteria (unit:%).

Criteria	a <sub>1</sub>	b <sub>1</sub>	b <sub>2</sub>	b <sub>3</sub>	c <sub>1</sub>	c <sub>2</sub>	c <sub>3</sub>	d <sub>1</sub>	d <sub>2</sub>	d <sub>3</sub>	d <sub>4</sub>	e <sub>1</sub>	e <sub>2</sub>	e <sub>3</sub>
a <sub>1</sub>	0.000	2.286	2.000	3.286	3.286	1.286	3.143	2.286	2.429	2.571	2.143	1.429	2.000	2.714
b <sub>1</sub>	2.000	0.000	2.857	2.714	1.857	1.429	1.429	2.286	1.429	1.143	1.571	1.429	1.286	2.143
b <sub>2</sub>	2.143	2.714	0.000	3.286	2.000	1.429	1.571	2.714	1.571	1.143	1.571	1.571	1.286	1.429
b <sub>3</sub>	3.143	3.571	3.000	0.000	2.000	1.286	1.857	3.143	2.143	1.571	1.714	1.429	1.286	2.429
c <sub>1</sub>	2.286	1.857	1.571	1.857	0.000	2.714	2.286	1.571	1.143	1.429	1.286	1.286	1.429	2.571
c <sub>2</sub>	1.286	1.857	2.286	2.286	2.857	0.000	2.143	1.857	1.857	1.857	2.143	1.714	2.000	2.000
c <sub>3</sub>	3.143	1.286	1.286	2.143	2.714	1.429	0.000	1.571	1.429	2.714	1.286	1.143	1.571	2.714
d <sub>1</sub>	2.143	2.857	2.714	3.000	2.143	1.571	1.857	0.000	2.286	1.714	1.857	1.143	1.429	1.714
d <sub>2</sub>	1.857	1.286	1.571	1.714	1.857	1.714	2.000	1.571	0.000	2.571	1.714	1.857	2.286	1.714
d <sub>3</sub>	2.143	1.143	1.286	1.714	1.571	2.429	3.143	1.286	3.000	0.000	1.143	2.000	2.286	1.714
d <sub>4</sub>	1.857	1.429	1.143	1.714	1.286	1.714	1.571	1.571	1.571	1.571	0.000	1.429	1.143	1.429
e <sub>1</sub>	1.286	1.143	1.286	1.571	1.571	1.714	1.286	1.286	3.286	2.429	1.286	0.000	3.429	2.286
e <sub>2</sub>	1.571	1.286	1.143	1.571	2.000	2.143	1.857	1.429	3.286	3.000	1.000	3.143	0.000	2.000
e <sub>3</sub>	2.857	2.143	2.143	3.143	2.857	2.286	2.571	1.571	1.286	1.714	0.857	1.571	1.857	0.000

**Table A2**  
Group consensuses of the eight respondents on the degree of influence among the criteria (unit:%).

Criteria	a <sub>1</sub>	b <sub>1</sub>	b <sub>2</sub>	b <sub>3</sub>	c <sub>1</sub>	c <sub>2</sub>	c <sub>3</sub>	d <sub>1</sub>	d <sub>2</sub>	d <sub>3</sub>	d <sub>4</sub>	e <sub>1</sub>	e <sub>2</sub>	e <sub>3</sub>
a <sub>1</sub>	0.000	2.125	1.875	3.000	3.375	1.250	3.250	2.125	2.250	2.375	2.000	1.375	1.875	2.875
b <sub>1</sub>	1.875	0.000	2.625	2.625	1.875	1.375	1.375	2.500	1.375	1.125	1.500	1.375	1.250	2.000
b <sub>2</sub>	2.000	2.750	0.000	3.375	1.875	1.375	1.500	2.875	1.500	1.125	1.500	1.500	1.250	1.625
b <sub>3</sub>	3.125	3.625	3.125	0.000	1.875	1.375	1.750	3.250	2.000	1.500	1.625	1.375	1.250	2.625
c <sub>1</sub>	2.125	1.875	1.625	1.875	0.000	2.750	2.250	1.500	1.125	1.500	1.250	1.250	1.500	2.750
c <sub>2</sub>	1.250	1.750	2.125	2.125	2.875	0.000	2.000	1.750	1.750	1.750	2.000	1.750	1.875	2.125
c <sub>3</sub>	3.125	1.250	1.250	2.000	2.500	1.375	0.000	1.500	1.375	2.500	1.250	1.250	1.500	2.625
d <sub>1</sub>	2.000	3.000	2.750	3.000	2.000	1.625	1.750	0.000	2.125	1.625	1.750	1.125	1.375	1.625
d <sub>2</sub>	1.750	1.250	1.500	1.625	1.750	1.625	2.000	1.625	0.000	2.750	1.875	1.750	2.250	1.625
d <sub>3</sub>	2.000	1.125	1.250	1.625	1.500	2.250	3.000	1.250	2.875	0.000	1.375	1.875	2.125	1.625
d <sub>4</sub>	1.750	1.375	1.125	1.625	1.250	1.625	1.500	1.500	1.625	1.625	0.000	1.375	1.125	1.375
e <sub>1</sub>	1.250	1.125	1.375	1.500	1.625	1.625	1.250	1.250	3.125	2.250	1.250	0.000	3.500	2.125
e <sub>2</sub>	1.500	1.250	1.125	1.500	2.250	2.375	1.750	1.375	3.125	2.750	1.000	2.875	0.000	1.875
e <sub>3</sub>	3.000	2.000	2.000	3.125	3.000	2.500	2.500	1.500	1.375	1.625	0.875	1.500	1.750	0.000

Note: Errors of gap ratio (%) =  $\frac{1}{n(n-1)} \sum_{i=1}^n \sum_{j=1}^n \frac{|g_{ij}^{\rho} - g_{ji}^{\rho}|}{g_{ij}^{\rho}} \times 100\% = 4.89\% < 5\%$  (see Eq. (1)), less than 5%, i.e., significant confidence is 95.11%, where  $\rho = 8$  denotes the number of experts and  $t_{ij}^{\rho}$  is the average influence of criterion  $i$  on criterion  $j$ , and  $n$  denotes number of criteria; here when  $n = 14$ ,  $n \times n$  matrix deducts the diagonal elements  $n$ ; the number of gap ratio elements is  $n(n - 1) = 14 \times 13$ .

achieve the aspiration level (zero gaps) in the performance of each e-store. This is an important finding in this study. The proposed model is suitable for dealing with any complex decision-making issues with interdependent criteria. The study has established a causal-effect model of the effect of e-store management and verified the efficiency of the relational structure model using satisfactory statistical techniques.

Previous e-store research has focused on improving context and design, whereas the current study confirms that e-stores are useful and that satisfying customers' needs and giving perfect post-purchase service are very important to e-stores' success. This study also indicates that the performance of the three selected e-stores is rather unsatisfactory in this regard. Their managers must therefore bridge existing gaps in understanding the customers' needs to improve the e-stores' performance.

This idea is a new approach to solving real-world problems (Tzeng's group). First, the traditional model assumes that the criteria are independent from the hierarchical structure, but the relationships between dimensions and criteria are usually interdependent in the real world. Second, the relatively good solution provided by the existing alternatives is replaced by aspiration levels to fit today's competitive markets. Finally, the goal is to focus not only on "influence", "assessment", "ranking" and "selection" but also on "improvement" and "create strategies" to improve e-store performances.

We hope that this article will contribute to enhancing the efficiency of e-stores' marketing strategies. The results of this analysis should help managers to decide how to implement their e-store

business and marketing strategies more effectively. As such, this research provides an in-depth understanding of the management approach for e-store business.

**Appendix A**

Tables A1 and A2.

**References**

- [1] C. Albert, Service loyalty: the effects of service quality and the mediating role of customer satisfaction, *European Journal of Marketing* 36 (2002) 811–828.
- [2] A. Asllani, A. Lari, Using genetic algorithm for dynamic and multiple criteria web-site optimizations, *European Journal of Operational Research* 176 (2007) 1767–1777.
- [3] S. Ažman, B. Gomišček, Asymmetric and nonlinear impact of attribute-level performance on overall customer satisfaction in the context of car servicing of four European automotive brands in Slovenia, *Organizacija* 45 (2012) 75–86.
- [4] S. Ba, R. Kalakota, A.B. Whinston, Using client-broker-server architecture for Intranet decision support, *Decision Support Systems* 19 (1997) 171–192.
- [5] G. Balabanis, N. Reynolds, A. Simintiras, Bases of e-store loyalty: perceived switching barriers and satisfaction, *Journal of Business Research* 59 (2006) 214–224.
- [6] H.H. Bauer, M. Grether, M. Leach, Building customer relations over the Internet, *Industrial Marketing Management* 31 (2002) 155–163.
- [7] W.O. Bearden, J.E. Teel, Selected determinants of consumer satisfaction and complaint reports, *Journal of Marketing Research* 20 (1983) 21–28.
- [8] D.J. Cahill, The managerial implications of the learning organization: a new tool for internal marketing, *Journal of Services Marketing* 9 (1995) 43–51.
- [9] A. Carini, V. Sehgal, P.F.Evans, D. Roberge, *European Online Retail Forecast, 2010–2015*. February 28, 2011. <[http://www.forrester.com/rb/Research/european\\_online\\_retail\\_forecast%2C\\_2010\\_to\\_2015/qj/id/58597/t/2](http://www.forrester.com/rb/Research/european_online_retail_forecast%2C_2010_to_2015/qj/id/58597/t/2)>.

- [10] E.C. Chang, Y.F. Tseng, Research note: e-store image, perceived value and perceived risk. *Journal of Business Research*, in press, <<http://www.sciencedirect.com/science/article/pii/S0148296311001998>>.
- [11] H.H. Chang, S.W. Chen, The impact of online store environment cues on purchase intention: trust and perceived risk as a mediator, *Online Information Review* 32 (2008) 818–841.
- [12] H.H. Chang, S.W. Chen, Consumer perception of interface quality, security, and loyalty in electronic commerce, *Information & Management* 46 (2009) 411–417.
- [13] C.H. Chen, G.H. Tzeng, Creating the aspired intelligent assessment systems for teaching materials, *Expert Systems with Applications* 38 (2011) 12168–12179.
- [14] F.H. Chen, T.S. Hsu, G.H. Tzeng, A balanced scorecard approach to establish a performance evaluation and relationship model for hot spring hotels based on a hybrid MCDM model combining DEMATEL and ANP, *International Journal of Hospitality Management* 30 (2011) 908–932.
- [15] S.-C. Chen, The customer satisfaction–loyalty relation in an interactive e-service setting: the mediators, *Journal of Retailing and Consumer Services* 19 (2012) 202–210.
- [16] S.C. Chen, G.S. Dhillon, Interpreting dimensions of consumer trust in e-commerce, *Information Technology and Management* 4 (2003) 303–318.
- [17] Y.C. Chen, H.P. Lien, G.H. Tzeng, Measures and evaluation for environment watershed plans using a novel hybrid MCDM model, *Expert Systems with Applications* 37 (2010) 926–938.
- [18] Y.C. Chen, H.P. Lien, G.H. Tzeng, L.S. Yang, Fuzzy MCDM approach for selecting the best environment–watershed plan, *Applied Soft Computing* 11 (2011) 265–275.
- [19] Z. Chen, A.J. Dubinsky, A conceptual model of perceived customer value in e-commerce: a preliminary investigation, *Psychology and Marketing* 20 (2003) 323–347.
- [20] J.S. Chiou, L.Y. Pan, Antecedents of internet retailing loyalty: differences between heavy versus light shoppers, *Journal of Business and Psychology* 24 (2009) 327–339.
- [21] W.Y. Chiu, G.H. Tzeng, H.L. Li, Improving the e-store business model for satisfying customers' needs using a hybrid MCDM combined DANP with grey relational model, in: *The Second KES International Symposium IDT 2010*, Publishing, Baltimore, USA, pp. 113–121.
- [22] Chloe, European online shopping to grow by 12% a year: predictions. February 28, 2012 <<http://internetretailing.net/2012/02/european-online-shopping-to-grow-by-12-a-year-predictions/>>.
- [23] K.S. Chon, The role of destination image in tourism: a review and discussion, *Tourism Review* 45 (1990) 2–9.
- [24] A. Ellinger, H. Shin, W.M. Northington, F.G. Adams, D. Hofman, K. O'Marah, The influence of supply chain management competency on customer satisfaction and shareholder value, *Supply Chain Management: An International Journal* 17 (2012) 249–262.
- [25] A.E. Ellinger, D.F. Lynch, J.D. Hansen, Firm size, web site content, and financial performance in the transportation industry, *Industrial Marketing Management* 32 (2003) 177–185.
- [26] S. Elliott, *Electronic Commerce: B2c Strategies and Models*, John Wiley & Sons Inc., New York, NY, USA, 2002.
- [27] E.C. Fransi, F.M. Viadiu, A study of e-retailing management: analysing the expectations and perceptions of Spanish consumers, *International Journal of Consumer Studies* 31 (2007) 613–622.
- [28] C. Gan, M. Clemes, V. Limsombunchai, A. Weng, A logit analysis of electronic banking in New Zealand, *International Journal of Bank Marketing* 24 (2006) 360–383.
- [29] C. Gan, V. Limsombunchai, M. Clemes, A. Weng, Consumer choice prediction: artificial neural networks versus logistic models, 2005 <<http://hdl.handle.net/10182/329>>.
- [30] J. Ganesh, K.E. Reynolds, M. Luckett, N. Pomirleanu, Online shopper motivations, and e-store attributes: an examination of online patronage behavior and shopper typologies, *Journal of Retailing* 86 (2010) 106–115.
- [31] D.K. Gauri, A. Bhatnagar, R. Rao, Role of word of mouth in online store loyalty, *Communications of the ACM (Association for Computing Machinery)* 51 (2008) 89–91.
- [32] M. Gill, P.F. Evans, V. Sehgal, M.D. Costa, European Online Retail Forecast: 2011–2016. February 27, 2012 <[http://www.forrester.com/Europe+Online+Retail+Forecast+2011+To+2016/fulltext/-/E-RES60745?docid=60745&src=RSS\\_2&cm\\_mmc=Forrester\\_-\\_RSS\\_-\\_Document\\_-\\_23](http://www.forrester.com/Europe+Online+Retail+Forecast+2011+To+2016/fulltext/-/E-RES60745?docid=60745&src=RSS_2&cm_mmc=Forrester_-_RSS_-_Document_-_23)>.
- [33] S. Gounaris, S. Dimitriadis, V. Stathakopoulos, An examination of the effects of service quality and satisfaction on customers' behavioral intentions in e-shopping, *Journal of Services Marketing* 24 (2010) 142–156.
- [34] J. Hanlan, D. Fuller, S. Wilde, Destination decision making: the need for a strategic planning and management approach, *Tourism Planning & Development* 3 (2006) 209–221.
- [35] J. Hillebrand, D. Olszewski, R. Sedefov, Legal highs on the internet, *Substance Use & Misuse* 45 (2010) 330–340.
- [36] J.W.R. Ho, C.L. Tsai, G.H. Tzeng, S.K. Fang, Combined DEMATEL technique with a novel MCDM model for exploring portfolio selection based on CAPM, *Expert Systems with Applications* 38 (2011) 16–25.
- [37] Y.H. Hung, S.C.T. Chou, G.H. Tzeng, Knowledge management adoption and assessment for SMEs by a novel MCDM approach, *Decision Support Systems* 51 (2011) 270–291.
- [38] D.J.F. Jeng, G.H. Tzeng, Social influence on the use of clinical decision support systems: revisiting the unified theory of acceptance and use of technology by the fuzzy DEMATEL technique, *Computers and Industrial Engineering* 62 (2012) 819–828.
- [39] A. Khare, S. Rakesh, Antecedents of online shopping behavior in india: an examination, *Journal of Internet Commerce* 10 (2011) 227–244.
- [40] D.J. Kim, Y.I. Song, S.B. Braynov, H.R. Rao, A multidimensional trust formation model in B-to-C e-commerce: a conceptual framework and content analyses of academia/practitioner perspectives, *Decision Support Systems* 40 (2005) 143–165.
- [41] I.M. Langella, J. Carbo, V. Dao, An examination of the symbiosis between corporations and society with lessons for management education and practice, *Global Virtue Ethics Review* 6 (2012) 51–82.
- [42] J.N. Lee, S.M. Pi, R.C. Kwok, M.Q. Huynh, The contribution of commitment value in internet commerce: an empirical investigation, *Journal of the Association for Information Systems* 4 (2003) 39–64.
- [43] W.-Y. Liang, C.-C. Huang, T.-L. Tseng, Y.-C. Lin, J. Tseng, The evaluation of intelligent agent performance – an example of B2C e-commerce negotiation, *Computer Standards & Interfaces* 34 (2012) 439–446.
- [44] C.C. Lin, H.Y. Wu, Y.F. Chang, The critical factors impact on online customer satisfaction, *Procedia Computer Science* 3 (2011) 276–281.
- [45] C.L. Lin, M.S. Hsieh, G.H. Tzeng, Evaluating vehicle telematics system by using a novel MCDM techniques with dependence and feedback, *Expert Systems with Applications* 37 (2010) 6723–6736.
- [46] J. Liou, G.H. Tzeng, C.C. Hsu, W.C. Yeh, Reply to comment on using a modified grey relation method for improving airline service quality, *Tourism Management* 33 (2012) 719–720.
- [47] J.J.H. Liou, Developing an integrated model for the selection of strategic alliance partners in the airline industry, *Knowledge-Based Systems* 28 (2012) 59–67.
- [48] J.J.H. Liou, C.Y. Tsai, R.H. Lin, G.H. Tzeng, A modified VIKOR multiple-criteria decision method for improving domestic airlines service quality, *Journal of Air Transport Management* 17 (2010) 57–61.
- [49] J.J.H. Liou, G.H. Tzeng, C.Y. Tsai, C.C. Hsu, A hybrid ANP model in fuzzy environments for strategic alliance partner selection in the airline industry, *Applied Soft Computing* 11 (2011) 3515–3524.
- [50] C.H. Liu, G.H. Tzeng, M.H. Lee, Strategies for improving cruise product sales in the travel agency using hybrid MCDM models, *The Service Industries Journal* (2011) 1–22.
- [51] C.H. Liu, G.H. Tzeng, M.H. Lee, Improving tourism policy implementation – the use of hybrid MCDM models, *Tourism Management* 33 (2012) 413–426.
- [52] S. Mulpuru, V. Sehgal, P.F. Evans, A. Hoar, D. Roberge, US Online Retail Forecast, 2011–2016. February 27, 2012, <<http://www.forrester.com/US+Online+Retail+Forecast+2011+To+2016/fulltext/-/E-RES60672?docid=60672>>.
- [53] S. Mulpuru, V. Sehgal, P.F. Evans, D. Roberge, US Online Retail Forecast, 2010–2015. February 28, 2011, <[http://www.forrester.com/rb/Research/us\\_online\\_retail\\_forecast%2C\\_2010\\_to\\_2015/q/id/58596/t/2](http://www.forrester.com/rb/Research/us_online_retail_forecast%2C_2010_to_2015/q/id/58596/t/2)>.
- [54] C. Nistor, R. Nistor, M.-C. Muntean, E-commerce: winners' choice, in: *Proceedings of the 10th WSEAS International Conference on Applied Computer Science*, Publishing, Japan, 2010, pp. 298–303.
- [55] R.L. Oliver, *Satisfaction: A Behavioral Perspective on the Consumer*, second ed., M.E. Sharpe, Inc., New York, 2010.
- [56] ONS, Retail sales:mixed picture continues. April 21, 2011, <<http://www.statistics.gov.uk/default.asp>>.
- [57] S. Opricovic, *Multicriteria optimization of civil engineering systems*, Faculty of Civil Engineering. Publishing, Belgrade, 1998.
- [58] S. Opricovic, G.H. Tzeng, Compromise solution by MCDM methods: a comparative analysis of VIKOR and TOPSIS, *European Journal of Operational Research* 156 (2004) 445–455.
- [59] Y.P. OuYang, H.M. Shieh, G.H. Tzeng, A VIKOR technique based on DEMATEL and ANP for information security risk control assessment, *Information Sciences*, in press, <<http://www.sciencedirect.com/science/article/pii/S0020025511004695>>.
- [60] T. Ozaki, M.C. Lo, E. Kinoshita, G.H. Tzeng, Decision-making for the best selection of suppliers by using minor ANP, *Journal of Intelligent Manufacturing* (2011) 1–8.
- [61] M. Pachauri, Researching online consumer behaviour: current positions and future perspectives, *Journal of Customer Behaviour* 1 (2002) 269–300.
- [62] R.R. Peterson, W.V. Grembergen, Integration strategies and tactics for information technology governance, *Strategies for Information Technology Governance*, Idea Group Inc. (IGI), 2003, pp. 37–80.
- [63] G.L. Polites, C.K. Williams, E. Karahanna, L. Seligman, A theoretical framework for consumer e-satisfaction and site stickiness: an evaluation in the context of online hotel reservations, *Journal of Organizational Computing and Electronic Commerce* 22 (2012) 1–37.
- [64] M.E. Ponter, *Competitive Advantage: Creating and Sustaining Superior Performance*, Free Press, New York, 1998.
- [65] M.E. Porter, *Strategy and the internet*, *Harvard Business Review* 79 (2001) 62–78.
- [66] J. Reedy, S. Schullo, *Electronic Marketing: Integrating Electronic Resources into the Marketing Process*, second ed., Thomson Learning, Ohio, USA, 2004.
- [67] F.J. Riggins, H.S.S. Rhee, Toward a unified view of electronic commerce, *Communications of the ACM (Association for Computing Machinery)* 41 (1998) 88–95.
- [68] M.O.K. Robert, T. McEachern, Web-based customer decision support systems, *Communications of the ACM (Association for Computing Machinery)* 41 (1998) 71–78.
- [69] T. Rueter, E-retail spending to increase 62% by 2016. February 27, 2012, <<http://www.internetretailer.com/2012/02/27/e-retail-spending-increase-45-2016>>.

- [70] T.L. Saaty, Decision Making with Dependence and Feedback: The Analytic Network Process: The Organization and Prioritization of Complexity, RWS Publications, Pittsburgh, PA, 1996, pp. 362–370.
- [71] R.A. Shang, Y.C. Chen, L. Shen, Extrinsic versus intrinsic motivations for consumers to shop on-line, *Information & Management* 42 (2005) 401–413.
- [72] Y.C. Shen, G.T.R. Lin, G.H. Tzeng, Combined DEMATEL techniques with novel MCDM for the organic light emitting diode technology selection, *Expert Systems with Applications* 38 (2011) 1468–1481.
- [73] J. Sheth, A model of industrial buyer behavior, *Journal of Marketing* 37 (1973) 50–56.
- [74] K.O. Siddiqi, Interrelations between service quality attributes, customer satisfaction and customer loyalty in the retail banking sector in Bangladesh, *International Journal of Business and Management* 6 (2011) 12–36.
- [75] M. Singh, E-services and their role in B2C e-commerce, *Managing Service Quality* 12 (2002) 434–446.
- [76] D.M. Szymanski, R.T. Hise, e-Satisfaction: an initial examination, *Journal of Retailing* 76 (2000) 309–322.
- [77] M.T. Tang, G.H. Tzeng, Fuzzy MCDM model for pricing strategies in the internet environment, *Journal of Commercial Modernization* 1 (1998) 19–34.
- [78] M.T. Tang, G.H. Tzeng, S.W. Wang, A hierarchy fuzzy MCDM method for studying electronic marketing strategies in the information service industry, *Journal of International Information Management* 8 (1999) 1–22.
- [79] C. Tarantola, P. Vicard, I. Ntzoufras, Monitoring and improving greek banking services using bayesian networks: an analysis of mystery shopping data (2012).
- [80] P.L. To, C. Liao, T.H. Lin, Shopping motivations on internet: a study based on utilitarian and hedonic value, *Technovation* 27 (2007) 774–787.
- [81] W.-C. Tsao, Y.-L. Tseng, The impact of electronic-service quality on online shopping behaviour, *Total Quality Management & Business Excellence* 22 (2011) 1007–1024.
- [82] A.C.B. Tse, F. Yim, Factors affecting the choice of channels – online vs. conventional, *Journal of International Consumer Marketing* 14 (2002) 137–152.
- [83] G.H. Tzeng, C.Y. Huang, Combined DEMATEL technique with hybrid MCDM methods for creating the aspired intelligent global manufacturing & logistics systems, *Annals of Operations Research* (2011) 1–32.
- [84] G.H. Tzeng, M.H. Teng, J.J. Chen, S. Opricovic, Multicriteria selection for a restaurant location in Taipei, *International Journal of Hospitality Management* 21 (2002) 171–187.
- [85] Y.L. Wang, G.H. Tzeng, Brand marketing for creating brand value based on a MCDM model combining DEMATEL with ANP and VIKOR methods, *Expert Systems with Applications* 39 (2012) 5600–5615.
- [86] M. Warkentin, V. Sugumaran, R. Sainsbury, The role of intelligent agents and data mining in electronic partnership management, *Expert Systems with Applications*, in press, <<http://www.sciencedirect.com/science/article/pii/S0957417412007907>>.
- [87] W. Wei, J. Shen, S. Ji, Introducing mobile channel into electronic supply chain, in: *The 3rd International Conference on Grid and Pervasive Computing*, Publishing, 2008, pp. 121–126.
- [88] R.E. Widing II, W.W. Talarzyk, Electronic information systems for consumers: an evaluation, *Journal of Marketing Research* 30 (1993) 125–141.
- [89] Y.K. Wong, C.J. Hsu, A confidence-based framework for business to consumer (B2C) mobile commerce adoption, *Personal and Ubiquitous Computing* 12 (2008) 77–84.
- [90] J.H. Wu, Y.M. Wang, Development of a tool for selecting mobile shopping site: a customer perspective, *Electronic Commerce Research and Applications* 5 (2006) 192–200.
- [91] R. Yan, J. Wang, B. Zhou, Channel integration and profit sharing in the dynamics of multi-channel firms, *Journal of Retailing and Consumer Services* 17 (2010) 430–440.
- [92] J.L. Yang, G.H. Tzeng, An integrated MCDM technique combined with DEMATEL for a novel cluster-weighted with ANP method, *Expert Systems with Applications* 38 (2011) 1417–1424.
- [93] T.K. Yu, J.H. Seinfeld, Observability and optimal measurement location in linear distributed parameter systems, *International Journal of Control* 18 (1973) 785–799.
- [94] M. Zeleny, *Multiple Criteria Decision Making*, McGraw-Hill Companies, 1982, pp. 83–93.
- [95] J.F. Engel, R.D. Blackwell, P.W. Miniard, *Consumer behavior*, sixth ed., Dryden Press, Orlando, Fla., 1990.