國　立　交　通　大　學

資訊管理研究所

博士論文

改善電子商店經營策略新混合式多評準決策模式之應用

Using a new hybrid MCDM model for improving e-store business strategies

研 究 生：邱婉瑜

指導教授：曾國雄 講座教授

黎漢林 講座教授

中 華 民 國 101 年 9 月

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國 立 交 通 大 學

資 訊 管 理 研 究 所

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指導教授：黎漢林、曾國雄

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（英）Using a new hybrid MCDM model for improving e-store business strategies

合於博士資格水準、業經本委員會評審認可。

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Using a new hybrid MCDM model for improving e-store business strategies

A DISSERTATION OF WAN-YU CHIU
WAS ACCEPTED AS PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY

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September 21, 2012

改善電子商店經營策略新混合式多評準決策模式之應用

學生：邱婉瑜　　指導教授：曾國雄
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摘　　要

在這個時代，有很多的消費者會從網路商店購買所需要的產品和服務。也因為電子商店經營者有權力分配不同的資源，所以他們需要了解網路商店消費者的購物行為，以提供最好的服務品質與附加價值，來激勵瀏覽他們網路商店的顧客有購買慾去購買他們的產品。隨著網路購物服務的日漸普及，網路商店競爭越來越激烈。因此，管理者應了解客戶的需求並採取相關的因應措施並給予市場行銷策略，以改善他們的服務品質，並確保顧客的忠誠度。因此，這篇文章的主要目的是在各準則之間相互關聯性和回饋性問題的情況下，如何評估及改善電子商店的市場策略，並且應採用何種創新與創造性之策略，以滿足及提高客戶之滿意度，並減少實際績效值與渴望水準所造成的差距呢？如何使人們的生活帶來更便捷的服務呢？本論文提出一種新的混合式多準則決策（MCDM）模式結合DEMATEL方法，並以DANP加上VIKOR及灰色關聯模式的方法來解決這些問題。

新的混合式VIKOR和灰色關聯模式，在處理解決現實世界中的構面/準則間具有相互關聯性(Interdependence)及回饋性(Feedback)的問題。更具體地說，DANP和VIKOR與灰色關聯評估模式相結合，可產生出具有影響力的網路關係圖（Influential Network Relations Map, INRM），還有影響權重(Influential weights)，以及渴望水準(Aspiration level)與實際績效之間的差距。最後以三個真實的案例作為實證分析，使用新的混合式多準則決策(hybrid MCDM)模式，是可以提供電子商店經理者創造出最佳的市場行銷策略。如此，以現有的知識為基礎去了解並滿足消費者的需求(customers' needs)，可減少電子商店與顧客之間的認知差距，使得電子商店不僅能保有目前的消費者，更能使他們願意回購，並能提供最有效率及高品質的顧客服務，為他們增加更多的客戶，創造更高的價值，使得電子商店的經營效果更能接近渴望水準。

關鍵詞：電子商務、電子商店經營、網路商店、顧客需求、市場策略、多準則決策、決策制定實驗及評估實驗室、網路分析法、以決策制定實驗及評估為基礎的網路分析法、VIKOR、灰色關聯分析。

Using a new hybrid MCDM model for improving e-store business strategies

Student: Wan-Yu Chiu

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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. With the increasing popularity of online shopping services, e-stores are experiencing ever more fierce competition. Thus, it is imperative that managers take steps to improve their services and ensure customer loyalty, and this can only be done by understanding their customers' needs and developing appropriate marketing strategies. 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 and to enhance strategies by adopting innovation and creativity to satisfying/promoting human life and convenient service. We propose a new hybrid Multiple Criteria Decision Making (MCDM) model, combining the Decision Making Trial and Evaluation Laboratory (DEMATEL), DEMATEL-based Analytic Network Process (DANP), VIšekriterijumsko KOmpromisno Rangiranje (VIKOR) methods, with grey relational model to solve these problems. This new hybrid VIKOR and grey

relational model will address interdependent problems among dimensions/criteria in the real world and provide feedback. More specifically, a DANP (DEMATEL-based ANP) and a VIKOR model with a grey relational assessment model will be combined to produce a influential network relations map (INRM), showing the influential weights and gaps between the actual performance and the level of aspiration. 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 best marketing strategies that to reduce and to closer aspiration level for e-store managers to improve their business model in order to meet consumers' needs, encourage them to repurchase, and to enable stores to provide the most effective and efficient service for their customers.

***Keywords*:** Electronic Commerce (EC); E-store business; Internet stores; Customers' needs; Marketing strategies; Multiple Criteria Decision-Marking (MCDM); Decision Making Trial and Evaluation Laboratory (DEMATEL); Analytic Network Process (ANP); DEMATEL-based ANP (DANP); VIšekriterijumsko KOmpromisno Rangiranje (VIKOR); Grey Relational Analysis (GRA).

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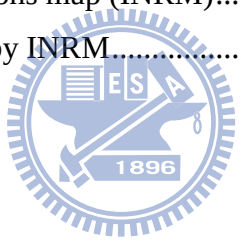


Chapter 1 Introduction

This chapter presents of this dissertation the motivation, problem statements, research objectives, framework, methods, and contributions. These topics will be described in the following sections.

1.1 Motivation and problem statements

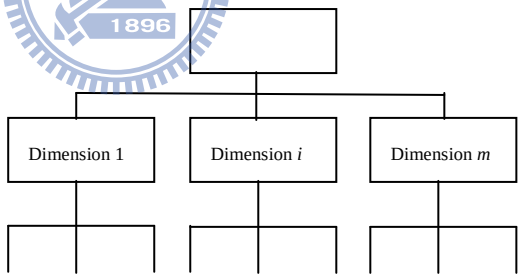
E-stores have become an important retailing channel, and many such stores have been established and are experiencing a continuous increase in sales. It has become increasingly common for consumers to buy products and services from e-stores because these types of stores provide them with a convenient and fast shopping environment and high-quality products and services, saving people's time and money. E-store has become increasingly common for people to buy products from e-stores on the Internet, since these stores offer convenient and speedy shopping twenty four hours a day, seven days a week. With the advent of the Internet, stores are able to offer consumers a wider choice of products and services with minimal effort and cost, which helps shoppers to make better decisions and employ a more efficient decision-making process (Peterson and Grembergen, 2003; Widing and Talarzyk, 1993). This process of buying, selling, or exchanging products, services, and information via computer networks, including the Internet, is generally defined as Electronic Commerce (EC) (Turban, et al., 2000). It goes without saying that a well-developed and well-managed website is critical for the success of e-stores, and the first priority for achieving this is to acquire an in-depth understanding of consumer behaviour (Wu and Wang, 2006), particularly since their habits of shopping in e-stores may be different from in traditional retail stores (Alba, et al., 1997; Huarng and Christopher, 2003; Winer, et al., 1997).

Therefore, accurate knowledge of marketplace consumption is a critical factor of a successful e-store. 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.

1.2 Research objectives

Previous EC researchers have focused on the consumers' motivations (Ganesh, et al., 2010; Shang, et al., 2005), the shopping behaviour (Khare and Rakesh, 2011; Tsao and Tseng, 2011), the intelligent agents (Liang, et al., 2012; Warkentin, et al., 2012), the satisfaction-loyalty relationship (Balabanis, et al., 2006; Chen, 2012; Polites, et al., 2012), and the risk (Chang and Tseng, 2011). This research focuses on how to manage e-stores and how to create marketing strategies. Previous related methods application have focused on influence (Jeng and Tzeng, 2012), assessment (Chen and Tzeng, 2011), ranking (Hung, et al., 2011; Yang and Tzeng, 2011), selection (Chen, et al., 2011b; Ho, et al., 2011; Liou, 2012; Liou, et al., 2011; Ozaki, et al., 2011; Shen, et al., 2011), and improvement (Chen, et al., 2011a; Chiu, et al., 2010; Liou, et al., 2012; Liou, et al., 2010; Liu, et al., 2011, 2012; Ou Yang, et al., 2011; Tzeng and Huang, 2011; Wang and Tzeng, 2012). Thus, this study seeks a new hybrid Multiple Attribute Decision Making (MADM) model (see **Fig. 1.**) 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, and grey relational analysis (GRA) to find that how to closer the aspiration levels 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. Thus, this research seeks to propose a new hybrid VIKOR and grey relational model to help e-store managers to understand their customers' needs in order to improve their service and achieve their aspiration to develop their e-store marketing strategies.



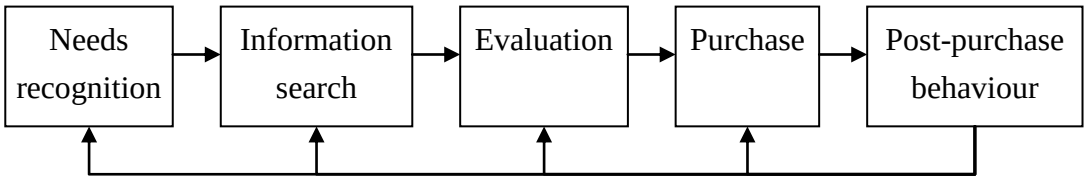
Alternatives	c_1 ⋯ c_j ⋯ c_n Criteria
	w_1 ⋯ w_j ⋯ w_n
A_1	$x_1(1)$ ⋯ $x_1(j)$ ⋯ $x_1(n)$
⋮	⋮ ⋮ ⋮
A_k	$x_k(1)$ ⋯ $x_k(j)$ ⋯ $x_k(n)$
⋮	⋮ ⋮ ⋮
A_K	$x_K(1)$ ⋯ $x_K(j)$ ⋯ $x_K(n)$
Aspiration value x^*	$x^*(1)$ ⋯ $x^*(j)$ ⋯ $x^*(n)$

Source: Tzeng & Huang (2011)

Fig. 1: The MADM evaluation framework

1.3 Research framework and methods

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 (Chon, 1990; Gan, et al., 2006; Gan, et al., 2005; Hanlan, et al., 2006; Pachauri, 2002; Robert and McEachern, 1998; Wong and Hsu, 2008). Others propose that the steps as **Fig. 2.** are needs recognition, information search, evaluation, purchase, and post-purchase behaviour (Lin, et al., 2011; Tse and Yim, 2002). 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.



Source: Lin, et al., 2011; Tse & Yim, 2002

Fig. 2: Consumer behaviour

Based on these criteria, Bizrate.com and Alexa.com conducted surveys asking respondents to rate retailers on 14 e-store attributes 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 (Gauri, et al., 2008). A detailed description of these components is provided in **Table 1** and **Fig. 3.** In summary, the

intact criteria, which include five influential dimensions and fourteen criteria, need to be considered (see **Table 1** and **Fig. 3.**).

Table 1. Reorganisation of the current research.

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

Source: Engel et al., 1990; Robert & McEachern, 1998; Gauri et al., 2008

Having surveyed several Taiwan EC websites, Chang and Chen (2009) found that, according to users, Yahoo.com, Yahoo auction, PChome.com, and Books.com were the four top online shopping sites (Chang and Chen, 2009). Another study (To, et al., 2007) found that the most popular website 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 (2008) 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%) (Chang and Chen, 2008). Therefore, this study chooses the three most popular e-stores (i.e., Yahoo, PChome, and Books) to demonstrate the proposed method.

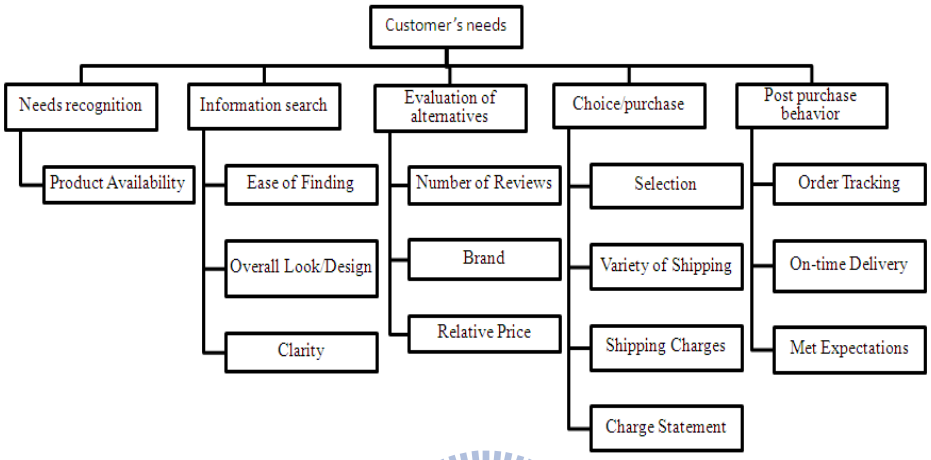


Fig. 3. Reorganization of current research

The current study proposes a new hybrid MCDM model, which combines DANP (DEMATEL-based ANP) and VIKOR and grey relational analysis (GRA), to resolve real life problems, using an expert group (high accuracy) to provide the perspective of business enterprises. A DEMATEL technique is used to detect complex relationships and build an influential network relations map (INRM) of the dimensions/criteria to measure, evaluate and improve e-stores' business strategies. The DANP makes it possible to measure all tangible and intangible criteria in this new model. The basic concept of an analytical network process (ANP) was adopted by this research in order to overcome problems of dependence and feedback (Saaty, 1996) and the DANP technique was used to determine the relative influential weights for improving the traditional method, i.e. that an un-weighted supermatrix has equal weights. Qualitative/quantitative measurements and an evaluation of comprehensive improvements are used the VIKOR to compute the distance that from performance to

aspiration levels and used the GRA to build an index of grey coefficients in the e-store business strategy, and to bring the system index of grey coefficients closer to the aspired level. Thus, the DANP combined the VIKOR with the GRA, constructs a planned measurement model to develop and improve e-store marketing strategies to satisfy consumers' needs.

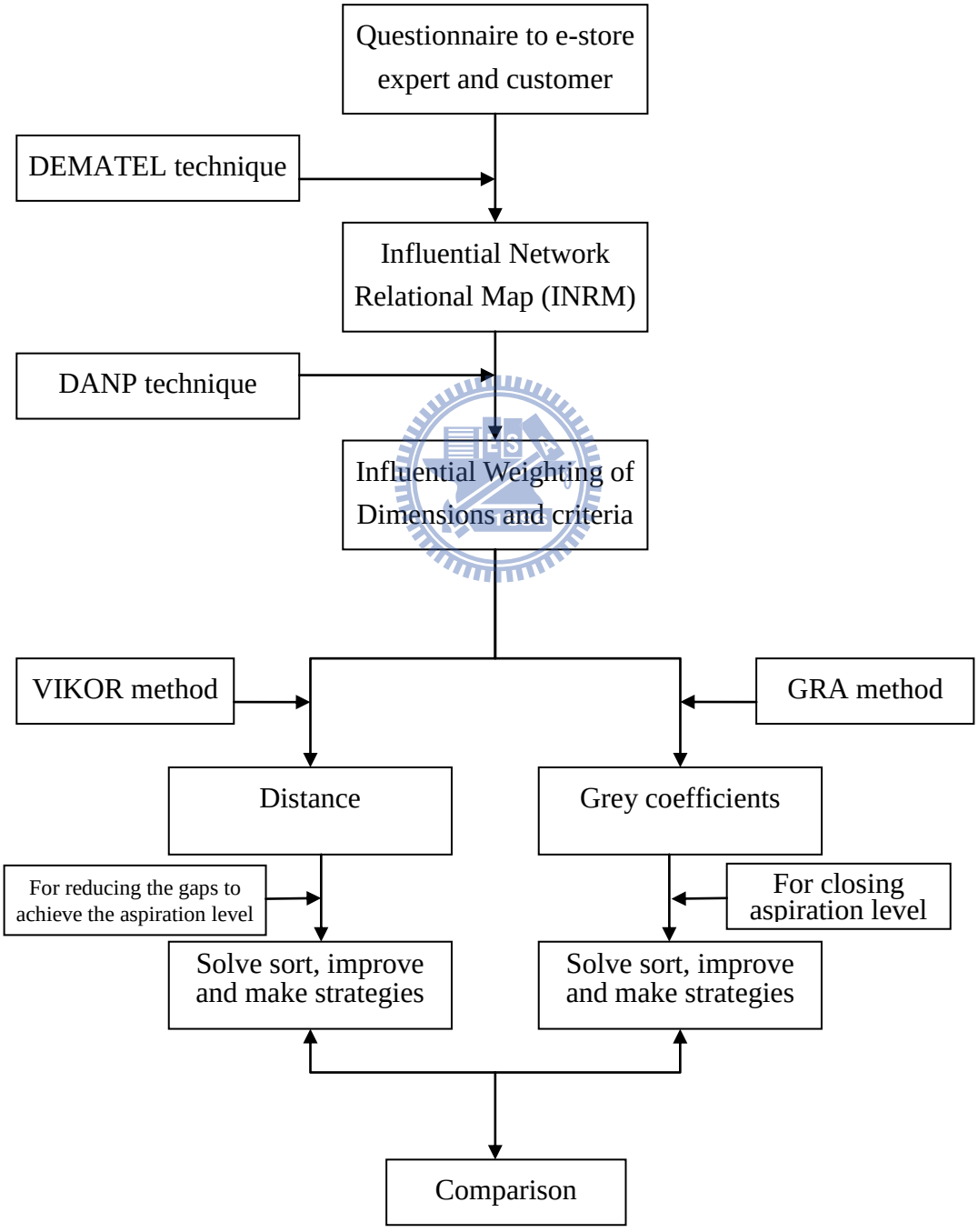


Fig. 4: Research framework and process

1.4 Contributions of this research

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 mutually interdependent in the real world. Second, the relatively good solutions provided by the existing alternatives are 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 "influential relationship", "improvement for achieving aspiration levels" and "setting strategies base on INRM" to improve e-store performances (see **Fig. 5.**).

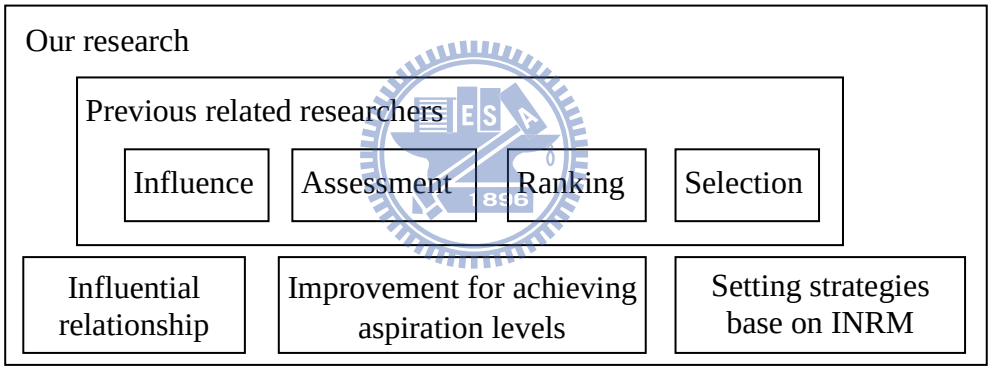


Fig. 5. The research differs previous.

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 , improvement, and setting strategies. Because this study focuses on the effects of certain influential relationships among dimensions 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.

1.5 Research outline

The remainder of this paper is organised as follows. Chapter 2 reviews the consumer decision-making process and evaluation framework, including e-store business criteria and performance. Chapter 3 provides a brief introduction of the DEMATEL technique, the DANP influential weights and the VIKOR method with the GRA 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 Chapter 4 to demonstrate the proposed model and, finally, conclusions and remarks are presented in Chapter 5.

Chapter 2 Literature review

This chapter presents of this thesis relation literature include electronic commerce, E-store, electronic commerce marketing analysis, and customer satisfaction. These topics will be described in the following sections.

2.1 Electronic commerce

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 (Ba, et al., 1997; Liu, et al., 2012; Reedy and Schullo, 2004). EC includes e-stores, and because shopping is a complex behaviour composed of rational choices, amusement, and social communication (Wei, et al., 2008; Wu and Wang, 2006), understanding consumers' wants and needs is critical for the stores' successful management and development (Fransi and Viadiu, 2007; Wu and Wang, 2006). This understanding particularly applies to e-stores, in which consumers' shopping behaviour may be different from that in traditional brick-and-mortar stores (Shang, et al., 2005; Yan, et al., 2010). 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 (Peterson and Grembergen, 2003; Widing and Talarzyk, 1993).

2.2 E-store

An e-store markets and sells products or services offered by a company (Nistor, et al., 2010). E-stores are becoming critically important to online retailers, and they have become important parts of retailer strategy (Ganesh, et al., 2010). 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 (Chiou and Pan, 2009; Elliott, 2002) that sells products and services online (Cahill, 1995; Riggins and Rhee, 1998). 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 (Hillebrand, et al., 2010; Singh, 2002; Wong and Hsu, 2008). 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 (Asllani and Lari, 2007; Kim, et al., 2005; Tang and Tzeng, 1998; Tang, et al., 1999). Consequently, e-store management is a key issue for the development of e-commerce.

2.3 Electronic commerce marketing analysis

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 (Carini, et al., 2011). Forrester research forecasts as **Fig.6.** 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 (Chloe, 2012; Gill, et al., 2012). The UK Office for National Statistics reports that e-store sales increased by 13.1% in March 2011 (ONS, 2011). 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 (see **Fig. 7.**), 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 (Chloe, 2012; Gill, et al., 2012). 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% (Mulpuru, et al., 2011). Forrester research forecasts note that U.S. 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$1,207 in 2012 to US$1,738 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 (see **Fig. 8.**) (Mulpuru, et al., 2012; Rueter, 2012). All available reports indicate that sales by e-stores are growing rapidly in all areas.

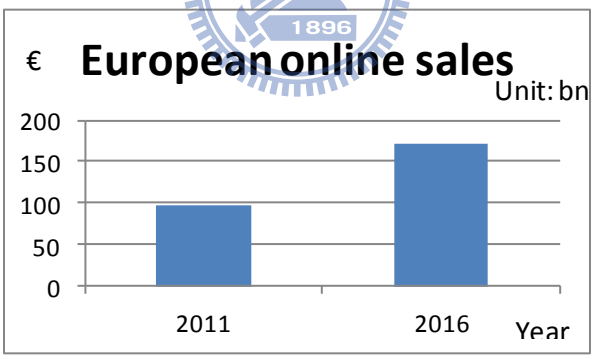


Fig. 6. The European online sales is growing

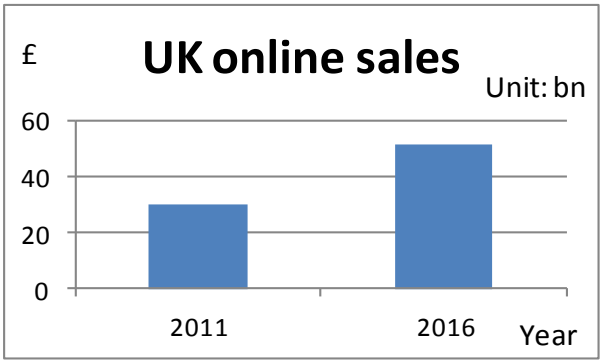


Fig. 7. The UK online sales is growing

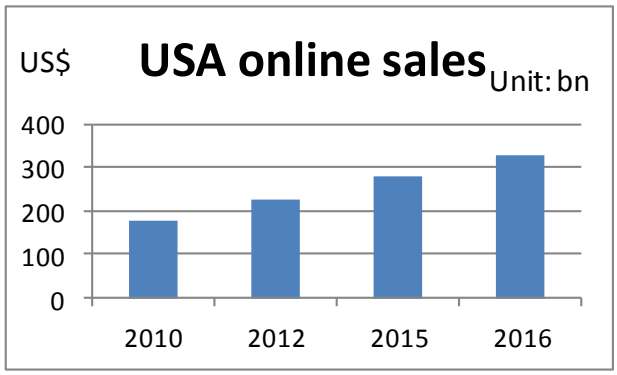


Fig. 8. The USA online sales is growing

2.4 Customer satisfaction

Customer satisfaction has been considered most important issues for marketers and customer researchers (Lee, et al., 2003; Oliver, 2010; Sheth, 1973). Companies need to develop strategies that help company develop sustainable business practices (Langella, et al., 2012). E-store should to meet customers' needs (Porter, 2001) and increase customer satisfaction by creating customer value in consumer marketing (Chen and Dubinsky, 2003; Ponter, 1998). Loyal customers that indulge in repeat purchases are the bedrock of any business (Albert, 2002). Customer satisfaction is important mostly because of its indirect influence on the profitability of companies (Ažman and Gomišček, 2012); satisfied customers tend to make not only more purchases but also repeat purchases (Bearden and Teel, 1983; Siddiqi, 2011; Szymanski and Hise, 2000), and customer satisfaction has become a key element of many companies' business strategies (Ellinger, et al., 2012). Therefore, understanding the criteria that influence customer satisfaction is important not only to describe the actual situation but also to plan improvements, and actions (Tarantola, et al., 2012).

Marketing activities should be designed to increase customer satisfaction (Gounaris, et al., 2010). 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.

Chapter 3 Research framework and method

This research uses the DEMATEL technique and combines a DANP with a VIKOR method and GRA 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) (Saaty, 1996). Then, the VIKOR method and GRA method with influential weights (DANP) are 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 and close to achieve the aspiration level and satisfy the customers' needs based on INRM. The research process is illustrated in **Fig. 9**.

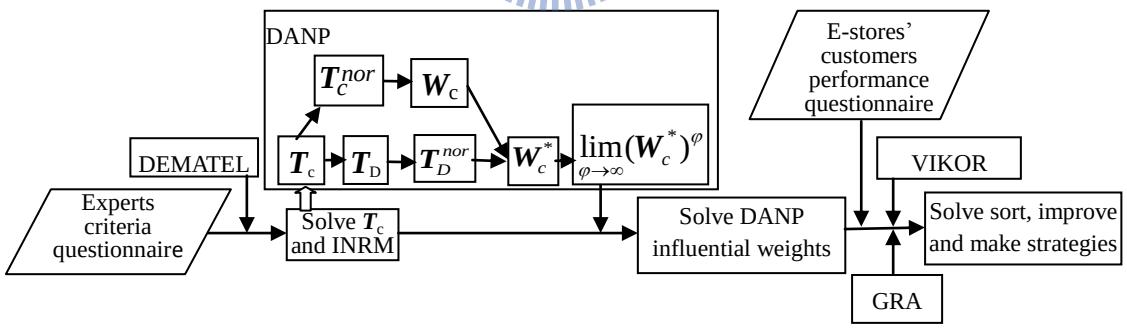


Fig. 9. Model procedure of the current research

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 $\boldsymbol{T}_c$ and $\boldsymbol{T}_D$ 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 (Jeng and Tzeng, 2012; Liou, 2012; Liu, et al., 2012; Ou Yang, et al., 2011; Shen, et al., 2011; Tzeng and Huang, 2011; Wang and Tzeng, 2012; Yang and Tzeng, 2011). 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 (Chen, et al., 2011b; Chiu, et al., 2010; Liou, 2012; Liu, et al., 2012; Ou Yang, et al., 2011).

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), '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 $\boldsymbol{G} = [g_c^{ij}]_{n\times n}$ of direct relationships can be obtained (see Eq. (1)). All diagonal of criteria are zero by pairwise comparison.

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

For example: *a* influence *d* is 1 units, *d* influence *a* is 3 units, *b* influence *a* is 2 units, *b* influence *c* is 4 units, and *c* influence *d* is 3 units.

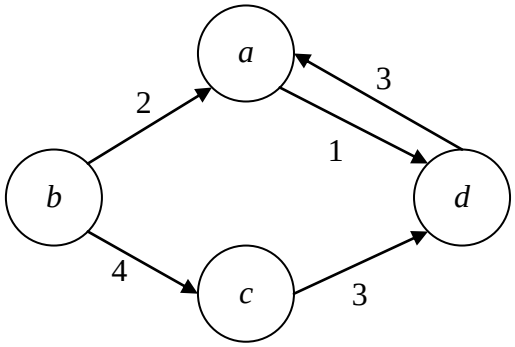


Fig. 10. The directed graph.

Table 2. Matrix G of direct relations for **Fig. 10.**

Crteria	*a*	*b*	*c*	*d*	Total
a	0	0	0	1	1
b	2	0	4	0	**6**
c	0	0	0	3	3
d	3	0	0	0	3
Total	5	0	4	4	-

Step 2: **Normalise the direct-influence matrix** G**.**

The normalised matrix X is acquired by using Eq.(2). The maximum total of rows or columns is one.

$$X = vG \tag{2}$$

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

For example: $v = \frac{1}{6}$ in **Table 2.**

$$X = vG = \frac{1}{6} \times \begin{bmatrix} 0 & 0 & 0 & 1 \\ 2 & 0 & 4 & 0 \\ 0 & 0 & 0 & 3 \\ 3 & 0 & 0 & 0 \end{bmatrix} = \begin{bmatrix} 0 & 0 & 0 & \frac{1}{6} \\ \frac{2}{6} & 0 & \frac{4}{6} & 0 \\ 0 & 0 & 0 & \frac{3}{6} \\ \frac{3}{6} & 0 & 0 & 0 \end{bmatrix},$$

Table 3. After normalize the direct-influence matrix X

	a	*b*	*c*	*d*	Total
a	0	0	0	0.167	0.167
b	0.333	0	0.667	0	1
c	0	0	0	0.5	0.5
d	0.5	0	0	0	0.5
Total	0.833	0	0.667	0.667	

Step 3: **Attain a total-influential matrix** $\boldsymbol{T}_c$.

When the normalised direct-influential matrix $\boldsymbol{X}$ is obtained, the total-influential matrix $\boldsymbol{T}_c$ of the INRM can be obtained from Eq.(3), in which $\boldsymbol{I}$ denotes the identity matrix,

$$\begin{aligned}\boldsymbol{T}_c &= \boldsymbol{X} + \boldsymbol{X}^2 + \boldsymbol{X}^3 + ... + \boldsymbol{X}^\ell \\ &= \boldsymbol{X}(\boldsymbol{I} + \boldsymbol{X} + \boldsymbol{X}^2 + ... + \boldsymbol{X}^{\ell-1})(\boldsymbol{I} - \boldsymbol{X})(\boldsymbol{I} - \boldsymbol{X})^{-1} \\ &= \boldsymbol{X}(\boldsymbol{I} - \boldsymbol{X}^\ell)(\boldsymbol{I} - \boldsymbol{X})^{-1} \\ &= \boldsymbol{X}(\boldsymbol{I} - \boldsymbol{X})^{-1}, \text{ when } \lim_{\ell\to\infty} \boldsymbol{X}^\ell = [0]_{n\times n}\end{aligned} \tag{3}$$

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

For example:

Table 4. The total-influence matrix $\boldsymbol{T}_c$ of **Table 3.** by math software**.**

Criteria	*a*	*b*	*c*	*d*	Total (***r***)
a	0.091	0	0	0.182	0.273
b	0.545	0	0.667	0.425	1.637
c	0.273	0	0	0.546	0.819
d	0.546	0	0	0.091	0.637
Total (***s***)	1.455	0	0.667	1.244	-

Step 4: **Analyse the results**.

At this stage, the row sums and the column sums of the matrix components are separately expressed as vector $\boldsymbol{r} = \left[\sum_{j=1}^{n} t_c^{ij}\right] = (r_1, ..., r_i, ..., r_n)'$ and vector $\boldsymbol{s} = \left[\sum_{i=1}^{n} t_c^{ij}\right]' = (s_1, ..., s_j, ..., s_n)'$ by using Eqs. (4)-(5). Let $i = j$ and $i, j \in \{1, 2, ..., n\}$; the horizontal axis vector $(r_i + s_i)$ is then defined by adding r_i to s_i, to illustrate the influence 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,

$$\boldsymbol{T}_c = [t_c^{ij}]_{n\times n},\ i, j \in \{1, 2, ..., n\}$$

$$\boldsymbol{r} = \left[\sum_{j=1}^{n} t_c^{ij}\right]_{n\times 1} = \left[t_c^{i}\right]_{n\times 1} = (r_1, ..., r_i, ..., r_n)' \quad (4)$$

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

For example:

Table 5. For example **Table 4** vector $\boldsymbol{r}$ and vector $\boldsymbol{s}$ express the sum of the rows and the sum of the columns from the total-influence matrix $\boldsymbol{T}_c$.

	$\boldsymbol{r}$	$\boldsymbol{s}$	$\boldsymbol{r_i + s_i}$	$\boldsymbol{r_i - s_i}$	Note
a	0.273	1.455	1.728	-1.182	affected
b	1.637	0.000	1.637	1.637	cause
c	0.819	0.667	1.486	0.152	cause
d	0.637	1.244	1.881	-0.607	affected

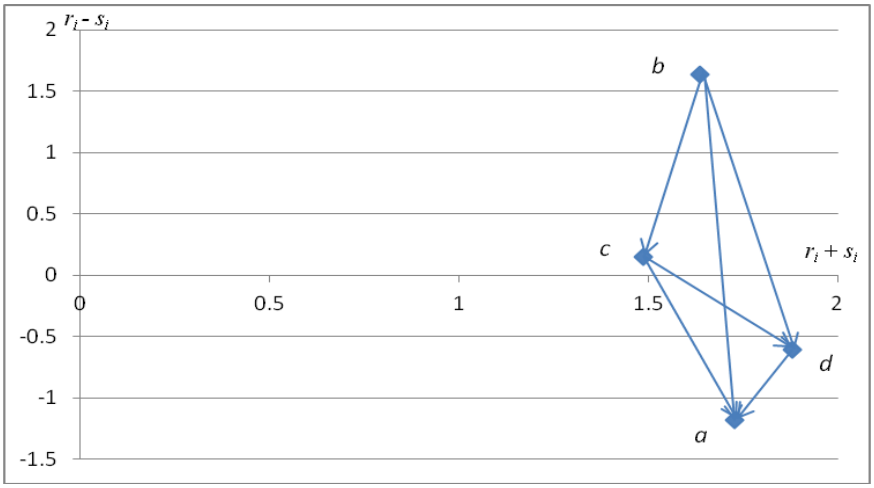
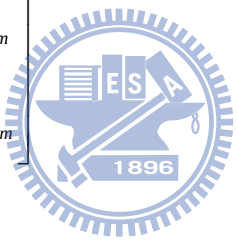


Fig. 11. The total-influence of DEMATEL graph for **Table 5.**

From **Fig. 11.** we know, the *b* affects *c*, d and *a*. The *c* affects *d* and *a*. The *d* affects *a*. The *b* and *c* is cause. The *d* and *a* is affected.

where vector $\boldsymbol{r}$ and vector $\boldsymbol{s}$ express the sum of the rows and the sum of the columns from the total-influential matrix $\boldsymbol{T}_c = [t_c^{ij}]_{n\times n}$, respectively, and the superscript $'$ denotes the transpose (Chen, et al., 2010). Two different total influence matrices are then applied. The first one, $\boldsymbol{T}_c = \left[t_c^{ij}\right]_{n\times n}$ (see Eq. (6)), pertains to *n* criteria, while the second one, $\boldsymbol{T}_D = \left[t_D^{ij}\right]_{m\times m}$, is devoted to *m* dimensions (clusters) from $\boldsymbol{T}_c$ (see Eq. (9)).

$$\boldsymbol{T}_c = \begin{array}{c} \\ D_1 \\ \vdots \\ D_i \\ \vdots \\ D_m \end{array} \begin{array}{c} \begin{array}{cccccc} D_1 & & \cdots & D_j & \cdots & D_m \\ c_{11}\ldots c_{1n_1} & & \cdots & c_{j1}\ldots c_{jn_j} & \cdots & c_{m1}\ldots c_{mn_m} \end{array} \\ \begin{bmatrix} \boldsymbol{T}_c^{11} & \cdots & \boldsymbol{T}_c^{1j} & \cdots & \boldsymbol{T}_c^{1m} \\ \vdots & & \vdots & & \vdots \\ \boldsymbol{T}_c^{i1} & \cdots & \boldsymbol{T}_c^{ij} & \cdots & \boldsymbol{T}_c^{im} \\ \vdots & & \vdots & & \vdots \\ \boldsymbol{T}_c^{m1} & \cdots & \boldsymbol{T}_c^{mj} & \cdots & \boldsymbol{T}_c^{mm} \end{bmatrix} \end{array} \begin{array}{l} c_{11} \\ c_{12} \\ \vdots \\ c_{1n_1} \\ \vdots \\ c_{i1} \\ c_{i2} \\ \vdots \\ c_{in_i} \\ \vdots \\ c_{m1} \\ c_{m2} \\ \vdots \\ c_{mn_m} \end{array} \tag{6}$$



3.1.2 DANP for finding the influential weights in each criterion

Step 5: Find the normalised matrix $\boldsymbol{T}_c^{nor}$ by dimensions and clusters.

Normalise $\boldsymbol{T}_c$ with the total degrees of effect and influence of the dimensions and clusters to obtain $\boldsymbol{T}_c^{nor}$, as shown in Eq.(7).

$$\boldsymbol{T}_c^{nor} = \begin{array}{c} \\ D_1 \\ \vdots \\ D_i \\ \vdots \\ D_m \end{array} \begin{array}{c} \begin{array}{cccc} D_1 & \cdots & D_j & \cdots & D_m \\ c_{11}..c_{1n_1} & \cdots & c_{j1}..c_{jn_j} & \cdots & c_{m1}..c_{mn_m} \end{array} \\ \begin{bmatrix} \boldsymbol{T}_c^{nor_{11}} & \cdots & \boldsymbol{T}_c^{nor_{1j}} & \cdots & \boldsymbol{T}_c^{nor_{1m}} \\ \vdots & & \vdots & & \vdots \\ \boldsymbol{T}_c^{nor_{i1}} & \cdots & \boldsymbol{T}_c^{nor_{ij}} & \cdots & \boldsymbol{T}_c^{nor_{im}} \\ \vdots & & \vdots & & \vdots \\ \boldsymbol{T}_c^{nor_{m1}} & \cdots & \boldsymbol{T}_c^{nor_{mj}} & \cdots & \boldsymbol{T}_c^{nor_{mm}} \end{bmatrix} \end{array} \begin{array}{l} \\ c_{11} \\ c_{12} \\ \vdots \\ c_{1n_1} \\ \\ c_{i1} \\ c_{i2} \\ \vdots \\ c_{in_i} \\ \\ c_{m1} \\ c_{m2} \\ \vdots \\ c_{mn_m} \end{array} \tag{7}$$

Step 6: Build an unweighted supermatrix $\boldsymbol{W}_c$.

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, $\boldsymbol{W}_c$, as shown in Eq.(8).

$$\boldsymbol{W}_c = \left(\boldsymbol{T}_c^{nor}\right)' = \begin{array}{c} \\ D_1 \\ \vdots \\ D_i \\ \vdots \\ D_m \end{array} \begin{array}{c} \begin{array}{cccc} D_1 & \cdots & D_j & \cdots & D_m \\ c_{11}..c_{1n_1} & & c_{j1}..c_{jn_j} & & c_{m1}..c_{mn_m} \end{array} \\ \begin{bmatrix} \boldsymbol{W}_c^{11} & \cdots & \boldsymbol{W}_c^{i1} & \cdots & \boldsymbol{W}_c^{m1} \\ \vdots & & \vdots & & \vdots \\ \boldsymbol{W}_c^{1j} & \cdots & \boldsymbol{W}_c^{ij} & \cdots & \boldsymbol{W}_c^{mj} \\ \vdots & & \vdots & & \vdots \\ \boldsymbol{W}_c^{1m} & \cdots & \boldsymbol{W}_c^{im} & \cdots & \boldsymbol{W}_c^{mm} \end{bmatrix} \end{array} \begin{array}{l} \\ c_{11} \\ \vdots \\ c_{1n_1} \\ \\ c_{i1} \\ \vdots \\ c_{in_i} \\ \\ c_{m1} \\ \vdots \\ c_{mn_m} \end{array} \tag{8}$$

Unweighted supermatrix $\boldsymbol{W}_c$ is the matrix transposed from $\boldsymbol{T}_c^{nor}$ (basic concept from the ANP by Saaty (1996), 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 7: Find the normalised total-influential matrix $\boldsymbol{T}_D^{nor}$.

The total-influential matrix $\boldsymbol{T}_D$ needs to be normalised by dividing it by the following formula:

$$t_D^i = \sum_{j=1}^{m} t_D^{ij}$$

$$\boldsymbol{T}_D = \begin{bmatrix} t_D^{11} & \cdots & t_D^{1j} & \cdots & t_D^{1m} \\ \vdots & & \vdots & & \vdots \\ t_D^{i1} & \cdots & t_D^{ij} & \cdots & t_D^{im} \\ \vdots & & \vdots & & \vdots \\ t_D^{m1} & \cdots & t_D^{mj} & \cdots & t_D^{mm} \end{bmatrix} \begin{matrix} \\ \\ \rightarrow \sum_{j=1}^{m} t_D^{ij} = t_D^i \\ \\ \\ \rightarrow \sum_{j=1}^{m} t_D^{mj} = t_D^m \end{matrix} \quad (9)$$

Thus, the total-influential matrix can be normalised and presented as $\boldsymbol{T}_D^{nor}$. Then, the sum of each row can be defined as $t_D^i = \sum_{j=1}^{m} t_D^{ij}$, where $i = 1, ..., m$, and $\boldsymbol{T}_D$ 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. (9). Therefore, a total-influential matrix $\boldsymbol{T}_D$ can be normalised and represented as $\boldsymbol{T}_D^{nor}$. $\boldsymbol{T}_D^{nor} = \left[t_D^{ij} / t_D^i \right]_{m \times m}$, as in Eq. (10). Then, each row of the normalised $\boldsymbol{T}_D^{nor}$ can be summed to equal one, so that $\sum_{j=1}^{m} t_D^{nor_{ij}} = 1$.

$$\boldsymbol{T}_D^{nor} = \begin{bmatrix} t_D^{11}/t_D^1 & \cdots & t_D^{1j}/t_D^1 & \cdots & t_D^{1m}/t_D^1 \\ \vdots & & \vdots & & \vdots \\ t_D^{i1}/t_D^i & \cdots & t_D^{ij}/t_D^i & \cdots & t_D^{im}/t_D^i \\ \vdots & & \vdots & & \vdots \\ t_D^{m1}/t_D^m & \cdots & t_D^{mj}/t_D^m & \cdots & t_D^{mm}/t_D^m \end{bmatrix} = \begin{bmatrix} t_D^{nor_{11}} & \cdots & t_D^{nor_{1j}} & \cdots & t_D^{nor_{1m}} \\ \vdots & & \vdots & & \vdots \\ t_D^{nor_{i1}} & \cdots & t_D^{nor_{ij}} & \cdots & t_D^{nor_{im}} \\ \vdots & & \vdots & & \vdots \\ t_D^{nor_{m1}} & \cdots & t_D^{nor_{mj}} & \cdots & t_D^{nor_{mm}} \end{bmatrix} \quad (10)$$

Step 8: Find the influential weights of the DANP.

The total-influential matrix $\boldsymbol{T}_c$ needs to be normalised by dividing the dimension and cluster (Eq. (9)), so $\boldsymbol{T}_c$ is normalised by summarising the row by dimensions and clusters to obtain $\boldsymbol{T}_c^{nor}$. An unweighted super-matrix $\boldsymbol{W}_c$ can be obtained by transposing $\boldsymbol{T}_c^{nor}$, i.e., $\boldsymbol{W}_c = \left(\boldsymbol{T}_c^{nor} \right)'$. Using (Eq. (11)), a weighted super-matrix $\boldsymbol{W}_c^*$ (improving the traditional ANP by using equal weights to make it appropriate for the real world) can be obtained by the product of $\boldsymbol{T}_D^{nor}$ and $\boldsymbol{W}_c$, i.e.,

$\boldsymbol{W}_c^* = \boldsymbol{T}_D^{nor}\boldsymbol{W}_c$ (Eq. (11)). This result demonstrates that these influential level values are the basis of normalisation to determine a weighted super-matrix.

$$\boldsymbol{W}_c^* = \boldsymbol{T}_D^{nor}\boldsymbol{W}_c = \begin{bmatrix} t_D^{nor_{11}}\boldsymbol{W}_c^{11} & \cdots & t_D^{nor_{i1}}\boldsymbol{W}_c^{i1} & \cdots & t_D^{nor_{m1}}\boldsymbol{W}_c^{m1} \\ \vdots & & \cdots & & \vdots \\ t_D^{nor_{1j}}\boldsymbol{W}_c^{1j} & \cdots & t_D^{nor_{ij}}\boldsymbol{W}_c^{ij} & \cdots & t_D^{nor_{mj}}\boldsymbol{W}_c^{mj} \\ \vdots & & \vdots & & \vdots \\ t_D^{nor_{1m}}\boldsymbol{W}_c^{1m} & \cdots & t_D^{nor_{im}}\boldsymbol{W}_c^{im} & \cdots & t_D^{nor_{mm}}\boldsymbol{W}_c^{mm} \end{bmatrix} \quad (11)$$

Step 9: Obtain the DANP.

Limit the weighted super-matrix by raising it to a sufficiently large power φ until it converges and becomes a long-term stable super-matrix to obtain global priority vector, which defines the influential weights $\boldsymbol{w} = (w_1, ..., w_j, ..., w_n)$ from $\lim_{\varphi\to\infty}(\boldsymbol{W}_c^*)^{\varphi}$ 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 (Lin, et al.; Liou, et al., 2010; Opricovic, 1998; Opricovic and Tzeng, 2004; Tzeng, et al., 2002). 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 (Yu and Seinfeld, 1973; Zeleny, 1982).

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.; $f_j^* = \max\left\{ f_{kj} \mid k = 1,2,...,K \right\}$ in this case. Likewise, the negative ideal point is set as the lowest performance score among all alternatives, when smaller is worst; i.e., $f_j^- = \min\left\{ f_{kj} \mid k = 1,2,...,K \right\}$ 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 $A_1,...,A_k,...,A_K$; $\boldsymbol{w}_j$ 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 $\boldsymbol{T}$ from the DEMATEL technique to make it applicable to the real-world situation, where $j = 1,2,...,n$, 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 $\boldsymbol{f}_{kj}$ for an alternative $\boldsymbol{A}_k$ 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

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

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, $j = 1, 2, ..., n$. 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 (see **Fig. 12.**).

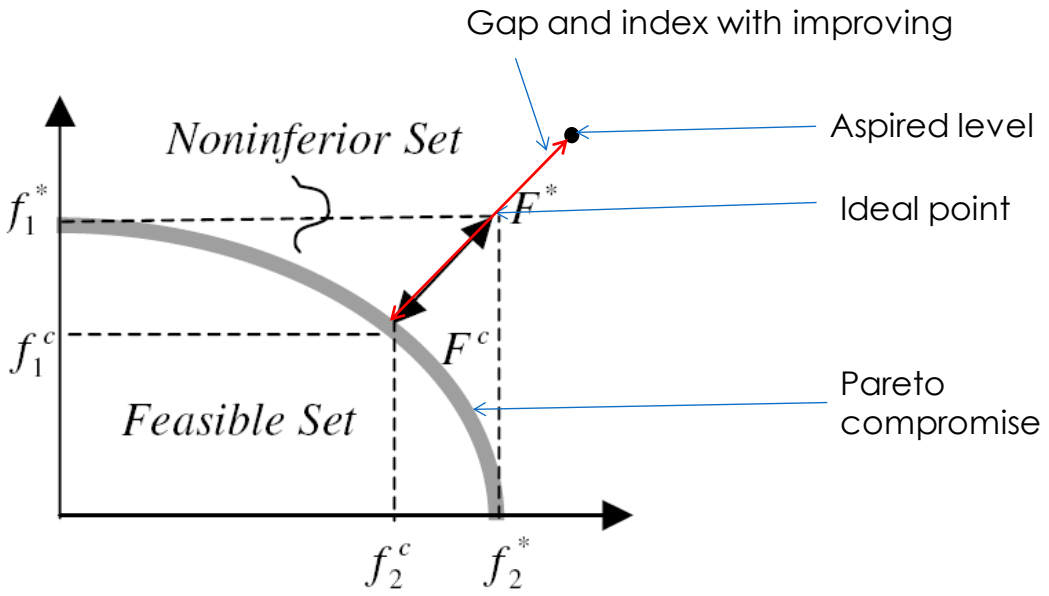


Fig. 12. Aspired level, ideal point, and compromise solution

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:

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

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).

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

$$Q_k = L_k^{p=\infty} = \max_j \left\{ y_{kj} \mid j = 1, 2, ..., n \right\}, \quad \forall k \tag{15}$$

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

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

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.

3.3 Grey relational analysis

Ever since Deng (Deng, 1982) proposed the grey theory, related models have been developed and applied to MCDM problems. Similar to the fuzzy set theory, the grey theory is a practical mathematical approach which can be used to deal with systems control, selecting vendor, modeling, predictions, and decision-making (Chiou and Tzeng, 2001; Deng, 1985, 1986; Liou, et al., 2012; Liu, et al., 2012; Wang and Tzeng, 2012). In this research, a GRA combined with DANP is used to resolve the relative influential weights of interdependence and feedback problems among dimensions/criteria and, although the traditional GRA of weights (by AHP) is independent in assumption, these problems are not independent in the real world. This

section contains a brief review of the calculation process for the grey relational model, and this research modifies the definitions of Chiou and Tzeng (Chiou and Tzeng, 2001).

A sequence of data called an 'aspiration level' is set, and a degree-index coefficient of a performance value (ex., Eq. (18) in $x_k(j)$) in each criterion (j) of alternative (k) is built to attain the aspiration level (ex., Eq. (18) in $x^*(j)$). This degree-index coefficient $\gamma(x^*(j), x_k(j))$ is called the "grey relational coefficient" in order to know which criterion should be improved to come close to the aspiration level (target). The 'aspiration value' in this paper is set at 10 points for the value of each criterion, and the performance matrix Eq. (18) of each criterion can be obtained by questionnaires using a scale from 0 points (completely unsatisfactory) to 10 points (extremely satisfactory). Therefore, in this research, 10 points is set as the aspiration level and zero (0) points as the worst value. How the aspiration level can be achieved differs from the traditional approach (see **Fig. 12.**).

Let the initial relationship matrix be a $K \times n$ matrix, where there are K alternatives and n criteria, obtained by surveying the relationship as follows:

$$
\begin{array}{lccccc}
 & & & \boxed{\text{Criteria}} & & \\
\text{Alternatives} & c_1 & \cdots & c_j & \cdots & c_n \\
 & w_1 & \cdots & w_j & \cdots & w_n \\
x_1 & \left[\begin{array}{c} x_1(1) \\ \vdots \end{array}\right. & \cdots & \begin{array}{c} x_1(j) \\ \vdots \end{array} & \cdots & \left.\begin{array}{c} x_1(n) \\ \vdots \end{array}\right] \\
\vdots & & & & & \\
x_k & \begin{array}{c} x_k(1) \\ \vdots \end{array} & \cdots & \begin{array}{c} x_k(j) \\ \vdots \end{array} & \cdots & \begin{array}{c} x_k(n) \\ \vdots \end{array} \\
\vdots & & & & & \\
x_K & \left[\begin{array}{c} x_K(1) \end{array}\right. & \cdots & \left.\begin{array}{c} x_K(j) \end{array}\right. & \cdots & \left.\begin{array}{c} x_K(n) \end{array}\right] \\
\text{Aspired values } x^* & x^*(1) & \cdots & x^*(j) & \cdots & x^*(n)
\end{array}
\qquad (18)
$$

Therefore, the degree-index coefficient of a grey relational model for the aspiration value is:

$$\gamma(x^*(j), x_k(j)) = \frac{\min_k \min_j |x^*(j) - x_k(j)| + \varsigma \max_k \max_j |x^*(j) - x_k(j)|}{|x^*(j) - x_k(j)| + \varsigma \max_k \max_j |x^*(j) - x_k(j)|} \quad (19)$$

then the integrating (fusing) degree-index of the grey relational model can be obtained, and the larger it is the better (shown as the integrating/fusing degree-index of coming close to the aspiration value).

$$\gamma(x^*, x_k) = \sum_{j=1}^{n} w_j \gamma(x^*(j), x_k(j)), \quad (20)$$

where j^{th} denotes j^{th} criterion and $j = 1, 2, ..., n;$ k^{th} denotes k^{th} alternative and $k = 1, 2, ..., K;$ the influential weight w_j can be obtained by ANP based on DEMATEL (DANP), when the criteria are interdependent and feedback problems in the real world.

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

We use 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 ←0,1,2,…,9,10→ 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 Descriptions 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 in searching for the right product. Because e-stores are able to respond rapidly to changes in the marketplace, many prestigious companies have incorporated e-stores 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 twenty-four hours 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 (Chen and Dhillon, 2003).

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 (Asllani and Lari, 2007; Ellinger, et al., 2003). 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 (Bauer, et al., 2002). 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. 13**). 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 14×14 matrix $\boldsymbol{G}$, obtained using pair-wise comparisons in terms of influences and directions between criteria, is shown in **Table 6**.

Table 6. Initial influential matrix $\boldsymbol{G}$.

Dimensions/criteria ($\boldsymbol{G}$)		A. Need recognition	B. Information search			C. Alternatives evaluation			D. Choice/ Purchase				E. Post-purchase behavior			
		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	Total
A. Need recognition	a_1Product 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_1Ease 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_2Overall 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_3Clarity	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_1Number 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_2Brand	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_3Relative 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_1Selection	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_2Variety 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_3Shipping 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_4Charge 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 behavior	e_1Order 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_2On-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_3Met 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	-

As matrix $\boldsymbol{G}$ shows, the normalised direct-relation matrix $\boldsymbol{X}$ is calculated using Eqs. (1) and (2), as shown **in Table 7**. Then, the total-influential matrix $\boldsymbol{T}_c$ can

be derived using Eqs. (3), (6) and (9), as shown in **Tables 8 and 9**. 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 10**. Thus, the INRM of the DEMATEL technique can be obtained as shown in **Fig. 13** by using **Table 10**.

Table 7. Normalised direct-relation X.

Dimensions/criteria (X)		A. Need recognition	B. Information search			C. Alternatives evaluation			D. Choice/ Purchase				E. Post-purchase behavior		
		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 8. 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 9. Total-influential dimensions matrix T_D.

Dimensions	A. Need recognition	B. Information search	C. Evaluation of alternatives	D. Choice/ Purchase	E. Post-purchase behavior	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 behavior	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 10. 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 behavior	**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

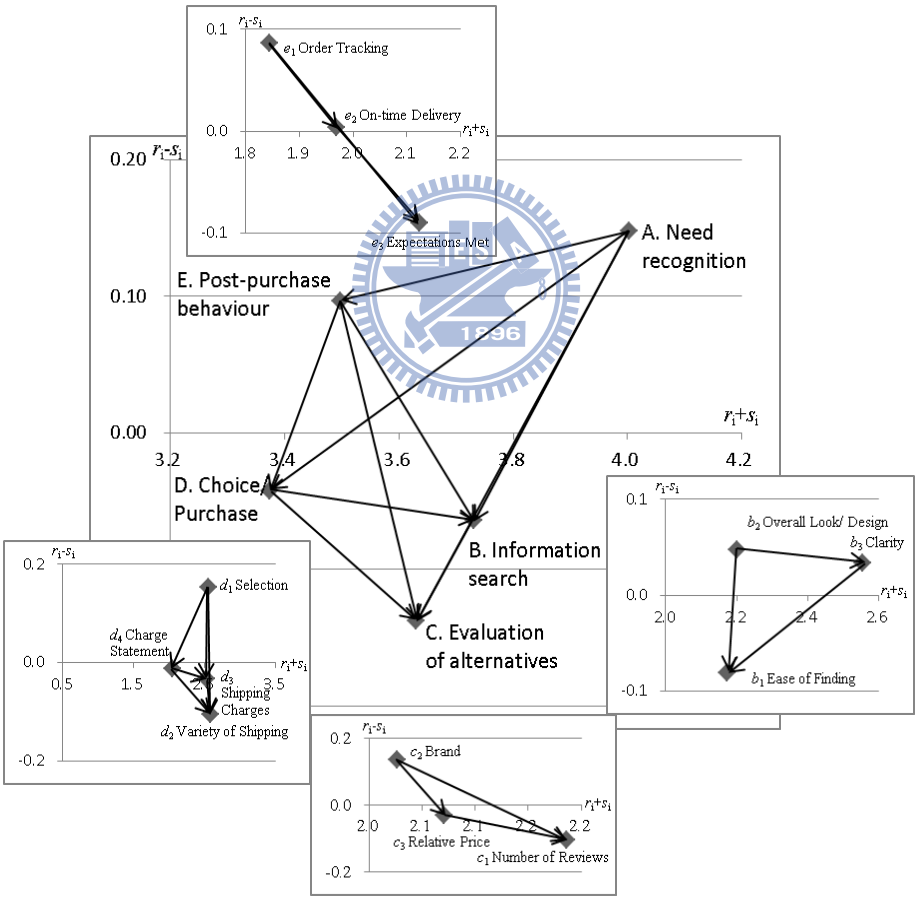


Fig. 13. Influential network relations map (INRM)

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 $\boldsymbol{W}_c$ can be obtained by transposing the normalised matrix $\boldsymbol{T}_c^{nor}$, i.e., $\boldsymbol{W}_c = \left(\boldsymbol{T}_c^{nor}\right)'$, as shown in **Table 11**.

Table 11. Unweighted supermatrix $\boldsymbol{W}_c$.

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 behavior	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

The influential weights $\boldsymbol{W}_c^*$ of DANP based on Eqs. (6)-(11) are shown in **Table 12**.

Table 12. The weighted supermatrix $\boldsymbol{W}_c^*$, produced by weighting the unweighted supermatrix $\boldsymbol{W}_c$.

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 behavior	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

The influential weights of DANP can be obtained by limiting the power of the

weighted super-matrix ($\lim_{\varphi\to\infty}(\boldsymbol{W}_c^*)^{\varphi}$) until it reaches a steady-state (see **Table 13**).

Table 13. Influential weights by stable matrix of DANP when power $\lim_{\varphi\to\infty}(\boldsymbol{W}_c^*)^{\varphi}$.

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

4.4 Results and analysis in evaluation for e-store management performance

Table 14. Using VIKOR method computing performance values combined with the influential weights of the criteria according to the DANP.

Alternatives				Yahoo (A_1)		Pchome (A_2)		Books (A_3)	
Dimensions/Criteria	Local weight (based on DANP)	Global weight (DANP)	aspiration value	Performance (A_1)	Gap (VIKOR)	Performance (A_2)	Gap (VIKOR)	Performance (A_3)	Gap (VIKOR)
A.Need recognition	**0.079**			**7.212**	**(0.279)**	**7.261**	**(0.274)**	**7.040**	**(0.296)**
a_1 Product Availability	1.000	0.079	10.000	7.212	(0.279)	7.261	(0.274)	7.040	(0.296)
B.Information search	**0.226**			**7.336**	**(0.266)**	**7.341**	**(0.266)**	**7.605**	**(0.239)**
b_1 Ease of Finding	0.318	0.072	10.000	7.586	(0.241)	7.481	(0.252)	7.484	(0.252)
b_2 Overall Look/ Design	0.310	0.070	10.000	7.133	(0.287)	7.108	(0.289)	7.668	(0.233)
b_3 Clarity	0.372	0.084	10.000	7.292	(0.271)	7.417	(0.258)	7.656	(0.234)
C.Evaluation of alternatives	**0.223**			**7.584**	**(0.242)**	**7.510**	**(0.249)**	**7.491**	**(0.251)**
c_1 Number of Reviews	0.359	0.080	10.000	7.735	(0.226)	7.511	(0.249)	7.508	(0.249)
c_2 Brand	0.300	0.067	10.000	7.644	(0.236)	7.628	(0.237)	8.114	(0.189)
c_3 Relative Price	0.341	0.076	10.000	7.373	(0.263)	7.405	(0.259)	6.927	(0.307)
D.Choice/ Purchase	**0.270**			**7.759**	**(0.224)**	**7.550**	**(0.245)**	**7.710**	**(0.229)**
d_1 Selection	0.259	0.070	10.000	7.983	(0.202)	7.687	(0.231)	7.892	(0.211)
d_2 Variety of Shipping	0.270	0.073	10.000	7.776	(0.222)	7.511	(0.249)	7.666	(0.233)
d_3 Shipping Charges	0.263	0.071	10.000	7.104	(0.290)	7.188	(0.281)	7.255	(0.274)
d_4 Charge Statement	0.208	0.056	10.000	8.285	(0.171)	7.889	(0.211)	8.115	(0.188)
E.Post-purchase behaviour	**0.202**			**7.544**	**(0.246)**	**7.546**	**(0.245)**	**7.791**	**(0.221)**
e_1 Order Tracking	0.292	0.059	10.000	7.605	(0.240)	7.484	(0.252)	7.626	(0.237)
e_2 On-time Delivery	0.322	0.065	10.000	7.610	(0.239)	7.582	(0.242)	7.746	(0.225)
e_3 Met Expectations	0.386	0.078	10.000	7.442	(0.256)	7.564	(0.244)	7.953	(0.205)
Total	**1.000**	**1.000**	-	**7.538(2)**	**0.246(2)**	**7.470(3)**	**0.253(3)**	**7.601(1)**	**0.240(1)**

In Taiwan, 1,018 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 14**), 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 14**).

4.5 Discussions and building e-store business strategies

This study has three results. First, in the INRM, it can be easily understood from **Fig. 13** and **Table 10** that five dimensions influence each other. For example, dimension A (need recognition) affects dimensions E (post-purchase behaviour), D (choice/purchase), B (information search) and C (evaluation of alternatives) (A→{E, D, B, C}); dimension E (post-purchase behaviour) affects dimensions D (choice/purchase), B (information search) and C (evaluation of alternatives) (E→{D, B, C}); dimension D (choice/purchase) affects dimensions B (information search) and C (evaluation of alternatives) (D→{B, C}); and dimension B (information search) affects dimension C (evaluation of alternatives) (B→{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. 13 and **Table 10** demonstrate that criterion e_1 (order tracking) affects criteria e_2 (on-time delivery) and e_3 (expectations met) (e_1→{e_2, e_3}), and criterion e_2 (on-time delivery) affects criterion e_3 (expectations met) (e_2→{e_3}). In addition, criterion d_1 (selection) affects criteria d_4 (charge statement), d_3 (shipping charges), and d_2 (variety of shipping) (d_1→{d_4, d_3, d_2}), criterion d_4 (charge statement) affects criteria d_3 (shipping charges) and d_2 (variety of shipping) (d_4→{d_3, d_2}), and criterion d_3

(shipping charges) affects criterion d_2 (variety of shipping) ($d_3 \rightarrow \{d_2\}$). Criterion b_2 (overall look and design) affects criteria b_3 (clarity) and b_1 (ease of finding) ($b_2 \rightarrow \{b_3, b_1\}$), and criterion b_3 (clarity) affects criterion b_1 (ease of finding) ($b_3 \rightarrow \{b_1\}$). Criterion c_2 (brand) affects criteria c_3 (relative price) and c_1 (number of reviews) ($c_2 \rightarrow \{c_3, c_1\}$), and criterion c_3 (relative price) affects criterion c_1 (number of reviews) ($c_3 \rightarrow \{c_1\}$).

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 $\succ$ post-purchase behaviour $\succ$ choice/purchase $\succ$ information search $\succ$ 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. (2008). 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, coupons, premiums, sweepstakes, samples, and light products to persuade customers to buy products to improve the dimension "need recognition (A)" (Buil, et al., 2012; D'Astous, et al., 2004; Jamal, et al., 2012; Lee, 2002; Palazon and Delgado-Ballester, 2011; Shimp, 2010). 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)" (Chiu, et al., 2012; Hiraoka, 2004; Marconi, 1999). 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)" (Bivona, 2012; Cesari and Lynch, 2011; Chiu, et al., 2012; Dennis, et al., 2005; Vrechopoulos, 2001). 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)" (Brown, et al., 2001; Chandler and Hyatt, 2002; Chiu, et al., 2012; Heinemann and Schwarzl, 2010a; Qiu and Benbasat, 2009). 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)" (Chen and Dubinsky, 2003; Heinemann and Schwarzl, 2010b; Janse van Noordwyk, 2008) (see **Fig. 13**).

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 13**, 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. 13** and **Table 13** 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. 13**) 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 14**), which ranked three e-stores' performances, determined that Books surpassed Yahoo, which surpassed PChome (Books (A_3) $\succ$ Yahoo (A_1) $\succ$ 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 constituting 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 14** (shown in **Table 15**). 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 essential dimension because this consideration primarily determines the consumers' choice of e-store.

Table 15. E-stores' priority strategies.

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.

According to the DANP based on the basic concept of ANP, the data in **Table 13** 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 14** 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 13**). 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 15**. 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.

4.6 Using a grey relational model to evaluate e-store management degrees and coefficients

Nine senior e-store users who regularly use e-stores in Taiwan were asked to evaluate their level of satisfaction with each criterion. The performance scores (SAW, simple additive weight) and aspiration level (by GRA) of e-store users are shown in **Table 16**, and it can be seen that these three e-stores all score lower than 0.753 and Yahoo and PChome only score 0.699 and 0.684 respectively. The global influential weights in the DANP can be used to compare the performances of Yahoo, PChome, and Books, since the DANP can provide significant feedback. So, how can e-stores come close to the aspiration level? According to **Table 16** and **Fig. 14**, they should improve "need-recognition", and then consider "post-purchase behavior", "information search", and "choice/purchase", and finally, provide alternatives for

evaluation.

Table 16. Performance values combined with influential weights by DANP and GRA.

Dimensions/ Criteria	Local weight	Global weight (ANP)	aspired value	Yahoo (A_1) Performance	Yahoo (A_1) $\gamma(x^*(j), x_1(j))$	Pchome (A_2) Performance	Pchome (A_2) $\gamma(x^*(j), x_2(j))$	Books (A_3) Performance	Books (A_3) $\gamma(x^*(j), x_3(j))$
A. Needs recognition	**0.080**			**7.778**	**0.690**	**8.000**	**0.725**	**7.000**	**0.592**
a_1 Product Availability	1.000	0.080	10.000	7.778	0.690	8.000	0.725	7.000	0.592
B. Information search	**0.229**			**8.299**	**0.777**	**7.605**	**0.667**	**8.656**	**0.859**
b_1 Ease of Finding	0.319	0.073	10.000	8.333	0.784	7.667	0.674	8.222	0.763
b_2 Overall Look/ Design	0.310	0.071	10.000	8.222	0.763	7.333	0.630	8.556	0.829
b_3 Clarity	0.371	0.085	10.000	8.333	0.784	7.778	0.690	9.111	0.967
C. Evaluation of alternatives	**0.221**			**7.050**	**0.647**	**7.462**	**0.657**	**6.913**	**0.584**
c_1 Number of Reviews	0.362	0.080	10.000	8.778	0.879	7.778	0.690	7.000	0.592
c_2 Brand	0.294	0.065	10.000	5.111	0.439	6.444	0.537	6.444	0.537
c_3 Relative Price	0.344	0.076	10.000	6.889	0.580	8.000	0.725	7.222	0.617
D. Choice/ Purchase	**0.269**			**7.940**	**0.729**	**8.028**	**0.736**	**8.054**	**0.735**
d_1 Selection	0.268	0.072	10.000	7.778	0.690	8.333	0.784	8.111	0.744
d_2 Variety of Shipping	0.268	0.072	10.000	8.778	0.879	8.333	0.784	8.222	0.763
d_3 Shipping Charges	0.260	0.070	10.000	7.111	0.604	7.333	0.630	7.778	0.690
d_4 Charge Statement	0.204	0.055	10.000	8.111	0.744	8.111	0.744	8.111	0.744
E. Post-purchase behavior	**0.201**			**7.268**	**0.629**	**7.404**	**0.646**	**8.850**	**0.907**
e_1 Order Tracking	0.284	0.057	10.000	6.667	0.558	7.333	0.630	8.222	0.763
e_2 On-time Delivery	0.318	0.064	10.000	8.000	0.725	8.111	0.744	9.222	1.000
e_3 Met Expectations	0.398	0.080	10.000	7.111	0.604	6.889	0.580	9.000	0.935
Aspiration level x_i^*				10.000	-	10.000	-	10.000	-
The worst value x_i^-				0.000	-	0.000	-	0.000	-
$\gamma(x^*, x_k)$				-	0.699 (2)	-	0.684 (3)	-	0.753 (1)

Note: Here setting the performance as aspiration level is $x_j^* = 10$ and the worst value is $x_j^- = 0$ in each criterion.

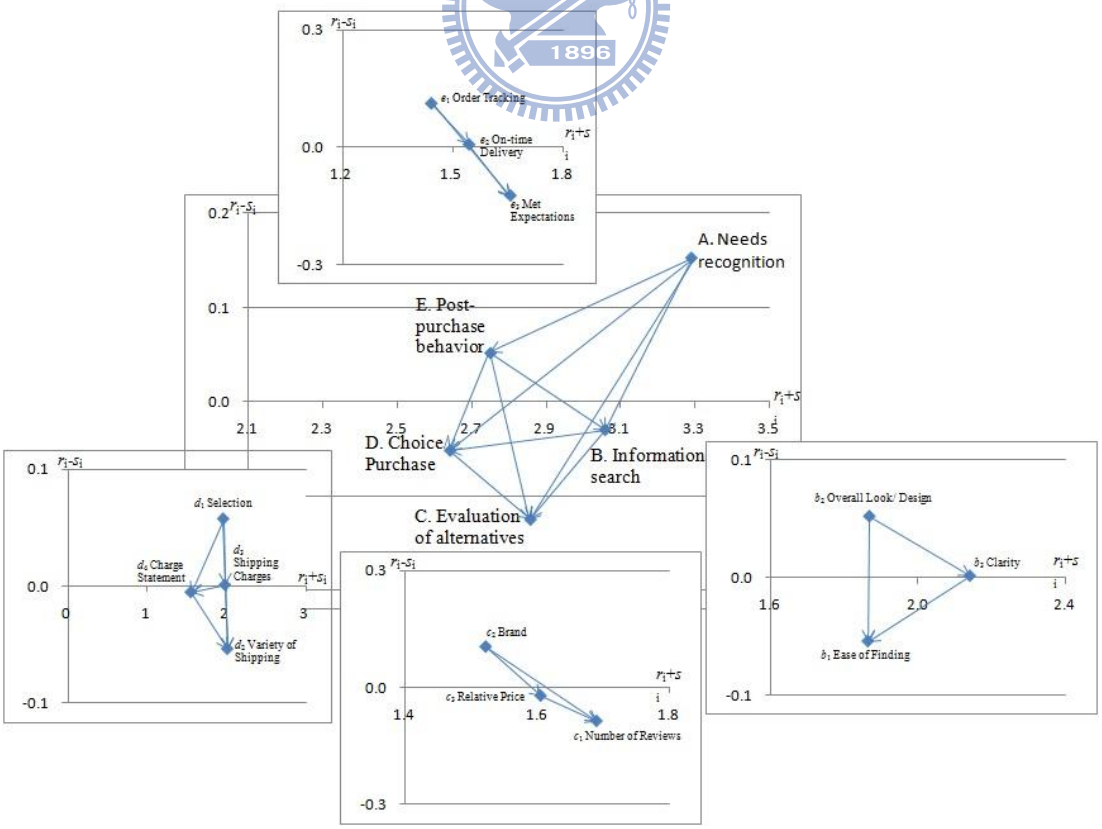


Fig. 14. Influential relationships by INRM

The overall grey relational degree of coming close to the level of aspiration can be defined by integrating/fusing and calculating the obtained data in order to determine why Books surpasses Yahoo, and Yahoo surpasses PChome (Books (A_3) $\succ$ Yahoo (A_1) $\succ$ PChome (A_2)). The overall grey relational degree of Books (0.753), Yahoo (0.699) and PChome (0.684) is close (under 0.07). The integration of the grey relational coefficient of Yahoo in the DANP further demonstrates that the post-purchase behaviour coefficient is 0.629 at the lowest point. Thus, Yahoo should prioritize an improvement in its post-purchase behaviour, after which the other dimensions which can be ranked in order of priority for improvement are evaluation of alternatives, need-recognition, and choice/purchase and information search. The dimensions to be improved by PChome in order of priority are post-purchase behavior, evaluation of alternatives, information search, needs-recognition, and choice/purchase, and Books should prioritize improving the dimensions of evaluation of alternatives, need-recognition, choice/purchase, information search and post-purchase behavior. Thus, Yahoo, PChome, and Books must enhance these dimensions of their business in order to change their management style (see **Table 17**)

4.7 Using GRA method to evaluation and discussions

E-store strategies can be defined (see **Table 17**) using the data in **Table 16** and based on **Fig. 14**. **Table 17** demonstrates that each e-store's priority strategies are different.

In terms of influential relationships (**Fig. 14**) customers' behaviour in e-stores can be seen to be different from that in traditional shopping channels, because e-store customers firstly confirm that the products are what they need; secondly, refer to their past experience; thirdly, search for related product information; fourthly, understand

the interface of the e-stores and how to complete a purchase, before finally choosing the alternative which suits their requirements in this visual purchasing environment.

Table 16 (Performance values combined with influential weights by DANP and GRA) can also be used to obtain more detailed results for Books in terms of its achievement in improving the primary criteria, namely, brand, product availability, and number of reviews. The results are the same as in the real world because Books does not advertise on TV or in any newspapers. Books' major sales products are books, but there is no information about the number of reviews on the web. It may be that Books could improve its number of reviews by learning from Amazon to sell other products to improve product availability, and provide a chat room or blog where buyers can discuss their feelings. Yahoo firstly needs to improve its brand and order tracking. In fact, Yahoo only ships orders when payment has been received, and advertises the fact that products will arrive about seven days after that. Yahoo's order tracking is full of uncertainty, whereas if Books e-store receives an order before noon, customers can pay and receive their products in their designated 7-eleven store after noon the next day. Since 7-eleven stores are prolific in Taiwan, perhaps Yahoo could adopt the Books e-store strategy to improve its order tracking. Finally, PChome needs to improve its brand and products or services to meet customers' expectations. PChome's major sales consist of 3C products, and very often, the colors in reality are different from those in the pictures on the website, so PChome should improve its packaging and after-sales communication with its customers. These results indicate that Books, Yahoo, and PChome must enhance their brands. They should advertise their e-stores, provide authentic pictures of products, identify regular customers and motivate them to become loyal by improving their brands and advertising them more. They should strengthen their efforts to develop a well-established brand name, which will help to build customers' trust.

Based on the results previously provided, the relative influential weights of the criteria and index can be determined using the DANP (DEMATEL-based ANP) in conjunction with a grey relational analysis (GRA). The DEMATEL works with the DANP to construct a new model to measure the effect of e-store businesses. The degree of the grey relational analysis can distinguish the three e-stores and find the gaps between them. Future studies should evaluate and categorize e-stores using ISM, De novo programming, and a fuzzy integration related to e-store management strategies, since these models can be used to resolve other business problems. The proposed model is well suited for dealing with the identified business strategies to resolve problems which stem from complex approaches. Because the DANP criteria are interdependent, they can be applied to many fields, such as consumer behaviour, human resources, servicing needs, school management, corporation management, and management problems (see **Table 16**). The performance, gaps, and indices of the e-stores, Yahoo, PChome, and Books can be determined from the information shown in **Table 17**. Since the performance is significantly better and the gap is significantly smaller, the level of performance of these three e-stores can be ranked as Books, followed by Yahoo and PChome respectively.

The strategies which focus on the goal of e-stores to satisfy customers' needs, are shown in **Table 17**. Since none of these strategies is the same, when managing an e-store, this new method must be used to determine customers' feelings and needs in order to define any gaps and improve them to achieve the ideal solution or level of aspiration.

Table 17. E-store strategies

Yahoo	The priority index for improving the dimensions includes post-purchase behaviour, evaluation of alternatives, need-recognition, choice/purchase, and information search. The priority index strategies for improving e-stores include high-quality post-sale service programs, fast delivery (order tracking and on-time delivery), complete packaging, service speed, reassuring communication after the purchase,

	guarantees, and liberal return policies (meeting expectations); past experience, word-of-mouth (chat rooms and Blogs), services offered (brand), display other e-store references or relative prices (relative price), and correcting any unfavourable misconceptions (number of reviews); advertising, sight of product, offering sales promotion (trial of product), and identifying and appealing to patronage motives; shipping prices (shipping charges), assorted merchandise, easy to access and navigate, animated graphics should be attractive, satisfactory number of alternatives, improving network crowding (selection), various methods of payment, clear bill of sale (charge statement), convenient and easy transaction (variety of shipping methods); e-store appearance, careful design of e-store website, expected value of additional information, and variety of categories (overall look/design, clarity, and ease of finding).
PChome	The priority index for improving the dimensions includes post-purchase behaviour, evaluation of alternatives, information search, need-recognition, and choice/purchase. The priority index strategies for improving the e-store include complete packaging, service speed, reassuring communication after the purchase, guarantee and liberal return policies (meeting expectations), high-quality post-sale service programs, fast delivery (order tracking and on-time delivery); past experience, word-of-mouth (chat rooms and blogs), services offered (brand), and correcting any unfavourable misconceptions (number of reviews), display other e-store references or relative prices (relative price); e-store appearance, careful design of e-store website, expected value of additional information, variety of categories (overall look/design, ease of finding, and clarity); advertising, sight of product, offer sales promotions (trial of product), identifying and appealing to patronage motives; shipping prices (shipping charges), various methods of payment, clear bill of sale (charge statement), assorted merchandise, easy to access and navigate, animated graphics should be attractive, satisfactory number of alternatives, improving network crowding (selection), convenient, and easy transaction (variety of shipping methods).
Books	The priority index for improving the dimensions includes the evaluation of alternatives, need-recognition, choice/purchase, information search, and post-purchase behaviour. The priority index strategies for improving the e-store include past experience, word-of-mouth (chat rooms and blogs), services offered (brand), correcting any unfavourable misconceptions (number of reviews), display other e-store references or relative prices (relative price); advertising, sight of product, offer sales promotions (trial of product), identifying and appealing to patronage motives; shipping prices (shipping charges), assorted merchandise, easy to access and navigate, animated graphics should be attractive, satisfactory number of alternatives, improving network crowding (selection), various methods of payment, clear bill of sale (charge statement), convenient, and easy transaction (variety of shipping); e-store appearance, careful design of e-store website, expected value of additional information, and variety of categories (ease of finding, overall look/design, and clarity); high-quality post-sale service programs, fast delivery (order tracking and on-time delivery), complete packaging, service speed, reassuring communication after the purchase, guarantee and liberal return policies (meeting expectations).

Source: Buil, et al., 2012; D'Astous, et al., 2004; Jamal, et al., 2012; Lee, 2002; Palazon and Delgado-Ballester, 2011; Shimp, 2010; Chiu, et al., 2012; Hiraoka, 2004; Marconi, 1999; Bivona, 2012; Cesari and Lynch, 2011; Dennis, et al., 2005; Vrechopoulos, 2001; Brown, et al., 2001; Chandler and Hyatt, 2002; Heinemann and Schwarzl, 2010a; Qiu and Benbasat, 2009; Chen and Dubinsky, 2003; Heinemann and Schwarzl, 2010b; Janse van Noordwyk, 2008.

Chapter 5 Conclusions and remarks

The 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 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.

Using GRA of 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.

Since e-stores can offer products at a reduced price, and consumers can shop at any time and in any place, effective e-store management is essential in the business field. The proposed model can measure effectiveness by determining the central criteria to be evaluated and illustrating the interdependence among dimensions/criteria based on a influential network relationship map (INRM) with a DEMATEL technique. It can also identify the elements and propose the best strategy to improve the effectiveness of an e-store. Indeed, the results indicate that the effectiveness calculated using the proposed model is consistent with that of the DANP combined with a grey relational analysis (GRA) for e-store management, and this may be worth researching further. It is suitable for dealing with any complex decision-making issues connected with interdependent criteria. The study has established a causal model of effective e-store management, and verified the relational structure model using

satisfactory statistical techniques in order to confirm the model's efficiency.

This research is different from previous group research because (1) The enquiry times were reduced by the DEMATEL and the DANP using the same questionnaire, (2) The DANP differed from the prior research which used a DEAMTEL and ANP method, (3) The influential weights of a traditional ANP are equal, but in this paper, it had different weights, (4) Traditionally, SEM is always used to obtain a relationship map, whereas this study used a DEMATEL, (5) The traditional grey relational analysis (the aspired level is always the maximum performance and the worst level is always the minimum performance) is different from the grey relational analysis in this study (the aspired level was the best; for example: in a scale from 0 to 10, 10 was the best and 0 was the worst), (6) This paper developed some questions to obtain a relationship map to know how to improve the e-business, to ascertain the distance between the aspired level and the dimensions/criteria of each e-store, to determine which dimensions/criteria needed to be improved as a priority, and how to use this knowledge base to develop a marketing strategy. This paper differs from others which simply provided a relationship map or computed the performance to select the best level of aspiration. This paper has provided the managers of the three e-stores with the best strategy to achieve a competitive advantage.

In terms of e-store management, the study found Books surpassed Yahoo in terms of the overall grey relational degree, and Yahoo, in turn, surpassed PChome (Books (0.753) $\succ$ Yahoo (0.699) $\succ$ PChome (0.684)). The e-store ranking further indicates the dimensions which need the most improvement, namely, need-recognition $\succ$ post-purchase behavior $\succ$ information search $\succ$ choice/purchase $\succ$ evaluation of alternatives. Thus, these results can help to develop effective strategic management to resolve real-life problems.

The results of the statistical analysis should help managers to decide how and

where to more effectively allocate their e-store business strategies. As such, the research provides a better knowledge base for management approaches in e-stores. It is hoped that these results will help e-store managers to understand how to improve their business model to satisfy consumers' needs, generate more repurchases, and devise the best marketing strategies to effectively and efficiently achieve customer satisfaction and reach the highest levels of aspiration.

Over all, we can obtain to use the VIKOR and GRA method can get the same index result (see Table 14 and Table 16) that they have the same as the theoretical basis. This research proved questionnaire using nine experts and 1,018 customers the result the same, therefore, we can to use small number of samples can be obtained the same results.

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Appendix A

Table A1. Group consensuses of the seven respondents on the degree of influence matrix G among the criteria.

Unit: %

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
a_1	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_1	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_2	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_3	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_1	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_2	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_3	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_1	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_2	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_3	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_4	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_1	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_2	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_3	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 matrix G among the criteria.

Unit: %

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
a_1	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_1	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_2	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_3	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_1	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_2	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_3	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_1	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_2	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_3	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_4	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_1	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_2	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_3	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 (%) $= \frac{1}{n(n-1)} \sum_{i=1}^{n} \sum_{j=1}^{n} \frac{\left| g_c^{ij\rho} - g_c^{ij(\rho-1)} \right|}{g_c^{ij\rho}} \times 100\% = 4.89\% < 5\%$ (see Eq.(1)), less than 5%, i.e., significant confidence is 95.11%, where $\rho = 8$ denotes the number of experts and t_{ij}^{ρ} 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 $n(n-1) = 14 \times 13$.

Appendix B: The questionnaire

網路商店評比

您好！這是一份有關「**網路商店評比**」之學術研究，旨在探討網路商店各準則之影響程度以及兩者間的關聯性。

素仰您在此領域的卓越成就，若能獲致您寶貴的意見，將對本研究成果與信度將有極大的助益，您所提供的資料僅作學術統計分析之用，決不單獨對外發表或轉作其他用途，敬請您寬心填答。

您的支持，將是本研究可否順利完成的關鍵。誠摯盼望 您能撥冗惠填卓見，俾作為本研究之參考。在此，謹致上最誠摯的謝意。專此 敬祝

商祺

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壹、填寫說明

本問卷分為 6 個部份，分別為**壹、填寫說明**；**貳、準則重要度與檢核評估**；**參、影響關係矩陣填寫方式**；**肆、14 項準則之影響關係之評比**；**伍、各網路商店對 14 項準則之重視度; 陸、個人基本資料**。

貳、準則(效標)重要度與檢核評估

寫下您對下列描述的重視程度及檢核程度，說明如下：

完全不重視或欠佳← 1,2,3,4,5,6,7,8,9,10 →非常重視或優良

準則最重要；10，準則最不重要：1　　準則優良：10，　準則欠佳：1

表一、網路商店準則重要度與滿意度評估

構面	影響準則(效標)	**準則重要度 1~10；準則最重要：10，準則最不重要：1**	**準則檢核 1~10 準則優良：10 準則欠佳：1**
A.需求確認	a_1 產品可用性		
B.資訊搜尋	b_1 產品資訊容易找尋		
	b_2 整體網頁設計看起來		
	b_3 網頁清楚描述產品資訊		
C.選擇評估	c_1 網友購後的評價次數		
	c_2 網路商店開店的年數		
	c_3 產品的價格		
D.購買	d_1 選擇容易		
	d_2 可選購不同的運送方式		
	d_3 運費金額		
	d_4 帳單繳費方式		
E.購後行為	e_1 訂貨追蹤		
	e_2 準時送達		
	e_3 符合預期		

參、影響關係矩陣填寫方式

填寫指標說明：**0.沒影響**；**1.低影響**；**2.中影響**；**3.高影響**；**4.極高影響**

舉例說明，**A 對於 B 的影響程度為極高影響故在位置上填入 4**

	A	B	C	D	E
A		4			
B					

【實例說明】

1. **需求確認**對**資訊搜尋**之影響程度為(**極高影響**)故在方格內填入 **4**。

2. **購買**對**需求確認**之影響程度為(**高影響**)故在方格內填入 **3**

構面	需求確認	資訊搜尋	選擇評估	購買	購後行為
需求確認		**4**			
資訊搜尋					
選擇評估					
購買	**3**				
購後行為					

肆、14 項準則之影響程度關係之評比

準則影響關係評比		A 構面	B 構面			C 構面			D 構面				E 構面		
		產品可用性	產品資訊容易找尋	整體網頁設計看起來	網頁清楚描述產品資訊	網友購後的評價次數	網路商店開店的年數	產品的價格	選擇容易	可選購不同的運送方式	運費金額	帳單繳費方式	訂貨追蹤	準時送達	符合預期
A 構面	產品可用性	■													
B 構面	產品資訊容易找尋		■												
	整體網頁設計看起來			■											
	網頁清楚描述產品資訊				■										
C 構面	網友購後的評價次數					■									
	網路商店開店的年數						■								
	產品的價格							■							
D 構面	選擇容易								■						
	可選購不同的運送方式									■					
	運費金額										■				
	帳單繳費方式											■			
E 構面	訂貨追蹤												■		
	準時送達													■	
	符合預期														■

(0.沒影響；1.低影響；2.中影響；3.高影響；4.極高影響)

伍、你覺得各網路商店對14項準則之重視度

完全不重視← 0,1,2,3,4,5,6,7,8,9,10 →非常重視

準則影響關係評比		YAHOO 奇摩	Pchome 網路家庭	Books 博客來
A 構面	產品可用性			
B 構面	產品資訊容易找尋			
	整體網頁設計看起來			
	網頁清楚描述產品資訊			
C 構面	網友購後的評價次數			
	網路商店開店的年數			
	產品的價格			
D 構面	選擇容易			
	可選購不同的運送方式			
	運費金額			
	帳單繳費方式			
E 構面	訂貨追蹤			
	準時送達			
	符合預期			

陸、個人基本資料

1. 性別：□男、□女
2. 教育程度：□專科、□大學、□碩士、□博士
3. 年齡：□ 30歲(含)以下、□ 31~40歲(含)、□ 41~50歲(含)、□ 51~60歲(含)、□ 61~70歲(含)、□ 70歲以上

Appendix C: The research's overview map

The three of E-stores: A1=Yahoo, A2=PChome, A3=Books

E-store 5 dimension and 14 criteria
A: Needs recognition; a_1: Product Availability,
B: Information search; b_1: Ease of Finding, b_2: Overall look/Design, b_3: Clarity
C: Evaluation of alternatives; c_1: Number of Reviews, c_2: Brand, c_3: Relative Price
D: Choice/Purchase; d_1: Selection d_2: Variety of Shipping, d_3: Shipping Charges, d_4: Charge Statement
E: Post-purchase behaviour; e_1: Order Tracking, e_2: On-time Delivery, e_3: Met Expectations

Assessment criteria of mutual influence by experts

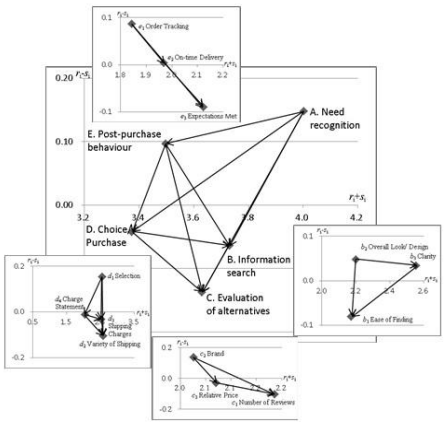
	a_1	b_1	b_2	b_3	c_1	c_2	c_3	d_1	d_2	d_3	d_4	e_1	e_2	e_3
a_1	0	2	2	3	3	1	3	2	2	2	2	1	2	3
b_1	2	0	3	3	2	1	1	3	1	1	2	1	1	2
b_2	2	3	0	3	2	1	2	3	2	1	2	2	1	2
b_3	3	4	3	0	2	1	2	3	2	2	2	1	1	3
c_1	2	2	2	2	0	3	2	2	1	2	1	1	2	3
c_2	1	2	2	2	3	0	2	2	2	2	2	2	2	2
c_3	3	1	1	2	3	1	0	2	1	3	1	1	2	3
d_1	2	3	3	3	2	2	2	0	2	2	2	1	1	2
d_2	2	1	2	2	2	2	2	2	0	3	2	2	2	2
d_3	2	1	1	2	2	2	3	1	3	0	1	2	2	2
d_4	2	1	1	2	1	2	2	2	2	2	0	1	1	1
e_1	1	1	1	2	2	2	1	1	3	2	1	0	4	2
e_2	2	1	1	2	2	2	2	1	3	3	1	3	0	2
e_3	3	2	2	3	3	3	3	2	1	2	1	2	2	0

Assessment e-stores' performance by 1,018 consumers (y_{kj})

	Yahoo	PChome	Books
a_1	7.2	7.3	7.0
b_1	7.6	7.5	7.5
b_2	7.1	7.1	7.7
b_3	7.3	7.4	7.7
c_1	7.7	7.5	7.5
c_2	7.6	7.6	8.1
c_3	7.4	7.4	6.9
d_1	8.0	7.7	7.9
d_2	7.8	7.5	7.7
d_3	7.1	7.2	7.3
d_4	8.3	7.9	8.1
e_1	7.6	7.5	7.6
e_2	7.6	7.6	7.7
e_3	7.4	7.6	8.0

DEMATEL technique

Influential network relations map (INRM)



The Performance of E-store

Performance $= \sum_{j=1}^{n} w_j y_{kj}$

VIKOR or GRA method

Find $\max_j \sum_{j=1}^{n} w_j y_{kj}$ to solve sort, improve and create strategies

DANP method

Criteria of influential weights $\boldsymbol{w} = (w_1, ..., w_j, ..., w_n)$

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

簡　　歷

學歷

雲林科技大學	資訊管理研究所	畢業	89/9~91/6
世新大學	資訊管理學系	畢業	83/9~85/6
大同商業專科學校	電子資料處理科	畢業	79/9~83/6

經歷

國立中壢高商	資料處理科代理教師	93/8~96/7
元培科技大學	資訊管理學系兼任講師	91/9~93/7
新竹市立培英國中	電腦科 代理教師	92/8~93/7
雲林縣大成商工	資料處理科專任教師暨綜合高中導師	85/8~91/7

發表著作

◆ 期刊論文 (Journal Paper)

1. Wan-Yu Chiu, Gwo-Hshiung Tzeng, Han-Lin Li (2012). A new hybrid MCDM model combining DANP with VIKOR to improve e-store business. *Knowledge-Based Systems*. (SCI, impact factor: 2.422, accept)

2. Wan-Yu Chiu, Gwo-Hshiung Tzeng, Han-Lin Li (2010). Improving the E-Store Business Model for Satisfying Customers' Needs Using a Hybrid MCDM Combined DANP with Grey Relational Model, *The Second KES International Symposium IDT 2010*. Publishing, Baltimore, USA, pp. 113-121. (EI)

3. Wan-Yu Chiu, Gwo-Hshiung Tzeng, Han-Lin Li (2012). Developing e-store marketing strategies to satisfy customers' needs using a new hybrid grey relational model. *International Journal of Information Technology and Decision Making*. (SCI, impact factor: 3.139, revise)

◆ 研討會論文 (Conference Paper)

1. Wan-Yu Chiu, Gwo-Hshiung Tzeng, Han-Lin Li. Improving the E-Store Business Model for Satisfying Customers' Needs Using a Hybrid MCDM Combined DANP with Grey Relational Model, *The Second KES International Symposium IDT 2010.* Baltimore, USA, July 28-30, 2010.
2. Wan-Yu Chiu, Gwo-Hshiung Tzeng, Han-Lin Li. The e-store business strategies for improving customers' needs using a hybrid MCDM combined Fuzzy DANP with VIKOR, *The 21st International Conference on Multiple Criteria Decision Making.* Jyväskylän, Finland, June 13-17, 2011.