

**A CONSUMER PERSPECTIVE E-COMMERCE WEBSITE
EVALUATION MODEL**

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Abstrak

Kaedah penilaian laman web yang sedia ada mempunyai beberapa kelemahan seperti mengabaikan kriteria pengguna dalam membuat penilaian, tidak dapat berurusan dengan kriteria kualitatif, dan melibatkan timbangan dan pengiraan skor atau markah yang kompleks. Kajian ini bertujuan untuk membangunkan model hibrid penilaian laman web e-dagang yang berorientasikan pengguna berdasarkan Proses Hierarki Analisis Kabur (FAHP) dan Kaedah *Hardmard* (HM). Empat fasa telah terlibat dalam membangunkan model: pengenalpastian keperluan, kajian empirikal, pembinaan model, dan pengesahan model. Pengenalan keperluan dan kajian empirikal digunakan untuk mengenal pasti kriteria reka bentuk web kritikal dan mengumpul pilihan pengguna dalam talian. Data yang dikumpul daripada 152 pengguna di Malaysia dengan menggunakan soal selidik dalam talian, telah digunakan untuk mengenal pasti ciri kritikal dan skala kepentingan laman web e-dagang. Model penilaian yang baharu terdiri daripada tiga komponen. Pertama, kriteria penilaian pengguna yang terdiri daripada prinsip-prinsip penting yang dipertimbangkan oleh pengguna; kedua, mekanisme penilaian yang mengintegrasikan FAHP dan HM yang terdiri daripada pernyataan matematik yang menghuraikan tanggapan subjektif, formula baharu untuk mengira timbangan dan skor bagi setiap kriteria; dan ketiga, prosedur penilaian yang terdiri daripada aktiviti-aktiviti penubuhan matlamat, penyediaan dokumen, dan pengenalpastian prestasi laman web. Model ini telah diteliti oleh enam orang pakar dan digunakan dalam empat kajian kes. Hasil kajian menunjukkan bahawa model baharu adalah praktikal, dan sesuai untuk menilai laman web e-dagang dari perspektif pengguna, dan mampu untuk mengira timbangan dan skor atau markah bagi kriteria kualitatif dengan cara yang mudah. Di samping itu, ia dapat membantu pembuat keputusan untuk membuat keputusan dengan cara pengukuran yang objektif. Model ini juga menyumbang pengetahuan baharu dalam bidang penilaian perisian.

Kata kunci: Model penilaian laman web e-dagang, Proses Hierarki Analisis Kabur, Kaedah *Hardmard*.

Abstract

Existing website evaluation methods have some weaknesses such as neglecting consumer criteria in their evaluation, being unable to deal with qualitative criteria, and involving complex weight and score calculations. This research aims to develop a hybrid consumer-oriented e-commerce website evaluation model based on the Fuzzy Analytical Hierarchy Process (FAHP) and the Hardmard Method (HM). Four phases were involved in developing the model: requirements identification, empirical study, model construction, and model confirmation. Requirements identification and empirical study were to identify critical web-design criteria and gather online consumers' preferences. Data, collected from 152 Malaysian consumers using online questionnaires, were used to identify critical e-commerce website features and scale of importance. The new evaluation model comprised of three components. First, the consumer evaluation criteria that consist of the important principles considered by consumers; second, the evaluation mechanisms that integrate FAHP and HM consisting of mathematical expressions that handle subjective judgments, new formulas to calculate the weight and score for each criterion; and third, the evaluation procedures consisting of activities that comprise of goal establishment, document preparation, and identification of website performance. The model was examined by six experts and applied to four case studies. The results show that the new model is practical, and appropriate to evaluate e-commerce websites from consumers' perspectives, and is able to calculate weights and scores for qualitative criteria in a simple way. In addition, it is able to assist decision-makers to make decisions in a measured objective way. The model also contributes new knowledge to the software evaluation field.

Keywords: E-commerce website evaluation model, Fuzzy Analytical Hierarchy Process, Hardmard Method.

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List of Abbreviations

DMs	Decision Makers
ACSI	American Customer Satisfaction Index
AHP	Analytic Hierarchy Process
ANP	Analytical Network Process
BNP	Best Number Preference
CAS	Criteria Average Score
CEC	Consumer Evaluation Criteria
CI	Consistency Index
COA	Center of Area
CR	Consistency Ratio
DQAS	Descriptive Question Average Score
FAHP	Fuzzy Analytic Hierarchy Process
IEEE	Institute of Electrical and Electronics Engineers
ISO	International Organization for Standardization
KMO	Kaiser-Meyer-Olkin
MCDM	Multi-Criteria Decision Making
SPSS	Statistical Package for the Social Sciences
TFN	Triangular Fuzzy Number
WAS	Weight Average Sum

List of Publications

Tarawneh, O., Ahmad, F. (2009). Investigating the characteristics used in quantitative analysis of websites evaluation. *Paper presented at the 4th International Conference on Information Technology held on 3-5 June 2009, Al-Zaytoonah University, Jordan* (pp.69). Jordan: IEEE Computer Society

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Tarawneh, O., Ahmad, F., & Yahaya, J. (2012). B2C Quality Evaluation Factors from Jordanian Consumer Perspective. *In Proceedings of Knowledge Management International Conference, KMICe held on 4-6 July 2012 at Johor Bahru, Malaysia* (pp.246-250). Johor Bahru, Malaysia: KMICe.

CHAPTER ONE

INTRODUCTION

Chapter One presents the background of the study, followed by the research problem, research motivation, research questions, research objectives, research scope, and research methodology.

1.1 Background

The importance of companies' websites has been recognized by many. A website is defined as a collection of related web pages on a particular subject that includes a beginning file called a home page. According to Olsina et al., (2001), Sekaran (2006) and Zhang et al. (2008), websites are considered as applications on the World Wide Web, which in turn is considered as software (Dominic & Jati, 2010). According to Jinling (2005), the web plays a major role in diverse application domains, such as business, education, industry and entertainment.

Many companies are moving from the traditional way of doing business to the electronic way to cope with the evolution, to be competitive and remain sustainable (Liu et al., 2007; Miranda et al., 2006). As a result, companies have begun to focus on e-commerce website construction in their strategic planning activities (Liu & Hu, 2008). In general, e-commerce can be defined as a business process of selling and buying products, information, and services through online communications or via the internet medium (El-Aleem et al., 2005; Li et al., 2005). Indeed, e-commerce is considered as one of the best methods for buying and selling products, services, and information electronically. Therefore, a large number of e-commerce websites have

been established by companies to enhance their reputation and provide good services to the consumers through their companies' websites.

Since, e-commerce has made a significant impact on companies' growth, it is necessary for companies to evaluate their websites (Lee & Kozar, 2006; Laudon & Traver, 2007). Leahy (2004) defined website evaluation as a process of collecting, analyzing, and evaluating data that informs how well the website meets its objectives. Websites evaluation is thus an important matter. By evaluating e-commerce websites', the website owners can know the degree of reputation and popularity of their e-commerce websites with the consumers; the companies can know the consumers' needs (Li & Chen, 2010; Li & Wei, 2010). Also, the researchers and developers can know how to improve and measure the performance of e-commerce websites in the first place (Yu et al., 2011); the strength and weakness of the e-commerce websites can be known; new methods for improvement can be sought; the operational condition can be clarified (Liu & Hu, 2008), and e-commerce websites can be promoted to enhance their overall performance level (Zhang et al., 2008). Therefore, an accurate evaluation of these sites is needed (Wang & Zhou, 2009).

Website evaluation belongs to multi-criteria decision making (MCDM) field (Yücenur & Demirel, 2012; Ağırgün, 2012). It refers to making a preference decision, such as evaluation or selection over the available alternative using a set of criteria. Multi-criteria decision making consists of several alternatives, amongst which the decision-makers (DMs) have to give weights to each criterion. There are many multi-criteria decision making methods, and among these are simple additive weighting (SAW), technique ordering preference by similar ideal solution (TOPSIS), and analytic hierarchy process (AHP) (Tsai et al., 2010; Huang et al., 2009). The method

can be defined as a systematic process of achieving certain ends (Oxford University Press, 2014). In other words, it is a systematic process and techniques used to achieve certain target. Most of existing website evaluation methods suffer from several weaknesses which are omitting the consumer perspective in the process of websites development and evaluation, inability to handle the imprecision and subjective in decision making (Lee et al., 2012; Li & Pang, 2011), time consuming, and involves complex mathematical programming.

Understanding consumer criteria on their preference with regard to websites has become an important issue to study in order to evaluate e-commerce websites (Cheung et al., 2003). Jackson et al. (2006) defined consumer criteria as a process of what, when, why, and where consumers buy or do not buy (product or services). He combined criteria from psychology, sociology, social, anthropology and economics to understand the consumer decision making process and needs (Wang et al., 2008).

In order to obtain accurate results, many criteria related to consumer' perspective must be captured and used in the evaluation (Bai et al., 2008; Zviran et al., 2006). Unfortunately, most e-commerce websites were developed without having a clear knowledge of what criteria contribute to a desirable e-commerce website (Dominic & Jati, 2010; Pita et al., 2009; Lee & Kozar, 2006; Phippen et al., 2004; Yu et al., 2011; Phan et al., 2005). Most of the website's evaluation models concentrate on the websites' criteria itself and a few are concerned with other criteria (Yu et al., 2011). In general, the definition of model in this study would be a conceptual structure, graphical, and mathematical representation intended to serve as a guide or support for evaluating the e-commerce websites objectively (Leijnse & Hassanizadeh, 1994). In

other words, it is a graphical presentation that shows a systematic process of website evaluation.

Based on past literatures, it was found that there are a lack of research on e-commerce evaluation that deals with the consumer's perspective (Hausman & Siekpe, 2009; Lee & Kozar, 2006; Song & Zahedi, 2005; Cheung et al., 2003; Gamon et al., 2005; Lee & Lee, 2006; Wang & Zhou 2009; Yahaya et al., 2008). As a result, many websites that were launched fail to attract consumers (Noruzi, 2005; Norzi, 2006). One reason is the websites that were developed deviates from consumer expectations (Albuquerque & Belchior, 2002; Tian, 2004) that may lead to a low quality website (Phan et al., 2005). Consumer perspective can be defined as the consumer ability to recognize all relevant data and understand their importance (Zhang & Prybutok, 2005). For example, in online marketing, the consumer perspective would be opinions related to consumer impression, awareness, and consciousness about a product, information, or services provided by companies (Morris & Dillon, 1997).

E-commerce website evaluation is still in the immature (initial) phase where the methods are inefficient and evaluation made is mostly considered from the subjective view (cannot be measured) rather than the objective view (can measure), which makes the evaluation of e-commerce websites difficult and not easily understood (Li & Pang, 2011; Saeid et al., 2011; Wang, 2009). This means that the evaluation of the website criteria is considered subjective, depending mostly on experts' judgments rather than an objective way which can be measured and calculated (Saeid et al., 2011). Therefore, in order to evaluate e-commerce websites objectively, the appropriate evaluation methods are needed (Li & Wei, 2010; Wuwei, 2009).

The decision makers' face a problem when giving a score to certain criteria based on a specific scale (crisp value). This is because it is improbable to assign a crisp value for subjective criteria, when the information is uncertain or imprecise (Chang & Wang, 2009).

Multi-criteria decision making methods face different kinds of uncertainty, which generally could be considered by using fuzzy set theory (Zimmermann, 1987; Rao, 2007). Fuzzy set theory is appropriate when parameters are uncertain and subjective (Zarghami & Szidarovszky, 2009). A fuzzy based has been used in different studies (Lee et al., 2012; Dominic & Jati, 2010; Tong & Ji-Shun, 2010; Li & Pang, 2011; Wei et al., 2010; Lee et al., 2011). This approach is used when the evaluation and weights cannot be given precisely and used to model the uncertainty of human judgments and such problem is known as fuzzy multiple criteria decision making.

Also, most of the evaluation methods are time consuming and involve complex mathematical programming. Hardmard method can be used to overcome on the time consuming and the complexity of mathematical programming. Hardmard method is suitable to deal with matrix and easy to program (Million, 2007).

To address these problems, this study aims to develop a consumer e-commerce website evaluation model that can evaluate the e-commerce websites objectively with the consumer criteria as the main focus. The model includes a set of evaluation mechanisms and procedures to evaluate the websites.

1.2 Research Problem

Many websites fail to help companies reach their objectives because most of the e-commerce websites were developed without having clear knowledge of what criteria contribute to a desirable e-commerce website (Tsai et al., 2010; Dominic & Jati, 2010; Pita et al., 2009; Tan et al., 2009; Lee & Kozar, 2006; Phippen et al., 2004; Yu et al., 2011; Phan et al., 2005). As a result, many e-commerce websites do not attract the attention that they deserve because the websites mainly deviate from consumer expectations (Albuquerque & Belchior, 2002; Deraman et al., 2010; Tian, 2004).

Currently, there are many website evaluation models and among these models are the integrated model for airlines proposed by Pita et al., (2009), a mathematical evaluation model for fashion websites proposed by Zhu and Tong (2010), and new hybrid fuzzy MCDM model proposed by Chou and Cheng (2012). Most of evaluation models evaluate the websites based on technical perspective, such: Wang (2009); he used the criteria: traffic rank, user reach, page views, speed, and linked sites. Dominic and Jati (2010); they used the criteria: load time, response time, page rank, traffic, design optimization, accessibility error, and broken link criteria. Whereas, some of the researchers evaluated the websites based on the non-technical perspective, such as Pita et al., (2009), they used these criteria: - price, product, place, promotion, info quality, and service quality. Joia and Oliveria (2008), they used the criteria: - user style, user orientation, perceived utility, perceived ease of use, pleasure, trust, and attitude and intention to purchase. Based on the scenario described above, the following sub problems were identified.

Most of the website's evaluation models concentrate on technical criteria of the websites and are less concerned about other criteria related to non-technical criteria (Yu et al., 2011; Tarawneh et al., 2012). Based on past literatures, it was found that there is a lack of research on e-commerce evaluation that deals with the consumer's perspective (Hausman & Siekpe, 2009; Lee & Kozar, 2006; Song & Zahedi, 2005; Cheung et al., 2003; Gamon et al., 2005; Lee et al., 2006; Wang & Zhou 2009; Yahaya et al., 2008). Moreover, criteria used for the e-commerce evaluation models are not consistent. This means, that each model evaluates the e-commerce websites using different criteria than other models, and some of the criteria are overlapping with other models. As such, these criteria need to be refined frequently because the e-commerce website is a dynamic medium (Joia & Olivera, 2008). Some of the criteria that are considered as important now may not be important in the future and vice versa. Therefore, there is a need to investigate the criteria that contribute to a desirable e-commerce website and include more criteria related to consumers.

Several evaluation models are unscientific due to the evaluation being mostly considered from subjective view which it is difficult to measure (Wang, 2009). This means that the evaluation of the website criteria is considered subjective, depending mostly on experts' judgments rather than an objective way which can be measured and calculated (Saeid et al., 2011). In other's words, there is a difficulty in evaluating the subjective/qualitative criteria (Li & Pang, 2011). The decision makers' face a problem when they give a score to certain criteria based on a specific scale and used crisp value. Furthermore, they were unsure of the value that they give to some subjective criteria. Therefore, the websites' evaluation models were found to be inadequate for dealing with the imprecision or uncertainty of the linguistic evaluation

(Lee et al., 2012). Linguistic evaluation mean using a linguistic expression (one or more words such as Best, Good, Fair, Bad) to assign values for the criteria instead of using the crisp value in the process of the evaluation (Zadeh, 1975). Most of the websites' evaluation models neglecting the fuzziness of subjective judgment and other relative interest group's perception in the process of evaluation. Fuzzy set theory introduced by Bellman and Zadeh in 1970 is considered the most effective and appropriate theory compared to the traditional mathematical theory for dealing with the uncertainty and imprecision of the human judgments and decision making process in multi-criteria decision making (Zimmermann, 1996; Deng, 2005; Wibowo, 2011). Therefore, the fuzzy set theory can be used in this research to solve the problem in the imprecision and uncertainty.

Most of the evaluation methods are time consuming because of the mathematical calculations and number of pairwise comparisons that increases as the number of criteria increases (Yeh et al., 2000; Deng, 2005; Pohekar and Ramachandran, 2004; Velasquez & Hester, 2013). Analytical Hierarchy Process method (AHP) considered the appropriate method for business website evaluation because these different criteria which affect the performance of e-commerce website belong to different levels (Li & Pang, 2011). As mentioned earlier, Hardmard multiplication method is suitable to deal with matrix and easy to program (Million, 2007). Therefore, Hardmard multiplication method can be used to overcome on the time consuming and the complexity of mathematical programing.

Based on the above scenario, e-commerce websites evaluation model includes more consumer criteria, comprising evaluation method includes a set of mechanisms and procedure to evaluate the e-commerce websites is needed.

1.3 Research Motivation

Firstly, this research aims to help the e-commerce websites companies to reach their objectives and meet the consumers' needs by providing e-commerce websites evaluation model. This model consists of consumer evaluation criteria, new evaluation mechanism, and new evaluation procedures.

Secondly, this research offers more comprehensive criteria for e-commerce website evaluation from consumer perspectives that can be used to improve company websites to meet the consumers' needs.

Thirdly, this research provides standard criteria that can be used by the companies to develop their websites or evaluate the e-commerce websites. This in turn, will keep the companies competitive and sustainable. Further, this research is useful as it provides and improves the company e-commerce websites, help firms and companies to improve their marketing strategies.

Fourthly, this research defines a new mechanism and procedure to evaluate the subjective criteria (criteria cannot be measured directly) of e-commerce websites. This new mechanism is dealing with the subjectiveness, and imprecision of the human judgments and decision making process in multi-criteria decision making and dealing with the problem of time consuming. Also, the proposed mechanism makes the mathematical calculations easier.

Finally, this research is useful and beneficial to other researchers. Other researchers may find this study to be useful for its contribution to the literature and empirical findings obtained from this research.

1.4 Research Questions

The research questions are as follows:

1. What criteria do web consumer consider important when evaluating e-commerce websites?
2. How to determine the weight of subjective criteria?
3. How to define a set of standard procedure that can facilitate the evaluation process?
4. How to evaluate the e-commerce website evaluation model based on the consumer perspective?

1.5 Research Objectives

The research objectives are as follows:

1. To identify the consumer criteria for e-commerce website evaluation.
2. To develop a hybrid e-commerce website evaluation model based on consumer perspective.
3. To define a set of conducting procedures for the proposed model.
4. To evaluate the proposed model.

1.6 Research Scope

This research focused on commercial websites. In other words, this research focuses on the e-commerce websites that provides consumers with the products, services, and information; the consumers in his turn pay an amount of money for the companies that own these websites. Data were gathered from the Malaysian consumers who conduct online purchases. Survey method (monkey survey) was used to as a tool to distribute and collect the questionnaire. The sample chosen in this study is the

convenience sampling. The convenience sample was used because it considered the best method to deal with the unknown population (Black, 1999).

1.7 Research Methodology

The macro view of the proposed model is shown in Figure 1.0

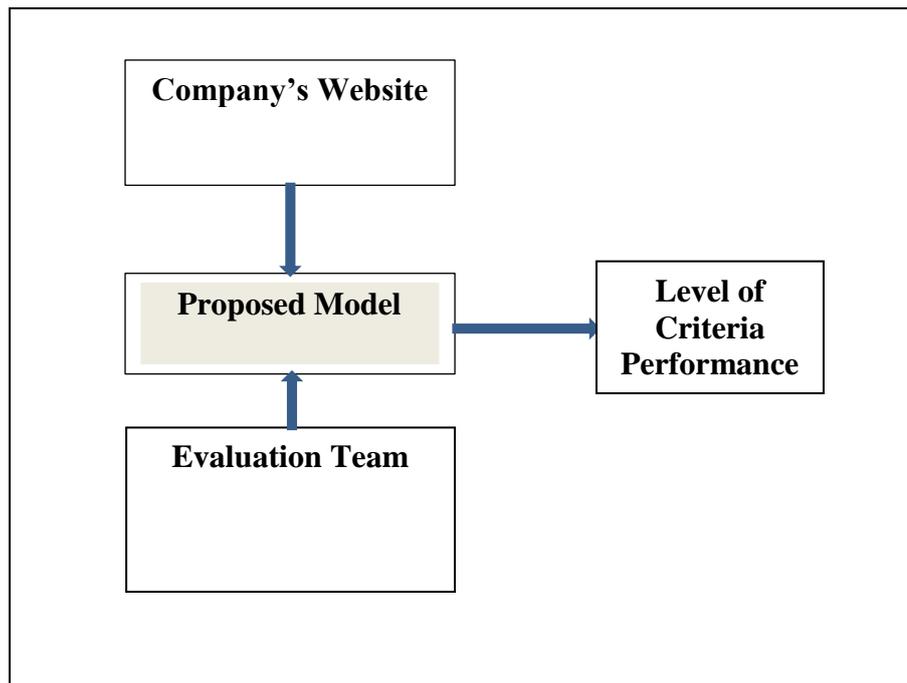


Figure 1.0. Macro view of the proposed model

The proposed model through the assistance of the evaluation team will evaluate a company's website. The result produced is the level of criteria performance. Proposed model was constructed in Four Phases. Figure 1.1 shows the overall structure. A detailed discussion on the methodology is presented in Chapter Three.

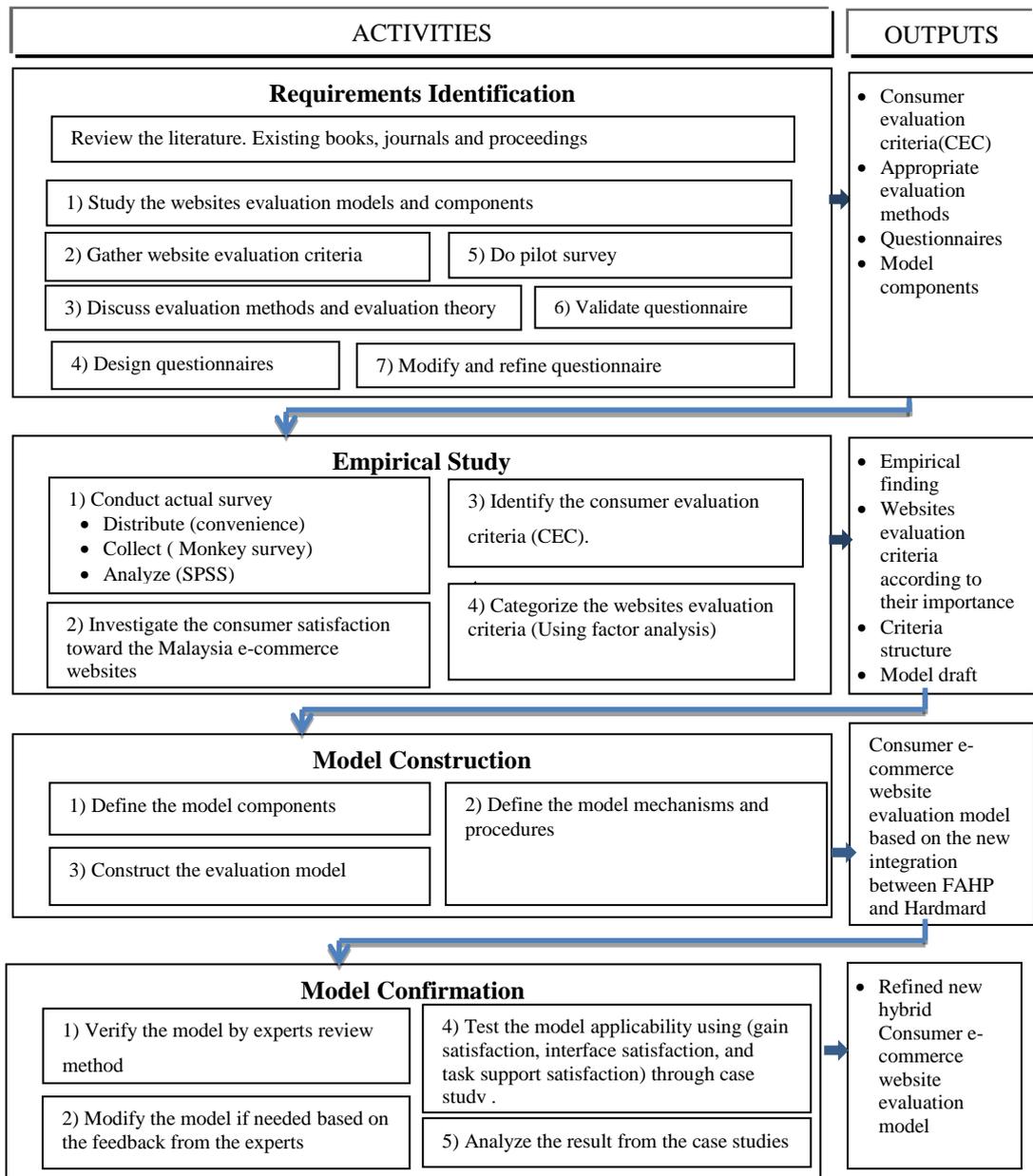


Figure 1.1. Research methodology for constructing the proposed model

1.8 Contributions

This research provides standard criteria for e-commerce website's evaluation and pushing the boundaries of the criteria by including more consumer criteria than other e-commerce websites evaluation models. Moreover, this research provides new categorization for the criteria based on the consumer perspective.

This research contributes towards the field of software engineering, particularly in software evaluation and websites' evaluation by providing a new hybrid consumer perspective e-commerce website evaluation model based on Fuzzy Analytical Hierarchy Process (FAHP), Hardmard method, Operational Laws of Triangular Fuzzy Numbers, and Weight Average Sum (WAS).

This research presents a new design on e-commerce website evaluation model. The consumer perspective criteria are included and measured, provided by new modern forms to gather the weight from the experts and the score from the consumers and provided by new formulas to calculate the criteria weights and score in order to evaluate the e-commerce website.

In addition, this model defines a new mechanism to measure the qualitative criteria for e-commerce website's application objectively. This mechanism is dealing with the imprecision and subjective of the evaluation, and the time consuming problem, thus making the evaluation scientific, realistic, and simple.

The mechanism in this model allows dealing with big numbers of criteria compared to other mechanisms in other models. Also, give opportunity to increase the number of experts that participate in the process of the evaluation.

Moreover, it defines a procedure to evaluate the website objectively, thus making the evaluation scientific, realistic, and simple. Evaluating the websites objectively makes the measurement of the criteria score easy and understandable. Also, this research contributes toward the research area by providing a scheme in describing the overall activities and steps of evaluation procedures.

This research provides a semi computational system to calculate the criteria weight using mathematical software and develops score list and weight list forms which make the data collection from the developers and the consumers more efficient and simple.

As additional expected contribution, this research provides new constructed questionnaires to the domain area. These questionnaires were tested and examined by content test, and constructive test.

Furthermore, this research presents empirical findings from the survey that is obtained in Malaysian firms. It offers a view of the implementation of the website's evaluation, particularly in Malaysian firms.

1.9 Thesis Organization

This section outlines the rest of the chapters as follows:

1.9.1 Chapter Two

This chapter gives an overview of the e-commerce websites evaluation criteria, the methods used in e-commerce website evaluation, website evaluation techniques, and validation methods of websites evaluation models. It also mentions some of the strengths and the weaknesses of each evaluation method. The final section of this chapter talks about evaluation theory to identify the model components, and fuzzy set. It includes references from books, journals, newspapers, and proceedings.

The aim of this chapter is to investigate the criteria that affect the quality of the evaluation in e-commerce website applications, the limitation of websites evaluation

methods. Reviewing the current websites evaluation models would enable the researcher to have a broad understanding of the subject matter .

1.9.2 Chapter Three

This chapter presents the research methodology that has been used to achieve the research objectives. The methodology consists of four sequential phases where each phase includes a set of input, activities, and output to achieve the research objectives. The final aim is to construct a consumer perspective e-commerce websites evaluation model.

1.9.3 Chapter Four

This chapter presents the findings of the empirical study that was conducted in Malaysia. The empirical study was done to understand the issues related to the consumer satisfaction toward the e-commerce websites they used, rank and categorize the criteria based on their importance from the consumers' perspectives.

1.9.4 Chapter Five

This chapter presents the consumer e-commerce website evaluation model (CREE). The model and its components are also presented and discussed. Besides these, the criteria, mechanisms, and procedure used to evaluate e-commerce website application were elaborated.

1.9.5 Chapter Six

This chapter presents the validating process of CREE. Case study method was used to validate the proposed model.

1.9.6 Chapter Seven

This final chapter highlights the conclusion of this research; specifically the research contribution, limitation, and future work. Here, the research questions are answered and the research objectives are achieved.

1.10 Conclusion

This chapter presents the research background and the research problem. The research motivations were also included in this chapter to explain why the problems mentioned in earlier stage need to be solved. Based on the research problems and the research motivation, the research questions and objectives were mapped in order to solve the research problems. The main focus of this research is evaluation on commercial websites. To achieve the research objectives the methodology was presented. The methodology phases involved were requirements identification, empirical study, model construction, model confirmation.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

As mentioned earlier, the aim of this chapter is to investigate the criteria used in the website evaluation, investigate the existing methods used in website evaluation, and investigate the problem associated with each method. The evaluation techniques, validation method used in the study, fuzzy set, and evaluation theory are also discussed.

2.2 Website Evaluation

Website evaluation can be defined as a process of collecting, analyzing, and evaluating data that informs how well the website meets its objectives (Leahy, 2004). Websites evaluation is thus an important matter. As mentioned earlier, website evaluation belongs to Multi-criteria decision making (MCDM) problem field (Yücenur & Demirel, 2012; Ağırgün, 2012). It refers to making a preference decision, such as evaluation or selection over the available alternative using a set of criteria.

Many efforts have been made to address website evaluation for several organizational sectors. In particular, travel websites domain was the main focus in the literature (Lee et al., 2012; Baloglu & Pekcan, 2006; Law, 2007; Lee & Kozar, 2006; Wan, 2002; Chiang & Chen, 2012) followed by government websites, hospital (Li & Chen, 2010; Bueyuekoezkan & Ruan, 2007; Li & Pang, 2011) and e-learning websites and (Dominic & Jati, 2010; Shee & Wang, 2008; Kasli and Avcikurt, 2008). The next sections, discuss the evaluation criteria and the methods used in the evaluation.

Website evaluation can be done through two approaches. The first approach guarantees the development process of the websites and the second approach evaluates the website as a final product (Pressman, 2000; Behkamal et al., 2009). In this research the second approach was used to evaluate the e-commerce website.

2.3 Evaluation Criteria of E-commerce Websites

Defining the evaluation criteria is an essential and critical step in any evaluation process, especially in the e-commerce website evaluation; the Consumer Evaluation Criteria (CEC) is constructed based on the review results of the state-of-theory and state-of-practice of the e-commerce website evaluation (Yahaya, 2007). Website evaluation criteria's have been proposed in several contexts in recent years. The researchers were found to be struggling in this area to identify and determined important criteria for evaluating e-commerce websites. Olsina and Rossi (2002) and Olsina and Rossi (2000) used Quality Evaluation Method (QEM) to measure the usability, functionality, reliability, and efficiency of the website. Such a method was also used by Miranda, Cortés and Barriuso (2006) to evaluate the quality of the product. Zeithaml (2002) claimed that e-service quality has 7 dimensions which are reliability, efficiency, fulfillment, privacy, compensation, responsiveness, and contact. Next, Kim, Kim, and Lennon (2006) presented a modified E-SQUAL model. They expected to capture extensive service criteria available on clothes retail websites. Their modified model adds three additional dimensions to the previous model. The three new dimensions were personalization, graphic styles, and information. Miranda, Cortés, and Barriuso (2006) developed a Web Assessment Index (WAI), which focuses on four criteria: functionality, usability, efficiency, reliability. Also, this method was used in turn by Miranda-Gonza'lez and Ban'egil- Palacios (2004) but

they focus on different four criteria which are navigability, accessibility, content, and speed. Ho and Lee (2007) used factor analysis to develop a scale to e-travel websites. This scale focuses on five categories which are information, security, responsiveness website functionality, and customer relationships. In addition, Cao, Zhang, and Seydel (2005) used the same technique which is the factor analysis to propose three categories which are system quality, service quality, information quality, and attractiveness. Barnes and Vidgen (2002) proposed a new scale that measures the offering of the organization e-commerce website. The scale provided five criteria which are usability, information, empathy, design, and trust. Usability was measured and defined in various ways (Agarwal & Venkatesh, 2002). Nielsen (1994) claimed that usability can be measured by five criteria's which are: memorability learnability, low error rate or easy error recovery, efficiency, and satisfaction. He also suggested that "usability is a quality criteria that evaluates how simple user interfaces are to use" (Nielsen, 2003). The Microsoft Usability Guideline (MUG) was also another method used to evaluate the usability of the website (Venkatesh et al., 2003). In Jinling and Huan's perspective (2007), MUG included five criteria: promotion, content, made-for-the-medium, ease of use, and emotion. International Organization for Standardization (ISO) defined usability as "the extent in which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use". Nielsen (2000) extended information system design for websites and suggested four criteria for usability; the criteria were credibility, response time, navigation, and content. Agarwal and Venkatesh (2002) also, proposed guidelines of Microsoft usability in order to measure the website usability using five dimensions (made-for-the-medium, emotion, content, promotion, ease of use). While, Tarafdar and Zhang (2005) proposed that the usability can be

measured by information content, download delay, ease of navigation, and website availability. Pita et al. (2009) proposed that the airline websites can be measured by price, place, promotion, product, service quality, info quality, and system quality.

The analysis of past research is tabulated in Appendix (A) shows there are lack of a comprehensive e-commerce website evaluation criteria (Pita et al., 2009). Furthermore, there is some of the evaluation studies includes the consumer criteria in the evaluation model. But, they do not consider the consumer criteria comprehensively. Each model evaluates the websites based on their own criteria while the criteria were different from model to a model. In other words, each of these models evaluated the websites from various dimensions with different criteria and methods. As observed from previous website's evaluation models, the availability to identify evaluation criteria is difficult to meet the requirements and the needs. Analysis of these studies has indicated that the criteria associated with these models were different and there is no consistency with regard to the consumer criteria. Table 2.1 shows the occurrence for the criteria that were used in the previous evaluation studies.

Table 2.1
Criteria Used in Previous Evaluation Models

Criteria/ research No. in Appendix A	Price	Communication	Currency	Relevance	Reliability	Responsiveness	Credibility	Security	Personalization	Navigability	Advertising	Speed	Link	Richness	Attractiveness	Resilience	Degree of care	Tangibility	presentability, visual appeal	Empathy	Awareness	Reputation	Product / value added	Content	Serviceability	Safety	Design	Functionality	Efficiency	Privacy	Enterprise features	Accessibility	Usability	Correctness	Stability	Clarity	Trust	Enjoyment	Accuracy	Promotion	User friendly interface	Visibility	Diversity of product, info										
1	*	*	*	*	*	*	*	*	*	*	*											*																															
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criteria / research No. in Appendix A	Price	Communication	Currency	Relevance	Reliability	Responsiveness	Credibility	Security	Personalization	Navigability	Advertising	Speed	Link	Richness	Attractiveness	Resilience	Degree of care	Tangibility	presentability, visual appeal	Empathy	Awareness	Reputation	Product / value added	Content	Serviceability	Safety	Design	Functionality	Efficiency	Privacy	Enterprise features	Accessibility	Usability	Correctness	Stability	Clarity	Trust	Enjoyment	Accuracy	Promotion	User friendly interface	Visibility	Diversity of product, info			
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occur	6	4	10	8	12	9	5	17	5	14	5	6	3	7	1	1	1	1	6	3	3	7	7	7	10	4	10	9	9	6	2	7	16	4	4	4	6	4	5	4	6	5	2			

Based on Table 2.1, it can be concluded there is a lack of researches on website evaluation from consumer perspectives. In other words, the previous evaluation models did not focus on the non-technical criteria such as: reputation, advertising, and price. Most of the evaluation models focus on the website technical criteria. The analysis of Table 2.1 also, shows that non-technical criteria did not consider in the process of evaluation compared to other's criteria. This means the consumer perspective needed to be considered more intensively. The occurrences of some criteria were found very low compared to other criteria such as security, usability, navigability, reliability, design, and functionality (43.6%, 41.0%, 35.9%, 30.78%, 25.64%, and 23.07%) respectively.

Table 2.2 presents the occurrence of some criteria related to thirty nine researches (Appendix A) among the other's criteria. Based on the criteria presented in Table 2.1, the most used and important criteria were obtained. This was done by calculating the occurrences of the criteria. The occurrences were calculated in terms of percentage. The formula used was the total number of occurrences divide by 39 (number of researchers) multiply by 100.

Table 2.2
Occurrences of Criteria on Past Researches

No.	Criteria	Occurrence Percentage %
1	Attractiveness	2.56 %
2	Degree Of Care	2.56 %
3	Resilience	2.56 %
4	Tangibility	2.56 %
5	Diversity Of (Product and Info)	5.12 %
6	Enterprise Features	5.12 %
7	Awareness	7.70 %
8	Empathy	7.70 %
9	Link	7.70%
10	Clarity	10.25 %
11	Communication	10.25 %
12	Correctness	10.25 %
13	Enjoyment	10.25 %
14	Promotion	10.25 %
15	Safety	10.25 %
16	Stability	10.26%
17	Accuracy	12.82 %
18	Advertising	12.82 %
19	Credibility	12.82 %
20	Personalization	12.82%
21	Visibility	12.82 %
22	Presentability	15.38%
23	Price	15.38 %
24	Privacy	15.38%
25	Speed	15.38%
26	User Friendly	15.38 %
27	Trust	15.40%
28	Accessibility	17.95%
29	Content	17.95%
30	Reputation	17.95%
31	Richness	17.95%
32	Value added	17.95%
33	Relevance	20.51%
34	Efficiency	23.08%
35	Functionality	23.08%
36	Responsiveness	23.08%
37	Currency	25.64%

38	Design	25.64%
39	Serviceability	25.64%
40	Reliability	30.77%
41	Navigability	35.90%
42	Usability	41.03%
43	Security	43.59%

As discussed earlier, it has been discovered that most of the websites have been developed without having clear guidelines of what criteria must consider to achieve a desirable website. This mean current website evaluation models do not incorporate with common and specific criteria to develop or evaluate their websites. Also, the consumer criteria were not considered comprehensively. Therefore, there is indeed a lack of standard evaluation models for business website evaluation. It can be concluded, there is a need to include more consumer criteria to the evaluation models. Based on the analysis in Table 2.1, the most used and important criteria should be considered for the website's evaluation and developments. The criteria are: usability, navigability, reliability, currency, serviceability, design, responsiveness, functionality, efficiency, and relevance. These criteria were found the most used criteria in the previous researches mentioned earlier. Followed by richness, reputation, value added, content, accessibility, price, speed, persentability, privacy, trust, user friendly, credibility, personalization, accuracy, and visibility. Thus, make the criteria communication, safety, correctness, stability, clarity, enjoyment, promotion, link, empathy, awareness, and diversity of product, info, and services etc come in the last place of usage in the process of developments and evaluation. These criteria were identified and will be filtered in Chapter Three, Section 3.1.1 and ranked and categorized in Chapter Four, Section 4.2.3.1. The criteria after the

filtering and categorizing in Chapter Four will be the first input and components of the proposed model.

2.3.1 E-commerce Evaluation Criteria Domains

According to Ethier et al., (2006), the research on website evaluation can be classified into four major research categories. The first considers that the information, system, and services are the main and critical criteria to evaluate the E-commerce websites (Ahn et al., 2007; Cao et al., 2005; Liu & Arnett, 2000; Moon & Kim, 2001). The second is concerned with websites functionalities such as design, response time, content (Bauer & Scharl, 2000; Evans & King, 1999; Huizingh, 2000). The third includes studies that present service as a fundamental aspect of website quality and include criteria such as reliability, responsiveness, assurance, and tangibility (Cai & Jun, 2003; Cox & Dale, 2002; Webb & Webb, 2004). The fourth category focuses on website quality based on information, responsiveness, reliability, and friendliness (Wan, 2000). Websites have to meet the consumers' expectations in terms of information, enjoyment, and transactions (Huang, 2005; Katerattanakul, 2002). The following Sections 2.3.1.1, 2.3.1.2, and 2.3.1.3 present the common categories used in websites evaluation.

2.3.1.1 System Criteria Domain

This domain is to measure the system performance criteria and the information processing system itself (Ahn et al., 2007; Lee & Kozar, 2006; Tsai et al., 2011). High system performance provides the consumers with more responsiveness,

privacy, and convenience (Ahn et al., 2007). It can be measured using the following criteria: security, navigability, and personalization.

This domain is defined for the period of the system analysis and development, depending on the consumers' needs. It is considered as one of the important criteria that affect consumers' satisfaction of the web. Thus, criteria such as technical adequacy, delay, security, appearance, and navigability, are considered important criteria that affect the performance of the system (Ahn et al., 2007). Lee and Kozar (2006) investigate the system success criteria to evaluate the e-business, which are navigability, response time, personalization, security, and telepresence.

Liao and Cheung (2001) presented the impact of the system capability on the usefulness and perceived ease of use of websites. Koufaris (2003) showed that using mechanisms for search may provide the consumers the feeling of enjoyment and fulfillment. Tsai et al., (2011) evaluate the quality of the system for airlines e-commerce websites based on three criteria which are security, navigability, and personalization. On the other hand, other researchers have developed various measures of system criteria like Swanson (1974), Emery (1971), and Hamilton (1981), whereby they included criteria to measure the quality of the system. The first criteria included reliability of the computer system, online response time, ease of terminal use. The second criteria included database content, aggregation of details, human factors, response time, and accuracy of the system. The third criteria included response time, turnaround time, data accuracy and currency, reliability,

completeness, flexibility of the system, and ease of use as a part of formative evaluation.

2.3.1.2 Information Criteria Domain

This domain refers to the overall information produced and delivered by a system as perceived by the consumer (Lee & Kozar, 2006; Tsai et al., 2011). At the phase of design and development of the system, various types of information are usually determined and some criteria such as timeliness, reliability, and accuracy are projected as a result of the system operation (Ahn et al., 2007). Srinivasan (1985) measured the user-perceived effectiveness of the system by the content which in turn included accuracy of the information, relevancy of information, adequacy, and understandability of the contents. In addition, he argued the form of the content which included quality of format, timeliness of reports, sequencing of information, and mode of presentation. Lee and Kozar (2006) investigate the information success criteria to evaluate the e-business which are understandability, relevancy, and currency.

Lederer et al., (2000) showed that information domain and perceived usefulness had strong relationship. Also, Jarvenpaa and Todd (1996) showed that information with high level of clarity and visual appeal of the products or services may generate positive comment from the consumers. Also, high levels of information quality (variety, completeness, detailed, accurate, timely, relevant, and reliable) could provide the consumers with convenience, enjoyment, and better purchase decisions

(Ahn et al., 2007). Tsai et al., (2011) evaluate the quality of the information for airlines e-commerce websites based on two criteria which are currency and relevancy. Koufaris (2003) decomposed the information into two groups, which are non-value-added and value-added, for more enrichment and satisfying shopping information and showed this decomposition could be helpful and interesting.

2.3.1.3 Services Criteria Domain

This domain refers to the overall support delivered by the e-commerce website such how well a delivered service level matches consumer expectation (Ahn et al., 2007; Lee & Kozar, 2006). For the services domain, numerous communication mechanisms are needed for accepting user complaints and their timely resolution within web-based projects. Also, web-based project involves the perception of users for helping them to be more effective, and know the feedback, consider their suggestion for the product and services, and participants to solve the problems (Ahn et al., 2007). Several researches considered measuring the services as tangibles: responsiveness and reliability (Pitt et al., 1995; Myers et al., 1997). Myers (1997) argued the services importance between the end user computing and the non-centered environments; and pointed to the danger if the information system researchers evaluate the e-commerce websites without taking the service into consideration. Lee and Kozar (2006) investigate the services success criteria to evaluate the e-business which are empathy, responsiveness, and reliability. Tsai et al., (2011) evaluate the quality of the services for airlines e-commerce websites based on three criteria which are responsiveness, reliability, and credibility. In

addition, Barnes and Vidgen (2001) built the WEBQUAL model to evaluate the services based on ten dimensions which are aesthetics, navigationally, reliability, competence, responsiveness, accessibility, credibility, security, communication and understandability. They also presented the measurement concepts to the service quality for the websites. However, a few studies have discussed the service as success criteria of websites, and there is an urgent need to consider other values of services from the consumers' perspective. This is because the service plays an important role in online retailing (Ahn et al., 2007). Sun & Lin (2009) concluded that there are urgent needs to discover the criteria of products that have an effect on consumer e-shopping.

2.4 The Methods Used in Evaluation of E-commerce Website

Various evaluation methods were employed to evaluate the websites based on individual preference using subjective approaches, such as the Analytic Hierarchy Process (Lee & Kozar, 2006; Zhu & Tong, 2010; Shee & Wang, 2008), the Technique for Order Preference by Similarity to an Ideal Solution (TOPSIS) (Tzeng & Opricovic, 2005; Celik et al., 2009; Bu"yu"ko"zkan & Ruan, 2007; Law, 2007), the Preference Ranking Organization Method for Enrichment Evaluation (PROMETHEE) (Albadvi et al., 2007; Behzadian et al., 2010; Bilsel et al., 2006), and the VIKOR (Pita et al., 2009; Bu"yu"ko"zkan et al., 2007).

Lee and Kozar (2006) present the application of the AHP to evaluate four online travel websites by adopting DeLone and McLean's IS success model. Specifically,

they investigate website quality criteria, investigate the criteria relative importance in choosing the most preferred website, and investigate the relationship between the website preference and financial performance. The application of AHP found to be useful to provide the decision makers of e-business companies to enhance the quality of their website. Zhu and Tong (2010) build an evaluation index system and evaluation mathematics model of fashion B2C e-commerce website in China through making use of AHP. The evaluation index was decomposed to three main categories which are product, website and service, the second level decomposed to 10 the third level decomposed to 36 indicators. Then, the judgment matrixes were generated and tested. The judgment matrixes were generated by using the pairwise comparison in all the level mentioned before and tested using the consistency check. After that, the weight was calculated to produce the final comparative judgment matrix. In this study, the applying of AHP found to be significance in the evaluation of fashion websites.

However, because of the limitation of the AHP method in dealing with the uncertainty and subjectiveness in the process of evaluation, several studies have been conducted on the development of the FAHP method for solving the above problems in a fuzzy environment (Kahraman et al., 2004; Celik et al., 2009). The FAHP method is considered as a systematic method employs the concepts of fuzzy set theory for making a decision (Kwong and Bai, 2003). This method allows the evaluator/decision maker to specify the degree of importance for the criteria in natural language or numerical value form (Cheng, 1996; Kahraman et al., 2004).

Bilsel et al. (2006) used the AHP with Fuzzy PROMETHEE ranking approach to evaluate the e-services quality of 9 hospitals based on 7 categories which are (integration of communication, tangibles, reliability, empathy responsiveness, confidence, and quality of information). Sun and Lin (2009) used TOPSIS method in order to evaluate the competitive advantages of shopping websites. Here the criteria that effect on the shopping websites were identified. The TOPSIS method was used to evaluate and rank four shopping websites by determining the weights of the identified criteria. The study shows that the application of the TOPSIS method enables a comprehensive and consistent study of all criteria involved in this evaluation process. While, Wang (2009) used TOPSIS method in order to evaluate ten e-commerce websites in effective way and avoid the subjectivity on the evaluation. To avoid the subjectiviness, the relative closeness degree of each evaluated object was adopted with the entropy analysis to calculate the index weight for five identified criteria. The method found to be practicable. Liu (2008) used TOPSIS method to rank the risk in terms of their overall performances. The calculation conducted on seven main risk criteria's (Physical Security, Requirements risk, Resources Risk, Managerial risk, Legal Risk, Outsourcing, and Culture Risk. The method was found to be feasible and effective.

Lee et al. (2012) present the TOPSIS method for evaluating the travel websites service quality in an airline industry under a fuzzy environment. Linguistic variables are used to evaluate the weights of all criteria. Linguistic variables are words used in a linguistic expression (one or more words such as Best, Good, Fair, Bad) and are

used to assign value for the criteria instead of using the crisp value (Integer numbers) (Zadeh, 1975). Also, linguistic variables such as (Excellent, Very good, Good, and bad) are used to evaluate the performance of each alternative with respect to each selected criterion such as (excellent, very good, good, and bad). Here, the decision matrix of the weight and performance were constructed. Then, a closeness coefficient for the criteria is identified and the distance between the alternative (suppliers) were calculated under fuzzy environment. The method is found to be very flexible which is capable of providing more objective information in the supplier selection and evaluation process. Also, Zhang et al. (2008) used TOPSIS method under fuzzy environment. They established evaluation index system and convert the system index to Normalized decision matrix. Then he calculated the weight for the matrix to determine the ideal and negative-ideal solutions and calculate the weighting distance of each alternative to the ideal solution. Yu et al. (2011) rank B2C e-commerce websites in e-alliance based on AHP and TOPSIS under the fuzzy environment. The AHP is applied to create the hierarchy structure and to determine weights of the criteria, fuzzy sets is obtained to present subjectivity and ambiguity with linguistic values, and TOPSIS method is used to obtain final ranking. However, this research did not take the fuzziness of the weight in consideration. In addition, Tsaur et al. (2002) used this method to evaluate the quality of the service in an airline industry by identifying the criteria that affect the service of quality. Then they calculated the weight using analytical hierarchy process (AHP) method. In later stage they used TOPSIS method to measure the closeness coefficient by measuring the

distances between the fuzzy positive ideal solution and the fuzzy negative ideal solution.

Fuzzy VIKOR method was used by Buyukozkan et al. (2007) in order to evaluate twenty one e-learning websites depending on seven main criteria (understandable content, complete content, security personalization, user interface, navigation, and interactivity). However, they neglected interrelationships between the seven main criteria when determining the criteria weights. Moreover, Buyukozkan and Ruan (2007) used FTOPSIS and FAHP to rank 13 government websites in Turkey based on six dimensions. Tsai et al. (2010) proposes new model to evaluate the websites of the national park in Taiwan. In this model the Decision-Making Trial and Evaluation Laboratory (DEMATEL) method was combined ANP and VlseKriterijumska Optimizacija I Kompromisno Resenje (VIKOR). The use of the DEMATEL was to cope with the interdependencies between the criteria of evaluation. ANP was used to calculate the weight for each criterion. Finally, the VlseKriterijumska Optimizacija I Kompromisno Resenje (VIKOR) to rank Taiwanese national park websites. The result of this research was that the national park websites need to be improved. However, this model is complex and time consuming especially when the number of criteria and decision makers increase. Chou and Cheng (2012) combined the fuzzy analytic network process (FANP) and fuzzy VlseKriterijumska Optimizacija I Kompromisno Resenje (FVIKOR) in order to evaluate the quality of CPAs websites in Taiwan. The results of this research helped Certified Public Accountant (CPAs) to identify the weaknesses and strengths of their websites. However, this method

neglected the consistency and found to be complex when the number of the criteria is increase. Yücenur and Demirel (2012) used extended VIKOR under fuzzy environment to determine the best feasible solution according to the predefined criteria. They combined the extended VIKOR with the fuzzy logic to solve the problem with non-commensurable criteria, assuming that compromising is acceptable for conflict resolution. Content analysis was used in other websites evaluation methods, such as (yes, no) scale and 5 Likert scale. Baloglu and Pekcan (2006) and Cai, Card, and Cole (2004) used this method to analyze 20 US tour operators and 139 hotels websites. Also, content analysis was used by Kasli and Avcikurt (2008) to examine the websites of 132 tourism departments at universities. In addition, Wan (2002) used the same method to evaluate 30 tourist hotels websites and 39 tour wholesalers using a 5-point rating scale. He took into account the performance on each criterion, but the relative importance of various criteria was neglected. Also, Many studies used the mathematical programming method in evaluation from the perspective of tangible cost and tangible benefits of the each alternative in certain situation (Li and Pang, 2011; Chiou et al., 2011; Sun and Wen, 2008; Albuquerque and BELCHIOR, (2003); Chang and Lee, (2010); Kameshwaran et al., (2007)). In tem of software certification, Jamaiah (2007) used weight score method (WSM) to rank the quality of the software combined with WAS (weight) average Sum. Chang and Lee (2010) applied this method for selecting and evaluating the best central airport networks. This method used to evaluate and select the best airport among other based on the airport performance. This method allows the decision maker to decide the number of destination nodes must be operated and what

nodes should be included to get the lowest operational cost. Kameshwaran et al. (2007) applies mathematical programming method for evaluating the e-procurement problem. He used this method to help the evaluator to deal with incommensurable units regard to e- procurement evaluation and selection. However, this method needs to specify the goals before the evaluation by the decision maker. Also, this method found to be suffering from lacks a systematic procedure for setting priorities among criteria (Lee and Kim, 2001; Gabriel et al., 2005).

Table 2.3 summarizes the strength and weaknesses of the common methods used in the website evaluation.

Table 2.3

Strength and Weaknesses of the Common Websites Evaluation Methods

MCDM methods	Strength	Weaknesses	Source
AHP	<ul style="list-style-type: none"> • Suitable for simple and complex problem • Support the objective and subjective data • Provide high efficient method to assign the weights • AHP enables decision makers to structure a decision making problem into a hierarchy, helping them to understand and simplify the problem. • It is flexible and powerful tool for handling both qualitative and quantitative multi-criteria problems. • AHP procedures are applicable to individual and group decision making • A certain value of consistency is allowed • Easy to capture and convenient. 	<ul style="list-style-type: none"> • The decision makers need to re-evaluate alternatives when the numbers of criteria or alternatives are changed. • Ranking of alternatives depends on the alternatives considered for evaluation hence adding or deleting alternatives can lead to changes in the final rank. • It cannot compute gaps between the status quo and ideal point. • Perfect consistency is very difficult • Time consuming with large numbers • Doesn't take into account the uncertainty 	<ul style="list-style-type: none"> • Tsai et al., (2010) • Huang et al., (2009). • Saaty, (2008) • Falessi et al., (2011) • Sun, (2010) • Ruth, (2008) • Pita et al., (2009)
Fuzzy logic	<ul style="list-style-type: none"> • The decision makers can use linguistic terms to evaluate alternatives easily and intuitively. • It improves decision making procedure by accommodating the vagueness and ambiguity occurred during human decision making. 	<ul style="list-style-type: none"> • Difficult to compute fuzzy appropriateness index values and ranking values for all alternatives. 	<ul style="list-style-type: none"> • Triantaphyllou & Lin, (1996).
WSM	<ul style="list-style-type: none"> • Very simple • Suitable for small problems 	<ul style="list-style-type: none"> • Lack of process to assign the weight • Does not support the large number of evaluation criteria • Weak in sustaining multi-value features • Include the summation of different data types (i.e. cost plus memory plus quality) • Weights to the attribute are assigned arbitrary and it is very difficult to assign weight when number of criteria is high. • To obtain a score using this method a common numerical scaling is required. 	<ul style="list-style-type: none"> • Alves & Finkelstein, (2003) • Maxville et al., (2004) • Solberg & Dahl, (2001)

		<ul style="list-style-type: none"> • Difficulties emerge when WAS is applied to multi-dimensional MCDM problems. 	
Analytical Network Process (ANP)	<ul style="list-style-type: none"> • There is no need for criteria structure • ANP is a relatively simple, intuitive method that can be accepted by managers and other decision-makers. • ANP allows for more complex interrelationships among the decision levels and attributes • ANP method is capable of handling interdependence among elements by obtaining the composite weights through the development of a “super matrix.” 	<ul style="list-style-type: none"> • The complexity increases exponentially with the number of indicators and their interdependencies, due both to the numbers of pairwise comparisons and to the dimensions of questionnaires. • There are also linguistic problems. The semantics used in pairwise comparison (e.g., “how much more important”) often does not keep up with more complex issues when comparing elements in a network structure • Insufficient and imprecise to capture the right judgments of the decision-maker 	<ul style="list-style-type: none"> • Pita et al., (2009) • Tsai et al., (2010)
Fuzzy Analytical Hierarchy Process (FAHP)	<ul style="list-style-type: none"> • FAHP should be able to tolerate vagueness or ambiguity. In other words, FAHP is capable of capturing a human's appraisal of ambiguity when complex multi-attribute decision making problems are considered • Similar scale to Saaty’s can be used • Overcome the inability of AHP to handle the imprecision and subjectiveness in the pairwise comparison process 	<ul style="list-style-type: none"> • Time consuming 	<ul style="list-style-type: none"> • Bueyuekoezkan & Ruan, (2007). • Tsai et al., (2010)
Fuzzy Analytical Network Process (FANP)	<ul style="list-style-type: none"> • Dealing with imprecise and uncertain human comparison judgments. • It allows for multiple representations of uncertain human preferences, as crisp, interval, and fuzzy judgments and can find a solution from incomplete sets of pairwise comparisons. • It measures the inconsistency of the uncertain human preferences by an appropriate consistency index. 	<ul style="list-style-type: none"> • Time consuming • The complexity increases exponentially with the number of indicators and their interdependencies, due both to the numbers of pairwise comparisons and to the dimensions of questionnaires. • Hard to convince DMs 	<ul style="list-style-type: none"> • Tsai et al., (2010) • Mikhailov & Singh, (2003).

TOPSIS	<ul style="list-style-type: none"> • This method generally, adopts AHP or Delphi to determine the evaluation index weight. 	<ul style="list-style-type: none"> • It judge the relative closeness degree based on two distance of D^+, D^-, which cannot reflect the exact quality for each website. • Scientific evaluation cannot be obtained adopting TOPSIS method. 	<ul style="list-style-type: none"> • Triantaphyllou & Lin, (1996).
Mathematical Programming Methods	<ul style="list-style-type: none"> • (a) avoid the possible solution bias, (b) consider all resource constraints, and (c) allow relative rankings of the evaluation and selection criteria in an easy manner. • The method is very much realistic as it can consider multiple objectives and multiple constraints with a certain degree of flexibility. More importantly, this method is capable of addressing various types of projects evaluation and selection situations. 	<ul style="list-style-type: none"> • This method needs complex mathematical computation in the evaluation process when the number of criteria increases. 	<ul style="list-style-type: none"> • Li and Pang, (2011) • Chiou et al., (2011) • Sun and Wen, (2008)

As shown in Table 2.3, the literature shows that most existing website evaluation methods suffer from several weaknesses which can be summarized in the following points i) the mathematical programming is very of complicated, ii) inability to handle the imprecision and subjective present in the decision making process, iii) time consuming and cognitively demanding on the decision maker (s).

To address these problems, this study aims to develop consumer e-commerce website evaluation model with respect to specific circumstances that the problem is in, which are inability to handle the imprecision and subjective present in the decision making process, time consuming and cognitively demanding on the decision maker (s), and the complexity of the mathematical programming.

2.4.1 Summary and Discussion

Past studies show that there are many methods for evaluation on commercial websites. However, there are only few of evaluation models that are widely recognized and accepted (Lee & Chen, 2010). Moreover, the diversity of the evaluation method means there is no standard evaluation method for websites evaluation. Many researchers have noted that there are lack on accepted method and criteria (Law et al., 2010; Morrison, Taylor; & Douglas, 2004; Tsai et al., 2010; Chiou et al., 2011; Pita at al., 2009). Previous model of evaluation used conventional method for evaluation such as AHP, WSM, and others, which are inadequate for dealing with the imprecision or uncertainty of the evaluation (Lee et al., 2012). Furthermore, majority of the methods rely only on a panel of experts to perform the evaluation. They were neglecting the fuzziness of subjective judgment and other relative interest group's perception in this process such as users and consumers. Thus, an effective

evaluation procedure is essential to promote the decision quality (Liu et al., 2012; Li & Pang, 2011; Wang et al., 2006).

2.5 Evaluation Techniques in Website Evaluation

There are many techniques were used in the evaluation process such as questionnaire survey, survey based on the individual reviews, survey based on focus group, case studies, statistical analysis, and checklists. All these techniques are available to be used in the evaluation technique. In constructing evaluation technique it is very important to ensure that the evaluation technique should be easy to use and understandable (Rae, Hausen & Robert, 1995). In this research, each of the following techniques was used to evaluate the e-commerce websites which are questionnaire survey, case study survey, expert reviews, and checklist.

Questionnaire survey can be defined as a comprehensive system for collecting data using a standardized questionnaire Kasunic (2005). Survey technique was used for conducting an empirical study in Malaysia. Specifically, this technique was chosen due to many reasons. Firstly, the aim of this study is descriptive. For example, it aims to describe the consumer's satisfaction toward the Malaysian e-commerce websites and describe the online buying habits of Malaysian consumers. Secondly, "What" or "how many/much" kind of research questions are suitable for survey approach. In order to collect data, a specific tool or instrument must be used. Therefore, questionnaire was used for this study due to several reasons such as: cost effectiveness; ease to analyze the data, coverage of a wide area, and also it supports a high degree of secrecy (Kirakowski, 2000).

Checklist technique is considered as one of the several techniques that can be used with different approaches. This technique is the easy way to ensure that business benefit statements will be quite clearly understood by the target respondents and easy to manipulate and customize. Indeed, it is considered as a good technique for software evaluation. Moreover, this technique involves formal reviews of intermediate and final websites as software products. For each website criteria, a checklist would list various questions to be asked. Checklist can be used as an instrument for websites evaluation because it can address quantitative as well as qualitative subjects (Faulkner 2006; Punter 1997; Sullivan 1996). Punter et al. (1997) said that the checklist technique is an important technique for evaluation and easy to customized. Behkamal et al., (2009) used the five point Likert scale list evaluation technique to evaluate the quality of B2B application. Therefore, it is considered as an important technique for evaluation. In this research it called score list form.

The score list form was constructed based on the output of the empirical study conducted in Malaysia (Chapter Four). Twenty six criteria were found to be important from the Malaysian consumer perspective. Then the measurements for each criterion were identified from the literature review. Table 2.4 shows the items/ descriptive questions used to measure the score for each criterion.

Table 2.4
Criteria Measurement Sources

Num	Criteria	Measure	Sources
1	Price	<ul style="list-style-type: none"> • Reasonability of the price provided by the website? • price comparison 	<ul style="list-style-type: none"> • Lin (2006) • Hasslinger et al. (2007) • Chiou et al. (2011)
2	Purchasing transaction	<ul style="list-style-type: none"> • The website provides various options for payments? • Ease of understanding policies • Ease of placing orders • Credibility of online transaction 	<ul style="list-style-type: none"> • Pita et al. (2009) • Kim & Kim (2004)
3	Safety	<ul style="list-style-type: none"> • The system operate without (internal) catastrophic failure • Good system recovery • Privacy protection • Payment systems security • Vulnerability • Site authentication • Access control • Confidentiality • Privacy • Clients authentication • Imputability 	<ul style="list-style-type: none"> • Cao et al. (2009) • Mario Barbacci, Mark et al. (1995) • Rababah & Masoud (2010)
4	Website Visibility	<ul style="list-style-type: none"> • Tracable, • Retrievable • Ease of access • Links visibility • Links visualization consistence 	<ul style="list-style-type: none"> • Wang et al. (2008) • Rababah & Masoud (2010) • Fitzpatrick, (2000)
5	User friendly	<ul style="list-style-type: none"> • Communication facilities • Forms of payment availability • Storage of purchase list • Products comparison • Printing facilities • Download facilities • Help availability 	<ul style="list-style-type: none"> • Rababah & Masoud (2010)
6	Diversity of products and services	<ul style="list-style-type: none"> • Product or services variety (Promote many type of products and services). • Customized offering • Product or services suggestion 	<ul style="list-style-type: none"> • Chiou et al., (2011)
7	correctness	<ul style="list-style-type: none"> • The accuracy of website information • The exactness of website information 	<ul style="list-style-type: none"> • Dragulanescu (2002) • Hasan & Abuelrub (2011)
8	Presentability	<ul style="list-style-type: none"> • Graphic representation. • Readability of the content. • Multimedia usage 	<ul style="list-style-type: none"> • Moustakis et al. (2006) • Moustakis et al.(2004) • Kim & Stoel (2004)
9	Currency (Updated)	<ul style="list-style-type: none"> • The website provides timely information (current, freshness, up to date) 	<ul style="list-style-type: none"> • Dragulanescu (2002)
10	Relevant	<ul style="list-style-type: none"> • Organization's objectives • Organization's history • Customers (audience) • Products or services • Photography of organization's facilities 	<ul style="list-style-type: none"> • Hasan, & Abuelrub (2011)

11	Trust on purchasing via credit cards or bank transfer	<ul style="list-style-type: none"> • Perception of safety • Trust on the internet as retail shopping • Trust on internet as retail shopping • Completeness 	<ul style="list-style-type: none"> • Hasslinger et al. (2007) • Rababah & Masoud (2010)
12	Clarity	<ul style="list-style-type: none"> • How do you rate the clarity of the websites information such as provide detail as possible, and free of mistakes? 	<ul style="list-style-type: none"> • Palmer (2002). • Henry & Kafura (1981)
13	Richness	<ul style="list-style-type: none"> • Product details • Comprehensive content coverage • Rich advertising and banner of product or services 	<ul style="list-style-type: none"> • Chiou et al. (2011)
14	Reliability	<ul style="list-style-type: none"> • Correct website function • Uncommon occurrence of website crash • Effective information delivery service • Correct information displayed 	<ul style="list-style-type: none"> • Lee et al. (2011) • Lee et al. (2012)
15	High responsiveness	<ul style="list-style-type: none"> • The consumers get fast respond once order has been confirmed. • Time needed to respond once order made. • Problem dealing mechanism • Provide relative information for problem solving • Respond to customer's complaints 	<ul style="list-style-type: none"> • Lee et al. (2011) • Lee et al. (2012)
16	Credibility	<ul style="list-style-type: none"> • Confidentiality • Integrity 	<ul style="list-style-type: none"> • Yang & Fang (2004) • Fitzpatrick (2000)
17	Enjoyable experience	<ul style="list-style-type: none"> • pleasure • joy 	<ul style="list-style-type: none"> • Wahab et al. (2010) • Al-Momani & Noor (2009)
18	Serviceability	<ul style="list-style-type: none"> • Before sale service • After sale service • Logistic service 	<ul style="list-style-type: none"> • Zhu & Tong (2010) • Cao et al. (2009) • Behkamal et al. (2006)
19	Navigability	<ul style="list-style-type: none"> • Searching and retrieving issue • Navigation and browsing issue • Domain specific functionality and content • Absence of navigability errors • Shortcut facility • Alternative paths • User level adaptability 	<ul style="list-style-type: none"> • Rababah & Masoud (2010)
20	Efficiency	<ul style="list-style-type: none"> • Page generation speed Fast display of the web page • Purchase process performance • Page generation speed • Graphics generation speed • Memory utilization saving • I/O devices utilization saving 	<ul style="list-style-type: none"> • Rababah & Masoud (2010) • Lee et al. (2011) • Lee et al. (2012)
21	Accessibility	<ul style="list-style-type: none"> • Memory utilization saving (System hang)? • Design the web page which is compatible with the assistive technologies • How do you rate the number of panes regarding frame? • Readable image title • Global Readability • How do you rate the mobile devices accessibility 	<ul style="list-style-type: none"> • Rababah & Masoud (2010) • Sun & Wen (2008)
22	Learnability	<ul style="list-style-type: none"> • Interface complexity • Interface density 	<ul style="list-style-type: none"> • ISO/IEC 9126 (2002)

		<ul style="list-style-type: none"> • Ease of component learning • Effectiveness of help system • Customizability • Interface Complexity 	
23	Understandability	<ul style="list-style-type: none"> • Design legibility (Readability of the website) • I/O Message Understandability • Site map Understandability • Comprehensibility of the website contents 	<ul style="list-style-type: none"> • Fitzpatrick (2000) • ISO/IEC 9126 (2002)
24	Reputation	<ul style="list-style-type: none"> • Average requested reputation • Market honesty • Average number of transactions • Average number of malicious incidents 	<ul style="list-style-type: none"> • Gutowska et al. (2009)
25	Enterprise features	<ul style="list-style-type: none"> • The website provides additional facilities that surprises their consumers in a positive way. Such as, provide and anticipate enough access to the questions that the consumer may have, provide the consumer with links to other sites that may deal better with some issue of interest to the consumer? 	Madu & Madu (2002)
26	Promotion	<ul style="list-style-type: none"> • Purchasing guarantee • Promotion campaign • Advertising banner • Discount 	<ul style="list-style-type: none"> • Chiou et al. (2011) • Pita et al. (2009) • al-Smadi (2013)

The complete score list form is shown in Appendix B.

2.6 Validation Methods of Websites Evaluation Models

Based on the studies shown in Appendix A, most of the evaluation models (53.8%) used case study method to validate their model. 38.46% of researchers used empirical study to validate their evaluation model. The rest of researchers used other methods to validate their evaluation models such as survey (7.74%). In this research two methods were used to verify the websites evaluation model: - (i) expert reviews, (ii) case study.

Expert review method is conducted after integrate the model components together. The feedback from the experts are collected and analysed to modify the model components. After the model modification, the model components are presented again to the experts. The experts are asked to answer questionnaire regard to verify the

evaluation model. The questionnaire is constructed based on criteria used by Kunda (2002).

The second method is case study. Four case studies are used to validate the proposed model. The goal of this method is to test the proposed model's applicability using the factors: gain satisfaction, interface satisfaction, and task support satisfaction. Here, the estimation factors for the case study have been identified according to Kunda (2002) and Kitchenham and Pickard (1998), as shown in Table 2.5. These factors were found to be suitable to validate the proposed models in such similar scenarios (Yusef, 2012; Hamid, 2013). Yusof (2012) used these factors to validate his proposed model in developments and improvements. Also, Hamid (2013) used these factors to validate framework for COTs selection and evaluation.

Table 2.5
Factors of Evaluating the Proposed Model (Adapted from Kunda, 2002; Kitchenham & Pickard, 1998)

Evaluation Factors	Variables
Gain satisfaction	<ul style="list-style-type: none"> - Perceived usefulness - Decision support satisfaction - Comparing with current method - Clarity - Appropriateness for task
Interface satisfaction	<ul style="list-style-type: none"> - Perceived ease of use - Internally consistent - Organization (Well organized) - Appropriate for audience - Presentation (readable and useful format)
Task support satisfaction	<ul style="list-style-type: none"> - Ability to produce expected results - Completeness - Ease to implementation - Understandability (easy to understand)

2.7 Evaluation Theory

Evaluation is considered as a multidisciplinary field, despite the concepts and process; the evaluation knowledge is feed from various fields (Scriven, 1991). Until lately, evaluation was considered as a part of other disciplines and not treated as a discipline in its own right. However, recently there has been a theoretical framework which considered as guideline or a general-purpose that defines the different types of evaluation methods. In this study the evaluation theory is used to construct the evaluation model based on the evaluation theory components.

Evaluation theory, describes the parts or the components for any evaluation method type. Scriven (1991) defined the components of the evaluation as target, criteria, standard or yardstick, data gathering technique, synthesis technique, and finally evaluation process. The target means the object that needs to be evaluated and the criteria means the attributes that need to be evaluated. Standard refers to optimal target compared and gathering technique means the technique used to collect the data. In addition, synthesis technique means the technique used to judge whether the target is good enough or not. Finally, evaluation process means the activities and tasks for which an evaluation is performed (Lopez, 2000).

One of the successful uses of the evaluation theory in software engineering is shown in the works that were carried out by Ares et al. (2000) and Zarour (2009). They used the evaluation theory to develop a framework for evaluating the methods of Software Process Assessment (SPA). Moreover, Casal et al. (1998) used the evaluation theory to develop a formal and systematic framework for evaluating the software process of an organization. Therefore, evaluation theory has been used to achieve the main goal of the study which is to construct consumer e-commerce websites evaluation model.

In general, the model components are criteria, evaluation techniques, evaluation process, and evaluation mechanisms (Alvaro et al., 2007; Alvaro et al., 2010).

- **Evaluation criteria**

It defines which criteria's are essential to evaluate e-commerce website. Research approach provides the model with new criteria from the consumers' perspectives (Chapter Four). Also, in the context of model construction, the criteria related to company and products were not neglected. Because most of the past researches were focus on the criteria of the websites itself and ignored the other types of criteria. Current websites evaluation models focus and depend on the usage of the evaluation process and development requirement more than studying and evaluating the criteria of the websites. Therefore, the consumer evaluation criteria must be investigated and identified.

- **Evaluation Techniques**

The second component is evaluation technique. The evaluation technique was used to evaluate the consumer criteria. The evaluation of the consumer criteria reflects the evaluation of the e-commerce websites. Score list was developed based on the output from the empirical study to obtain the score from the consumers. Weight list was developed to obtain the weights from the experts. This technique is easy and can be clearly understood by the target respondents and easy to manipulate and customize. Indeed, it is considered as a good technique of website evaluation. Moreover, this technique involves formal reviews of intermediate and final websites as software products. For each websites criteria or criteria, a Score list would list various questions to be asked. Score list can be used as an instrument for websites evaluation because it can address quantitative

as well as qualitative subjects. Therefore, Score list technique was selected to evaluate the e-commerce websites. Score list form Appendix B. weight list form Appendix E.

- **Evaluation Process**

This component defines a group of techniques, criteria, methods and tools to evaluate the e-commerce website components. It aims to establish a well-defined e-commerce website evaluation standard. This process is discussed in detail in Section 5.5.

- **Evaluation mechanisms**

This component requires a measurement mechanism for feedback and evaluation. It is a way to answer several questions associated with the enactment of any software process. Measurement is very important to provide the accurate data that is needed for evaluation and analysis. There are many mechanisms in the literature for defining measurable goals such as quality function deployment approach, software quality metrics approach, and goal question method (Scriven, 1991; Yahaya, 2007).

2.8 Fuzzy Set

The history of the fuzzy set goes back to the year 1965 when Professor Lotfi Zadeh introduced this term (Zadeh 1965). The main idea behind a fuzzy set is to use the linguistic variables to describe fuzzy terms and then map this linguistic variable to a numerical variable within two valued sets $\{0, 1\}$ of truth values of Boolean logic and replace these two values by the unit interval $[0, 1]$ in the decision making process.

In fuzzy set, each membership has a value intermediate between $[0, 1]$, referring to the degree of affiliation of a member of the set. In general, if the element is equal to 0 that means it's completely an outside set, however, if the element is equal to 1, that means it is completely an inside set and if the element has value between 0 and 1 it is a partially inside set (Bellman & Zadeh, 1970).

Let X be the universe of discourse, $X = \{x_1, x_2, \dots, x_n\}$. \tilde{A} is a fuzzy set of X that represent a set of order couples

$$\{(x_1, \mu_{\tilde{A}}(x_1)), (x_2, \mu_{\tilde{A}}(x_2)), \dots, (x_n, \mu_{\tilde{A}}(x_n))\}, \quad \mu_{\tilde{A}}: X \rightarrow [0, 1],$$

is the function of membership grade "Membership Function" of \tilde{A} , and $\mu_{\tilde{A}}(x_i)$ stands for the membership degree of x_i in \tilde{A} .

A fuzzy number represents a fuzzy subset in the universe of discourse X that is both convex and normal. Triangular Fuzzy Number, Trapezoidal Fuzzy Number, and Bell-Shaped Fuzzy Number are types of membership function. However, among the various types of membership function, this study aims to adopt the type of a triangular fuzzy number.

A triangular fuzzy number is a fuzzy number represented by three points (p_1, p_2, p_3) and $(p_1 < p_2 < p_3)$. The interpreted membership functions $\mu_{\tilde{A}}(x)$ of the fuzzy number \tilde{A} is:

$$\mu_{\tilde{A}}(x) = \begin{cases} 0, & x < p_1 \\ \frac{x-p_1}{p_2-p_1}, & p_1 \leq x \leq p_2 \\ 0, & x \leq p_3 \end{cases}$$

The triangular fuzzy number above can be shown as $\tilde{A} = (p_1, p_2, p_3)$

Where p_1 and p_3 represent fuzzy probabilities between the lower and upper boundaries of evaluation information.

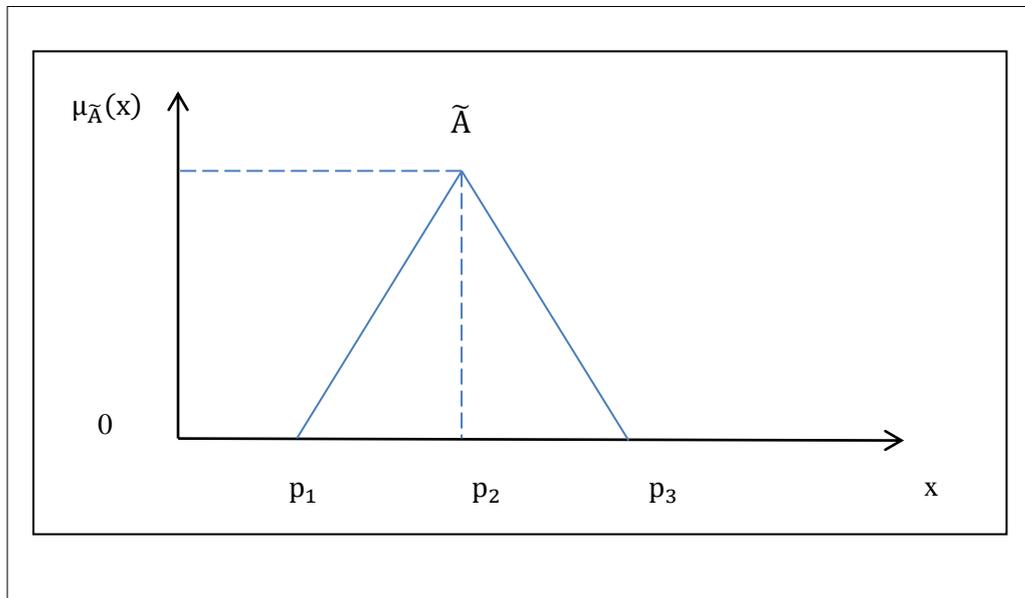


Figure 2.1. The membership function of the triangular fuzzy number

2.9 Summary

Because of the rapidly increasing of internet development, e-commerce is considered an excellent choice for companies to reach new consumers, reach the global development, and considered one of the most important contributions of the information technology revolution (Smith & Rupp, 2003). This study presents and tabulates thirty nine studies that have done on websites evaluation. Specifically, it presents some of websites evaluation models, evaluation methods, and criteria.

Failure of the dot.com companies occur when the behavior of the websites deviates from user expectations or if the websites neglect consumers' needs (Albuquerque & Belchior, 2002; Deraman et al., 2010; Tian, 2004). Unfortunately, the literature reveals a scarcity of studies on websites' quality evaluation from consumer perspectives. In other words, the consumers' perspective is often ignored in website

evaluation (Cheung et al., 2003; Gamon et al., 2005; Lee et al., 2006; Loiacono et al., 2002; Wang & Zhou 2009; Yahaya et al., 2008).

Hausman & Siekpe (2009), Lee & Kozar (2006), and Song & Zahedi (2005) related this failure to designers who did not take the consumer aspect or human element into consideration in their website development. Moreover, a large percentage of websites are unacceptable from the users' point of view (Lazar et al., 2004). Albuquerque & Belchior (2002), Schubert and Dettling (2001), and Schubert and Leimstoll (2002) reported that most of websites are far from what the users expect, and do not meet the consumers' needs.

Understanding the consumer criteria with regards to websites has become an important issue to study and focus on in order to evaluate the e-commerce websites from the perspectives of consumer (Cheung et al., 2003). However, the literature indicates that although measuring the satisfaction of user with e-commerce applications is very important, it is a very complex task and determining the factors that enhance a user's attitude to companies' websites is very critical (Ahn et al., 2007).

According to Institute of Electrical and Electronics Engineers (IEEE) standard definitions, and also supported by Albuquerque & Belchior (2002) and Tian (2004), failure of the e-commerce websites occurs when the behavior of the websites deviates from consumer expectations or if the websites neglect consumers' needs. Unfortunately, the literature reveals a scarcity of studies on e-commerce websites' evaluation from consumer perspectives. In other words, the consumers' perspective is

often ignored in website evaluation (Gamon et al., 2005; Lee et al., 2006; Loiacono et al., 2002; Wang & Zhou, 2009; Yahaya et al., 2008).

Through observing the literature about websites evaluation and related studies, it can be concluded, that there is a need for website evaluation model which consists of comprehensive evaluation criteria, suitable evaluation method, and evaluation process guidance. In other words, the literature does not have any commonly agreed standards for evaluating e-commerce website (Qi et al., 2010; Li & Chen, 2010). Also, most of websites evaluation models were constructed as follows: -i) identify the evaluation criteria, ii) establish hierarchy structure (system index), iii) select one of multi-criteria decision making methods to evaluate the websites (Lee et al., 2011; Liu et al., 2012; Tong & Ji-Shun, 2010).

CHAPTER THREE

RESEARCH METHODOLOGY

The purpose of this chapter is to explain the process of constructing the model. Four phases were involved and these include requirements identification, empirical study, model construction, and model confirmation. Each phase has inputs, activities or process and output. These phases are discussed in the following sections respectively.

3.1 Phase One: Requirements Identification

This phase reviews past studies on the research area, specifically concentrating on the models and methods used in websites evaluation and consumer evaluation criteria.

This phase is conducted in four parts, identifying consumer evaluation criteria, designing questionnaire, questionnaire testing, and identifying the evaluation model components. Sections 3.1.1, 3.1.2, 3.1.3, and Section 3.1.4 describe the activities conducted for each part respectively.

3.1.1 Identifying Consumer Evaluation Criteria

This part was performed by reviewing past literatures. Through reviewing the past studies, Fifty four criteria were identified from thirty nine researches collected from Google's scholar, ACM, IEEE, and Direct Science search engine from 2003 to 2012.

The criteria are: price, place, response time, understandability, telepresence, speed, link effectiveness, currency, navigability, richness, relevance, attractiveness, layout, before sale services, before sale services, logistics service (serviceability), enterprise features, risk control mechanism, efficiency, privacy, reliability, responsiveness, accessibility, usability, correctness, stability, personalization, learnability,

completeness, communication, credibility, security, advertising, resilience, degree of care, tangibility, presentability, visual appeal, empathy, awareness, reputation, product / value added, content, safety, design, functionality, clarity, trust, enjoyment, accuracy, promotion, user friendly interface, visibility, and diversity of product and services.

After the criteria were identified, filtering and removing duplicate criteria took place. The process was as follows. First, the criteria were listed vertically and horizontally (Table 3.1). The synonyms and the relations for each criterion were studied. If there is a strong relation between the criteria, the sign + is placed. If the criteria have the same synonyms (carry the same meaning) the sign \equiv is place. In other words, the sign + means there is a relation between the criteria. This relation must be presented because there is some related to others such as usability criteria; it represented by understandability, learnability, and operability. The sign \equiv means that the criteria have the same synonyms and in this case only one criterion will be selected. If there are some criteria reflect or related to certain criteria, these criteria will be removed because the related criteria cover his existence and so on.

Some of the criteria were removed because there are other criteria that give the same meaning, and some criteria were removed because there some criteria covered them. It has been found that two criteria carry the same meanings which are empathy and visual appeal. Empathy criterion is equivalent to the degree of care; visual appeal is equivalent to layout and presentability criteria.

In terms of overlapping or duplicate, 17 criterions found to cover each other completely and partially. A Place criterion is covered by communication and

transaction criteria. Privacy and security criteria were covered and replaced by safety criterion. The criteria currency, completeness, link effectiveness, relevancy, and accuracy criteria are cover content criteria. Also, the link effectiveness is covered by efficiency criteria. The criteria before sale services, after sale services, and logistic service can be expressed by one criteria which is serviceability. Design criteria can be replaced by layout and user friendly criteria. Functionality criteria can be replaced by the following criteria (speed, link, navigation, accuracy, and diversity of means of payment). Risk control management is covered by safety criteria. As a result after removing the duplicate and overlapping, only 35 criterions were identified and selected for the next stage which is the empirical study. The new generated criteria list was tabulated in Section 3.1.4.1.

3.1.2 Designing Questionnaire

The main goal of this study is to obtain the important criteria for e-commerce websites evaluation. In order to achieve the goal, survey technique was used to conduct the study (Malaysia). For conducting an empirical study in Malaysia. The aims of the survey were as follows.

1. To investigate the consumer satisfaction toward the Malaysian e-commerce websites.
2. To rank the consumer criteria based on their importance degree.
3. To identify the evaluation criteria for evaluating the e-commerce websites based on the criteria importance.

The questionnaires of the survey consisted of three main sections i) demographic data; ii) consumer satisfaction; iii) consumer evaluation criteria. Sections 3.1.2.1, 3.2.2.2, and 3.1.2.3 explain the formulation for the three sections. The questionnaire was designed and established based on several studies such as the studies by Escobar-Rodríguez and Carvajal-Trujillo (2012), Ellatif (2006), Huang et al., (2009), Lee and Kozar (2006), and ACSI (American Customer Satisfaction Index standard). To see the complete questionnaires refer to Appendix C. Table 3.2 shows the questionnaire items sources. The empirical study was conducted on Malaysian consumers due to the time constrains.

Table 3.2
Questionnaire Items Development

Section I: Demographic Data			
Variables	Item number	Items	Sources
Respondents details	1	Gender	Lee and Kozar (2006)
	2	Age	Lee and Kozar (2006)
	3	Educational level	Pintrich (1991) Online surveys "QuestionPro"
	4	Living place	Online surveys "QuestionPro"
	5	E-commerce knowledge	Yahaya, 2006 Ellatif (2006) Online surveys "QuestionPro"
	6	Online purchasing experiences	Online surveys "QuestionPro"
	7	Internet connection type	
	8	Online buying habits	
	9	Websites you frequently visit	Yahaya, 2006
Section II: General Information			
Variables	Item number	Items	Sources
Consumer Satisfaction	10	Overall, are you satisfied with the e-commerce websites that you use?	ACSI (American Customer Satisfaction Index standard).
	11	Does the services provided by the e-commerce websites live up to your expectation?	
	12	Do you agree that the performance and quality issues of the e-commerce website before selection or purchasing are important?	
	13	Based on your experience with the e-commerce websites, how likely are you to buy or visit the e-commerce websites again?	
	14	Based on your experience with the e-commerce websites, How likely are you to recommend the e-commerce websites to others?	Yahaya, (2006)
	15	Does all the e-commerce websites that you usually use follow any method to meet the consumers' needs? (eg. getting feedback; updating their websites according to consumers' recommendation etc.)	
	16	Do you think if consumers participate in the process of evaluation and development of an e-commerce websites, they can achieve their satisfaction?	
Section III: Consumer Related criteria			
Variables	Item number	Items	Sources
Evaluation Criteria	17	Price	Zhu and Tong (2010) Pita et al., (2009) Lee and Kozar (2006)

18	Diversity of product, info	(Liu,& Arnett, 2000). (Spremi & Strugar, 2008)
19	Understandability	Chou at el., (2012) Wei et al., (2010) Lee and Kozar (2006)
20	Speed	Tsai et al., (2010) Wang, (2009) Zhu & Tong, (2010)
21	Visibility	Chiou et al.,(2011) Wang, N., Liu, D., & Cheng, J. (2008)
22	Currency	Chou at el., (2012) Zhu and Tong (2010) Pita et al., (2009) Lee and Kozar (2006)
23	Navigability	Pita et al., (2009) Chou et al., (2012) Lee and Kozar (2006)
24	Richness	Chou et al., (2012) Tsai et al., (2010)
25	Relevance	Chou at el., (2012) Pita et al., (2009) Lee and Kozar (2006)
26	Attractiveness	Tsai et al., (2010) Joia & Oliveira, (2008)
27	Serviceability	Zhu and Tong (2010). (Behkamal et al., (2006) (Ahn et al., 2007) (Cao et al., 2005) (Lin, 2006) (Al-Momani & Noor, 2009)
28	Enterprise features	Wang et al., (2012)
29	User friendly interface	Li & Wei (2010) Wuwei (2009) (Behkamal et al., (2006)
30	Efficiency	Lee at el., (2012) (Kalaimagal and Srinivasn, 2010/a) (Sharma et al., 2008) (ISO, 2011)
31	Reliability	Lee at el., (2012) Pita et al., (2009) (Bertoa and Valecillo, 2002) (ISO, 2011) (Kalaimagal and Srinivasn, 2010/a) Lee and Kozar (2006)
32	Responsiveness	Lee at el., (2012) Pita et al., (2009) Lee and Kozar (2006)
33	Accessibility	Chou at el., (2012) Domini and Jati (2010) Sun and Wen, (2008)
34	Correctness	Li & Wei (2010) Wuwei, L. (2009)
35	Stability	Tong and Ji-Shun (2010). Li & Wei (2010) Wuwei, L. (2009) Li and Pang (2011)
36	Learnability	Lin, (2010)
37	purchasing transaction	Pita et al., (2009)
38	Credibility	Pita et al., (2009) Chiou et al.,(2011)
39	Resilience	(Ullah, M., & Zaidi, W. 2009)

40	Degree of care	Chou et al., (2012) Wei et al., (2010) Lee and Kozar (2006)
41	Tangibility	Chiou, W. C., Lin, C. C., & Perng, C. (2011) (Zeithaml, V., Berry, L., & Parasuraman, A., 1988) (Webb, H., & Webb, L., 2004) (Kim, J., & Lee, J., 2002) (Madu, C., & Madu, A., 2002) (Lin, P., 2006) (Cho, S., & Park, K., 2003)
42	Presentability, Visual appeal , Layout	Zhu and Tong (2010) Tong and Ji-Shun (2010) Li and Pang (2011) Wei et al., (2010)
43	Reputation	Gutowska and Sloane, (2009) Wang et al., (2012) Lee and Kozar (2006)
44	Product / value added	Pita et al., (2009)
45	Safety	Pita et al., (2009) Zhu and Tong (2010) Tong and Ji-Shun (2010) Li and Pang (2011) (ISO, 2011) (Kalaimagal and Srinivasn, 2010/b) (ISO, 2001) (Seffah et al., 2006) (Tam, 2012) Lee and Kozar (2006)
46	Personalization	Pita et al., (2009) Lee and Kozar (2006) Li and Pang (2011) Lee et al., (2011)
47	Clarity	Wei et al., (2010)
48	Trust	Fang-fang, C., & Yi-jun, L. (2006) Joia, L. A., & Oliveira, L. C. B. D. (2008) Lin, H. F. (2010) Yu, X., Guo, S., Guo, J., & Huang, X. (2011)
49	Enjoyment	Joia & Oliveira, (2008)
50	Accuracy	Wei et al., (2010)
51	Promotion	Zhu and Tong (2010) Pita et al., (2009)
52	Response time	Domini and Jati (2010) Lee and Kozar (2006) Chiou et al.,(2011)

The third Section (**User Related criteria**) was constructed based on the following researches:

- Yahaya, (2006)
- Escobar-Rodríguez and Carvajal-Trujillo (2012)
- Ellatif (2006)
- Huang et al., (2009)
- Lee and Kozar (2006)
- Kunda,(2002)

3.1.2.1 Demographic Data

Since the consumers' perspective is the main focus and consumers are considered as the main users of the websites, therefore demographic data were included in the questionnaire. Nine questions on demographic data that include gender, age, educational level, living place, e-commerce knowledge, e-commerce operating experiences, online purchasing experiences, internet connection type, online buying habits, and websites you frequently visit were constructed. "Yes/No" questions or the scale "0-1" (1 represent *yes*, 0 represent *no*) were used. Respondents were required to tick (✓) the appropriate answer.

3.1.2.2 Consumer Satisfaction

The second part was constructed to investigate the Malaysian e-commerce websites consumers' satisfaction based on the ACSI (American Customer Satisfaction Index standard). Eight questions related to consumer satisfaction were constructed.

Likert scale of 1 to 5 and "Yes/No" questions were used. The value is represented with 1 *strongly disagree*, and 5 represents *strongly agree*. Likert scale has been used widely by many (Ellatif, & Saleh, 2008; Behkamal et al., 2009; Elahi & Hassanzadeh, 2009). Table 3.3 shows an example of questions related to consumer satisfaction.

Table 3.3
User Satisfaction Question for Part B

Number	Example
1	Does the services provided by the e-commerce websites live up to your expectation?
2	Based on your experience with the e-commerce websites, how likely are you to buy or visit the e-commerce website again?

Table 3.4 shows an example of “YES/NO” question.

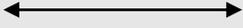
Table 3.4
YES/NO Questions

Number	Example
1	Overall, are you satisfied with the e-commerce websites that you use?
2	Does all the e-commerce websites that you usually use follow any method to meet the consumers’ needs? (eg. getting feedback; updating their websites according to consumers’ recommendation etc.)

3.1.2.3 Consumer Evaluation Criteria

Thirty five (35) criteria identified from Section 3.1.1 were listed in Section 3.1.4.1 and each criterion was used to determine the degree of importance. Example of questions for this part is shown in Table 3.5.

Table 3.5
Importance of Criteria of E-commerce Websites

No.	Consumer Evaluation Criteria	Very Low Very High				
		Consideration 				
1	Promotive activities	1	2	3	4	5
	The website provides attractive offers to encourage electronic purchasing (eg. Free delivery, discount)					
2	Clarity	1	2	3	4	5
	The information presented is comprehensive and clear.					
3	Enjoyable experience	1	2	3	4	5
	The capability of the website to entertain while browsing.					

The respondents were asked to rank the level of consideration of the listed consumer evaluation criteria considered as contributing criteria to achieve the desirable e-commerce websites applications.

The completed questionnaire consisted of 17 questions that were divided into three parts: part A, part B, and part C. Part A consists of 9 questions regard the demographic information about the users. Part B consists of 7 questions to investigate the consumer satisfaction. Part C, one question divided into 35 sub-question) to identify and rank the importance of evaluation criteria based on consumer perspectives. For details, see the completed questionnaire in Appendix C.

3.1.3 Questionnaire Testing

Once the questionnaires have been constructed, the questionnaire underwent many rounds of review and revision. The questionnaire was validated through two validation steps: content validity and constructive validity.

Firstly, content validity to measure if the questions measure the concept adequately. Content validity was tested by pilot study to ensure that all the questions are clear and understandable for the respondents. Secondly, construct validity was conducted to ensure that the questionnaire tab the concept as theorized. This was done by factor analysis using the SPSS package. Also, the reliability was checked and obtained (Sekaran & Bougie, 2010). This was to ensure that not only the content is comprehensive and appropriate, but the layout should also be user friendly, the instructions should be clear, and the language should be understandable.

3.1.3.1 Pilot Survey

According to Greenfield (1996), a pilot survey has two main purposes. The first is the development of instruments and procedures, where the pilot is a step on the way towards the final design. Here, the reliability and validity of the questionnaire are checked by the consumers or the respondents. The second function is the rehearsal of instruments and procedures, where the aim is to fine-tune a design. During the pilot survey, the questionnaire was distributed and answered by 35 respondents. At this stage, the questionnaire already designed and was ready to be tested. The validity and the reliability of the questionnaire were checked to ensure the consistency and the stability of the questionnaire. Here, the respondent gave the feedback about the questionnaire and

confirmed if the questionnaire is understandable and answerable. The potential outcomes from the survey were investigated. The aim of the pilot survey is to determine if the respondents are able to answer the questions listed in the survey. Minor modifications on some questionnaire items were advised by the pilot respondents. The feedbacks from the pilot respondents were used to refine the questionnaire before starting the actual survey.

The pilot test was administered in thirty five respondents. By conducting the pilot test, questions ambiguities, difficulties, incompleteness (to ensure all required items are included), and readability (to avoid miss interpretation of the posted questions) can be recognized. In addition, the time and motivation for answering the questions were also looked into. Having done the questionnaire testing, minor modifications over some of the questions were performed to improve the understandability and readability. Some of the unrequired questions were removed from the questionnaire.

In this study, the reliability of the evaluation criteria analysis was checked by the SPSS package (SPSS Version 14.0) using Cronbach's Alpha, which found 0.754 for all the consumer evaluation criteria, which is considered an acceptable percentage for the reliability of the consumer evaluation criteria.

3.1.4 Identifying the Evaluation Model Components

The model components were identified to draw the shape and process of construction phase. Based on evaluation theory Section 2.7, and reviewing past literatures referring to Appendix A, the model components were identified to draw the shape and process of

construction phase. The research components are: (i) consumer evaluation criteria (CEC); (ii) new evaluation mechanisms, (iii); and (iv) new evaluation procedure.

3.1.4.1 Consumer Evaluation Criteria

As mentioned in Section 3.1.1, fifty four criteria were identified and filtered in order to remove the criteria that carry the same meaning and replace the criteria that are interfering. Then, the new list was generated. Out of fifty four criteria, only thirty five criteria were listed and selected. Table 3.6 presents the thirty five of criteria that will be used in questionnaire construction.

Table 3.6
Consumer Criteria after Filtering

Num	Criteria	Num	Criteria
1	Price	19	Stability
2	Diversity of product, info	20	Learnability
3	Understandability	21	Communication and transaction
4	Speed	22	Credibility
5	Visibility	23	Resilience
6	Currency	24	Degree of care
7	Navigability	25	Tangibility
8	Richness	26	Presentability, Visual appeal , Layout
9	Relevance	27	Reputation
10	Attractiveness	28	Product / value added
11	Serviceability	29	Safety
12	Enterprise features	30	Personalization
13	User friendly interface	31	Clarity
14	Efficiency	32	Trust
15	Reliability	33	Enjoyment
16	Responsiveness	34	Promotion

17	Accessibility	35	response time
18	Correctness		

3.1.4.2 New Evaluation Mechanism

The new evaluation mechanism consists of three main mechanisms are i) mechanism to calculate the weight for each criterion, ii) mechanism to calculate the total score for each criterion, and iii) mechanism to identify the current situation for each criterion.

The first mechanism was constructed based on the new integration between the Fuzzy Analytical Hierarchy Process (FAHP) and Hardmard method to calculate the weight for each criterion. It consists of mechanism to scale the relative importance of the criteria, mechanism to constructing the fuzzy pairwise matrix, mechanisms to perform the judgments of pairwise comparison, mechanism to synthesis of the pairwise comparison, and performing the inconsistency test. Is start with generate triangular fuzzy number, invite the experts to fill weight list form, generate pair-wise comparison between the criteria, check the consistency of the criteria, apply the new integration between the Fuzzy Analytical Hierarchy Process (FAHP) and Hardmard method to calculate the weight for each criterion, and use center of area (COA) to convert the fuzzy value to crisp value best number preference (BNP).

The second mechanism was constructed based on Fuzzy Operational Laws of Triangular Fuzzy Numbers, and Weight Average Sum (WAS) in order to calculate the total score for each criterion. Five consumers were asked to fill the score list form. Then, the WAS were used under Fuzzy Operational Laws of Triangular Fuzzy Numbers to aggregate the total score for each criterion.

The third mechanism was constructed based on the weight variance analysis. The average weight and score were calculated for all the criteria's in order to identify the center point of evaluation. Then each criterion was presented as point (x, y). X represents the score and y represent the weight. The criteria fall above the evaluation point were found to be improved.

3.1.4.3 Evaluation Procedure

The process of evaluation consists of three phases: i) Planning Phase; ii) Examination Phase; and iii) Decision-making Phase. Section 5.5 (Chapter Five) discusses these phases in detail. The outputs of this phase in the research methodology are input for the Second Phase. Figure 3.1 shows a summary of the input, activities, and output of Phase One.

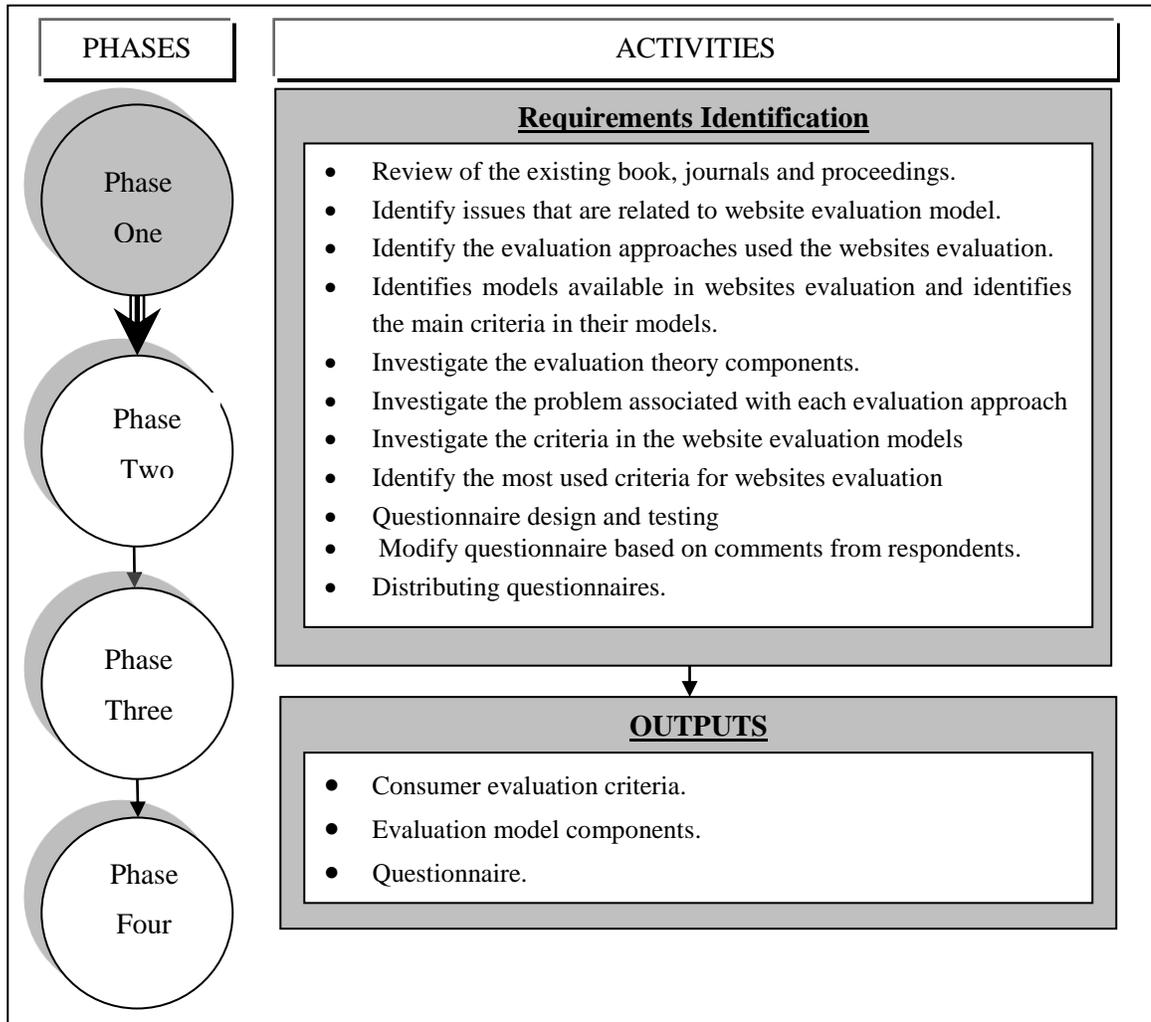


Figure 3.1. Input, activities and deliverable of requirements identification phase

The Planning Phase includes the activities before the start of the actual evaluation procedure. These activities were (i) establish the goal of the evaluation (ii); and brief the evaluation team and prepare documents. The procedure of planning begins with the decision of conducting the evaluation and selecting the evaluation team. The second activity was conducted to give a short briefing about the evaluation schedule and activities by holding a meeting between the evaluation team members. Here, the evaluation team prepared the documents needed for evaluation. The documents

consisted of a website manual, an evaluation score list, and a criteria weight list. The website manual was to obtain necessary information on the website before and during the evaluation. The evaluation score list was for the evaluator to rate the criteria of the website. The criteria weight score list was to identify the degree of importance for each criterion towards the website.

The Examination Phase includes conducting the evaluation and collecting data. First, five consumers were asked to fill the evaluation score list. Second, four experts were asked to fill the criteria weight score list. Next, the filled evaluation score list form and the filled criteria weight list form were collected by the team leader. The lists were checked and validate by the evaluation team members.

Finally, the Decision Making Phase includes identifying the current performance situation for the e-commerce websites by presenting the result of the analysis and preparing an evaluation report using weight variance analysis. Chapter Five explains the evaluation procedure in detail.

3.2 Phase Two: Empirical Study

This phase was to investigate consumer satisfaction, determine consumer evaluation criteria, and identify and rank the criteria based on their importance degree from consumer perspectives. During this phase, three main activities were conducted. These were questionnaire distribution, data collection, and data analysis. The activities are explained in Sections 3.2.1, 3.2.2, and 3.2.3. Figure 3.2 shows the activities of Phase Two.

3.2.1 Questionnaire Distribution

A large number of online consumer buyers are approached through some online shopping buyer pages. Recently, the use of the internet to conduct surveys is increased. The internet surveys help to access large population in less time and cost (Marsden & Wright, 2010). In this study, web based survey and convenience sampling were used. An online survey service (Survey Monkey) is used for this purpose. The link to the survey was posted to the target population using Facebook groups and pages related to online shopping. The survey is available in Bahasa Malay and English language.

In order to obtain enough respondents, the questionnaires were distributed through post to a large number of respondents. Top group buying websites in Malaysia were chosen. The actual survey link was posted on the Facebook pages for these websites. For example: Groupon, Everyday, Dealmates, MyDeal, MilkADeal, JackCow, StreetDeal, ILoveDiscounts, WeBuy, EziVoucher, DealHangat, Myooo, Hulala, Groupego, SuperDeals, jvBuyer, myiMart, JigoCity, CouponHouz, MyMetroMall, Hahah, MadnessDeal, GoodDeals2u, e9deal, MyCoupon, Coolpon, Deal4Real, iPayLess, DealTok, Squarelet, Aibay, Dealbuss, QmuRate, BuyDiscount, eBay Kuponan, GroupASave, JoyDeals, BuyNett, JuzDeal, SmartDeal, Hotvoucher, WrightOffer, Syokdeal, RedElephant, SayGoodDeal, PoinzCoupon, Qpon, Qponkini, SugarDeal, BuddyDeals, MagicDeal, PayLess, and Savemall, Weconomic. The online survey links were posted on these websites and the members were asked to participate and answer the questionnaires.

3.2.1.1 Population and Sample

The target samples are internet users in Malaysia. Based on the internet world stats, the number of internet users based on the Malaysia internet usage and telecommunications reports is 17,723,000, which representing 60.7% of the population (Salman & Hasim, 2011). Out of that number, there are 5 million broadband users, 2.5 million wireless broadband users and 10 million 3G subscribers. According to Sakaran (2006), the number of samples for 17,723,000 internet users (population) is 385 samples.

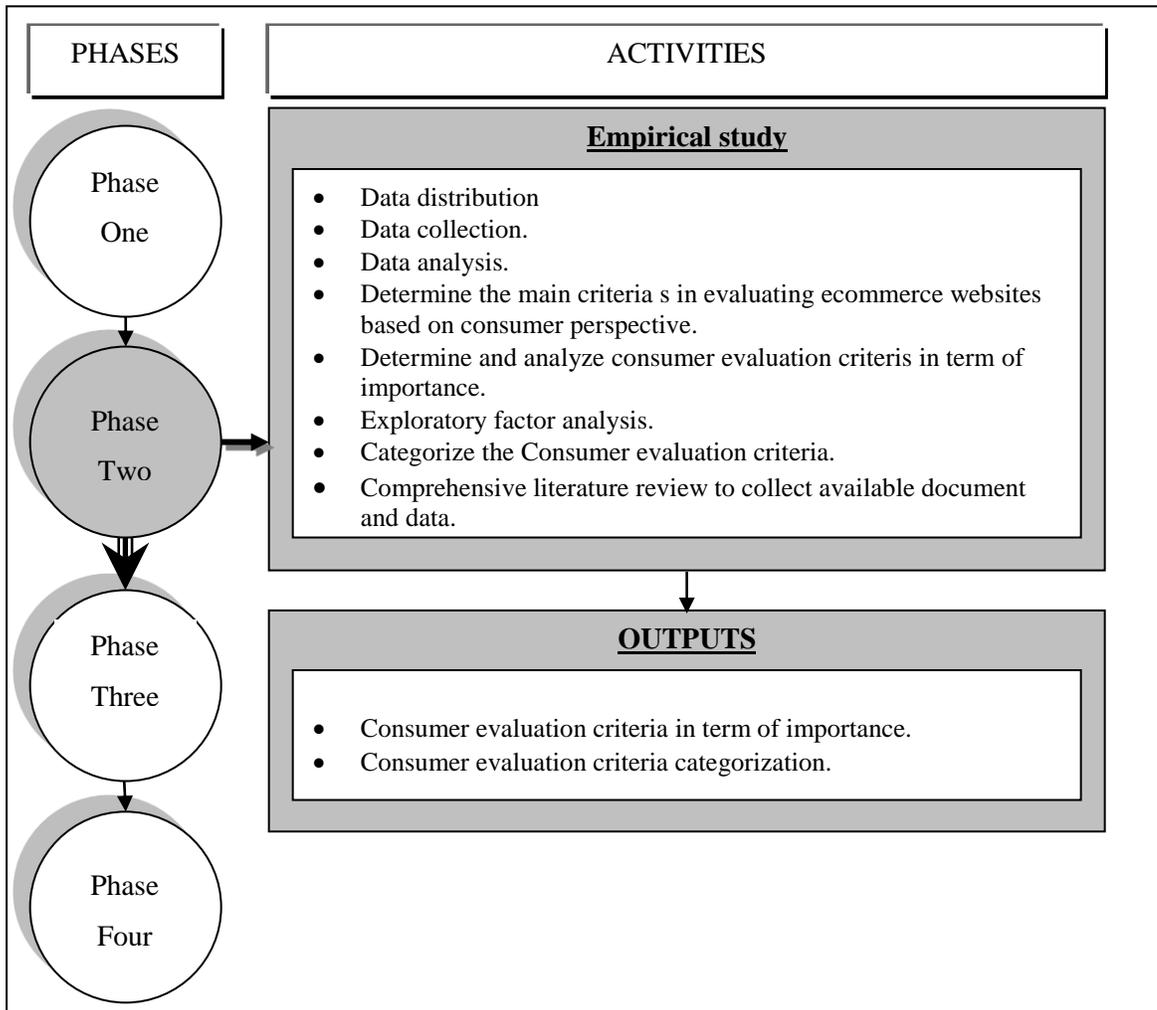


Figure 3.2. Inputs, activities and deliverable of empirical study phase

3.2.2 Data Collection

At this stage, the target group was selected to answer the questionnaires which are internet users' e-commerce websites. The sample size was determined. The percentage of distributed and returned questionnaires were calculated and presented. The survey period was three months (27 May, 2013 to 27 of August, 2013) and the link was in two languages. The numbers of returned questionnaires are shown in Table 3.7.

Table 3.7
Percentage of Returned Questionnaires

Number	Respondent	Questionnaire Returned	Sample Needed
1	Internet users	152 (40%)	384

The percentage of completed and returned questionnaires for the internet users is 40%. The remaining percentages 60% were founded unreliable or uncompleted (unreliable - because they were not consistent with the answers that have been given in the survey; uncompleted - not answered completely). Table 3.8 shows a summary of questionnaires distributed.

Table 3.8
Population and Sample Needed

Number	Respondent	Population	Sample Needed	Number of Sample Distributed
1	Internet users	17,723,000	384	on all the Facebook pages mentioned earlier

3.2.3 Data Analysis

Data was analyzed using statistical methods. Descriptive statistics (mean) and frequencies were used to present the information on demographic data and consumer satisfactions (Part B); and the importance of consumer evaluation criteria (Part C). Factor analysis, specifically exploratory factor analysis was used to categorize the Consumer Evaluation Criteria (CEC).

3.3 Phase Three: Model Construction

Deductive approach was used in this research to construct consumer e-commerce websites evaluation model. Figure 3.3 illustrates the inputs, activities, and output of the model construction phase. The new proposed model was called CREE model.

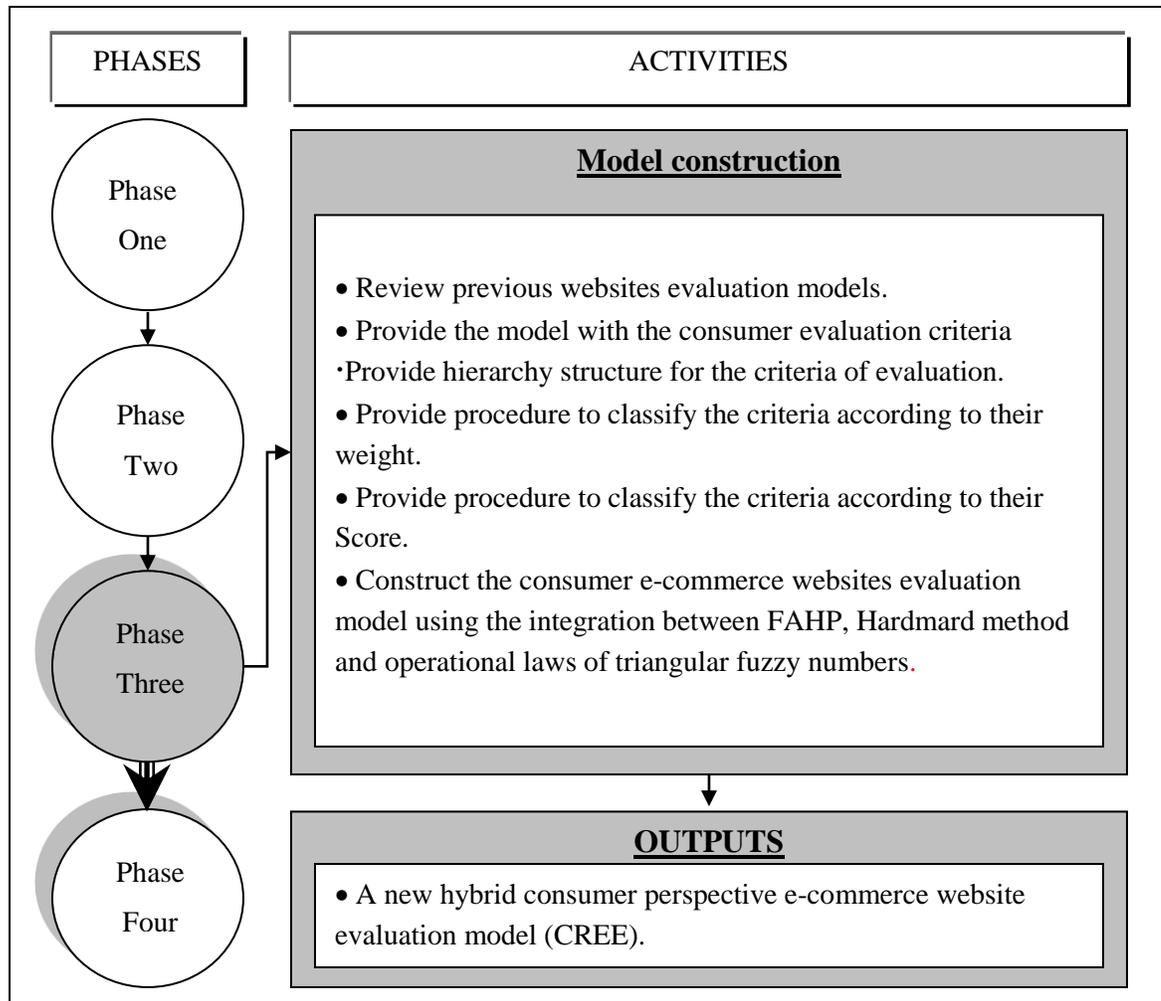


Figure 3.3. Inputs, activities and deliverable of model construction phase

The process of constructing the e-commerce website evaluation model is summarized in three main steps is: - 1) identify the model components by studying the literature reviews and based on the evaluation theory. The components are: - (i) consumer

evaluation criteria, (ii) evaluation mechanism, (iii) evaluation procedure; 2) identify appropriate methods, technique, and process needed to construct the model; and 3) integrate the model components to produce websites evaluation model. Chapter Five presents the model construction in details.

3.4 Phase Four: Model Confirmation

This phase evaluates the proposed model. The evaluation was used to verify and validate the results after implementing the model in real environment. Two methods were used: - (i) expert reviews, (ii) case study.

Firstly, six experts' reviewers were selected based on their publication and experiences. Each reviewer was given (i) the model components (criteria, mechanisms, processes); (ii) verification questionnaire; and (iii) weight and score form lists. They were asked to answer the verification questionnaire based on the documents given. Delphi Technique was used to verify the model. Three rounds with experts were conducted to verify the model. The model was then modified based on the comment given by the experts.

Secondly, four case studies were used to validate the proposed model. The goal was to test the proposed model applicability using the factors: gain satisfaction, interface satisfaction, and task support satisfaction in real environment. Many e-commerce companies were asked to evaluate their websites using the proposed model in order to test the proposed model in real environment. Only four e-commerce companies were accepted to evaluate their websites using the proposed model. Each company needs to hold meeting to identify the team of evaluation and the date of evaluation. Next, the

documents and the evaluation forms were prepared. Three internal experts were asked to fill the weight form and five consumers that were suggested by the company were asked to fill the score form. The results were presented to evaluation team to confirm the applicability of the proposed model using the factors (gain satisfaction, interface satisfaction, and task support satisfaction). Figure 3.4 shows the overall activities, input, and output from the Confirmation Phase.

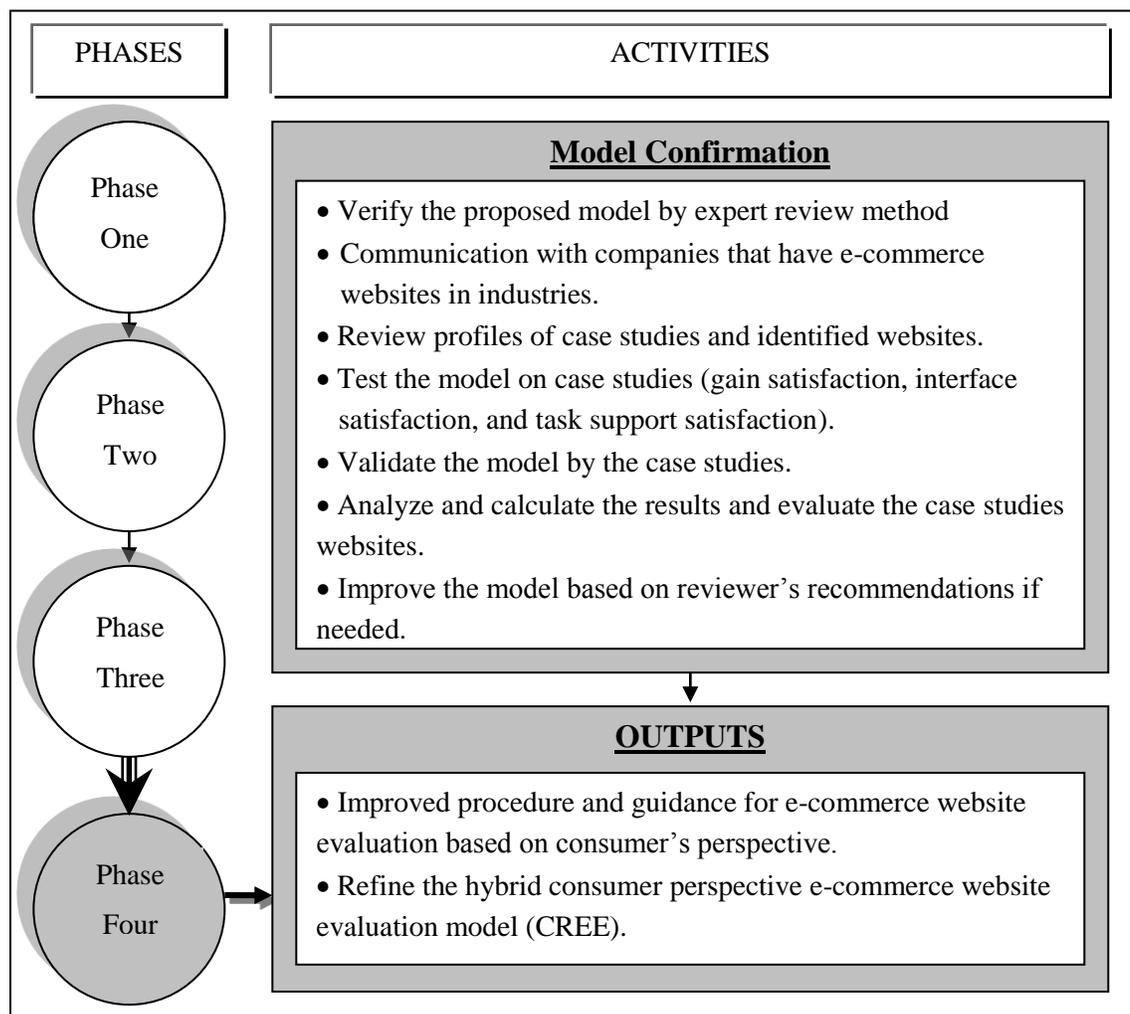


Figure 3.4. Inputs, activities and deliverable of model confirmation phase

CHAPTER FOUR

EMPIRICAL STUDY

4.1 Introduction

This chapter presents the empirical study findings conducted in Malaysia. This chapter aims to investigate the consumer satisfaction toward the Malaysian e-commerce websites, identify and rank the evaluation criteria based on their importance from the consumer perspectives.

4.2 Data Analysis

This section discusses the demographic on the respondents, general information about the consumer satisfaction, and discusses the consumer evaluation criteria in Sections 4.2.1, 4.2.2, and 4.2.3. Simple descriptive statistical analysis, such as mean, frequencies, percentages, and factor analysis, was used.

4.2.1 Demography Results

This section presents the demographic data in four sections: (i) distribution of the respondents' gender; (ii) distribution of the respondents' age; (iii) distribution of the respondents' educational level; (iv) distribution of respondents living states; (v) distribution of online buying habits for the consumers, and (vi) type of distribution for most visited sites. Here the respondents were asked if they heard about e-commerce and if they made an online purchase. All respondents asked negatively were not included in this survey.

- **Distribution of the of respondents' gender**

Table 4.1 demonstrates the distribution of respondents' gender in this survey. It shows that the majority of the respondents are females with (58%). Followed by the male with (42%). This differentiation can be explained by the nature of human behavior. Female like to shop more the males.

Table 4.1
Gender Distribution of Respondents

Respondent Gender	Frequency	Percent %
Female	88	58
Male	64	42
Total	152	100.0

- **Distribution of the of respondents' age**

Table 4.2 demonstrates the distribution of respondents' age in this survey. It shows that the majority of the respondents are from twenty two to thirty years of age (38.2%) followed by the respondent from thirty one to forty years (33.6%), from seventeen to twenty one years (15.8%), and above forty (11.8%) followed by those below 17 years (0.7%). This differentiation can be explained by the nature of human behavior. Older (above 40 years) and younger (less than seventeen years) tend to be less interested in conducting electronic purchasing.

Table 4.2
Age Distribution of Respondents

Respondent Age	Frequency	Percent %
Less than 17	1	0.7
From 17 to 21	24	15.8
From 22 to 30	58	38.2
From 31 to 40	51	33.6
Above 40	18	11.8
Total	152	100.0

- **Distribution of the respondents' educational level**

In terms of educational level, the analysis on respondents' background showed that 47.4% of the respondents have university degrees, 18.4% have advanced degrees, 11.2% have a diploma, 9.2% have PMR/SPM/secondary school; 7.9 % have PHD/ professional certificates; 5.3% have certificate holders, and 0.7 % does not have any of the mentioned certifications. This shows that educated people are mainly the ones who conduct transactions electronically (see Table 4.3).

Table 4.3
Distribution of Educational Level

Degree of Education	Frequency	Percent %
PMR/SPM/secondary school	14	9.2
Certificate holders	8	5.3
Diploma	17	11.2
University degree	72	47.4
Advance Diploma/Master	28	18.4
PHD/ Professional Certificates	12	7.9
Others	1	.7
Total	152	100.0

- **Distribution of respondents living state**

Table 4.4 presents the distribution of the respondents living state.

Table 4.4
Distribution of Living State

State Name	Frequency	Percent %
Perlis	9	5.9
Johor	12	7.9
Kedah	12	7.9
Kelantan	16	10.5
Negeri Sembilan	11	7.2
Pahang	6	3.9
Perak	12	7.9
Pinang	8	5.3
Sabah	6	3.9
Sarawak	5	3.3
Selangor	24	15.8
Terengganu	5	3.3
Wilayah Persekutuan	20	13.2
Others	6	3.9
Total	152	100.0

The majority of the respondents were from Selangor 15.8%, followed by Wilayah Persekutuan 13.2%, 10.5% from Kelantan, 7.9% from Kedah ,Perak and Johor, 7.2% Negeri Sembilan, 5.9% Perlis, 5.3% Pinang. The distribution percentage shows that the respondents from all Malaysia states were participated in the survey. This means the results of this survey reflects the respondent's perceptions from all over Malaysia places.

- **Distribution of online buying habits of the consumers**

The greatest number of respondents used internet for searching the best deal (48.03%), followed by experimental users who like to know the product before making purchase (23.03%). Using internet for convenience habit comes third (17.76%). Pleasure had the lowest percentage compared to other habits (9.21%). This indicates that majority of users seek useful information and best deal from the internet.

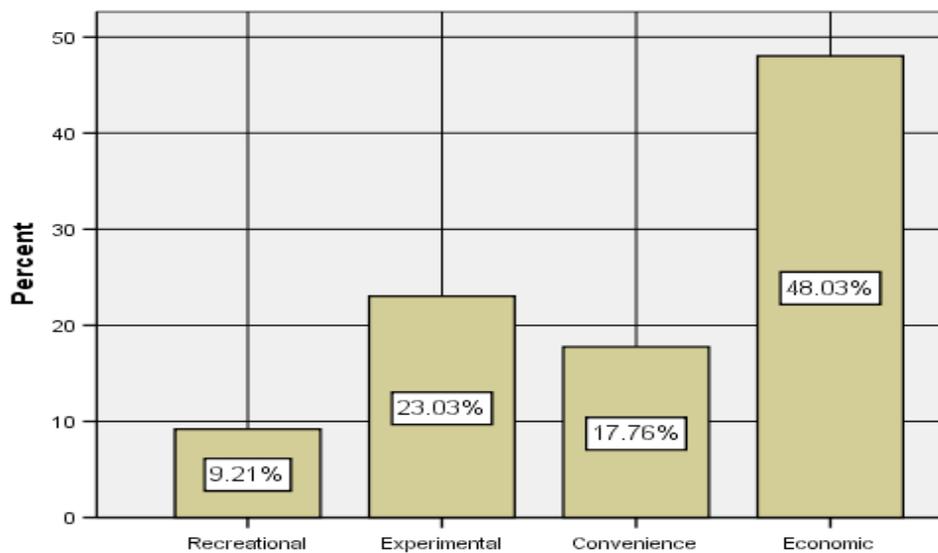


Figure 4.1. Buying habits distribution

- **Type of distribution for most visited sites**

The finding also showed that the private companies' websites are the most visited sites, compared with government and semi-government websites. Private companies' websites scored 86.2% because of the competition factor and consumer behavior of always searching for the best deal. This was followed by governments' websites with 9.9 % and semi-governments' websites with 3.9 %. This means the majority of respondents visit private companies' websites (see Table 4.5).

Table 4.5
Websites Type Distribution

Websites Type	Frequency	Percent %
Government websites	15	9.9
Semi-government websites	6	3.9
Private websites	131	86.2
Total	152	100.0

4.2.2 Current Consumer Satisfaction

This section discusses the consumer satisfaction based the ACSI (American Customer Satisfaction Index standard). The respondents were asked a set of questions to discuss the respondent’s satisfaction toward the e-commerce websites.

Firstly, the respondents were asked to indicate the overall satisfaction degree about the websites that the respondents used. The majorities were found satisfy about the overall websites that they used. The results show that 62.5% of respondents were found satisfied and 37.5% was not satisfied. Refer to Table 4.6.

Table 4.6
Overall Satisfaction Degree

Respondent Answers	Frequency	Percent %
No	57	37.5
Yes	95	62.5
Total	152	100.0

Secondly, when the respondents were asked if the websites provide special / unexpected services that may surprise the consumers and live up their expectation or get their satisfaction such as multimedia explanation. Unfortunately, the majority of them

answered negatively (42.7%). 23.7% of the respondents were neutral. Only 32.2% of the respondents answered that the websites provided those services. For more details see Table 4.7.

Table 4.7
Satisfaction Degree of the Services Provided by the Websites

Degree of Satisfaction	Frequency	Percent %
Strongly disagree	9	5.9
Disagree	56	36.8
Neutral	36	23.7
Agree	49	32.2
Total	2	1.3

Thirdly, in terms of decision-making in websites selection, the respondents were asked if they considered the quality and performance issues of the website before selection. The analysis of Table 4.8 shows that the majority of respondents (82.3%) take the quality and performance issues of the websites into account before selection and purchasing.

Table 4.8
Websites Quality Importance Prior Selection

Degree of Agreement	Frequency	Percent %
Strongly disagree	2	1.3
Disagree	7	4.6
Neutral	18	11.8
Agree	74	48.7
Strongly agree	51	33.6
Total	152	100.0

Fourthly, the respondents were asked if they like to buy or visit the e-commerce websites once again based on the respondent's experience. Most of the respondents 37.5 % were found not like to visit and buy from the websites again. Followed by 31.6% of respondents do not like or like to visit or buy again. 31% of respondents liked to visit and buy from the websites again. This mean, most of the respondents not like to visit or buy from the websites again. For more details see Table 4.9.

Table 4.9
Likely Degree to Buy and Visit the Websites Again

Likely Degree	Frequency	Percent %
Strongly dislike	6	3.9
Dislike	51	33.6
Neutral	48	31.6
Like	46	30.3
Strongly like	1	0.7
Total	152	100.0

Moreover, in Table 4.10 the respondents were asked if they like to recommend the e-commerce websites to others based on the respondent's experience. Most of the respondents do not like to recommend the sites to others with percentage 51.3%. Only 22.4% of the respondents liked to recommend the websites to others. The rests were neutral with 26.3%. This mean, most of the respondents were found to be not satisfied about the e-commerce websites because they do not like to visit, buy, and recommend the websites to others.

Table 4.10
Recommend Likely Degree

Likely Degree	Frequency	Percent %
Strongly dislike	5	3.3
Dislike	73	48.0
Neutral	40	26.3
Like	34	22.4
Strongly like	0	0
Total	152	100.0

When they asked if there are any methods to meet the consumer’s needs such as: getting feedback; updating their websites according to consumers’ recommendation. The results were: 35.5% of the respondents answered positively. About 53.9% stated that no methods were used. See Table 4.11.

Table 4.11
Method Used to Meet the Consumer Needs

Methods Followed	Frequency	Percent %
No	82	53.9
Yes	54	35.5
Do not know	16	10.5
Total	152	100.0

The analyzed data in Table 4.12 shows that the consumer participation in the process of evaluation and developments can help the companies to achieve the consumers’ satisfaction. The majority of respondents agreed and strongly agreed (87.5%) that the consumers participation in the process of evaluation and developments help the companies to achieve and reach the consumer satisfaction, followed by the respondents who do not agree (3.3%).

Table 4.12
Consumer Participation Degree

Agreement Degree	Frequency	Percent %
Strongly disagree	2	1.3
Disagree	3	2.0
Neutral	14	9.2
Agree	80	52.6
Strongly agree	53	34.9
Total	152	100.0

4.2.3 Consumer Evaluation Criteria

In this section, the respondents were asked to rank a list of criteria for evaluation and development of e-commerce websites. Results were established by calculating the mean score and selecting the appropriate interval that represented the actual mean for each evaluation criterion. Likert scale from 1 to 5 was used. Since the Likert scale with five internal scales was used to represent the degree of consideration for each evaluation criterion, an appropriate interval scale was needed to represent all levels of consideration. Since Likert scale used five variables and four intervals to represent all levels of consideration, an appropriate interval of 0.8 was chosen as follows:-

$$\text{Appropriate interval} = \text{number of intervals/number of variables}$$

$$\text{Appropriate interval for the study} = (4/5) = 0.8$$

The representation for the degree of the consideration for the contributed criteria is shown in Table 4.13. The same representation was used by Bidad & Campiseño (2010) and Ahmad et al. (2012).

Table 4.13
Internal Presentation for the Degree of Consideration

Mean Interval Presentation	Degree of Importance
From 1 to 1.80	Not considered
From 1.81 to 2.60	Low consideration
From 2.61 to 3.40	Average consideration
From 3.41 to 4.20	High consideration
From 4.21 to 5	Very High Consideration

Results were established and presented by calculating the mean score and selecting the mean score of high and very high consideration (See Table 4.14). Out of the 35 criteria, 26 criteria were selected. The analysis showed that price saving, purchasing transaction, safety, visibility, user friendly, diversity of products and services, correctness, presentability, updated or current, relevant, trust on purchasing via credit cards or bank transfer, clarity, richness, reliability, responsiveness, credibility, enjoyable experience, serviceability, navigability, response time, efficiency, accessibility, stability, learnability, understandability, reputation, enterprise features, and promotion. Other criteria with the lower mean score (less than 3.41) were considered as not commonly used in evaluating e-commerce websites.

Table 4.14 demonstrates the results of analysis based on respondents' answers of each evaluation criteria. In this part of the survey, respondents were asked to indicate the levels of consideration of all the consumer evaluation criteria. These criteria were taken into account during evaluation exercise of e-commerce websites in their companies. The score obtained in this analysis mapped into the level of consideration as in Table 4.13.

Table 4.14
Consumer Evaluation Criteria: Means Score

Consumer Evaluation Criteria	Mean	Level of Consideration
Authority of web documents	2.57	Low consideration
Tangibility	2.84	Average consideration
Personalization	3.02	Average consideration
Resilience	3.09	Average consideration
System response	3.10	Average consideration
Stability	3.14	Average consideration
Attractiveness	3.19	Average consideration
Value added for products and services	3.20	Average consideration
Degree of care	3.25	Average consideration
Learnability	3.44	High consideration
Navigability	3.46	High consideration
Enterprise features	3.49	High consideration
Understandability	3.52	High consideration
Reputation	3.55	High consideration
Accessibility	3.56	High consideration
Efficiency	3.63	High consideration
Correctness	3.63	High consideration
Relevant	3.68	High consideration
Clarity	3.68	High consideration
Updated or current	3.70	High consideration
Presentability	3.72	High consideration
Trust on purchasing via credit cards or bank transfer	3.72	High consideration
Richness	3.77	High consideration
Credibility	3.78	High consideration
Promotion	3.80	High consideration
Responsiveness	3.80	High consideration
Enjoyable experience	3.81	High consideration

Reliability	3.82	High consideration
Diversity of products and services	3.84	High consideration
Visibility	3.85	High consideration
Serviceability	3.89	High consideration
User friendly	3.91	High consideration
Purchasing transaction	3.93	High consideration
Price saving	4.07	High consideration
Safety	4.29	Very High consideration

The analysis showed that safety criteria were the most important criteria compared to other criteria defined in this survey with mean score 4.30; followed by serviceability, price, promotion, presentability, user friendly, trust on purchasing via credit card, reliability, credibility, purchasing transaction, richness, correctness, current, clarity, diversity of products and services, responsiveness, relevant, efficiency, accessibility, reputation, visibility, enjoyable experience, understandability, enterprise features, navigability, and learnability which were considered important criteria for e-commerce websites from the user perspective with different mean scores. The rests of the criteria were considered as average and low consideration.

4.2.3.1 Exploratory Factor Analysis

The twenty six consumer evaluation criteria obtained high and very high consideration from the consumer perspective. However, it is possible that some of these criteria are correlated with each other, or there may be some underlying dimensions that relate to these criteria. In an attempt to examine further consumer evaluation criteria, the technique of factor analysis was used to search for such dimensions.

SPSS package, specifically exploratory factor analysis, was used to categorize the new evaluation criteria to a meaningful group. This categorization is consistent with the literature that categorized some of these criteria and related it to the same field. Based on the factors analysis and expert opinion, the categorization was found to be reliable and acceptable. To test whether factor analysis was appropriate for e-commerce website evaluation, KMO and Bartlett test were first conducted. The result is reproduced in Table 4.15.

Table 4.15
KMO and Bartlett's Test for CEC

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.776
Bartlett's Test of Sphericity	Approx. Chi-Square	1704.207
	df	325
	Sig.	.000

From the above Table, the KMO measure for CEC showed value 0.776. This indicates a 'Meritorious' adequacy according to Hair et al., (2010) and hence is appropriate for use in further factor analysis. The Bartlett's test of sphericity yielded a value of 1704.207, and its associated significance level is very low (0.000). The factor analysis was conducted using PCA and varimax rotation with Kaiser Normalization (Ho, 2006). The results of the test revealed that there are five categorizations with an Eigen value of more than 1. The scree plot in Figure 4.2 show that the plot slopes steeply downwards from one criterion to three criteria.

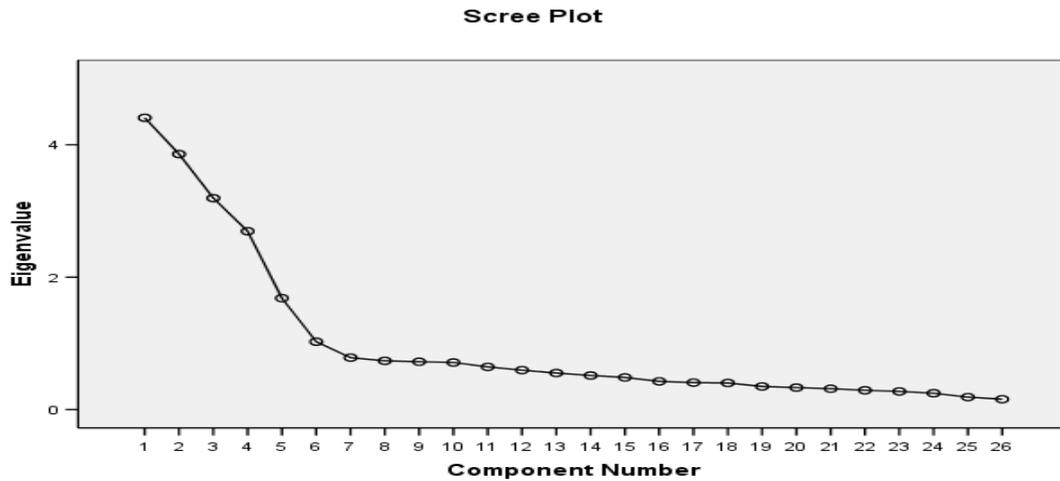


Figure 4.2. Scree plot for consumer evaluation criteria

Scree test is used to identify the optimum number of criteria that can be extracted before the amount of unique variance (criteria) begins to dominate the common variance structure (Bollen and Joreskog, 1985).

Considering the results of the scree plot test and the purpose of the criteria analysis was to search for the appropriate categories related to CEC. The five categories explained 77.6 % of the criteria. Appendix D presents all the analyses related to the exploratory factor analysis. Based on the above discussion Table 4.16 presents the five main criteria of consumer evaluation (CEC) which consists of 26 criterions. This is consistent with the literature review with addition to two new categories Section 2.3.1. These criteria were the first input to construct the new model. In this research the letter “e” was added to denote electronic commerce. Five “e” categorizations were produced through factors analysis. The categories were e-information, e-services, e-system, and new two categories e-usage and e-company.

Table 4.16
New Categorization of CEC

Category	Criteria
Level One	Level Two
(A) E-usage	Price saving
	Purchasing transaction
	Safety
	Visibility
	User friendly
	Diversity of products and services
(B) E-informational	Correctness
	Presentability
	Current
	Relevant
	Trust on purchasing via credit cards or bank transfer
	Clarity
	Richness
(C) E-services	High responsiveness
	Credibility
	Enjoyable experience
	Serviceability
	Reliability
(D) E-system	Navigability
	Efficiency
	Accessibility
	Learnability
	Understandability
(E) E-company	Reputation
	Enterprise features
	Promotive activities

After categorizing the twenty six criteria to five representative groups, selecting a suitable and representative name for these groups took place. Referring to literature review and expert views, five representative groups' names were assigned, which are e-usage group, e-information group, e-services group, e-system group, and e-company group.

E-usage category consists of the criteria that are related and connected to and touch the consumer in a direct way. In other words, it is related to consumer consideration such as the price and user friendliness. In addition, this category included six criteria, which are price saving, purchasing transaction, safety, visibility, user friendly, and diversity of products and services. E-information category consist of the criteria that are related to web information and web content, which are correcness, presentability, current/updated, relevant, trust, clarity, and richness. In addition, e-services category consist of the criteria that are related to services that can be provided by the web, which are reliability, high responsiveness, credibility, enjoyable experience, and serviceability. E-system category consists of the criteria that are related to the e-commerce system which are navigability, efficiency, accessibility, learnability, and understandability. E-company category consists of the criteria that related and touch the companies which are the reputation, enterprise features, and the promotion provided by the companies. This criteria consists the first components of the new proposed model.

4.3 Discussion and Conclusion

This chapter presents in detail the findings of the empirical study as follows:-

- 1) The greatest number of respondents was using the private company websites compared with government and semi-government websites. Private companies' websites scored 86.2% because of the competition factor and consumer behavior of always searching for the best deal. This was followed by government websites with 9.9 % and semi-governments' websites with 3.9 %. Moreover, most of the respondents used the internet for searching the best deal (48.03%), followed by experimental users who like to know the product before making purchases (23.03%). Using internet for convenience habit comes third (17.76%). Pleasure had the lowest percentage compared to other habits (9.21%). This indicates that the majority of users seek useful information and the best deal from the internet.
- 2) As mentioned earlier, the survey indicates that most Malaysian companies (54.0%) do not follow certain method to meet the consumer needs (Example. Getting feedback; updating their websites according to consumer recommendation, etc.) (10.5 %) of respondents answered do not know if their websites follow certain methods to meet the consumers need whilst only (35.5%) of respondents were answered positively.
- 3) The majority of the respondents 87.5% agreed and strongly agreed that the participation of the consumers in the process of evaluation and developments is very important to meet the consumers need and get the consumers satisfaction. Since the consumers play a significant role in the success of the companies, their perspectives must be taken into consideration.

- 4) Based on the ACSI (American Customer Satisfaction Index standard) the respondent's satisfactions were investigated. The analysis shows that the respondents found to be not satisfied with their e-commerce websites. Furthermore, Most of the respondents 37.5 % were found prefer not to visit and buy from the websites again. Followed by 31.6% of respondents were found to be neutral to visit or buy again. In the other hand, (31%) of respondents liked to visit and buy from the websites again. This mean, most of the respondents do not like to visit or buy from the websites again. In addition, most of the respondents will not recommend the sites to others with percentage 51.3%. Only 22.4% of the respondents were found to recommend the websites to others.
- 5) Thirty five criteria from literature review were identified. These criteria were measured and ranked in the survey. Out of the 35 criteria, only 26 criteria were selected based on their importance from the consumer perspective. Moreover, five categories were identified to represent the twenty six criteria. The categorization and the criteria are presented in Section 4.2.3.1. This categorization consistent with the literature review (Lee & Kozar, 2006; Chou et al., 2012; Wei et al., 2010; Lin, 2010). This criteria is the first components of the new proposed model.

It can be concluded; a good number of Malaysian companies' e-commerce websites were developed without taking the criteria makes the e-commerce websites desirable for the consumers into consideration. This result is consistent with the result of other studies (Lau, 2006; Lee and Kozar, 2006; Allahawiah and Altarawne, 2009; Hausman & Siekpe, 2009). The above discussion indicates that there is a need for guidance or

standard mechanisms for e-commerce websites evaluation and development that the companies can follow when they develop their websites.

In a nutshell, this chapter contributes toward this research by providing a new questionnaire with regards to consumer evaluation criteria. Twenty six evaluation criteria have been categorized to five new categorizations. In addition, this study contributes toward the Malaysian e-commerce websites by investigating the consumer's satisfactions. The findings from this empirical study would facilitate the development of the proposed model and will be useful to Malaysian companies and consumers by improving the performance of the e-commerce websites.

CHAPTER FIVE

MODEL CONSTRUCTION

5.1 Introduction

This chapter presents the new hybrid model (CREE) based on the integration between Fuzzy Analytical Hierarchy Process (FAHP), Hardmard method, Operational Laws of Triangular Fuzzy Numbers, and Weight Average Sum (WAS).

5.2 Proposed Model

Figure 5.1 shows the proposed CREE Model and its components. CREE model consists of three components: consumer evaluation criteria (CEC), evaluation mechanism, and evaluation procedure. Sections 5.3, 5.4, and 5.5 explain each of the components respectively.

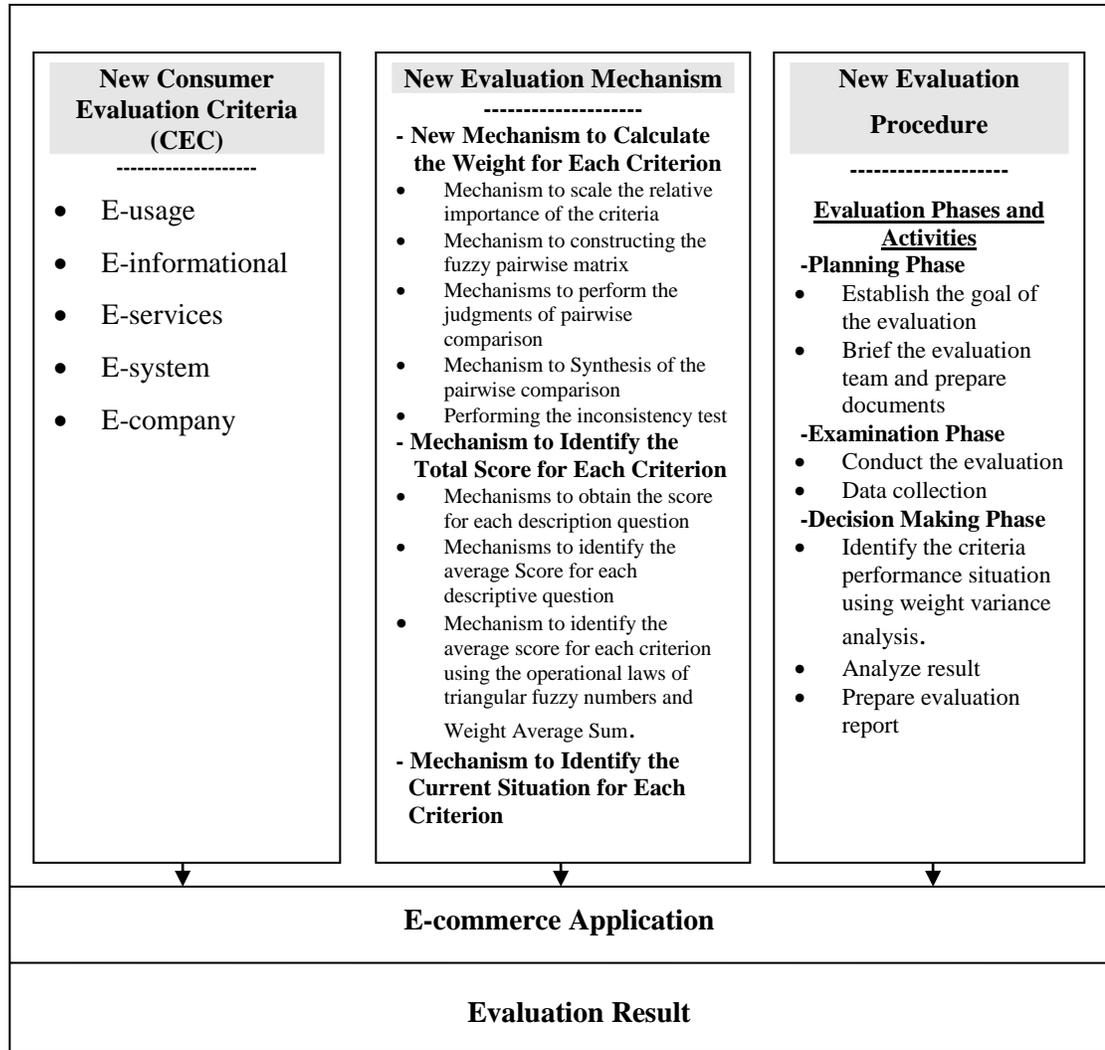


Figure 5.1. New hybrid consumer e-commerce website evaluation model (CREE)

5.3 Consumer Evaluation Criteria

As mentioned in Section 4.2.3.1, five categories were established to classify the evaluation criteria (Figure 5.2), which are: E-usage, E-information, E-services, E-system, and E-company.

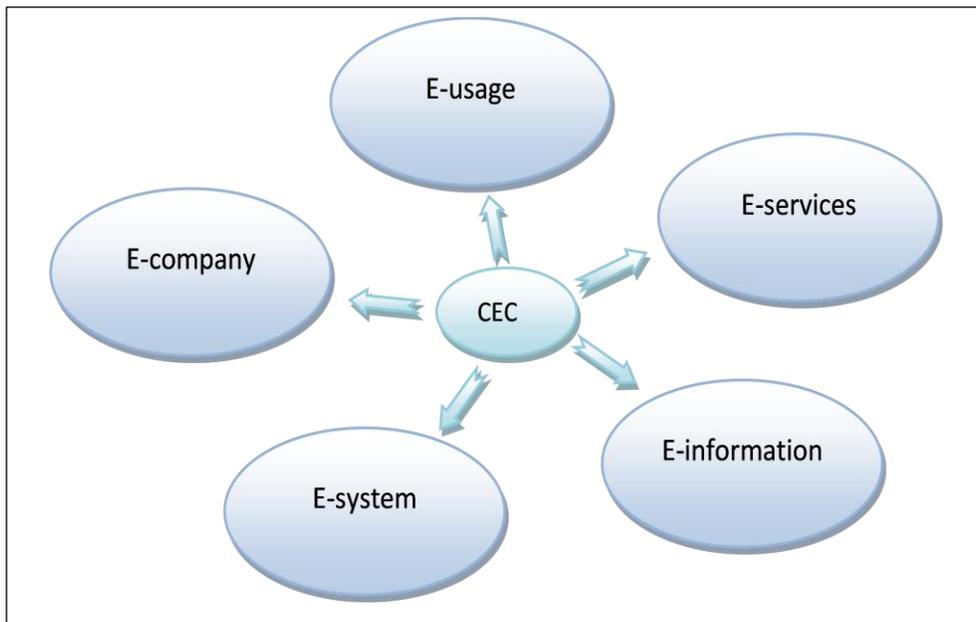


Figure 5.2. CEC categories

The following sections discuss the CEC categories and criteria.

5.3.1 E-usage

As mentioned earlier, e-usage is related to how the users use a website. It describes the user convention (Blixrud, 2001). E-usage is measured by six criteria: price saving, purchasing transaction, safety, visibility, user friendly, and diversity of products and services.

Table 5.1
E-usage Decomposed Criteria

Category	Criteria	Description
	Price	<ul style="list-style-type: none"> • Price Reasonability • Price comparison mechanism
	Purchasing transaction	<ul style="list-style-type: none"> • Payment variety • Ease of understanding policies. • Ease of placing orders.
	Safety	<ul style="list-style-type: none"> • The system operate without (internal) catastrophic failure • Good system recovery

E-usage		<ul style="list-style-type: none"> • Privacy protection • Payment systems security • Vulnerability • Site authentication • Access control • Confidentiality • Imputability
	Website Visibility	<ul style="list-style-type: none"> • Traceable • Retrievable • Ease of access • Links visibility • Links visualization consistence
	User friendly	<ul style="list-style-type: none"> • Communication facilities (interactivity) • Forms of payment availability • Storage of purchase list • Products comparison • “Shopping cart” metaphor • Printing facilities • Download facilities • Help availability
	Diversity of products and services	<ul style="list-style-type: none"> • Product or services variety (Promote many type of products and services). • Customized offering • Product or services suggestion

Price saving measures if the website provides reasonable price in order to help the consumers to save as much money as possible compared to other websites. The purchasing transaction measures the ability of the websites to provide various options for payments, ease of understanding policies, and ease of placing orders. Safety measures the ability of the system to operate without (internal) catastrophic failure (in other words, measure the ability of the website to operate smoothly), if it has a good system recovery and privacy protection, if the payment system secure, the degree of control process, the confidentiality of the websites info, degree of the privacy that the website keep, pass word needed for user authentication, and related to safe domain. Website visibility measures if the website is well promoted at other websites and media. It measures by tracability, retrievability, ease of use, link visibility, and links

visualization consistence. User friendly measures if the websites are easy to use such as communication facilities, forms of payment availability, help availability, storage of purchasing list, product comparison, printing facilities, and download facilities.

Diversity of products and services measure the website’s ability to provide variation of products customized offering, and product or services suggestion.

5.3.2 E-information

E-information reflects consumers’ perception on specific dimensions of information. It refers to quality of the information provided by the e-commerce websites (Lin, 2010). E-information is measured by six criteria: correctness, presentability, updated or current, relevant, trust on purchasing via credit cards or bank transfer, clarity, and richness.

Table 5.2
E-information Decomposed Criteria

Category	Criteria	Description
E-information	Correctness	<ul style="list-style-type: none"> • The accuracy of website information • The exactness of website information
	Presentability	<ul style="list-style-type: none"> • Graphic representation. • Readability of the content. • Multimedia usage
	Currency (Updated)	<ul style="list-style-type: none"> • The website provides timely information (current, freshness, up to date)
	Relevant	<ul style="list-style-type: none"> • Organization’s objectives • Organization’s history • Consumers (audience) • Products or services • Photography of organization’s facilities
	Trust on purchasing via credit cards or bank transfer	<ul style="list-style-type: none"> • The invulnerability of the website toward the purchasing activities. Such as safety, confidentiality, and accountability (auditable)? • Completeness
	Clarity	<ul style="list-style-type: none"> • How do you rate the clarity of the websites information such as provide detail as possible, and free of mistakes?
	Richness	<ul style="list-style-type: none"> • Product details

- Comprehensive content coverage
 - Rich advertising and banner of product or services
-

Correctness measures the exactness and accuracy of information that the web provides. Such as, precise information (no spelling, grammar errors) source of information is identified. Presentability measures if the website information appearance and layout are attractive. Such as, readability of the content, the multimedia usage, and graphic representation. Website current (updated) of the website measures the timely information. Relevant measures if the website info is related to each other. Such as, company objectives and history, consumers, products/ services, and photography of company facilities. Trust on purchasing via credit cards or bank transfer measures the trust of internet as retail shopping. In other words, trust on purchasing activities in terms of, confidentiality, accountability, and completeness. Clarity measures the clearness of the websites to consumers and measures the ability of the websites to provide as many details as possible to consumers, such as if there are advertisements, whether they interfere with their ability to use the page. Richness is the ability of the websites to provide enough info about the products and services. It measures by product details, comprehensive content coverage, and the richness of the advertising and banner of specific product or services.

5.3.3 E-services

E-service reflects the consumers' perception of specific dimensions of service. The ability of the e-commerce websites to support and deliver a set of services to consumers (Cao et al., 2005). E-service is measured by five criteria: reliability, responsiveness, credibility, enjoyable experience, and serviceability.

Table 5.3
E-services Decomposed Criteria

Category	Criteria	Description
E-services	Reliability	<ul style="list-style-type: none"> • Correct website function • Uncommon occurrence of website crash • Effective information delivery service • Correct information displayed
	High responsiveness	<ul style="list-style-type: none"> • The consumers get fast respond once order has been confirmed. • Time needed to respond once order made. • Problem dealing mechanism • Provide relative information for problem solving
	Credibility	<ul style="list-style-type: none"> • Respond to consumer's complaints • How do you rate the confidence and integrity of the websites?
	Enjoyable experience	<ul style="list-style-type: none"> • The entertainments provided by the websites while the consumer browsing the websites.
	Serviceability	<ul style="list-style-type: none"> • Before sale service • After sale service • Logistic service

Reliability measures the consistency of performance of the product or services over the time. It measured by the correctness of the website function and information displayed, Effective information delivery service, and uncommon occurrence of website crash. High responsiveness measures the time delay needed to get a response from the websites. It measures if the consumers get fast respond once order has been confirmed; time needed to respond once order made, if it deal with problems, provide relative information for problem solving, and respond to consumer's complaints. Credibility involves having the consumers' best interests at heart, to purchase without fear such as, the confidentiality and integrity. Enjoyable experience measures if the website entertains the consumer while browsing the website. Such as, pleasure and joy. Serviceability deals with the ease of servicing the website when necessary or resolving conflicts and complaints from consumers. It measures if the consumer can make complaints enquiry

information via the websites such as before sale services, after sale services and logistic service.

5.3.4 E-system

E-system reflects consumers' perception on specific dimensions of the system. It refers to the perceived ability of e-commerce website to provide suitable functions in relation to consumer (Lin, 2010). E-system is measured by seven criteria: navigability, efficiency, accessibility, learnability, and understandability.

Table 5.4
E-system Decomposed Criteria

Category	Criteria	Description
E-system	Navigability	<ul style="list-style-type: none"> • Searching and retrieving issue • Navigation and browsing issue • Domain specific functionality and content • Absence of navigability errors • Shortcut facility • Alternative paths • User level adaptability
	Efficiency	<ul style="list-style-type: none"> • Purchase process performance • Page generation speed • Graphics generation speed • Memory utilization saving • I/O devices utilization saving
	Accessibility	<ul style="list-style-type: none"> • Information access • Readability by deactivating the Browser Image Feature • technologies compatible • Mobile devices accessibility
	Learnability	<ul style="list-style-type: none"> • Interface complexity • Interface density • Ease of component learning • Effectiveness of help system • Customizability • Interface Complexity

Understandability

- Design legibility (Readability of the website)
 - I/O Message Understandability
 - Site map Understandability
 - Comprehensibility of the website contents
-

Navigability measure if the websites provide search and retrieve mechanisms, browsing mechanisms, websites function related to content domain, absence of navigability errors, shortcut facilities, alternative paths, and user level adaptability. Efficiency measure if the websites provide reasonably purchase process performance, reasonably page generation speed, reasonably graphic generation speed, Memory size used, system hang?. Accessibility measure if the websites support for text-only version, readable image title, global readability, and technologies compatible (ex. Mobile devices accessibility). Learnability measures the capability of the website to enable the user to learn its application. Understandability measures the capability of the website to enable the user to understand whether the website application is suitable, and how it can be used for particular tasks and conditions of use. Such as readability of the website, the understandability of the I/O message and website map, and the comprehensibility of the website contents.

5.3.5 E-company

E-company reflects consumers' perception on specific dimensions of the company. E-company is measured by three criteria: reputation, enterprise features, and promotion.

Table 5.5
E-company Decomposed Criteria

Category	Criteria	Description
E-company	Reputation	<ul style="list-style-type: none"> • Average requested reputation • Market honesty • Average number of transactions • Average number of malicious incidents
	Enterprise features	<ul style="list-style-type: none"> • The website provides additional facilities that surprises their consumers in a positive way. • Provide and anticipate enough access to the questions that the consumer may have? • Provide the consumer with links to other sites that may deal better with some issue of interest to the consumer?
	Promotion	<ul style="list-style-type: none"> • Purchasing guarantee • Promotion campaign • Advertising banner • Discount

Reputation measure if the websites is well recognized. It measures the average requested reputation, the market honesty, the average number of transactions and the average number of malicious incidents. Average requested reputation is the mean value of all reputation ratings of the website compared to other websites. Market honesty is the mean value of the actual outcomes from the transactions produced by the provider agents. Average number of transactions is the average number of accepted transactions. Average number of malicious incidents is the average number of malicious incidents for the website. Enterprise features measure if the website provides additional facilities that surprises their consumers in a positive way, provide and anticipate enough access to the questions that the consumer may have, and provide the consumer with links to other sites that may deal better with some issue of interest to the consumer? Examples: The

consumer can be a winner for the top 10 buyers for the day; a consumer can be given a surprise trip to somewhere because of his/her regular online purchase. Promotive activities measure if the website provides attractive offers to encourage electronic purchasing (eg. Free delivery, discount). It is measured by purchasing guarantee, promotion campaign, advertising and banner, and discount. Table 5.6 shows the overall structure of the websites evaluation criteria (CEC).

Table 5.6
Decomposition of the Website Evaluation Criteria

Target	Category Level One	Criteria Level Two
E-commerce Websites Structure	(A) E-usage	Price saving
		purchasing transaction
		Safety
		Visibility
		User friendly
		Diversity of products, services, and information
	(B) E-informational	Correctness
		Presentability
		Current
		Relevant
		Trust on purchasing via credit cards or bank transfer
		Clarity
	(C) E-services	Richness
		High responsiveness
		Credibility
		Enjoyable experience
		Serviceability
	(D) E-system	reliability
		Navigability
		Efficiency
Accessibility		
Learnability		
(E) E-company	Understandability	
	Reputation	
	enterprise features	
	promotive activities	

5.4 New Evaluation Mechanism

This component includes three main mechanisms: i) mechanism to calculate the weight for each criterion, ii) mechanism to calculate the total score for each criterion, and iii) mechanism to identify the current situation for each criterion. The new integration between FAHP with Hardmard methods were used to calculate the weight for each criterion. The new integration between these two methods will make the calculation of the weight more efficient and overcome on the previous problems (subjectivness, time consuming, and the complexity of programming) even if the number of DMs and criteria increase. Using the Fuzzy AHP will deal with the subjectivness. Integrate the method of Hardmard will deal with the time consuming and complexity of the programing even if the number of criteria is huge. Also, the integration between the Operational Laws of Triangular Fuzzy Numbers with Weight Average Sum were used to calculate the total score for each criterion in the e-commerce website and weight variance analysis was used to identify the current situation for each criterion.

5.4.1 A New Mechanism to Calculate the Weight for Each Criterion

This mechanism is carried out through five stages, which are, i) mechanism to scale the relative importance of the criteria; ii) mechanism to construct the pairwise matrix; iii) mechanism to perform the judgments of pairwise comparisons; iv) mechanism to synthesize the pairwise comparison; and v) performing the consistency.

5.4.1.1 Mechanism to Scale the relative importance of the criteria

The design of the questionnaire incorporates pair-wise comparisons of decision elements within the hierarchical model, each evaluator is asked to express relative

importance of two criteria in the same level by a nine-point rating scale. Collect the scores of pair-wise comparison, and form pair-wise comparison matrices for each of the K evaluators. The evaluators fill their expression relative importance based on the Table shown below.

Table 5.7
Triangular Fuzzy Numbers Scale for Pairwise Comparison

Intensive of Importance	Definition	Fuzzy Representation
1 [~]	Equal importance	(1,1,3)
3 [~]	Moderate importance	(1,3,5)
5 [~]	Strong importance	(3,5,7)
7 [~]	Very strong importance	(5,7,9)
9 [~]	Extreme importance	(7,9,9)
2 [~] , 4 [~] , 6 [~] , 8 [~]	Intermediate judgment values	

5.4.1.2 Mechanism to Construct the Fuzzy Pairwise Matrix

The pairwise comparisons are used to assign the weight for the criteria. The evaluation criteria are sorted in CEC in a full hierarchy structure where the criteria are distributed through several levels. Figure 5.3 shows an example from the CEC hierarchy structure.

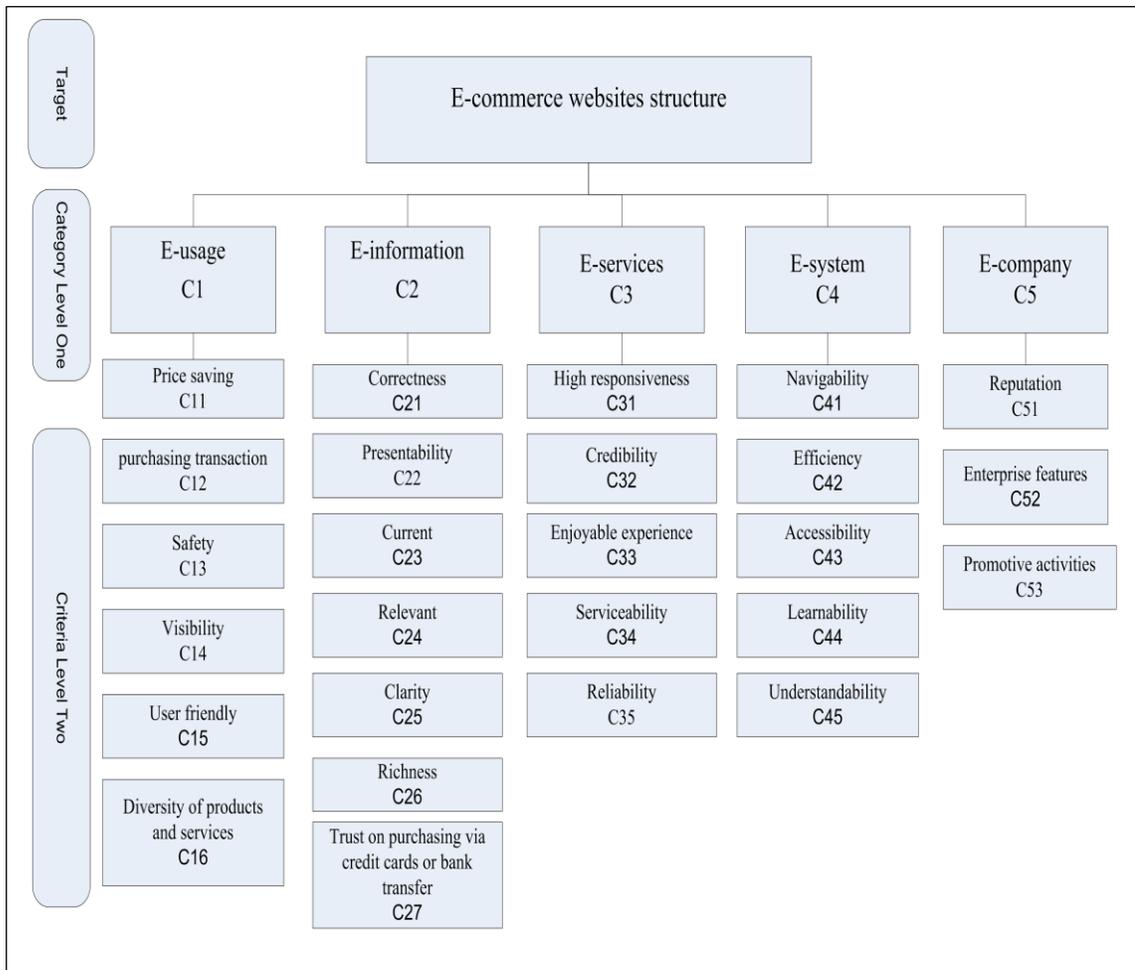


Figure 5.3. CEC hierarchy structure

The sibling criteria at each level are compared in pairs to judge which of each criterion is preferred or important with respect to their parents. The pairwise comparison process sorts the sibling criteria at each level of the CEC in the matrix of two dimensions (square matrix) where the same criteria are sorted horizontally in the first row and vertically in the first column in the matrix, as shown in Figure 5.4. The criteria in the matrix is represented by $(C_1 \dots C_n)$ and the relative importance degree of each C_i in the column compared to the C_j in the row is represented by (r_{ij}) with the constraints that $r_{ij} = 1/r_{ji}$ when $i \neq j$, and $r_{ii} = 1$ when $i = j$.

Criteria	C ₁	C ₂	C ₃	...	C _m
C ₁	r _{1,1}	r _{1,2}	r _{1,3}	...	r _{1,m}
C ₂	r _{2,1}	r _{2,2}	r _{2,3}	...	r _{1,m}
C ₃	r _{2,1}	r _{3,2}	r _{3,3}	...	r _{1,m}
.
.
.
C _n	r _{n,1}	r _{n,2}	r _{n,3}	...	r _{n,m}

Figure 5.4. The pairwise matrix

At the CEC, the main five categories in the first level are compared with respect to the evaluation target using one pairwise comparison matrix, as shown in the Table 5.8.

Table 5.8

The Pairwise Comparison Matrix for Level One in CEC (Level One)

Website Category	E-usage	E-information	E-services	E-system	E-company
E-usage	1	r _{1,2}	r _{1,3}	r _{1,4}	r _{1,5}
E-information	1/ r _{1,2}	1	r _{2,3}	r _{2,4}	r _{2,5}
E-services	1/ r _{1,3}	1/ r _{2,3}	1	r _{3,4}	r _{3,5}
E-system	1/ r _{1,4}	1/ r _{2,4}	1/ r _{3,4}	1	r _{4,5}
E-company	1/ r _{1,5}	1/ r _{2,5}	1/ r _{3,5}	1/ r _{4,5}	1

In the second level, based on the five categories there are five pairwise comparison matrixes where the criteria of each category are represented by one matrix such as the E-usage category criteria price saving, purchasing transaction, safety, visibility, user friendly, and diversity of products and services are compared with each other with respect to the E-usage category using one pairwise matrix as shown in Table 5.9. The same procedure is applied for the other categories (E-information, E-services, E-system, E-company).

Table 5.9
The Pairwise Comparison Matrix of the E-usage Category (Level Two)

E-usage Category	Price saving	Purchasing transaction	Safety	Visibility	User friendly	Diversity of products and services
Price saving	1	$r_{1,2}$	$r_{1,3}$	$r_{1,4}$	$r_{1,5}$	$r_{1,6}$
Purchasing transaction	$1/ r_{1,2}$	1	$r_{2,3}$	$r_{2,4}$	$r_{2,5}$	$r_{2,6}$
Safety	$1/ r_{1,3}$	$1/ r_{2,3}$	1	$r_{3,4}$	$r_{3,5}$	$r_{3,6}$
Visibility	$1/ r_{1,4}$	$1/ r_{2,4}$	$1/ r_{3,4}$	1	$r_{4,5}$	$r_{4,6}$
User friendly	$1/ r_{1,5}$	$1/ r_{2,5}$	$1/ r_{3,5}$	$1/ r_{4,5}$	1	$r_{5,6}$
Diversity of products and services	$1/ r_{1,6}$	$1/ r_{2,6}$	$1/ r_{3,6}$	$1/ r_{4,5}$	$1/ r_{5,6}$	1

The pairwise comparison is done between the siblings with respect to their parents in each matrix. Table 5.10 summarizes the number of pairwise comparisons matrixes at each level of the CEC.

Table 5.10
The Pairwise Comparison Matrixes in CEC

CEC Levels	Number of Criteria	Number of Pairwise Matrixes
Level 1	5	1
Level 2	28	5

5.4.1.3 Mechanisms to Perform the Judgments of Pairwise Comparisons

The pairwise comparison begins by comparing the relative importance of each two criteria in the matrix, e.g. “*is C_1 important than C_2 with respect to their parent? How much is it important ($r_{i,j}$)?*”. In order to determine the intensive importance of each pairwise comparison (r_{ij}), a fundamental scale of fuzzy numbers suggested by Saaty (1980) is used. This scale is shown in Section 5.4.1.1 Table 5.7, has been proven in

practice and validated by decision problems experiments in helping the team developers or experts to assign related importance to each pair of the ratio. The number of the pairwise comparisons in each matrix is determined by the following formula:

$$\text{Pairwise comparisons in each matrix} = n(n-1)/2 \dots\dots\dots (5.1)$$

where “n” is the number of criteria in the matrix.

For instance, by referring to the example in Table 5.8 which has six criteria (n=6), the identification of the pairwise comparisons number in the matrix is done by applying the previous formula: $6*(6-1)/2 = 15$ pairwise comparisons.

The judgments are decided based on the evaluation team. For more explanation, refer to the example in Table 5.7. In the first level of the CEC, the number of pairwise comparison is $5*(5-1)/2 = 10$. The pairwise comparisons should be conducted in this matrix with respect to the target of evaluation the e-commerce website applications.

These are some of such comparisons:

- Is the “E-usage category” important then the “E-information category”? Yes, it is a moderate importance than domain category (~3), according to the scale in Table 5.7.
- Is “E-information category” important than the “E-services category”? Yes, it is strongly important than the E-services category (5).
- Is the “E-services category” important than the “E-system category”? No, the operational environment is moderately important than the E-system category (1/3).

Table 5.11 presents how the weight obtained from the experts. Then this table is converted to pairwise comparison as shown in Figure 5.5

Table 5.11
The Judgment of Primary Criteria With Respect to E-Commerce Websites

With Respect to E-commerce Website		Importance (influence) of One Primary Criteria over Another																	
Criteria	<div style="display: flex; justify-content: space-between; align-items: center;"> Extremely Important ← Equal → Extremely Important </div>																		Criteria
	E-usage	9	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8	
E-usage	9	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8	9	E-services
E-usage	9	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8	9	E-system
E-usage	9	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8	9	E-company
E-information	9	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8	9	E-services
E-information	9	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8	9	E-system
E-information	9	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8	9	E-company
E-services	9	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8	9	E-system
E-services	9	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8	9	E-company
E-system	9	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8	9	E-company

The reciprocals are then assigned to other each of the pair-wise comparisons in the matrix. The reciprocals are considered if the expert considered the criteria in the right column is more important than the criteria on the left column, see Figure 5.5.

E-commerce Websites Evaluation	E-usage	E-information	E-services	E-system	E-company
E-usage	1	(1,3,5)	(3,5,7)	(1,3,5)	(3,5,7)
E-information	1/(1,3,5)	1	(1,3,5)	(1,1,3)	(1,3,5)
E-services	1/(3,5,7)	1/(1,3,5)	1	1/(1,3,5)	(1,3,5)

E-system	1/(1,3,5)	1/(1,1,3)	(1,3,5)	1	(1,3,5)
E-company	1/(3,5,7)	1/(1,3,5)	1/(1,3,5)	1/(1,3,5)	1

Figure 5.5. Example of performing the judgments pairwise comparisons

5.4.1.4 Mechanism to Synthesis the Pairwise Comparison

After the completion of assigning the evaluation team judgments in each matrix, the best number preference (BNP) for each criterion is calculated using Center of Area Method (COA) which it considered the weight. To do so, the Hardmard method was used.

Hadamard Multiplication of matrices definition, for two matrices A, B of the same dimensions. The Hadamard product (or the entry wise product) of A and B is a binary operation that takes two matrices of the same dimensions, and produces another matrix where each element ij is the product of elements ij of the original two matrices, i.e.

$$[A \circ B]_{ij} = (a_{ij})(b_{ij}) \text{ for all } 1 \leq i \leq m, 1 \leq j \leq n. \quad (5.1)$$

$$\check{R}^g = [\check{r}_{ij}]^g \quad (5.2)$$

Where \check{R}^g is the a fuzzy judgment matrix of evaluator k , \check{r}_{ij}^g the fuzzy assessments between criterion i and criterion j of evaluator g ,

$$\check{r}_{ij}^g = (l_{ij}^g, m_{ij}^g, u_{ij}^g) \text{ } n \text{ is the number of the related criteria at the this level,} \\ \check{r}_{ij}^g = (1,1,1), \quad \forall i = j, \text{ and } \check{r}_{ij}^g = 1/\check{r}_{ji}^g, \forall j, j = 1,2, \dots, n \quad (5.3)$$

Let $\tilde{E}^g, g, 1 = 1, \dots, p$ are experts matrices of size k, g number of evaluators or expert participate on the evaluation. Then \tilde{E}^g 's are fuzzy matrices as follows example:

$$\tilde{E}^g = (A^g, M^g, N^g), \text{ for } g = 1, \dots, p.$$

Where A^g, M^g, N^g are crisp matrices,

The BNP_{w_i} are obtained using the following six steps.

- **Step One:** Find the following three Hadamard products, as follows

- Let $A_h = [a_{h_{i,j}}]_{i,j=1}^k$, where

$$A_h = \prod_{g=1}^p A^g = A^1 \circ A^2 \circ A^3 \dots A^p \quad (5.4)$$

- Let $M_h = [m_{h_{i,j}}]_{i,j=1}^k$, where

$$M_h = \prod_{g=1}^p N^g = M^1 \circ M^2 \circ M^3 \dots M^p$$

- Let $N_h = [n_{h_{i,j}}]_{i,j=1}^k$, where

$$N_h = \prod_{g=1}^p N^g = N^1 \circ N^2 \circ N^3 \dots N^p$$

Then A_h, M_h, N_h are square crisp matrices of size k

$$\left\{ \begin{array}{l} \text{Where } \tilde{E}_1 = \begin{pmatrix} (1,1,1) & (1,3,5) & (5,7,9) \\ \left(\frac{1}{5}, \frac{1}{3}, 1\right) & (1,1,1) & (1,3,5) \\ \left(\frac{1}{9}, \frac{1}{7}, \frac{1}{5}\right) & \left(\frac{1}{5}, \frac{1}{3}, 1\right) & (1,1,1) \end{pmatrix}, \text{ then } A_1 = \begin{pmatrix} 1 & 1 & 5 \\ \frac{1}{5} & 1 & 1 \\ \frac{1}{9} & \frac{1}{5} & 1 \end{pmatrix}, B_1 \\ \\ = \begin{pmatrix} 1 & 3 & 7 \\ \frac{1}{3} & 1 & 3 \\ \frac{1}{7} & \frac{1}{3} & 1 \end{pmatrix}, C_1 = \begin{pmatrix} 1 & 5 & 9 \\ 1 & 1 & 5 \\ \frac{1}{5} & 1 & 1 \end{pmatrix} \end{array} \right\}$$

$$\left\{ \begin{aligned} \text{Where } \tilde{E}_2 &= \begin{pmatrix} (1,1,1) & (1,1,3) & (3,5,7) \\ \left(\frac{1}{3}, 1, 1\right) & (1,1,1) & (1,3,5) \\ \left(\frac{1}{7}, \frac{1}{5}, \frac{1}{3}\right) & \left(\frac{1}{5}, \frac{1}{3}, 1\right) & (1,1,1) \end{pmatrix}, \text{ then } A_2 = \begin{pmatrix} 1 & 1 & 3 \\ \frac{1}{3} & 1 & 1 \\ \frac{1}{7} & \frac{1}{5} & 1 \end{pmatrix}, B_2 \\ &= \begin{pmatrix} 1 & 1 & 5 \\ 1 & 1 & 3 \\ \frac{1}{5} & \frac{1}{3} & 1 \end{pmatrix}, C_2 = \begin{pmatrix} 1 & 3 & 7 \\ 1 & 1 & 5 \\ \frac{1}{3} & 1 & 1 \end{pmatrix} \end{aligned} \right\}$$

$$\left\{ \begin{aligned} \text{Where } \tilde{E}_3 &= \begin{pmatrix} (1,1,1) & \left(\frac{1}{5}, \frac{1}{3}, 1\right) & (5,7,9) \\ (1,3,5) & (1,1,1) & (1,3,5) \\ \left(\frac{1}{9}, \frac{1}{7}, \frac{1}{5}\right) & \left(\frac{1}{5}, \frac{1}{3}, 1\right) & (1,1,1) \end{pmatrix}, \text{ then } A_3 = \begin{pmatrix} 1 & \frac{1}{5} & 5 \\ 1 & 1 & 1 \\ \frac{1}{9} & \frac{1}{5} & 1 \end{pmatrix}, B_3 \\ &= \begin{pmatrix} 1 & \frac{1}{3} & 7 \\ 3 & 1 & 3 \\ \frac{1}{7} & \frac{1}{3} & 1 \end{pmatrix}, C_3 = \begin{pmatrix} 1 & 1 & 9 \\ 5 & 1 & 5 \\ \frac{1}{5} & 1 & 1 \end{pmatrix} \end{aligned} \right\}$$

$$\left\{ \begin{aligned} \text{Where } \tilde{E}_4 &= \begin{pmatrix} (1,1,1) & \left(\frac{1}{5}, \frac{1}{3}, 1\right) & (7,9,9) \\ (1,3,5) & (1,1,1) & (3,5,7) \\ \left(\frac{1}{9}, \frac{1}{9}, \frac{1}{7}\right) & \left(\frac{1}{7}, \frac{1}{5}, \frac{1}{3}\right) & (1,1,1) \end{pmatrix}, \text{ then } A_4 = \begin{pmatrix} 1 & \frac{1}{5} & 7 \\ 1 & 1 & 3 \\ \frac{1}{9} & \frac{1}{7} & 1 \end{pmatrix}, B_4 \\ &= \begin{pmatrix} 1 & \frac{1}{3} & 9 \\ 3 & 1 & 5 \\ \frac{1}{9} & \frac{1}{5} & 1 \end{pmatrix}, C = \begin{pmatrix} 1 & 1 & 9 \\ 5 & 1 & 7 \\ \frac{1}{7} & \frac{1}{3} & 1 \end{pmatrix} \end{aligned} \right\}$$

$$\left\{ \begin{aligned} \text{Where } \tilde{E}_5 &= \begin{pmatrix} (1,1,1) & \left(\frac{1}{7}, \frac{1}{5}, \frac{1}{3}\right) & (1,1,3) \\ (3,5,7) & (1,1,1) & \left(\frac{1}{3}, 1, 1\right) \\ \left(\frac{1}{3}, 1, 1\right) & (1,1,3) & (1,1,1) \end{pmatrix}, \text{ then } A_5 = \begin{pmatrix} 1 & \frac{1}{7} & 1 \\ 3 & 1 & \frac{1}{3} \\ \frac{1}{3} & 1 & 1 \end{pmatrix}, B_5 \\ &= \begin{pmatrix} 1 & \frac{1}{5} & 1 \\ 5 & 1 & 1 \\ 1 & 1 & 1 \end{pmatrix}, C_5 = \begin{pmatrix} 1 & \frac{1}{3} & 3 \\ 7 & 1 & 1 \\ 1 & 3 & 1 \end{pmatrix} \end{aligned} \right\}$$

$$\left\{ \begin{aligned} A^1 &= \begin{pmatrix} 1 & 1 & 5 \\ \frac{1}{5} & 1 & 1 \\ \frac{1}{9} & \frac{1}{5} & 1 \end{pmatrix}, A^2 = \begin{pmatrix} 1 & 1 & 3 \\ \frac{1}{3} & 1 & 1 \\ \frac{1}{7} & \frac{1}{5} & 1 \end{pmatrix}, A^3 = \begin{pmatrix} 1 & \frac{1}{5} & 5 \\ 1 & 1 & 1 \\ \frac{1}{9} & \frac{1}{5} & 1 \end{pmatrix}, A^4 = \begin{pmatrix} 1 & \frac{1}{5} & 7 \\ 1 & 1 & 3 \\ \frac{1}{9} & \frac{1}{7} & 1 \end{pmatrix}, A^5 \\ &= \begin{pmatrix} 1 & \frac{1}{7} & 1 \\ 3 & 1 & \frac{1}{3} \\ \frac{1}{3} & 1 & 1 \end{pmatrix} \end{aligned} \right\}$$

- **Step Two:** Compute **p – root** for the all entries of **A_h, M_h, N_h** , as follows

- Let $A_w = [a_{w_{i,j}}]_{i,j=1}^k$, Where,

$$a_{w_{i,j}} = (a_{h_{i,j}})^{1/p} \quad \text{for } i, j = 1, \dots, k \quad (5.5)$$

- Let $M_w = [m_{w_{i,j}}]_{i,j=1}^k$, where

$$m_{w_{i,j}} = (m_{h_{i,j}})^{1/p} \quad \text{for } i, j = 1, \dots, k$$

- Let $N_w = [n_{w_{i,j}}]_{i,j=1}^k$, where

$$n_{w_{i,j}} = (n_{h_{i,j}})^{1/p} \quad \text{for } i, j = 1, \dots, k$$

As mentioned earlier, $g, 1 = 1.., p$ are experts matrices of size k , g number of evaluators or expert participate on the evaluation.

$$A_h = \begin{pmatrix} 1 & \frac{1}{5^{2/5} * 7^{1/5}} & 5^{2/5} * 21^{1/5} \\ \frac{1}{5^{1/5}} & 1 & 1 \\ \frac{1}{33^{2/5} * 7^{1/5}} & \frac{1}{5^{3/5} * 7^{1/5}} & 1 \end{pmatrix} = \begin{pmatrix} 1. & 0.35595 & 3.49971 \\ 0.72478 & 1. & 1. \\ 0.14555 & 0.25799 & 1. \end{pmatrix}$$

$$M_h = \begin{pmatrix} 1 & \frac{1}{15^{1/5}} & 5^{1/5} 21^{2/5} \\ 15^{1/5} & 1 & 3^{3/5} 5^{1/5} \\ \frac{1}{5^{1/5} 21^{2/5}} & \frac{1}{3^{3/5} 5^{1/5}} & 1 \end{pmatrix} = \begin{pmatrix} 1. & 0.58181 & 4.66318 \\ 1.71877 & 1. & 2.66727 \\ 0.21445 & 0.37492 & 1. \end{pmatrix}$$

$$N_h = \begin{pmatrix} 1 & 5^{1/5} & 33^{2/5} * 7^{1/5} \\ 5^{2/5} * 7^{1/5} & 1 & 5^{3/5} * 7^{1/5} \\ \frac{1}{5^{2/5} * 21^{1/5}} & 1 & 1 \end{pmatrix} = \begin{pmatrix} 1. & 1.37973 & 6.87052 \\ 2.80936 & 1. & 3.87616 \\ 0.28574 & 1. & 1. \end{pmatrix}$$

- **Step Three:** Multiple the entries for each row for A_c, M_c, N_c

- Let $A_c = [a_{ci}]_{i=1}^k$, where

$$a_{ci} = \prod_j^k (a_{wij}), \text{ for } i = 1, \dots, k$$

then

$$A_c = (a_{c1}, a_{c2}, \dots, a_{ck})^T$$

$$= \left(\prod_j^k (a_{w1j}), \prod_j^k (a_{w2j}), \dots, \prod_j^k (a_{wkj}) \right)^T \quad (1.4)$$

- Let $M_c = [m_{ci}]_{i=1}^k$, where

$$m_{c_i} = \prod_j^k (m_{w_{ij}}), i = 1, \dots, k$$

then

$$\begin{aligned} M_c &= (m_{c_1}, m_{c_2}, \dots, m_{c_k})^T \\ &= M_c = \left(\prod_j^k (m_{w_{1j}}), \prod_j^k (m_{w_{2j}}), \dots, \prod_j^k (m_{w_{kj}}) \right)^T = \end{aligned}$$

- Let $N_c = [n_{c_i}]_{i=1}^k$, where

$$n_{c_i} = \prod_j^k (n_{w_{ij}}), \text{ for } i = 1, \dots, k$$

then

$$\begin{aligned} N_c &= (n_{c_1}, n_{c_2}, \dots, n_{c_k})^T \\ &= \left(\prod_j^k (n_{w_{1j}}), \prod_j^k (n_{w_{2j}}), \dots, \prod_j^k (n_{w_{kj}}) \right)^T \end{aligned}$$

Then A_c, M_c, N_c are crisp vectors of diminution k

$$A_c = \begin{pmatrix} 3^{1/5} \\ 1 \\ 5^{1/5} \\ 1 \\ \hline 35^{3/5} * 21^{2/5} \end{pmatrix} = \begin{pmatrix} 1.24573 \\ 0.72478 \\ 0.03755 \end{pmatrix}$$

$$M_c = \begin{pmatrix} 3^{1/5} * 7^{2/5} \\ 3^{4/5} * 5^{2/5} \\ 1 \\ \hline 335^{2/5} \end{pmatrix} = \begin{pmatrix} 2.71309 \\ 4.58443 \\ 0.08040 \end{pmatrix}$$

$$N_c = \begin{pmatrix} 33^{2/5} * 35^{1/5} \\ 57^{2/5} \\ 1 \\ \hline 5^{2/5} * 21^{1/5} \end{pmatrix} = \begin{pmatrix} 9.47945 \\ 10.8895 \\ 0.28574 \end{pmatrix}$$

- **Step Four:** Compute ***k* – root** for the all elements of vectors ***A_c, M_c, N_c***, as follows

- Let $A_f = [a_{f_i}]_{i=1}^k$, where

$$a_{f_i} = (a_{c_i})^{\frac{1}{k}} \quad \text{for } i = 1, \dots, k \quad (5.7)$$

- Let $M_f = [m_{f_i}]_{i=1}^k$, where

$$m_{f_i} = (m_{c_i})^{\frac{1}{k}} \quad \text{for } i = 1, \dots, k$$

- Let $N_f = [n_{f_i}]_{i=1}^k$, where

$$n_{f_i} = (n_{c_i})^{\frac{1}{k}} \quad \text{for } i = 1, \dots, k$$

Using the crisp vectors A_f, M_f, N_f , we can construct the following fuzzy vector $\tilde{R}_f = (A_f, M_f, N_f)$, where $\tilde{R}_{f_i} = (a_{f_i}, m_{f_i}, n_{f_i}), i = 1, \dots, k$ are triangular fuzzy numbers

$$\tilde{R}_f = \begin{pmatrix} \tilde{R}_{f_1} \\ \tilde{R}_{f_2} \\ \vdots \\ \tilde{R}_{f_k} \end{pmatrix} = \begin{pmatrix} (a_{f_1}, m_{f_1}, n_{f_1}) \\ (a_{f_2}, m_{f_2}, n_{f_2}) \\ \vdots \\ (a_{f_k}, m_{f_k}, n_{f_k}) \end{pmatrix}$$

$$A_f = \begin{pmatrix} 3^{1/15} \\ 1 \\ 5^{1/15} \\ 1 \\ \hline 3^{7/15} * 5^{1/5} * 7^{2/15} \end{pmatrix} = \begin{pmatrix} 1.076 \\ 0.898 \\ 0.335 \end{pmatrix}$$

$$M_f = \begin{pmatrix} 3^{1/15} * 7^{2/15} \\ 3^{4/15} * 5^{2/15} \\ 1 \\ \hline 3^{1/3} * 35^{2/15} \end{pmatrix} = \begin{pmatrix} 1.395 \\ 1.661 \\ 0.432 \end{pmatrix}$$

$$N_f = \begin{pmatrix} 3^{7/15} * 35^{1/15} \\ 5^{1/3} * 7^{2/15} \\ 1 \\ \hline 5^{2/15} * 21^{1/15} \end{pmatrix} = \begin{pmatrix} 2.116 \\ 2.217 \\ 0.659 \end{pmatrix}$$

$$\begin{pmatrix} \tilde{R}_{f_1} \\ \tilde{R}_{f_2} \\ \tilde{R}_{f_3} \end{pmatrix} = \begin{pmatrix} (3^{1/15}, 3^{1/15} \times 7^{2/15}, 3^{7/15} \times 35^{1/15}) \\ (\frac{1}{5^{1/15}}, 3^{4/15} \times 5^{2/15}, 5^{1/3} \times 7^{2/15}) \\ (\frac{1}{3^{7/15} \times 5^{1/5} \times 7^{2/15}}, \frac{1}{3^{1/3} \times 35^{2/15}}, \frac{1}{5^{2/15} \times 21^{1/15}}) \end{pmatrix}$$

$$= \begin{pmatrix} (1.0759, 1.39472, 2.11638) \\ (0.89825, 1.66122, 2.2165) \\ (0.33486, 0.4316, 0.6586) \end{pmatrix}$$

- **Step Five:** Find the sum of all rows of $\tilde{\mathbf{R}}_f$ fuzzy vectors as follows,

Let \tilde{r}_s is a triangular fuzzy number, where

$$\begin{aligned} \tilde{r}_s &= \sum_{i=1}^k \tilde{R}_{f_i} = \tilde{R}_{f_1} + \tilde{R}_{f_2} + \dots + \tilde{R}_{f_k} \\ &= (a_{f_1}, m_{f_1}, n_{f_1}) + (a_{f_2}, m_{f_2}, n_{f_2}) + \dots + (a_{f_k}, m_{f_k}, n_{f_k}) \end{aligned} \quad (5.8)$$

$$\tilde{r}_s = \{(2.30911, 3.4875, 4.99154620)\}$$

Let $i\tilde{r}_s$ is a triangular fuzzy number represents the inverse of \tilde{r}_s , as follows

$$i\tilde{r}_s = (\tilde{r}_s)^{-1} \quad (5.9)$$

$$i\tilde{r}_s = \{0.200338, 0.28673, 0.43306\}$$

- **Step Six:** Compute the weight for each criterion

Let $W = [w_i]_{i=1}^k$, where

$$w_i = \tilde{R}_{f_i} \otimes i\tilde{r}_s \quad \text{for } i = 1, \dots, k \quad (5.10)$$

then

$$W = \begin{pmatrix} w_1 \\ w_2 \\ \vdots \\ w_k \end{pmatrix} = \begin{pmatrix} \tilde{r}_{f_1} \otimes i\tilde{r}_s \\ \tilde{r}_{f_2} \otimes i\tilde{r}_s \\ \vdots \\ \tilde{r}_{f_k} \otimes i\tilde{r}_s \end{pmatrix}$$

And,

$$BNP_{w_i} = \frac{[(U_{w_i} - L_{w_i}) + (M_{w_i} - L_{w_i})]}{3} + L_{w_i} \quad \text{for } i = 1, \dots, k \quad (5.11)$$

Then

$$, BNP = \begin{pmatrix} BNP_{w_1} \\ BNP_{w_2} \\ BNP_{w_k} \end{pmatrix}$$

$$\begin{pmatrix} w_1 \\ w_2 \\ w_3 \end{pmatrix} = \begin{pmatrix} (0.2155, 0.39991, 0.91653) \\ (0.1799, 0.4763, 0.95989) \\ (0.06708, 0.12375, 0.28524) \end{pmatrix}$$

$$\begin{pmatrix} BNP_{w_1} \\ BNP_{w_2} \\ BNP_{w_3} \end{pmatrix} = \begin{pmatrix} 0.5107 \\ 0.5387 \\ 0.1587 \end{pmatrix}$$

5.4.1.5 Performing the Inconsistency Test

According to the analysis of Csutora and Buckley (2001), let $\check{R} = [\check{r}_{ij}]$ be a fuzzy judgment matrix with triangular fuzzy number $\check{r}_{ij} = (l_{ij}, m_{ij}, u_{ij})$ and form $R = [m_{ij}]$. If R is consistent, then Fuzzy R is consistent too. Saaty (1990) provides a consistency index to measure any inconsistency within the judgments in each pair-wise comparison matrix as well as for the entire hierarchy. The consistency index (CI) is formulated as follows:

$$CI = (\lambda_{\max} - n) / (n - 1) \dots\dots\dots (5.12)$$

where “ n ” is number of criteria in the matrix, and λ_{\max} is the maximum eigen value of the matrix.

Accordingly, the consistency ration (CR) can be computed with the use of following equation:

$$CR = CI/RI \dots\dots\dots (5.13)$$

If the calculated CR of a pair-wise comparison matrix is less than 0.1, the consistency of the pair-wise judgment can be thought of as being acceptable. Moreover, if the consistency is not passed, the original values in the pair-wise comparison matrix must be revised by the evaluator.

λ_{\max} can be calculated by following steps:

- 1) Multiply the summation of each column in the matrix by the weight vector and obtaining the new vector.

- 2) Divide all the elements of the weighted sum matrices or new vector by their respective weight vector element.
- 3) Find out the average of these values to obtain λ_{\max} .

Choosing the suitable value of RI is based on the size of the matrix (n) as stated in Table 5.12. The RI value is developed by Saaty and his colleagues at the Oak Ridge National Laboratory by generating random matrices and calculating the mean of CI. Once identified the RI value, the CR can be calculated. According to Saaty, the judgment matrix is considered as inconsistent when the $CR > 0.1$. This means that the judgments in that matrix need to be reviewed and improved.

Table 5.12
Random Index

Size of Matrix (n)	1	2	3	4	5	6	7	8	9	10	11	12
Random Index (RI)	0	0	0.58	0.9	1.12	1.24	1.32	1.41	1.45	1.49	1.51	1.58

5.4.2 Mechanism to Identify the Total Score for each Criterion

The process of identifying the total score $[M(u)]$ for each criterion consists of four mechanisms: i) mechanisms to obtain the score for each descriptive question; ii) mechanisms to identify the average score for each descriptive question; iii) mechanisms to identify the average score for each criterion; and iv) mechanisms to defuzzify the average score for each criterion to crisp value. Sections 5.4.2.1, 5.4.2.2, 5.4.2.3, and 5.4.2.4 explain each step in detail.

5.4.2.1 Mechanism to Obtain the Score for Each Descriptive Question

This mechanism is to obtain the importance degree of for each given descriptive question. Five linguistic variables for rating the criteria were presented in the following Table 5.13. The same five linguistic variables for rating were proposed by Yu et al., (2011).

Table 5.13
Fuzzy rates of alternatives against criteria by linguistic variables

Linguistic Variables	Fuzzy Number
Worst (W)	(0.00, 0.00, 2.50)
Poor (P)	(0.00, 2.50, 5.00)
Fair (F)	(2.50, 5.00, 7.50)
Good (G)	(5.00, 7.50, 10.0)
Best (B)	(7.50, 10.0, 10.0)

Table 5.14 gives an example and explains how to obtain the value score for the descriptive question. Appendix B presents the mechanism to obtain the importance score for each criterion. The score list is constructed based on the criteria presented on Section 5.3.

Table 5.14
An Example of Obtaining Scores for E-usage Category and Criteria

Category	Criteria	Description Question	Linguistic Variables	Consumers				
				A	B	C	D	E
E-Usage	Price saving	Reasonability of the price provided by the website?	Worst (W), Poor (P), Fair (F), Good (G), Best (B)	Ca1	Cb1	Cc1	Cd1	Ce1

	Purchasing transaction	The website provides various options for payments?	Worst (W), Poor (P), Fair (F), Good (G), Best (B)	Ca2	Cb2	Cc2	Cd2	Ce2
	Safety	The system operate without (internal) catastrophic failure Good system recovery	Worst (W), Poor (P), Fair (F), Good (G), Best (B)	Ca3	Cb3	Cc3	Cd3	Ce3
			Worst (W), Poor (P), Fair (F), Good (G), Best (B)	Ca3	Cb3	Cc3	Cd3	Ce3
	Website Visibility	The website is promoted at other website and media such as tracable, retrievable, and ease of access.	Worst (W), Poor (P), Fair (F), Good (G), Best (B)	Ca4	Cb4	Cc4	Cd4	Ce4
	User friendly	Communication facilities; Forms of payment availability; Storage of purchase list; Products comparison “Shopping cart” metaphor; Printing facilities	Worst (W), Poor (P), Fair (F), Good (G), Best (B)	Ca5	Cb5	Cc5	Cd5	Ce5
		Download facilities; Communication facilities; Help availability	Worst (W), Poor (P), Fair (F), Good (G), Best (B)	Ca5	Cb5	Cc5	Cd5	Ce5
	Diversity of products and services	Promote many type of products and services	Worst (W), Poor (P), Fair (F), Good (G), Best (B)	Ca6	Cb6	Cc6	Cd6	Ce6
		complete description of products and Services	Worst (W), Poor (P), Fair (F), Good (G), Best (B)	Ca6	Cb6	Cc6	Cd6	Ce6

Table 5.14 shows the E-usage criteria that need to be evaluated by the consumers (A, B, C, D and E). Criteria show the specific item to be evaluated and measure shows the description of each criteria. Scale of linguistic variable scores that can be given for each criterion. Ca₁ means “the value given by consumer named ‘A’ for the first criteria. Ca₂ means “the value given by consumer named ‘A’ for the second criteria. Vb₂ means “the value given by consumer named ‘B’ for the second criteria. Ve₆ means “the value given by consumer named ‘E’ for the criteria number six of the E-usage category and so on. Table 5.15 shows an example of the scores given by consumers A and B.

Table 5.15

An Example of Obtaining Scores for Criteria from Decision Makers A and B

Category	Criteria	Description Question	Linguistic Variables	Consumers	
				A	B
E-Usage	Price saving	<ul style="list-style-type: none"> Reasonability of the price provided by the website? 	Worst (W), Poor (P), Fair (F), Good (G), Best (B)	W	P
	purchasing transaction	<ul style="list-style-type: none"> The website provides various options for payments? 	Worst (W), Poor (P), Fair (F), Good (G), Best (B)	G	B
	Safety	<ul style="list-style-type: none"> The system operate without (internal) catastrophic failure 	Worst (W), Poor (P), Fair (F), Good (G), Best (B)	B	G
		<ul style="list-style-type: none"> Good system recovery 	Worst (W), Poor (P), Fair (F), Good (G), Best (B)	W	F
	Website Visibility	<ul style="list-style-type: none"> The website is promoted at other website and media such as tracable, retrievable, and ease of access. 	Worst (W), Poor (P), Fair (F), Good (G), Best (B)	P	F

Based on the Table 5.15, consumer A gave a score W, G, B, W, P and B for criteria price saving, purchasing transaction, safety, visibility, user friendly, diversity of products and services respectively; while consumer B gave a score P,B,G,F,F, and B for the same criteria.

5.4.2.2 Mechanism to Identify the Average Score for Each Descriptive Question

The score given by each consumer were converted from linguistic variables to fuzzy number based on the Table 5.13. The fuzzy numbers were added and divided by the number of the consumers. Equation (1) shows the mathematical expression used.

n

$$\text{Descriptive Question Average Score (DQAS)}_x = \sum_{n=1} (C_{xj}) / n \dots\dots(5.14)$$

(C_{xj}) Represents the value given by the Consumers

(n) Represents the consumers number

(x) Descriptive question

The processes of addition and division calculations are obtained by using the operational laws of triangular fuzzy numbers in Table 5.16.

Table 5.16
Operational Laws of Triangular Fuzzy Numbers

Operational law	Expression
Addition	$\tilde{a} + \tilde{b} = (a_1, a_2, a_3) + (b_1, b_2, b_3) = (a_1 + b_1, a_2 + b_2, a_3 + b_3)$
Subtraction	$\tilde{a} - \tilde{b} = (a_1, a_2, a_3) - (b_1, b_2, b_3) = (a_1 - b_1, a_2 - b_2, a_3 - b_3)$
Multiplication	$\tilde{a} \times \tilde{b} = (a_1, a_2, a_3) \times (b_1, b_2, b_3) = (a_1 \times b_1, a_2 \times b_2, a_3 \times b_3)$ $k\tilde{a} = k \times (a_1, a_2, a_3) = (k \times a_1, k \times a_2, k \times a_3)$
Division	$\tilde{a} \div \tilde{b} = (a_1, a_2, a_3) \div (b_1, b_2, b_3) = (a_1 \div b_1, a_2 \div b_2, a_3 \div b_3)$
Inverse	$\tilde{a}^{-1} = (a_1, a_2, a_3)^{-1} = \left(\frac{1}{a_3}, \frac{1}{a_2}, \frac{1}{a_1}\right)$

Table 5.17 shows an example of how descriptive questions average score is calculated

Table 5.17
An Example of Calculating Description Question Average Score

Category A		Consumers				Description Question Average Score (DQAS) =	
Criteria	Description Question	Cons ₁	Cons ₂	•	•		Cons _n
W	DQ ₁	C _{1,DQ1}	C _{2,DQ1}	•	•	C _{n,DQ1}	DQAS _{DQ1} = (C _{1,DQ1} + C _{2,DQ1} + + C _{n,DQ1}) / num of consumers
	DQ ₂	C _{1,DQ2}	•	•	•	C _{n,DQ2}	DQAS _{DQ2} = (C _{1,DQ2} + + C _{n,DQ2}) / num of consumers
	DQ ₃	C _{1,DQ3}	•	•	•	•	•
	DQ ₄	C _{1,DQ4}	•	•	•	•	•
Y	DQ ₁	•	•	•	•	•	•
	DQ ₂	•	•	•	•	•	•

	DQ ₃	•	•	•	•	•	•
Z	DQ ₁	•	•	•	•	•	•
	•	•	•	•	•	•	•
	•	•	•	•	•	•	•
	DQ _j	C _{1,DQj}	C _{2,DQj}	•	•	C _{n,DQj}	$DQAS_{DQj} = (C_{1,DQj} + C_{2,DQj} + \dots + C_{n,DQj}) / \text{number of consumers}$

Here, category A has three criteria W, Y, and Z. Each one of these criteria has a set of descriptive question known as DQ₁, DQ₂, DQ₃, ..., until DQ_j. Consumers (Cons₁, Cons₂, ..., Cons_n) need to give scores for each descriptive question. C_{1,DQ1} means “the value given by consumer₁ for descriptive question (DQ₁). C_{2,DQ1} means “the value given by consumer₂ for descriptive question (DQ₁). The average score for each description question was then calculated. An example on the calculation is shown in Table 5.18.

Table 5.18
A Running Example of Calculating Descriptive Question Average Score

Category A		Consumers					Descriptive Question Average Score (DQAS) =
Criteria	description Question	Con1	Con2	Con 3	Con 4	Cons5	
W	DQ1	0.00, 0.00, 2.50	0.00, 2.50, 5.00	0.00, 2.50, 5.00	0.00, 0.00, 2.50	0.00, 0.00, 2.50	$((0.00+0.00+0.00+0.00+0.00)+(0+2.5+2.5+0+0)+(2.5+5+5+2.5+2.5)) / 5 = (0.00, 1.00, 3.50)$
	DQ2	2.50, 5.00, 7.50	5.00, 7.50, 10.0	2.50, 5.00, 7.50	5.00, 7.50, 10.0	2.50, 5.00, 7.50	(3.5, 4.0, 8.5)
	DQ3	5.00, 7.50, 10.0	5.00, 7.50, 10.0	5.00, 7.50, 10.0	2.50, 5.00, 7.50	2.50, 5.00, 7.50	(4.0, 6.5, 9.0)
	DQ4	2.50, 5.00, 7.50	5.00, 7.50, 10.0	2.50, 5.00, 7.50	5.00, 7.50, 10.0	2.50, 5.00, 7.50	(3.5, 6.0, 8.5)
Y	DQ1	7.50, 10.0, 10.0	5.00, 7.50, 10.0	5.00, 7.50, 10.0	5.00, 7.50, 10.0	5.00, 7.50, 10.0	(5.5, 8.0, 10.0)
	DQ2	5.00, 7.50, 10.0	5.00, 7.50, 10.0	5.00, 7.50, 10.0	2.50, 5.00, 7.50	2.50, 5.00, 7.50	(4.0, 6.5, 9.0)
	DQ3	7.50, 10.0, 10.0	5.00, 7.50, 10.0	5.00, 7.50, 10.0	5.00, 7.50, 10.0	5.00, 7.50, 10.0	(3.5, 8.0, 10.0)

Z	DQ1	0.00, 0.00, 2.50	0.00, 2.50, 5.00	0.00, 2.50, 5.00	0.00, 0.00, 2.50	0.00, 0.00, 2.50	(0.00, 1.00, 3.50)
	DQ2	2.50, 5.00, 7.50	5.00, 7.50, 10.0	2.50, 5.00, 7.50	5.00, 7.50, 10.0	2.50, 5.00, 7.50	(3.5, 6.0, 8.5)
	DQ3	5.00, 7.50, 10.0	5.00, 7.50, 10.0	5.00, 7.50, 10.0	2.50, 5.00, 7.50	2.50, 5.00, 7.50	(4.0, 6.5, 9.0)
	DQ4	2.50, 5.00, 7.50	5.00, 7.50, 10.0	2.50, 5.00, 7.50	5.00, 7.50, 10.0	2.50, 5.00, 7.50	(3.5, 6.0, 8.5)

Table 5.18 gives an example about how to calculate the descriptive question average score for an online bookstore known as AMAZININE. First the consumers of the website (at least five) were selected. Then, they were given an evaluation score list as shown in Appendix B. These consumers were required to give a score, ranging from Worst (W) to Best (B) linguistic variables scale. The score lists were collected from all five consumers and tabulated as in Table 5.18.

DQAS was then calculated by adding all scores given by the consumers and dividing the total by the number of the consumers. In this example, the numbers of the consumers was five. Thus, for DQ₁, the DQAS is $((0.00+0.00+0.00+0.00+0.00) + (0+2.5+2.5+0+0) + (2.5+5+5+2.5+2.5)) / 5 = (0.00, 1.00, 3.50)$.

The DQAS for the descriptive question was used to identify the score for the criteria in Section 5.4.2.3.

5.4.2.3 Mechanism to Identify the Average Score for Each Criterion

The average score for each Description question was added and then divided by the number of description question. Equation (2) shows mathematical expression used.

$$\text{Criteria Average score (CAS)}_s = \frac{\sum_{t=1}^t (\text{DQAS}_{\text{DQn}})}{t} \text{----- (5.15)}$$

(DQAS_{DQn}) Represents the average score for each descriptive question

(s) Represents the criteria name

(t) Represents the number of descriptive question s

Table 5.19 shows an example of how criteria score are calculated

Table 5.19
An Example of Calculating Criteria Average Score

Category A		Descriptive Question Average Score (DQAS) =	Criteria Average Score (CAS)=
Criteria	Description Question		
W	DQ ₁	DQAS _{DQ1} = (C _{1,DQ1} + C _{2,DQ1} +.....+ C _{n,DQ1})/ num of consumers	CAS _w =(DQAS _{DQ1} + DQAS _{DQ2} + DQAS _{DQ3} + DQAS _{DQ4}) / number of description question of W
	DQ ₂	DQAS _{DQ2} = (V _{1,DQ2} +.....+ V _{n,DQ2})/ num of consumers	
	DQ ₃	DQAS _{DQ3} = (V _{1,DQ3} +V _{2,DQ3} +...+V _{n,DQ3}) /num of consumers	
	DQ ₄	DQAS _{DQ4} = (V _{1,DQ4} +V _{2,DQ4} +...+V _{n,DQ4}) / num of consumers	
Y	DQ ₁	•	CAS _y =(DQAS _{DQ1} + DQAS _{DQ2} + DQAS _{DQ3} + DQAS _{DQ4}) / number of description question of Y
	DQ ₂	•	
	DQ ₃	•	

Z	DQ ₁	•	CAS _Z =(DQAS _{DQ1} + DQAS _{DQ2} + DQAS _{DQ3} + DQAS _{DQ4}) / number of description question of Z
	•	•	
	•	•	
	DQ _j	DQAS _{DQj} =(V _{1,DQj} + V _{2,DQj} + ...+ V _{n,DQj})/ number of consumers	

Here, the descriptive question or the item (DQ₁, DQ₂, ..., DQ_j) for each criteria were added and divided by the number of the description question for that criteria. Criteria W has four description questions (DQ₁, DQ₂, DQ₃ and DQ₄). The average score for these descriptive question s that were obtained in Section 5.3.2.2 were added and divided by the number of descriptive question s under the criteria. A running example on the calculation is shown in Table 5.20.

Table 5.20
A Running Example of Calculating Criteria Average Score

Category A		Consumers					Descriptive Question Average Score (DQAS) =	Criteria Average Score (CAS)=
Criteria	Description Question	Cons ₁	Cons ₂	Con ₃	Cons ₄	Cons ₅		
W	DQ ₁	0.00, 0.00, 2.50	0.00, 2.50, 5.00	0.00, 2.50, 5.00	0.00, 0.00, 2.50	0.00, 0.00, 2.50	((0.00+0.00+0.00+0.00+ 0.00)+(0+2.5+2.5+0+0) +(2.5+5+5+2.5+2.5)) /5= (0.00, 1.00, 3.50)	[(0.00, 1.00, 3.50) + (3.5, 4.0, 8.5) + (4.0, 6.5, 9.0) + (3.5, 6.0, 8.5)] / 4 = (2.75, 4.38, 7.38)
	DQ ₂	2.50, 5.00, 7.50	5.00, 7.50, 10.0	2.50, 5.00, 7.50	5.00, 7.50, 10.0	2.50, 5.00, 7.50	(3.5, 4.0, 8.5)	
	DQ ₃	5.00, 7.50, 10.0	5.00, 7.50, 10.0	5.00, 7.50, 10.0	2.50, 5.00, 7.50	2.50, 5.00, 7.50	(4.0, 6.5, 9.0)	
	DQ ₄	2.50, 5.00, 7.50	5.00, 7.50, 10.0	2.50, 5.00, 7.50	5.00, 7.50, 10.0	2.50, 5.00, 7.50	(3.5, 6.0, 8.5)	
Y	DQ ₁	7.50, 10.0, 10.0	5.00, 7.50, 10.0	5.00, 7.50, 10.0	5.00, 7.50, 10.0	5.00, 7.50, 10.0	(5.5, 8.0, 10.0)	(3.33, 7.50, 9.66)
	DQ ₂	5.00, 7.50, 10.0	5.00, 7.50, 10.0	5.00, 7.50, 10.0	2.50, 5.00, 7.50	2.50, 5.00, 7.50	(4.0, 6.5, 9.0)	

	DQ ₃	7.50, 10.0, 10.0	5.00, 7.50, 10.0	5.00, 7.50, 10.0	5.00, 7.50, 10.0	5.00, 7.50, 10.0	(3.5, 8.0, 10.0)	
Z	DQ ₁	0.00, 0.00, 2.50	0.00, 2.50, 5.00	0.00, 2.50, 5.00	0.00, 0.00, 2.50	0.00, 0.00, 2.50	(0.00, 1.00, 3.50)	(2.75, 4.87, 7.37)
	DQ ₂	2.50, 5.00, 7.50	5.00, 7.50, 10.0	2.50, 5.00, 7.50	5.00, 7.50, 10.0	2.50, 5.00, 7.50	(3.5, 6.0, 8.5)	
	DQ ₃	5.00, 7.50, 10.0	5.00, 7.50, 10.0	5.00, 7.50, 10.0	2.50, 5.00, 7.50	2.50, 5.00, 7.50	(4.0, 6.5, 9.0)	
	DQ ₄	2.50, 5.00, 7.50	5.00, 7.50, 10.0	2.50, 5.00, 7.50	5.00, 7.50, 10.0	2.50, 5.00, 7.50	(3.5, 6.0, 8.5)	

As shown in Table 5.20, the CAS is calculated by adding all DQAS for all description questions under the criteria and dividing the total by the number of description questions for the criteria. In this example, the criterion W has four DQAS: DQAS_{DQ1}, DQAS_{DQ2}, DQAS_{DQ3}, and DQAS_{DQ4}. Thus, CAS for criteria W is $[(0.00, 1.00, 3.50) + (3.5, 4.0, 8.5) + (4.0, 6.5, 9.0) + (3.5, 6.0, 8.5)] / 4 = (2.75, 4.38, 7.38)$.

5.4.2.4 Mechanism to Defuzzify the Average Score for Each Criterion to Crisp Value

At this stage, the average score for each criterion was added and calculated. Using the Center of Area Method (CoA) the fuzzy average score is defuzzified and calculated for each criteria.

If $u = (x_0, \sigma, \beta)$ is a triangular fuzzy number, then

$$M(u)_{w_i} = \frac{[(U_{w_i} - L_{w_i}) + (M_{w_i} - L_{w_i})]}{3} + L_{w_i} \quad \text{for } i = 1, \dots, k \quad (5.16)$$

Table 5.21 shows an example of how the defuzzification is calculated.

Table 5.21
An Example of Defuzzification

Category A		Description Question Average Score (DQAS) =	Criteria Average Score (CAS)=	$M(u)$
Criteria	Description Question			
W	DQ ₁	$DQAS_{DQ1} = (C_{1,DQ1} + C_{2,DQ1} + \dots + C_{n,DQ1}) / \text{num of consumers}$	$CAS_w = (DQAS_{DQ1} + DQAS_{DQ2} + DQAS_{DQ3} + DQAS_{DQ4}) / \text{number of description question of W}$	$M(u)_w = [(U_w - L_w) + (M_w - L_w)] / 3 + L_w$
	DQ ₂	$DQAS_{DQ2} = (V_{1,DQ2} + \dots + V_{n,DQ2}) / \text{num of consumers}$		
	DQ ₃	$DQAS_{DQ3} = (V_{1,DQ3} + V_{2,DQ3} + \dots + V_{n,DQ3}) / \text{num of consumers}$		
	DQ ₄	$DQAS_{DQ4} = (V_{1,DQ4} + V_{2,DQ4} + \dots + V_{n,DQ4}) / \text{num of consumers}$		
Y	DQ ₁	•	$CAS_y = (DQAS_{DQ1} + DQAS_{DQ2} + DQAS_{DQ3} + DQAS_{DQ4}) / \text{number of description question of Y}$	$M(u)_y = [(U_y - L_y) + (M_y - L_y)] / 3 + L_y$
	DQ ₂	•		
	DQ ₃	•		
Z	DQ ₁	•	$CAS_z = (DQAS_{DQ1} + DQAS_{DQ2} + DQAS_{DQ3} + DQAS_{DQ4}) / \text{number of description question of Z}$	$M(u)_z = [(U_z - L_z) + (M_z - L_z)] / 3 + L_z$
	•	•		
	•	•		
	DQ _j	$DQAS_{DQj} = (V_{1,DQj} + V_{2,DQj} + \dots + V_{n,DQj}) / \text{number of consumers}$		

The CAS was calculated under fuzzy roles. Therefore, each CAS presented in triangular number such as (U, M, L) . Here, the lower value was subtracted from the upper value; then the result was aggregate with result from subtraction of the lower value from the mean value. Then, the result from aggregation was divided by 3 and added to the lower value; see formula 5.16. A running example on the calculation is shown in Table 5.22.

Table 5.22
A Running Example of Defuzzification

Category A		Consumers					Description on Question Average Score (DQAS) =	Criteria Average Score (CAS)=	$M(u)$
Criteria	Measure	Cons ₁	Cons ₂	Con ₃	Cons ₄	Cons ₅			
W	DQ ₁	0.00, 0.00, 2.50	0.00, 2.50, 5.00	0.00, 2.50, 5.00	0.00, 0.00, 2.50	0.00, 0.00, 2.50	(0.00, 1.00, 3.50)	(2.75, 4.38, 7.38)	$\frac{[(7.38-2.75)+(4.38-2.75)]}{3} + 2.75 = 4.84$
	DQ ₂	2.50, 5.00, 7.50	5.00, 7.50, 10.0	2.50, 5.00, 7.50	5.00, 7.50, 10.0	2.50, 5.00, 7.50	(3.5, 4.0, 8.5)		
	DQ ₃	5.00, 7.50, 10.0	5.00, 7.50, 10.0	5.00, 7.50, 10.0	2.50, 5.00, 7.50	2.50, 5.00, 7.50	(4.0, 6.5, 9.0)		
	DQ ₄	2.50, 5.00, 7.50	5.00, 7.50, 10.0	2.50, 5.00, 7.50	5.00, 7.50, 10.0	2.50, 5.00, 7.50	(3.5, 6.0, 8.5)		
Y	DQ ₁	7.50, 10.0, 10.0	5.00, 7.50, 10.0	5.00, 7.50, 10.0	5.00, 7.50, 10.0	5.00, 7.50, 10.0	(5.5, 8.0, 10.0)	(3.33, 7.50, 9.66)	$\frac{[(9.66-3.33)+(7.5-3.33)]}{3} + 3.33 = 6.83$
	DQ ₂	5.00, 7.50, 10.0	5.00, 7.50, 10.0	5.00, 7.50, 10.0	2.50, 5.00, 7.50	2.50, 5.00, 7.50	(4.0, 6.5, 9.0)		
	DQ ₃	7.50, 10.0, 10.0	5.00, 7.50, 10.0	5.00, 7.50, 10.0	5.00, 7.50, 10.0	5.00, 7.50, 10.0	(3.5, 8.0, 10.0)		
Z	DQ ₁	0.00, 0.00, 2.50	0.00, 2.50, 5.00	0.00, 2.50, 5.00	0.00, 0.00, 2.50	0.00, 0.00, 2.50	(0.00, 1.00, 3.50)		$\frac{[(7.37-2.75)+(4.87-2.75)]}{3} + 2.75 = 5.0$

	DQ ₂	2.50, 5.00, 7.50	5.00, 7.50, 10.0	2.50, 5.00, 7.50	5.00, 7.50, 10.0	2.50, 5.00, 7.50	(3.5, 6.0, 8.5)	(2.75, 4.87, 7.37)	
	DQ ₃	5.00, 7.50, 10.0	5.00, 7.50, 10.0	5.00, 7.50, 10.0	2.50, 5.00, 7.50	2.50, 5.00, 7.50	(4.0, 6.5, 9.0)		
	DQ ₄	2.50, 5.00, 7.50	5.00, 7.50, 10.0	2.50, 5.00, 7.50	5.00, 7.50, 10.0	2.50, 5.00, 7.50	(3.5, 6.0, 8.5)		

As shown in Table 5.22, The M (u) for each criterion is calculated by subtraction the lower value from the upper value; then the result was aggregate with result from subtraction of the lower value from the mean value. Then, the result from aggregation was divided by 3 and added to the lower value. Thus, the M (u) for the criterion W is $[(7.38-2.75) + (4.38-2.75)] / 3 + 2.75 = 4.84$. Likewise, the M (u) for the criterion Y $[(9.66-3.33) + (7.5-3.33)]/3+3.33= 6.83$.

5.4.3 Mechanism to Identify the Current Situation for Each Criteria Using Weight Variance Analysis

At this stage, the weights for the criteria were calculated in Section 5.4.1 and the score were determined in Section 5.4.2. This mechanism is carried out through three steps, which are: i) calculate the total average weight for the criteria; ii) calculate the total average score for the criteria; and iii) assign the center of weight variance analysis.

Step One: calculate the total average weight for the criteria. The total average weights were calculated by adding all the weights for all criteria (BNP) and divide the summation on the number of the criteria. Referring to Section 5.4.1.4 the average weights calculated by adding $(0.5107+0.5387+0.1587) / 3= 0.403$.

Step Two: calculate the total average score for the criteria. The total average score was calculated by adding all the scores for all criteria $M(u)$ s and divide the summation on the number of the criteria. Referring to Section 5.4.2.4 the average score calculated by $(4.84+6.83+5.00) / 3 = 5.56$

Step Three: assign the center of weigh variance analysis. At this stage the average weight and the average score for the criteria were calculated. The center of weight variance analysis is (average score, average weight). The center is (5.56, 0.403). The aim if the weight variance analysis is to provide a graphic representation of which evaluation criteria are most in need of improvement.

The FAHP weight performs the vertical axis (y-axis), and the performance variance rate (Score) performs the horizontal axis (x-axis) of a coordinate diagram. This diagram is divided into four zone areas, as shown in Figure 5.6. The criteria located in different zones have different a managerial implications, and therefore require different actions for achieving an ideal performance. These four zones area are described as follows:

1) **Zone One** “*Need improvement*”: The CEC’s in this zone area are rated as having high performance variance rate and a high importance. Criteria falling in this zone area need to be improved.

2) **Zone Two** “*Need monitor*”: This zone area indicates that those criteria are considered important to evaluators and their performance variance rates are low. The CEC in this zone area need carefully monitor to ensure that low variance rate levels are maintained.

3) **Zone Three** “*Pay some attention*”: the CEC falling in this zone area considered low importance, and the performance variance rate is also relatively low. The developers and Managers should not be highly concerned about criteria in this Zone.

4) **Zone Four** “*Do not worry*”: CEC in Zone Four are rated as high performance variance rate and a low importance. It is therefore not necessary to focus additional effort or resources to criteria in this zone.

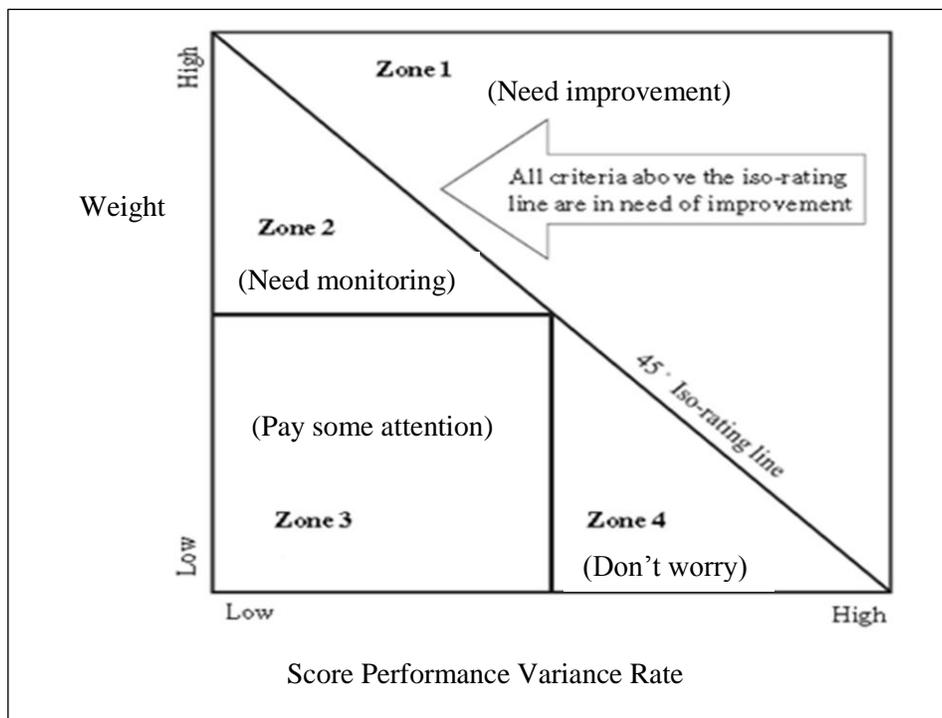


Figure 5.6. The weight-variance map (adapted from Tsai et al., 2011)

5.5 Evaluation Procedure

This section explains the procedure to evaluate e-commerce website applications. The procedure was constructed based on the work of Ares Casal et al. (1998). The procedure consisted of three phases: Planning Phase, Examination Phase, and Decision-Making Phase. Each phase includes a set of activities. Figure 5.6 illustrates each phase.

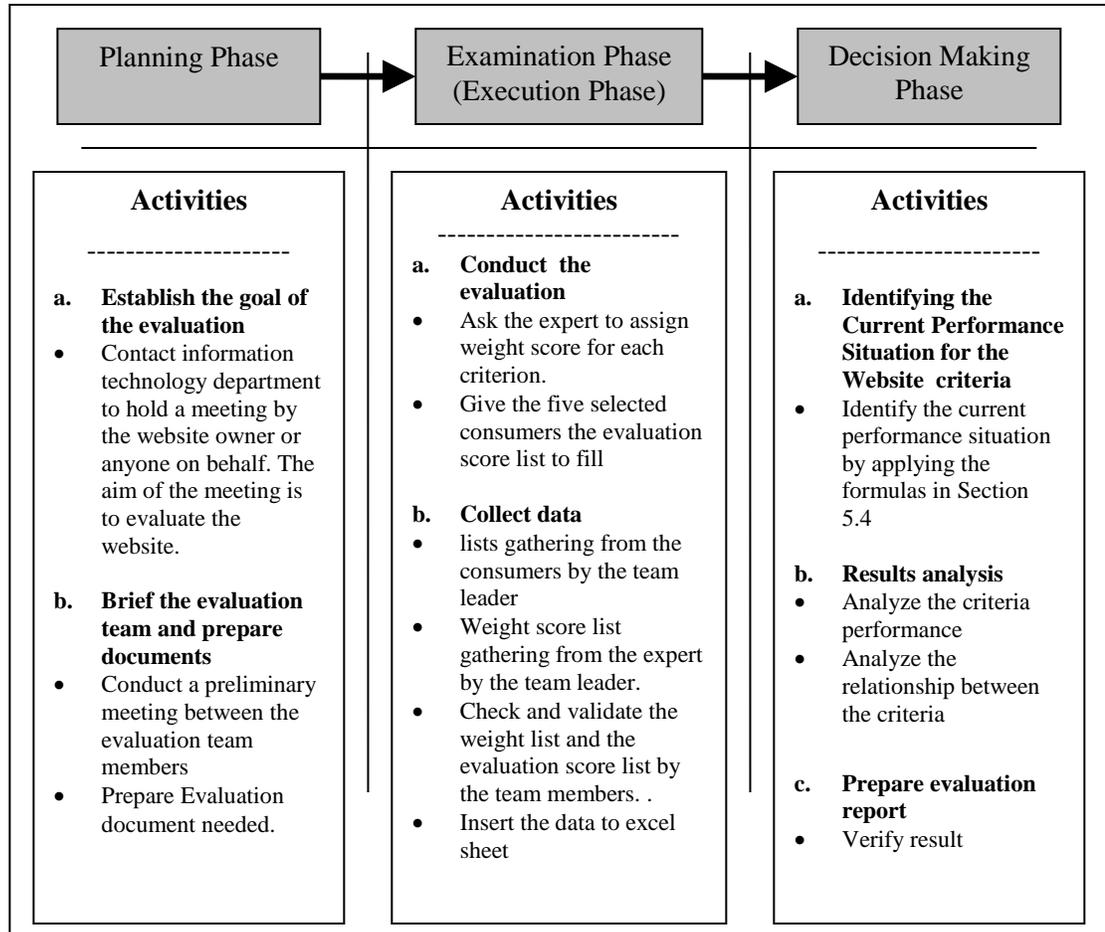


Figure 5.7. Procedures for e-commerce websites evaluation

5.5.1 Planning Phase

This phase discuss the activities before the start of the actual evaluation procedure.

Planning Phase includes a set of activities, which are: (i) establish the goal of the evaluation (ii); and brief the evaluation team and prepare documents.

5.5.1.1 Establish the Goal of the Evaluation

The procedure of planning begins with, the website owner/top management contacting the Information Technology Department to hold a meeting. The aim of the meeting is to evaluate the company website. The tasks for the meeting are to:

- Decide the website applications that need to be evaluated.
- Select five consumers from the list of consumers suggested by the Consumer Service Department.
- Contact the consumers to get their agreement to participate in the evaluation process.
- Select members for the evaluation team. The evaluation team should consist of:
 1. Three of company experts: the Manager of Information Technology Department, the Manager of Quality Assurance Department, and one website developers. Top management may suggest the appropriate employee. They are responsible to assign weight for the criteria. They must have the experiences in software evaluation and are familiar with or have good experience using e-commerce websites. The weight score of the criteria presented in Section 5.4.1.
 2. Five consumers: the consumers must be selected from the list provided by the Consumers Services Department. They are responsible to fill the evaluation score list form in order to evaluate the total score of website.
 3. Team leader: person suggested from the middle and high managements. He is responsible to distribute the responsibilities between the team

members, give the explanation and instructions to the evaluation team, gather and validate the criteria weight list and the evaluation score list.

- Assign a date and time for conducting the evaluation.

5.5.1.2 Brief the Evaluation Team and Prepare Documents

In this step, first the evaluation team will be given a short briefing by the team leader.

The briefing will focus on the evaluation schedule and activities to be conducted.

Specifically, the team leader will provide information about:

- Getting general information about the company website.
- Drawing the evaluation schedule (explanations and instruction).
- Distributing the responsibilities between the evaluation members.

Second, the evaluation team will prepare the documents needed for the evaluation. The documents are a website manual, an evaluation score list, and criteria weight list. Website manual is needed to obtain necessary information on the website before and during the evaluation. Evaluation score list is needed for the evaluator to rate the criteria of the website. Criteria weight score list is to identify the degree of importance for each criterion towards the website.

The evaluation score list must be filled by the consumers to avoid unfairness in evaluation. The criteria weight score list must be filled by the expert from inside the company because he can give the exact weight score for each criterion. For example, the

score weight for of a bank's website it is different from the weight score for a store that sells vegetables online.

5.5.2 Examination Phase

This phase includes conducting the evaluation and collecting data.

5.5.2.1 Conduct the Evaluation

First, the five consumers have to fill the evaluation score list. Five fuzzy scale points are used. Scale 1 =Worst, 2= Poor, 3 =Fair, 4= Good, 5=Best. In this stage, filling the evaluation score list by the consumers is done synchronously with website testing and checking.

Second, the four experts fill the criteria weight score list. They have to give a fuzzy weight score for each criterion based on the Table 5.7 Section 5.4.1.

5.5.2.2 Collect Data

In this step, the filled evaluation score list form and the filled criteria weight score list form will be collected by the team leader. The score list forms gathered from the consumers and the criteria weight score list form gathered from the experts. The lists will be checked and validate by the evaluation team members. Then, one of the evaluation members will enter the information separately into Excel for the calculation purposes.

5.5.3 Decision Making Phase

This phase includes identifying the current performance situation for the e-commerce websites by presenting the result of the analysis and preparing evaluation report.

5.5.3.1 Identifying the Current Performance Situation for the Website Criteria

The current performance situation will be calculated and identified based on the results from Sections 5.4.1, 5.4.2, and 5.4.3.

5.5.3.2 Result Analysis

The current performance situation for each criterion will be analyzed and presented. Also, the relationship between the criteria will be analyzed and presented. The aim of the analysis was to identify the weaknesses of the website.

5.5.3.3 Prepare Evaluation Report

At this step, a report is prepared. The result will be presented to evaluation team in order to verify the report. The report will be written in simple language. This report helps the top management to know the company website performance situation and the criteria and features that are further needed. The management members are encouraged to study the details of the reports and provide feedback to improve the website in the future. For more details see Appendix H.

5.6 The CREE Model Guideline

This guideline is for the organizations and companies seeking to evaluate their e-commerce websites. This guideline is intended to help the researchers from any discipline. Next section describes the CREE model guideline. Figure 5.8 shows the CREE Model Guideline.

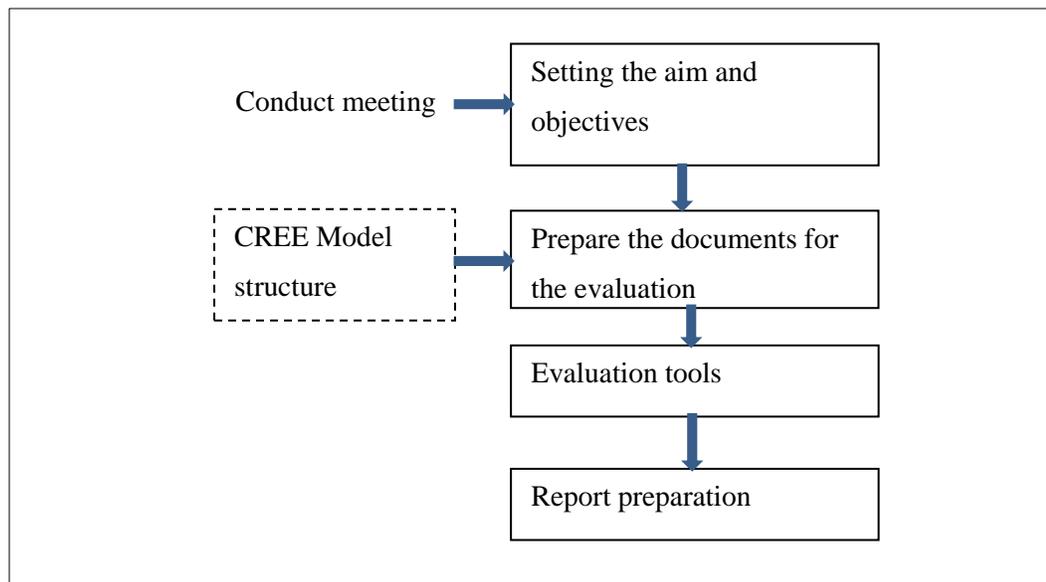


Figure 5.8. CREE model guideline

5.6.1 Preparing to Use the CREE Model

Before applying CREE Model, the companies/organization needs to read the all guideline document in full. In addition to the guideline document, users, and companies should attempt to identify all information about the guideline development process prior to the appraisal. This information sometimes contains in the same document of the recommendations

5.6.1.1 Setting the Aim and Objectives

First step needed is to clarify the aim(s) if the evaluation, what achievement needed? What is the purpose of the evaluation?. In term to set the aim/goal of the evaluation, the website owner/top management needs to contact the Information Technology Department to hold a meeting. The aim of the meeting is to clarify the aim of the evaluation. The meeting output are deciding the e-commerce website applications that need to be evaluated, select the evaluation team members, and set the date of the evaluation. Table 5.23 presents the evaluation members details

Table 5.23
The Evaluation Team Members

Evaluation Members	Members Tasks	Members Number Needed
Organization Experts	<ul style="list-style-type: none"> • He is the responsible to assign the weight for the criteria. 	(Three) <ul style="list-style-type: none"> • Manager of Information Technology • Quality Assurance Manager and one developer • Top management may suggest the appropriate employee.
Five external evaluators (consumers)	<ul style="list-style-type: none"> • They are responsible evaluate the website. 	(Five) <ul style="list-style-type: none"> • The consumers must be selected based on their using experiences in the websites.
Team leader	<ul style="list-style-type: none"> • He is responsible to distribute the responsibilities between the team members, give the explanation and instructions to the evaluation team, gather and validate the weight score list and the evaluation score list. 	(One) <ul style="list-style-type: none"> • Person suggested from the middle and high managements.

5.6.1.2 Prepare Documents

The evaluation team needs to prepare the documents for the evaluation. The documents are a website manual, an evaluation score list, and criteria weight list. Website manual is needed to obtain necessary information on the website before and during the evaluation. Evaluation score list is needed for the evaluator to rate the criteria of the website. Criteria weight score list is to identify the degree of importance for each criterion towards the website.

The evaluation score list must be filled by the consumers to avoid unfairness in evaluation. The criteria weight score list must be filled by the expert from inside the company because he can give the exact weight score for each criterion.

Table 5.24
Documents Needed for Conduct the Evaluation

No.	documents	Descriptions
1	Score list form	- The score list was constructed based on the selected criteria. See Appendix B.
2	Weight form	- Criteria weight list forms. See Appendix E.
3	Website specification	- Website specification (refer to the organization website specification)

5.6.1.3 Structure of the CREE Model

CREE model consists of three components: consumer evaluation criteria (CEC), evaluation mechanism, and evaluation procedure. Please refer to Sections 5.3, 5.4, and 5.5 for more details.

5.6.1.4 The CREE Model Evaluation Tools

CREE model includes three main tools to evaluate the e-commerce websites which are score list form and weight list form.

- **Score list form**

Score list form is to collect the criteria score from the consumer perspective. Here, the consumer need to rate each criterion from (worst, poor, fair, good, best). For more details please refer to Appendix B.

- **Weight list form**

This form is to collect the weight of the criteria from the organization experts. The experts need to rate the weight from (1 to 9).

Table 5.25
Triangular Fuzzy Numbers Scale for Pairwise Comparison

Intensive of importance	Definition	Fuzzy number
1 [~]	Equal importance	(1,1,3)
3 [~]	Moderate importance	(1,3,5)
5 [~]	Strong importance	(3,5,7)
7 [~]	Very strong importance	(5,7,9)
9 [~]	Extreme importance	(7,9,9)
2 [~] , 4 [~] , 6 [~] , 8 [~]	Intermediate judgment values	

Using the scale of 1 to 9 (with choice from equal to extremely important), please rate the following primary Criteria with respect to alternatives as the major reason for e-commerce websites evaluation and developments.

Table 5.26
The Judgment of Primary Criteria with Respect to E-commerce Websites

With respect to E-commerce website		Importance (influence) of one primary criteria over another																	
criteria	<div style="display: flex; justify-content: space-between; align-items: center;"> Extremely Important ← Equal → Extremely Important </div>																		criteria
	E-usage	9~	8~	7~	6~	5~	4~	3~	2~	1~	2~	3~	4~	5~	6~	7~	8~	9~	
E-usage	9~	8~	7~	6~	5~	4~	3~	2~	1~	2~	3~	4~	5~	6~	7~	8~	9~	E-services	
E-usage	9~	8~	7~	6~	5~	4~	3~	2~	1~	2~	3~	4~	5~	6~	7~	8~	9~	E-system	
E-usage	9~	8~	7~	6~	5~	4~	3~	2~	1~	2~	3~	4~	5~	6~	7~	8~	9~	E-company	
E-information	9~	8~	7~	6~	5~	4~	3~	2~	1~	2~	3~	4~	5~	6~	7~	8~	9~	E-services	
E-information	9~	8~	7~	6~	5~	4~	3~	2~	1~	2~	3~	4~	5~	6~	7~	8~	9~	E-system	
E-information	9~	8~	7~	6~	5~	4~	3~	2~	1~	2~	3~	4~	5~	6~	7~	8~	9~	E-company	
E-services	9~	8~	7~	6~	5~	4~	3~	2~	1~	2~	3~	4~	5~	6~	7~	8~	9~	E-system	
E-services	9~	8~	7~	6~	5~	4~	3~	2~	1~	2~	3~	4~	5~	6~	7~	8~	9~	E-company	
E-system	9~	8~	7~	6~	5~	4~	3~	2~	1~	2~	3~	4~	5~	6~	7~	8~	9~	E-company	

For more details, refer to Appendix E.

5.6.1.5 Report Presenting

This report helps the top management to know the company website performance situation, the criteria needed to be improved, the criteria and features that are further needed. Based on the results from Sections 5.4.1, 5.4.2, and 5.4.3 the results need to be presented on the following Table.

Table 5.27
Evaluation Result

No.	Category level one	Criteria	Zone number	Comments
1	E-usage	Price saving (C11)		
2		purchasing transaction (C12)		
3		Safety (C13)		
4		Visibility (C14)		
5		User friendly (C15)		
6		Diversity of products and services (C16)		

For more details, refer to Appendix H.

5.7 Discussion and Conclusion

This chapter discusses how the consumer e-commerce websites evaluation model (CREE) was constructed. This model consists of three components: consumer evaluation criteria (CEC), new evaluation mechanism, and new evaluation procedure. The CREE model of the e-commerce websites evaluation provides a set of supporting features that would make it more efficient than other models. In addition, CREE model is somewhat unique compared to the other methods pertaining to e-commerce websites evaluation. The descriptions of the features are as follows:

1. The CREE model was developed based on the research requirements and practical perspectives (empirical study), whereby most of the important processes, activities, techniques, and criteria were identified from the literature. These were then investigated in the real life in order to investigate the most important criteria for the model.

2. The main components of CREE model were explicitly defined and developed according to the basic components derived from the evaluation theory. This theory is considered as a base and standard theory for any evaluation process in various disciplines and fields.
3. This research has proposed the Consumer Evaluation Criteria (CEC) which emphasize on the consumer-related criteria. The CEC is developed based on the findings from the empirical study (refer to Section 4.2.3).
4. In order to offer a more reliable evaluation data and accurate decision, the CREE model includes a new decision making process based on the new integration between the FAHP, Hardmard method, Operational Laws of Triangular Fuzzy Numbers, and Weight Average Sum.

This new hybrid consumer e-commerce website evaluation model will be able to deal with the time consuming and fuzziness. CREE can deal with huge number of criteria and allows many experts to participate in the process of evaluation which make it unique compared to other models.

CHAPTER SIX

MODEL CONFIRMATION

6.1 Introduction

This chapter describes how the CREE model was verified and validated. The discussion in this chapter begins with verification by the experts, validation by the case study, and evaluation of the model.

6.2 Verification by Expert Review

The verification is needed to ensure that CREE model was built correctly. It was carried out through experts review method using Delphi Technique. The Delphi Technique was conducted through three rounds revisions as shown in Figure 6.1.

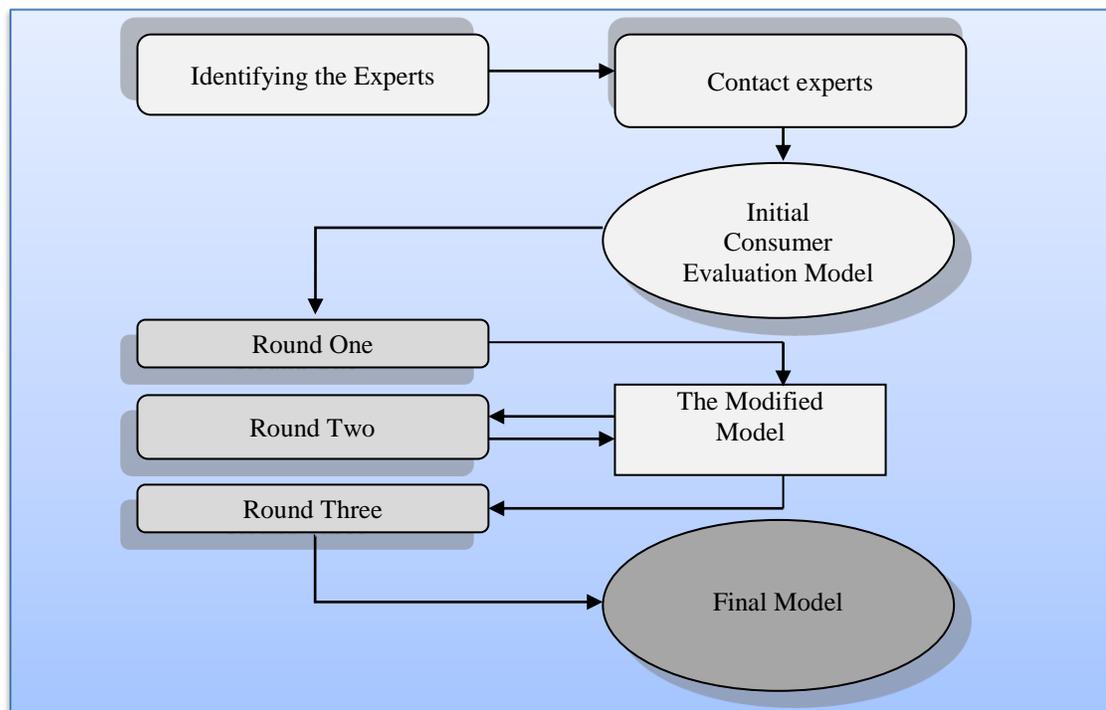


Figure 6.1. Verification process using delphi technique

In order to perform the expert method, there is need to meet the participants personally. Therefore, it was easy to contact the Malaysian expert members who are related to the research topic for participation. Also, it was easy to contact the Jordanian experts' members because of using the same language. This helps in discussing and understanding each other's during the verification process.

This section describes the process of verifying the CREE components. Faulkner (2006) has used expert review method to verify the design structured in software usability evaluation. The process is explained in detail in Sections 6.2.1, 6.2.2, 6.2.3, 6.2.4, and 6.2.5.

6.2.1 Identifying Experts Based On Experience

Ten researchers were selected as experts in Fuzzy, AHP, and websites development according to their publications and their rich knowledge and experience in this field. Four of the researchers were PhD holders, and the rest were developers.

6.2.2 Contact Experts

All ten experts were contacted through emails or hand phones. Out of ten, only six experts (60.0%) participated in the verification process. The profiles of reviewers are presented in Appendix F.

According to Hoffman (1998), and Nielsen & Molich (1990), three to five experts are enough to participate in the process of verification. Hallowell and Gambatese (2010) and Rowe and Wright (1999) considered three experts adequate for the verification

process. In this study six experts were participate in the process of verification. Some of the reviewers are working in Malaysia. Therefore, it was easy to have a meeting with them personally. Others are working in Jordan, mobile phone and Skype program were used as an instrument to arrange the meetings with those reviewers. Three rounds of meetings were conducted with each reviewer. Table 6.1 shows the schedule of the expert reviewers' meetings.

Table 6.1
The Schedule Expert Reviewers Meetings

	Round One	Round Two	Round Three
Reviewer 1	2, Sep, 2013	9, Sep, 2013	19, Sep, 2013
Reviewer 2	3, Sep, 2013	10, Sep, 2013	20, Sep, 2013
Reviewer 3	6, Sep, 2013	12, Sep, 2013	21, Sep, 2013
Reviewer 4	6, Sep, 2013	13, Sep, 2013	23, Sep, 2013
Reviewer 5	7, Sep, 2013	14, Sep, 2013	24, Sep, 2013
Reviewer 6	8, Sep, 2013	17, Sep, 2013	28, Sep, 2013

6.2.3 Interview of Experts (Round One)

Round One was conducted to obtain the experts' opinion on the consumer perspective evaluation model components. Each reviewer was given (i) the model components (criteria, mechanisms, processes); (ii) verification questionnaire (iii) weight and score list forms. The verification questionnaire was constructed based on some criteria collected from Behkamal et al., (2009); Kunda, (2002); and Moody et al., (2003).

The reviewers needed to answer the verification questionnaire based on the list given and return the completed questionnaire after one week. After one week, the completed questionnaires were gathered, analyzed, and documented. The result was presented at Round Two meeting. See Appendix G.

Table 6.2
Reviewers Answers and Suggestions

Reviewers Number	Answers									Suggestions in Term of		
	Clarity	Reliable	Comprehensiveness	Accuracy	Coherence	Appropriateness	Understandable	Simplicity answerable	Organisation Well organized	(a) Criteria and components	(b) Mechanism	(c) Procedure
1	√		√		√	√	√	√		a. (1) Present the criteria in hierarchy format (2) Use concept description rather than index (3) Convert the items in the description part to description rather than questions. b. (1) Reduce the calculation steps (2) Provide tool to collect the weight from the experts. (3) Use one defuzzification method in weight and score calculation rather than two methods. (4) Rearrange the weight calculation steps (make them easier). c. (1) Provide the process part with flow diagram which includes the evaluation activities and steps. (2) Prototype the process if possible.		
2	√	√		√	√	√	√	√	√	a. (1) Present the criteria in hierarchy format (2) Consider the security criteria. (3) Improve some name of the criteria. b. (1) Make the calculation results in 4 Digit places. c. (1) Move the process description to the methodology part.		
3	√	√	√	√		√	√	√	√	a. (1) Present the criteria in hierarchy format. (2) Improve the category name. b. (1) Use one defuzzification method. (2) Provide flow chart for the mechanism steps. (3) Be consistent with the difuzzification methods c. (1) No comments		

4	√	√	√	√	√	√	√	√	√	<p>a. (1) Suggested categorizing the criteria' credibility, safety, correctness, and trustworthiness under trust criteria.</p> <p>b. (1) Reduce the decimal places of the calculation result</p> <p>c. (1) No comments</p>
5		√	√	√	√	√	√	√	√	<p>a. (1) Suggested to provide the hierarchy format to the criteria and the categorization. (2) Improve the category name. (3) Merge the security with the safety criteria.</p> <p>b. (1) Provide tool to collect the weight from the experts. (2) Use one defuzzification method in weight and score calculation rather than two methods (3) Present the calculation in easier way.</p> <p>c. (1) no comments</p>
6		√	√	√	√	√	√	√	√	<p>a. (1) Rename some of the criteria such as (current to freshness or update. (2) Choose meaningful name for the categorization (3) Provide the criteria with the hierarchy structure (4) Convert the items in the description part to description rather than questions.</p> <p>b. (1) Use the same defuzzification methods to diffuzzify the score and the weight to crisp value.</p> <p>c. (1) Provide example how to collect the weight from the experts</p>

In this round, the first meeting with each expert review has been done, where their answers and suggestions of the verification questionnaires have been gathered to be used in verifying the proposed model components. Next section illustrates the answers of the verifying questions and the expert reviewers' suggestions in details.

- Expert Reviewers Answers

- **Reviewer One, Reviewer Two, Reviewer Four:** *The model components were found to be simple, clear, well organized, understood, and coherent since the model is constructed based on a certain theory (evaluation theory). In terms of*

the mechanisms and techniques used in the proposed model, the mechanisms and the technique were found to be adequate. The above mentioned reviewers found that the evaluation techniques used in the proposed model were answerable, clear, understood, and simple. Since the evaluation techniques (the score list, weight list) were constructed based on the criteria that identified from the empirical study. The mechanism used was found to be clear, understood, and simple since the mechanism used the matrix multiplication. In terms of coherence and comprehensiveness, the methods, techniques, and mechanisms were found to be consistent with each other's and with the literature review too. In terms of the process used in the proposed model, the activities, tasks, and steps used in the proposed model were found to be clear, understood, stable, and reliable since the proposed model integrates the AHP methods steps with the Hardmard method steps. Therefore, the activities were compatible and consistent.

- **Reviewer Three:** *The model components were found to be simple, clear, well organized, understood, and coherent. But, some of the criteria need more measure items. In terms of the mechanisms and techniques used in the proposed model, the mechanisms and the techniques were found to be long (need to shorten the steps). Also, the evaluation techniques used in the proposed model were answerable, clear, understood, and simple. Since the evaluation techniques (the score list, weight list) were constructed based on the criteria that identified from the empirical study. The mechanism used was found to be clear,*

understood, but long. In terms of coherence and comprehensiveness, the methods, techniques, and mechanisms were found to be consistent with each other's and with the literature review too. In term of process used in the proposed model, the activities, tasks, and steps used in the proposed model were found to be clear, understood, suitable, and long.

- **Reviewer Five; Reviewer Six:** *The model components were found to be overall simple, clear, well organized, understood, and coherent. But, some of the criteria were found to be unclear and not understandable. In terms of the mechanisms and techniques used in the proposed model, the mechanism used was found to be clear, understood, but not simple (some steps need to be simplified). Since the evaluation techniques (the score list, weight list) were constructed based on the criteria that identified from the empirical study, the techniques found to be adequate and acceptable. In terms of coherence and comprehensiveness, the methods, techniques, and mechanisms were found to be consistent with each other's and with the literature review too. But, the same difuzzification method must be used. In terms of the process used in the proposed model, the activities, tasks, and steps used in the proposed model were found to be clear, understood, and suitable.*

- Expert Reviewers Suggestions

- **Reviewer One, Reviewer Two, Reviewer Three:** *Define the criteria and the measures (descriptive questions). Include measurement for the criteria to be understandable and clear. Rename unclear criteria such as (current to freshness or update. support the criteria with the hierarchical structure diagram. The mechanisms need more explanation.*
- **Reviewer Four, Reviewer Five, Reviewer Six:** *Suggested to categorize the criteria credibility, safety, accuracy, and trustworthiness under trust criteria”. And remove promotive activities criteria. Add more measure items related to safety criterion. Reduce and simplify the calculation steps. Provide the process part with flow diagram which includes the evaluation activities and steps. Use the same defuzzification methods to diffuzzify the score and the weight to crisp value. Choose a meaningful name for the categorization.*

6.2.4 Interview Expert (Round Two)

Round Two was to present results of Round One; then to discuss with each reviewer on the answers and obtain an agreement if there is a conflict. Here, each reviewer looked at the answers of other reviewers. Table 6.3 shows the modification suggested.

Table 6.3
Modification Needed

Verification Criteria	Components	Required Modifications
Expert's suggestions	In term of criteria	<ul style="list-style-type: none"> • Use a meaningful name for the categorizations. • Provide the model with hierarchy structure to show the criteria distributions • Use criteria description rather than index for the criteria. • Make sure the criterion safety covers the security criteria.
	In term of mechanism	<ul style="list-style-type: none"> • Provide tool to collect the weight from the experts. • Reduce the calculation steps as possible. • Use one defuzzification method for the weight and score. • Provide examples for each step of the calculations • Rewrite the weight calculation steps (make them easier).
	In term of procedure	<ul style="list-style-type: none"> • Rewrite the process in easier flow and provide the process with the activities and steps.

Based on the results of Round Two, required modifications were conducted on the model components (criteria, mechanism, and process). Results of Round Two were used for Round Three.

6.2.5 Present Result (Round Three)

Round Three was to present the modified criteria, mechanisms, and process; also it requested final confirmation on the model components. The criteria, mechanisms, and process were found reliable, understandable, appropriate, clear, coherent, and well organized. As a result of these rounds, all experts agreed to the proposed model criteria, mechanisms, and process. Therefore, the proposed model components were accepted without modification.

6.3 Validation by Case Study

This section presents four case studies. One case study conducted in Malaysia and three case studies conducted in Jordan. The aim is to validate the proposed Model and to show its applicability in real environments. Three case studies were conducted in Jordan because they show their willingness to help more than other countries. Also, it was easy to contact them. One case study was conducted on Malaysia. To conduct the evaluation, three items are needed. Table 6.4 presents the items for conducting a website evaluation.

Table 6.4
Items Needed to Conduct the Evaluation

No.	Items	Descriptions
1	Website address	A website address is needed. The company may select specific function on the website to evaluate.
2	Participant	The evaluation team consists of ten members: <ol style="list-style-type: none">1) Three organization experts: the Manager of Information Technology and Quality Assurance Manager and one developer. Top management may suggest the appropriate employee. He is the responsible to assign weight score for the criteria.2) Five external evaluators (consumers): - the consumers must be selected based on their using experiences in the

		websites. They are responsible evaluate the website. 3) Team leader: - person suggested from the middle and high managements. He is responsible to distribute the responsibilities between the team members, give the explanation and instructions to the evaluation team, gather and validate the weight score list and the evaluation score list.
3	Document and evaluation forms	<ul style="list-style-type: none"> - Five Evaluation score list forms: - See Appendix B. - Criteria weight list forms. See Appendix E. - Website specification.

Each company will evaluate its website based on the evaluation procedure mentioned in Section 5.5 (Chapter Five). Sections 6.4, 6.5, 6.6, 6.7, and 6.8 present the detailed activities conducted during the evaluation process for Companies A, B, C, D and E respectively.

6.3.1 Company A Profile

Company A is a large private bookstore company in Amman, Jordan. Company A was selected because it is well known in Jordan and recognized as the market leader in office supplies, school supplies, IT products, electronics, video games, and books. It offers customized e-commerce platform that suits the Arab region culture and market needs. It specializes in selling Arabic and English books online and delivers books worldwide. Company A offers free domestic shipping all over Jordan. The consumers can order and buy books online using its website. Also, they can browse the categories of the books on the website and search about any book using the author's name and the book title. It provides the consumers the latest publications in the world via the company website. Also, the consumers of Company A are able to amend their shipping address or billing data or even choose the shipping company that suits them better. Also, the

consumers can fill out a form indicating exactly what they are looking for if there is something that is not listed in the e-store and Company A will find it for them. Company A aims to become the ‘Amazon’ of the Arab World.

6.3.1.1 Evaluation Process On Company A Website

The evaluation process as mentioned in Section 5.5 involves three phases: Planning Phase, Examination Phase, and Decision-Making Phase. The activities conducted for each phase are presented below.

a) Planning Phase

This phase includes two main activities: (i) establish the goal of the evaluation, and (ii) brief the evaluation and prepare documents. First, the website owner of Company A contacted the Information Technology Department to hold a meeting. The purpose of the meeting was to evaluate the website of Company A. The meeting was held on the 15th October, 2013. The results of the meeting were:

- The Company’s official website will be evaluated.
- Five consumers’ were identified and agreed to participate in the evaluation process.
- The evaluation team members were identified as follows:-
 1. Manager of Information Technology Department (Mr Ramiz), Manager of Quality Assurance Department (Mr Ahmad), and Developer (Mr Mohammad). They were responsible to assign weight for the criteria’s.

2. Five organization consumers were identified in order to fill the score list and rate Company A website.
 3. Evaluation team leader, Mr Sa'ed was responsible for distributing the responsibilities among the team members and giving the explanation and instructions to the evaluation team.
- The evaluation date assigned was on 17th October, 2013.

Second, after identifying the evaluation team, a second meeting was held after one week. The meeting aimed to give a briefing on the evaluation process and preparation of necessary documents for the team members. During the meeting, Mr Sa'ed gave a short briefing about the evaluation schedule and activities. He provided information on Company A website and gave explanation and instruction about the evaluation schedule, such as the steps of evaluation and the team members' responsibilities. Next, he prepared the evaluation document needed for the evaluation. He provided the experts a website manual and evaluation score list form. The Manager of Information Technology, Manager of Quality Assurance, and the developer were provided with criteria weight list form.

b) Examination Phase

This phase includes conducting the evaluation and collecting data.

- **Conduct the Evaluation**

First, the five consumers (evaluators) browsed the company website and then filled the evaluation score list form. In other words, the five evaluators filled the evaluation score list simultaneously with analysis of the website.

Second, the Manager of Information Technology Department, Quality Assurance Manager, and developer filled the criteria weight list form. What they needed to do was to assign a linguistic weight for each website criteria.

- **Collect Data**

At this stage, the filled evaluation score list form and the filled criteria weight list form were gathered by the team leader. The gathered evaluation score list form and the criteria's weight list form were checked and validated by the evaluation team members to ensure that all forms were completely answered. The forms were found to be complete and valid. Then, the team leader input all data into an Excel sheet,

The values from the criteria weight list form and evaluation score list form were organized and presented as matrix formulation in order to calculate the weight and the score for each criterion. Figure 6.2 shows the weight obtained from the three experts for level one of CEC.

		C1 e-usage	C2 e-info	C3 e-service	C4 e-system	C5 e-company			C1 e-usage	C2 e-info	C3 e-service	C4 e-system	C5 e-company	
C1	e-usage	1	~3	~1/3	~1/5	~1/1	C1	e-usage	1	~3	~1/3	~1/5	~1	
C2	e-info		1	~1/1	~1/5	~1/1	C2	e-info		1	~1/3	~1/3	~1/1	
C3	e-service			1	~1	~3	C3	e-service			1	~1/3	~3	
C4	e-system				1	~5	C4	e-system				1	~3	
C5	e-company					1	C5	e-company					1	
		expert 1 level 1							expert 2 level 1					

		C1 e-usage	C2 e-info	C3 e-service	C4 e-system	C5 e-company
C1	e-usage	1	~1	~1/3	~1/3	~1/3
C2	e-info		1	~1/5	~1/5	~1/1
C3	e-service			1	~1/3	~3
C4	e-system				1	~1
C5	e-company					1
		expert 3 level 1				

Figure 6.2. Weights given by three experts for level one of the CEC (Company A).

Then, the experts assigned the weight score for the second level for the CEC. Second level presents each category as mentioned in Section 5.4.1.2 and Appendix G. After obtaining the weight from the experts, the evaluation score take its place. The filled evaluation score list were extracted from the score list form and listed on excel sheet, see Appendix B.

c) Decision-Making Phase

To identify the current situation for the criteria, the weight and the score for each criterion is needed. Therefore, this phase includes calculation of the weight and score for each criterion. Also, it includes the result analysis and evaluation report preparation.

- **Calculate the Weight for Each Criterion**

In order to calculate the weight for each criterion, the calculation for (i) global weight for the level one of CEC and consistency test, (ii) global weight for level two of CEC and consistency test, and (iii) final criteria weight. The calculation conducted based on the formulas in Section 5.4.1. Table 6.5 presents the weight for the criteria in level one and two.

Here, the consistency tests were checked for each expert. The consistency ratio (CR) found to be less than 0.1. Therefore, the entire pair-wise comparison matrixes are acceptable. Based on Section 5.4.1.5 the consistency tests were conducted.

Table 6.5
Criteria Weights for Level One and Two (Company A)

No.	Category Level One	level One Global Weight	Criteria	Level Two Global Weight	Criteria Final Weight
1	E-usage	0.3832	Price saving	0.3420	0.131
2			purchasing transaction	0.4401	0.169
3			Safety	0.6674	0.256
4			Visibility	0.1896	0.073
5			User friendly	0.2290	0.088
6			Diversity of products and services	0.3194	0.122

7	E- informations	0.2965	Correctness	0.5246	0.156
8			Presentability	0.4147	0.123
9			Current	0.4954	0.147
10			Relevant	0.5248	0.156
11			Clarity	0.5948	0.176
12			Richness	0.3807	0.113
13			Trust on purchasing via credit cards or bank transfer	0.8266	0.245
14	E-services	0.7290	High responsiveness	0.5121	0.373
15			Credibility	0.5775	0.421
16			Enjoyable experience	0.2811	0.205
17			Serviceability	0.9254	0.675
18			Reliability	0.7296	0.532
19	E-system	0.8510	Navigability	0.2845	0.242
20			Efficiency	0.7504	0.639
21			Accessibility	0.3733	0.318
22			Learnability	0.6090	0.518
23			Understandability	0.8981	0.764
24	E-company	0.4396	Reputation	0.1585	0.070
25			Enterprise features	0.3362	0.148
26			Promotive activities	0.7654	0.336

In addition, the CRs of Table 6.5 were calculated for level one and two based on Section 5.1.4.5. In Level One the CR for the Experts 1, 2, and 3 are 0.070, 0.071, and 0.040 respectively. While, the CRs for the second level to C1, C2, C3, C4, and C5 are: (0.07, 0.052, 0.041), (0.064, 0.076, 0.046), (0.006, 0.066, 0.038), (0.038, 0.019, 0.023), and (0.033, 0.046, 0.003) for the experts 1, 2, and 3 respectively. This indicates that all of the judgments of decision makers are consistent.

At this stage, the weight was calculated for all categories and criteria. Here, the weight determined for each criterion was multiplied by the category global weight that the criterion belong to in order to determine the criteria final weight. For

example; the weight for price saving is calculated by multiply the global weight for the category E-usage with the weight determined for the price saving using FAHP and Hardmard methods. Therefore, the weight for price saving = $0.3832 * 0.342$, then the weight for price saving is (0.131).

- **Calculate the Total Score for each Criterion**

In order to obtain the Total Score for each criterion $M(u)$ the calculation for (i) DQAS, (ii) CAS, and (iii) Defuzzification were conducted. Table 6.6 shows an example of the scores from the score list form.

Table 6.6
An Example of Obtaining Scores for Criteria from Consumers 1,2,3,4 and 5

Category	Criteria	Description Question	Linguistic Variables	Consumers				
				A	B	C	D	E
E-company	Reputation	DQ1	Worst (W), Poor (P), Fair (F), Good (G), Best (B)	F	F	F	G	G
		DQ2	Worst (W), Poor (P), Fair (F), Good (G), Best (B)	G	G	G	F	F
		DQ3	Worst (W), Poor (P), Fair (F), Good (G), Best (B)	F	F	F	F	F
		DQ4	Worst (W), Poor (P), Fair (F), Good (G), Best (B)	F	F	F	F	F
	Enterprise features	DQ1	Worst (W), Poor (P), Fair (F), Good (G), Best (B)	P	P	P	F	F
		DQ2	Worst (W), Poor (P), Fair (F), Good (G), Best (B)	F	P	F	F	F
		DQ3	Worst (W), Poor (P), Fair (F), Good (G), Best (B)	P	P	P	W	W
	Promotion	DQ1	Worst (W), Poor (P), Fair (F), Good (G), Best (B)	G	G	F	F	F
		DQ2	Worst (W), Poor (P), Fair (F), Good (G), Best (B)	F	F	F	F	P
		DQ3	Worst (W), Poor (P), Fair (F), Good (G), Best (B)	F	F	F	F	P
		DQ4	Worst (W), Poor (P), Fair (F), Good (G), Best (B)	P	P	F	F	F

Based on Table 6.6, the first Consumer (Cons1) gave scores of F, G, F, and F to Reputation descriptive question (Reputation descriptive questions (DQ1, DQ2, DQ3, and DQ4), and gave scores of P, F, and P to Enterprise features (DQ1, DQ2, and DQ3). The scores given by the second, third, fourth, and fifth Consumers (Cons 2, Cons 3, Cons 4, and Cons 5) are as in the respective columns.

Based on Table 6.6 and Table 5.13 the linguistic variables given by the consumers were converted to the representative fuzzy number. Then, the DQAS for each descriptive question under each criterion were calculated based on the operational laws of triangular numbers Table 5.16. Table 6.7 shows an example of how to calculate DQAS.

Table 6.7
An Example of Calculating DQAS (Company A)

E-company		Consumers					Descriptive Question
Criteria's	Description Question	Cons ₁	Cons ₂	Cons ₃	Cons ₄	Cons ₅	Average Score DQAS =
Reputation	DQ1	(2.50, 5.00, 7.50)	(2.50, 5.00, 7.50)	(2.50, 5.00, 7.50)	(5.00, 7.50, 10.0)	(5.00, 7.50, 10.0)	$[(2.50, 5.00, 7.50) + (2.50, 5.00, 7.50) + (2.50, 5.00, 7.50) + (5.00, 7.50, 10.0) + (5.00, 7.50, 10.0)] / 5 = (3.50, 6.00, 8.50)$
	DQ2	(5.00, 7.50, 10.0)	(5.00, 7.50, 10.0)	(5.00, 7.50, 10.0)	(2.50, 5.00, 7.50)	(2.50, 5.00, 7.50)	(4.00, 6.50, 9.00)
	DQ3	(2.50, 5.00, 7.50)	(2.50, 5.00, 7.50)	(2.50, 5.00, 7.50)	(2.50, 5.00, 7.50)	(2.50, 5.00, 7.50)	(2.50, 5.00, 7.50)
	DQ4	(2.50, 5.00, 7.50)	(2.50, 5.00, 7.50)	(2.50, 5.00, 7.50)	(2.50, 5.00, 7.50)	(2.50, 5.00, 7.50)	(2.50, 5.00, 7.50)
Enterprise features	DQ1	(0.00, 2.50, 5.00)	(0.00, 2.50, 5.00)	(0.00, 2.50, 5.00)	(2.50, 5.00, 7.50)	(2.50, 5.00, 7.50)	(1.00, 3.50, 6.00)

	DQ2	(0.00, 2.50, 5.00)	(0.00, 2.50, 5.00)	(2.50, 5.00, 7.50)	(2.50, 5.00, 7.50)	(2.50, 5.00, 7.50)	(1.50, 4.00, 6.50)
	DQ3	(0.00, 2.50, 5.00)	(0.00, 2.50, 5.00)	(0.00, 2.50, 5.00)	(0.00, 0.00, 2.50)	(0.00, 0.00, 2.50)	(0.00, 1.50, 4.00)
Promotion	DQ1	(5.00, 7.50, 10.0)	(5.00, 7.50, 10.0)	(2.50, 5.00, 7.50)	(2.50, 5.00, 7.50)	(2.50, 5.00, 7.50)	(3.50, 6.00, 8.50)
	DQ2	(2.50, 5.00, 7.50)	(2.50, 5.00, 7.50)	(2.50, 5.00, 7.50)	(2.50, 5.00, 7.50)	(0.00, 2.50, 5.00)	(2.00, 4.50, 7.00)
	DQ3	(2.50, 5.00, 7.50)	(2.50, 5.00, 7.50)	(2.50, 5.00, 7.50)	(2.50, 5.00, 7.50)	(0.00, 2.50, 5.00)	(2.00, 4.50, 7.00)
	DQ4	(0.00, 2.50, 5.00)	(0.00, 2.50, 5.00)	(2.50, 5.00, 7.50)	(2.50, 5.00, 7.50)	(2.50, 5.00, 7.50)	(1.50, 4.00, 6.50)

DQAS was calculated by adding all scores given by the Consumers and dividing the total by the number of Consumers. In this example, the number of the Consumers was five. Thus, for Reputation DQ_1 , the DQAS was $[(2.50, 5.00, 7.50) + (2.50, 5.00, 7.50) + (2.50, 5.00, 7.50) + (5.00, 7.50, 10.0) + (5.00, 7.50, 10.0)] / 5 = (3.50, 6.00, 8.50)$. Likewise, for DQ_2 , the DQAS was $(5.00, 7.50, 10.0 + 5.00, 7.50, 10.0 + 5.00, 7.50, 10.0 + 2.50, 5.00, 7.50 + 2.50, 5.00, 7.50) / 5 = (4.00, 6.50, 9.00)$. This process was applied for all descriptive questions. Based on Table 6.7, the CAS for each criterion was calculated. Table 6.8 shows an example about how to calculate CAS.

Table 6.8
An Example of Calculating CAS

E-company		Consumers					Descriptive Question Average Score DQAS =	Criteria Average Score CAS =
Criteria's	Descripti on Question	Cons 1	Cons ₂	Cons ₃	Cons 4	Cons 5		
Reputation	DQ1	(2.50, 5.00, 7.50)	(2.50, 5.00, 7.50)	(2.50, 5.00, 7.50)	(5.00, 7.50, 10.0)	(5.00, 7.50, 10.0)	[(2.50, 5.00, 7.50) + (2.50, 5.00, 7.50) + (2.50, 5.00, 7.50)+ (5.00, 7.50, 10.0)+ (5.00, 7.50, 10.0)]/5 = (3.50, 6.00, 8.50)	[(3.50, 6.00, 8.50)+(4.00, 6.50, 9.00)+(2.50, 5.00, 7.50)+ (2.50, 5.00, 7.50) / 4 = (2.34, 5.62, 8.12)
	DQ2	(5.00, 7.50, 10.0)	(5.00, 7.50, 10.0)	(5.00, 7.50, 10.0)	(2.50, 5.00, 7.50)	(2.50, 5.00, 7.50)	(4.00, 6.50, 9.00)	
	DQ3	(2.50, 5.00, 7.50)	(2.50, 5.00, 7.50)	(2.50, 5.00, 7.50)	(2.50, 5.00, 7.50)	(2.50, 5.00, 7.50)	(2.50, 5.00, 7.50)	
	DQ4	(2.50, 5.00, 7.50)	(2.50, 5.00, 7.50)	(2.50, 5.00, 7.50)	(2.50, 5.00, 7.50)	(2.50, 5.00, 7.50)	(2.50, 5.00, 7.50)	
Enterprise features	DQ1	(0.00, 2.50, 5.00)	(0.00, 2.50, 5.00)	(0.00, 2.50, 5.00)	(2.50, 5.00, 7.50)	(2.50, 5.00, 7.50)	(1.00, 3.50, 6.00)	(0.833, 3.00, 5.50)
	DQ2	(0.00, 2.50, 5.00)	(0.00, 2.50, 5.00)	(2.50, 5.00, 7.50)	(2.50, 5.00, 7.50)	(2.50, 5.00, 7.50)	(1.50, 4.00, 6.50)	
	DQ3	(0.00, 2.50, 5.00)	(0.00, 2.50, 5.00)	(0.00, 2.50, 5.00)	(0.00, 2.50, 5.00)	(0.00, 2.50, 5.00)	(0.00, 1.50, 4.00)	
Promotion	DQ1	(5.00, 7.50, 10.0)	(5.00, 7.50, 10.0)	(2.50, 5.00, 7.50)	(2.50, 5.00, 7.50)	(2.50, 5.00, 7.50)	(3.50, 6.00, 8.50)	(3.00, 4.75, 7.25)
	DQ2	(2.50, 5.00, 7.50)	(2.50, 5.00, 7.50)	(2.50, 5.00, 7.50)	(2.50, 5.00, 7.50)	(0.00, 2.50, 5.00)	(2.00, 4.50, 7.00)	
	DQ3	(2.50, 5.00, 7.50)	(2.50, 5.00, 7.50)	(2.50, 5.00, 7.50)	(2.50, 5.00, 7.50)	(0.00, 2.50, 5.00)	(2.00, 4.50, 7.00)	
	DQ4	(0.00, 2.50, 5.00)	(0.00, 2.50, 5.00)	(2.50, 5.00, 7.50)	(2.50, 5.00, 7.50)	(2.50, 5.00, 7.50)	(1.50, 4.00, 6.50)	

The DQAS for each descriptive question was added and divided by the number of descriptive questions for each criterion. CAS for criteria Reputation was $[(3.50, 6.00, 8.50)+(4.00, 6.50, 9.00)+(2.50, 5.00, 7.50)+ (2.50, 5.00, 7.50)] / 4 = (2.34, 5.62, 8.12)$. Likewise, the CAS for the criterion Enterprise features was $[(1.00, 3.50, 6.00)+ (1.50, 4.00, 6.50)+ (0.00, 1.50, 4.00)]/3= (0.833, 3.00, 5.50)$.

Based on Table 6.8, the $M(u)$ defuzzification for each criterion was calculated. Table 6.9 shows an example about how to calculate the criteria average score in crisp value based on Center Of Area method (COA) as mentioned in Section 5.4.2.4.

Table 6.9
An Example of Calculating $M(u)$

E-company		Consumers					Descriptive Question Average Score DQAS =	Criteria Average Score CAS =	Defuzzification for Each Criterion $M(u)$
Criteria's	Description Question	Cons ₁	Cons ₂	Cons ₃	Cons ₄	Cons ₅			
Reputation	DQ1	0.00, 0.00, 2.50	0.00, 2.50, 5.00	2.50, 5.00, 7.50	2.50, 5.00, 7.50	0.00, 2.50, 5.00	(1.00, 3.00, 5.50)	$[(3.50, 6.00, 8.50)+(4.00, 6.50, 9.00)+(2.50, 5.00, 7.50)+ (2.50, 5.00, 7.50)] / 4 =$ (2.34, 5.62, 8.12)	$[(8.12-2.34)+(5.62-2.34)]/3 + 2.34 =$ 5.36
	DQ2	5.00, 7.50, 10.0	7.50, 10.0, 10.0	5.00, 7.50, 10.0	5.00, 7.50, 10.0	5.00, 7.50, 10.0	(5.50, 8.00, 10.0)		
	DQ3	7.50, 10.0, 10.0	5.00, 7.50, 10.0	5.00, 7.50, 10.0	2.50, 5.00, 7.50	5.00, 7.50, 10.0	(5.00, 7.50, 9.50)		
	DQ4	0.00, 0.00, 2.50	2.50, 5.00, 7.50	0.00, 2.50, 5.00	0.00, 2.50, 5.00	0.00, 2.50, 5.00	(0.50, 2.50, 5.00)		
Enterprise features	DQ1	0.00, 2.50, 5.00	2.50, 5.00, 7.50	2.50, 5.00, 7.50	2.50, 5.00, 7.50	2.50, 5.00, 7.50	(2.00, 4.50, 7.00)	(0.833, 3.00, 5.50)	3.11
	DQ2	0.00, 0.00, 2.50	0.00, 2.50, 5.00	2.50, 5.00, 7.50	2.50, 5.00, 7.50	0.00, 2.50, 5.00	(1.00, 3.00, 5.50)		
	DQ3	5.00, 7.50, 10.0	7.50, 10.0, 10.0	5.00, 7.50, 10.0	5.00, 7.50, 10.0	5.00, 7.50, 10.0	(5.50, 8.00, 10.0)		
Promotion	DQ1	7.50, 10.0, 10.0	5.00, 7.50, 10.0	5.00, 7.50, 10.0	2.50, 5.00, 7.50	5.00, 7.50, 10.0	(5.00, 7.50, 9.5)	(3.00, 4.75,	5.00

	DQ2	0.00, 0.00, 2.50	2.50, 5.00, 7.50	0.00, 2.50, 5.00	0.00, 2.50, 5.00	0.00, 2.50, 5.00	(0.50, 2.50, 5.00)	7.25)	
	DQ3	0.00, 2.50, 5.00	2.50, 5.00, 7.50	2.50, 5.00, 7.50	2.50, 5.00, 7.50	2.50, 5.00, 7.50	(2.00, 4.50, 7.00)		
	DQ4	0.00, 2.50, 5.00	0.00, 2.50, 5.00	2.50, 5.00, 7.50	2.50, 5.00, 7.50	0.00, 2.50, 5.00	(1.00, 3.50, 6.00)		

As shown in Table 6.9, M(u) was calculated by subtracted the lower value from the upper value; then the result was aggregate with result from subtraction of the lower value from the mean value. Then, the result from aggregation was divided by 3 and added to the lower value. Thus, M (u) for Reputation was $[(8.12-2.34) + (5.62-2.34)] / 3 + 2.34 = 5.36$. In summary, for the example given, the weight and the score are shown in Table 6.10.

Table 6.10
Score and Weight Obtained by Criteria's (Company A)

No.	Category Level One	Criteria	Criteria Final Score	Criteria Final Weight
1	E-usage	Price saving (C11)	4.03	0.131
2		purchasing transaction (C12)	5.33	0.169
3		Safety (C13)	7.50	0.256
4		Visibility (C14)	6.23	0.073
5		User friendly (C15)	4.78	0.088
6		Diversity of products and services (C16)	2.77	0.122
7	E-informations	Correctness (C21)	5.66	0.156
8		Presentability (C22)	5.33	0.123
9		Current (C23)	5.33	0.147
10		Relevant (C24)	7.10	0.156
11		Clarity (C25)	7.33	0.176
12		Richness (C26)	5.11	0.113

13		Trust on purchasing via credit cards or bank transfer (C27)	6.60	0.245
14	E-services	High responsiveness (C31)	3.33	0.373
15		Credibility (C32)	7.00	0.421
16		Enjoyable experience (C33)	3.50	0.205
17		Serviceability (C34)	3.25	0.675
18		Reliability (C35)	7.50	0.532
19	E-system	Navigability (C41)	5.57	0.242
20		Efficiency (C42)	7.30	0.639
21		Accessibility (C43)	6.54	0.318
22		Learnability (C44)	6.87	0.518
23		Understandability (C45)	6.87	0.764
24	E-company	Reputation (C51)	5.36	0.070
25		Enterprise features (C52)	3.11	0.148
26		Promotive activities (C53)	5.00	0.336

The above table shows, that the highest score is achieved by criteria Reliability (7.5), Safety (7.5), Clarity (7.33), Relevant (7.1) and Credibility (7.0), followed by Understandability (6.87), Learnability (6.87), Trust on purchasing via credit cards or bank transfer (6.60), and Accessibility (6.54). Other criteria obtained scores less than 6. This means, these criteria need to be improved and taken into consideration.

- **Result Analysis**

Based on the results shown in Table 6.10, the average score for each category is calculated. The average score was calculated by adding all the M(u)s for the criteria under the same category and dividing the total by the number of category criteria. For example, E-Company was $[(5.36+3.11+5.00)/3]= 4.49$. Likewise, for the E-

system was $[(5.57+7.30+6.54+6.87+6.87)/5]= 6.63$. This process was applied for the entire category. Table 6.11 shows the results.

Table 6.11
Score and Weight Obtained by Level One (Company A)

No.	Category Level One	Average Score	Weight
1	E-usage	5.11	0.38
2	E- information	6.07	0.296
3	E-services	4.92	0.73
4	E-system	6.63	0.85
5	E-company	4.49	0.44

Result on the weight and Score were analyzed to identify the category need to be improved. i.e. by identifying weakest category in the website. In order to determine the weakest criteria weight variance analysis was used and plotted in Figure 6.3.

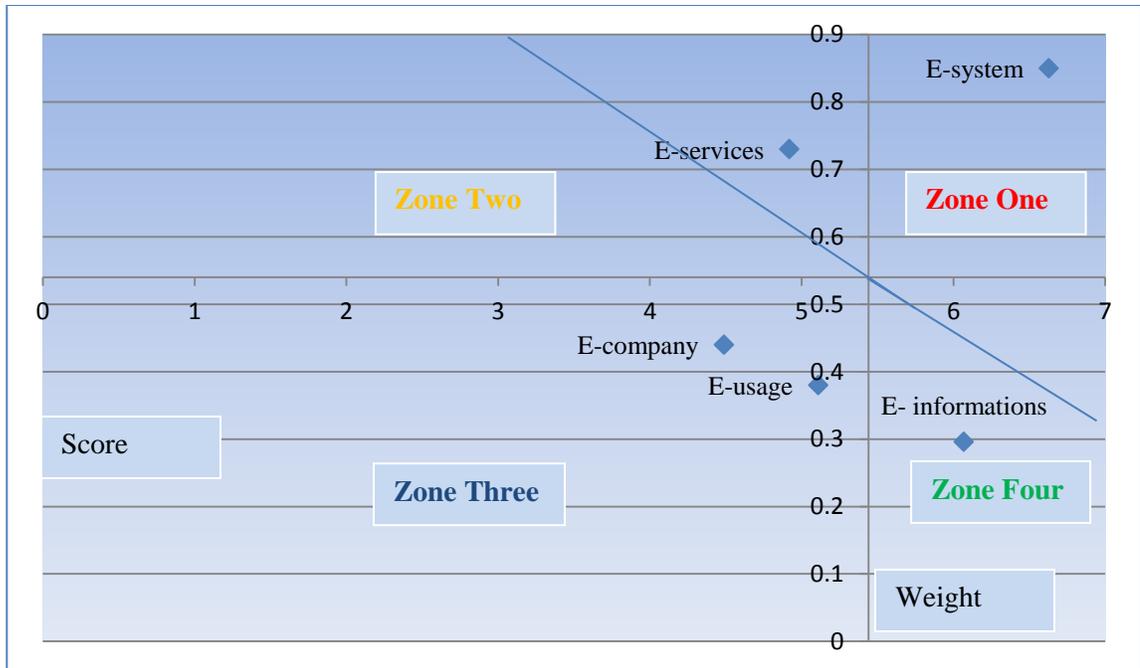


Figure 6.3. Category weight variance map (Company A)

The figure shows that E-system and E-services located in Zone One. This mean, the category E-system and E-services is perceived to be important for the consumers (evaluators); however, the rate of the performance variance is high in this Zone. E-system and E-service constitutes the top priority for remedial action, and the necessity of improvement is proportional to the horizontal distance from the iso-rating line. E-company and E-usage are falling in Zone Three. This mean, these two categories contain criteria of low performance variance rate and low importance. Therefore, the high managements should not be overly concerned about the criteria fall in Zone Three. E-information is falling in Zone Four. Therefore, it not necessary to focus additional effort to the category in this zone because of E-information has low importance and high performance variance rate.

In addition, the result on the weight and Score were analyzed to identify the criteria need to be improved. i.e. by identifying weakest criteria in the website. In order to determine the weakest criteria weight variance analysis was used and plotted in Figure 6.4.

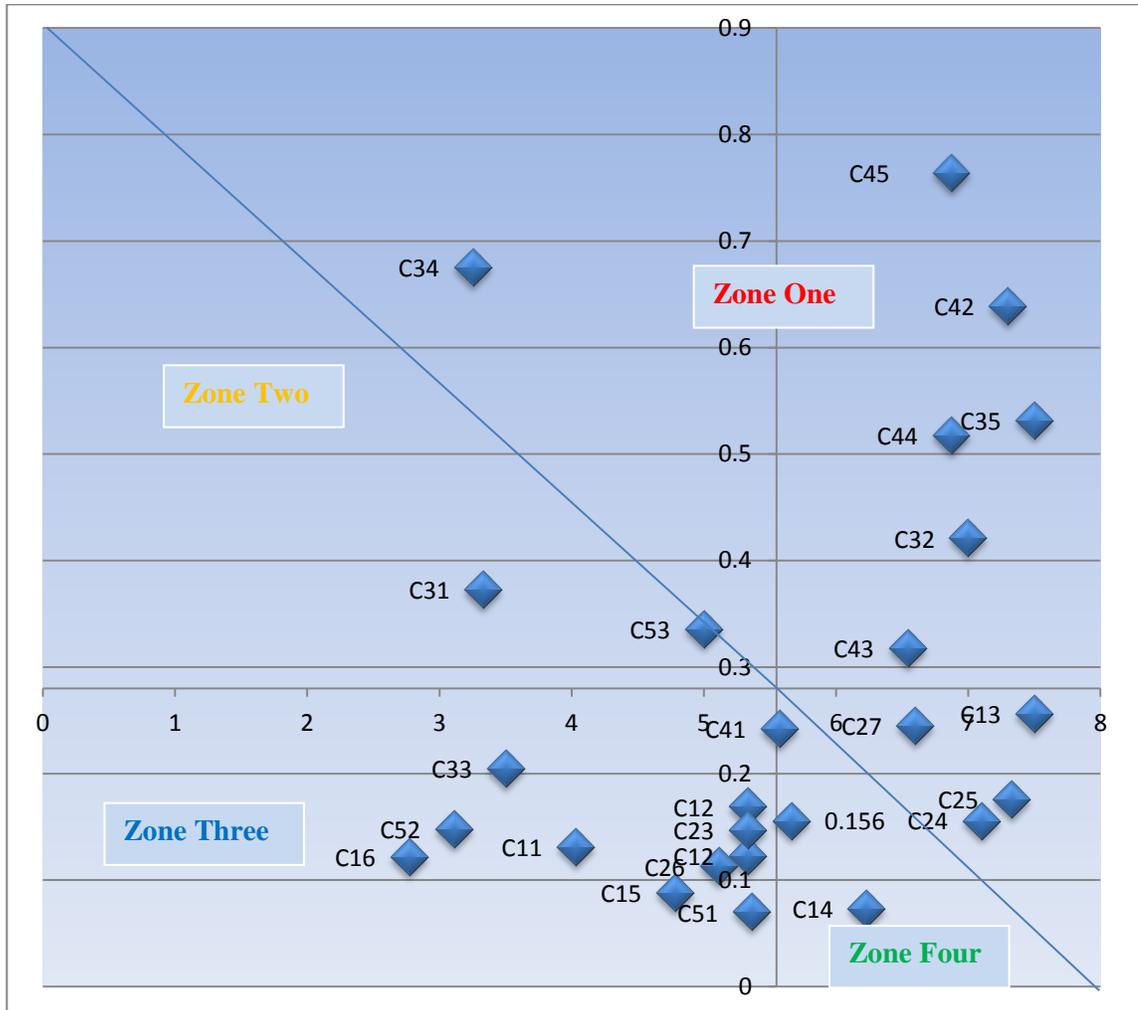


Figure 6.4. Criteria weight variance map (Company A)

Criteria Weight Variance Map was used to easily identify criteria that need to be improved and considered (Chang & Yang, 2008; Tsai et al., 2010). Figure 6.4 shows the

final result of each criterion. Each criterion is represented by point (x, y). The X-axis represents the score and Y-axis represents the weight. The average score for the weight and score should be calculated to identify the center of the weight variance map.

Based on the Figure 5.6; Section 5.4.2.5, the weakest criteria for Company A were: C45, C44, C43, C42, C35, C34, C32, C27, C25, C24 and C13); Understandability, Learnability, Accessibility, Efficiency, Reliability, Serviceability, Credibility, Trust on purchasing via credit cards or bank transfer, Clarity, Relevant, and Safety respectively. These criteria are falling in Zone One and perceived to be important for the consumers (evaluators). These eleven criteria constitute the top priority for remedial action, and the necessity of improvement is proportional to the horizontal distance from the iso-rating line. Whilst, C53, and C31 Promotive activities, and High responsiveness respectively are falling in Zone Two. Which mean that, these criteria require careful monitoring to ensure that low variance rate levels are maintained.

The criteria C52, C51, C33, C26, C23, C16, C15, C12, and C11 are falling in Zone Three. The criteria are: Enterprise features, Reputation, Enjoyable experience, Richness, Current, Diversity of products and services, User friendly, purchasing transaction, and Price saving. Zone Three criteria have low performance variance rate and low importance. Therefore, the high managements should not be overly concerned about the criteria fall in Zone Three.

The criteria Navigability, Visibility, and Presentability (C41, C14, and C22) are falling in Zone Four. These criteria have high performance variance and low importance. Therefore, not necessary to focus additional effort or resources to criteria fall in this Zone.

Based on the previous two Figures, e-system is falling in Zone One. As mentioned before, this category needs to be improved. However, not all the criteria of this category need improvements. The criteria C41 (Navigability) is falling in Zone Four while the rest of the criteria under the same category is falling in Zone One. This indicates that each category may consist of criteria need to be improved and maybe not. Also, e-service is falling in Zone One but the criterion C33 is falling in Zone Three which do not need improvement.

- **Prepare Evaluation Report**

Here, the results for BNP (weight) and M (u) for Company A website are presented. The weakest category and criteria are also presented. Referring to Section 5.5.3 (Chapter Five); based on Table 6.10, and based on Figures (6.3 and 6.4) the evaluation report is presented.

Table 6.12
Evaluation Report (Company A)

No.	Category Level one	Criteria	Zone Number	Comments
1	E-usage	Price saving (C11)	Three	Pay some attention
2		purchasing transaction (C12)	Three	Pay some attention
3		Safety (C13)	One	Need improvements
4		Visibility (C14)	Four	Do not worry
5		User friendly (C15)	Three	Pay some attention
6		Diversity of products and services (C16)	Three	Pay some attention
7	E-information's	Correctness (C21)	Three	Pay some attention
8		Presentability (C22)	Four	Do not worry
9		Current (C23)	Three	Pay some attention
10		Relevant (C24)	One	Need improvements
11		Clarity (C25)	One	Need improvements
12		Richness (C26)	Three	Pay some attention
13		Trust on purchasing via credit cards or bank transfer (C27)	One	Need improvements
14	E-services	High responsiveness (C31)	Two	Require carefully monitor
15		Credibility (C32)	One	Need improvements
16		Enjoyable experience (C33)	Three	Pay some attention
17		Serviceability (C34)	One	Need improvements
18		Reliability (C35)	One	Need improvements
19	E-system	Navigability (C41)	Four	Do not worry
20		Efficiency (C42)	One	Need improvements
21		Accessibility (C43)	One	Need improvements
22		Learnability (C44)	One	Need improvements
23		Understandability (C45)	One	Need improvements
24	E-company	Reputation (C51)	Three	Pay some attention
25		Enterprise features (C52)	Three	Pay some attention
26		Promotive activities (C53)	Two	Require carefully monitor

At this step, a report was prepared and a meeting was held to verify the report. All team members attended the meeting. The verified report was signed by the Manager of

Information Technology Department (Mr. Ramiz) on 19th October, 2013. This report helps the top management to know the company website performance situation and the criteria that need to be improved. The report was written in simple language (Appendix H). The management members were encouraged to study the details of the reports and provide feedback to improve the website in future.

6.3.2 Company B Profile

Company B is one of the large private trading e-commerce companies in Jordan. The Company was established in 2000 and is located in Amman. Company B is a professional trading and manufacturing products company. It is the first online store that is specialized in selling product X worldwide. Company B has integrated production, sales and services in dealing with many different types of customers. Currently, it exports its products to many countries such as USA, China, UK, UAE, KSA, Canada, European and Asian regions.

It offers customized e-commerce platform that suits all types of consumers and market needs. The consumers can order and pay online. Also, they are able to browse the product categories and see the new arrivals and prices. In addition, it provides the consumers adequate information and pictures about the products. The consumer can personalize his/her products through the company website by selecting the size and the type of the product. Moreover, the consumers are able to amend their shipping address or billing data or even choose the shipping company that suits them better.

6.3.2.1 Evaluation Process on Company B Website

The evaluation process involves three phases: Planning Phase, Examination Phase, and Decision-Making Phase. The activities conducted for each phase are detailed below.

a) Planning Phase

This phase includes two main activities: (i) establish the goal of the evaluation, and (ii) brief the evaluation and prepare documents. First, the website owner of Company B contacted the Information Technology Department to hold a meeting. The purpose of the meeting was to evaluate the website of Company B. The meeting was held on the 11th November, 2013. The results of the meeting were:

- The Company's official website will be evaluated.
- Five consumers' were identified and agreed to participate in the evaluation process.
- The evaluation team members were identified as follows:-
 1. Manager of Information Technology Department (Mr Rami), Manager of Quality Assurance Department (Mr Ehsan), and Developer (Mr Alaa). They were responsible to assign weight score for the criteria's.
 2. Five organization consumers were identified in order to fill the score list and rate Company B website.
 3. Evaluation team leader, Mr Ali was responsible for distributing the responsibilities among the team members and giving the explanation and instructions to the evaluation team.
- The evaluation date assigned was on 18th November, 2013.

Second, after identifying the evaluation team, a second meeting was held after one week. The meeting aimed to give a briefing on the evaluation process and preparation of necessary documents for the team members. During the meeting, Mr Ali gave a short briefing about the evaluation schedule and activities. He provided information on Company B website and gave explanation and instruction about the evaluation schedule, such as the steps of evaluation and the team members' responsibilities. Next, he prepared the evaluation document needed for the evaluation. He provided the experts a website manual and evaluation score list form. The Manager of Information Technology, Manager of Quality Assurance, and the developer were provided with criteria weight score list form.

b) Examination Phase

This phase includes conducting the evaluation and collecting data.

- **Conduct the Evaluation**

First, the five consumers (evaluators) browsed the company website and then filled the evaluation score list form. In other words, the five evaluators filled the evaluation score list simultaneously with analysis of the website.

Second, the Manager of Information Technology Department, Quality Assurance Manager, and developer filled the criteria weight list form. What they needed to do was to assign a linguistic weight for each website criteria.

- **Collect Data**

At this stage, the filled evaluation score list form and the filled criteria weight list form were gathered by the team leader. The gathered evaluation score list form and the criteria's weight list form were checked and validated by the evaluation team members to ensure that all forms were completely answered. The forms were found to be complete and valid. Then, the team leader input all data into an Excel sheet.

The values from the criteria weight list form and evaluation score list form were organized and presented as matrix formulation in order to calculate the weight for each criterion. The same procedure followed in pervious case study will be followed here too.

At this stage, the experts have assigned the weight for the first and second level for the CEC. After obtaining the weight from the experts, the evaluation score take its place. The filled evaluation score list were extracted from the score list form and listed on excel sheet.

c) Decision-Making Phase

To identify the current situation for the criteria, the weight and the score for each criterion is needed. Therefore, this phase includes calculation of the weight and score for each criterion. Also, it includes the result analysis and evaluation report preparation.

- **Calculate the Weight for Each Criterion**

This section calculates the BNP (weight) for each criterion to Company B. The finding from the calculation is shown in Table 6.13.

Table 6.13
Criteria Weights for Level One and Two (Company B)

No.	Category Level One	level One Global Weight	Criteria	Level Two Global Weight	Criteria Final Weight
1	E-usage	0.449	Price saving	0.249	0.112
2			purchasing transaction	0.454	0.204
3			Safety	0.746	0.335
4			Visibility	0.246	0.110
5			User friendly	0.216	0.097
6			Diversity of products and services	0.407	0.183
7	E-informations	0.307	Correctness	0.459	0.141
8			Presentability	0.743	0.228
9			Current	0.306	0.094
10			Relevant	0.312	0.096
11			Clarity	0.487	0.150
12			Richness	0.199	0.061
13			Trust on purchasing via credit cards or bank transfer	0.951	0.292
14	E-services	0.628	High responsiveness	0.471	0.296
15			Credibility	0.712	0.447
16			Enjoyable experience	0.302	0.190
17			Serviceability	0.998	0.627
18			Reliability	0.782	0.491
19	E-system	0.650	Navigability	0.241	0.157
20			Efficiency	0.844	0.549
21			Accessibility	0.356	0.231
22			Learnability	0.540	0.351
23			Understandability	0.738	0.480
24	E-company	0.386	Reputation	0.187	0.072
25			Enterprise features	0.356	0.137
26			Promotive activities	0.757	0.292

In addition, the CRs of Table 6.13 were calculated for level one and two based on Section 5.1.4.5. In Level One the CR for the Experts 1, 2, and 3 are 0.034, 0.065, and 0.081 respectively. While, the CRs for the second level to C1, C2, C3, C4, and C5 are: (0.33, 0.051, 0.063), (0.021, 0.086, 0.048), (0.036, 0.089, 0.084), (0.039, 0.015, 0.029), and (0.0158, 0.033, 0.0157) for the experts 1, 2, and 3 respectively. This indicates that all of the judgments of decision makers are consistent.

At this stage, the weight was calculated for all categories and criteria. Here, the weight determined for each criterion was multiplied by the category global weight that the criterion belong to in order to determine the criteria final weight. For example; the weight for price saving is calculated by multiply the global weight for the category E-usage with the weight determined for the price saving using FAHP and Hardmard methods. Therefore, the weight for price saving = $0.449 * 0.249$, then the weight for price saving is (0.112).

- **Calculate the Total Score for each Criterion**

Based on Section 5.4.2, the Total Score for each criterion was calculated and presented with the weight calculated for each criterion in Table 6.14.

Table 6.14
Score and Weight Obtained by criteria's (Company B)

No.	Category Level One	Criteria	Criteria Final Score	Criteria Final Weight
1		Price saving (C11)	2.67	0.112
2		purchasing transaction (C12)	4.06	0.204
3		Safety (C13)	5.00	0.335
4		Visibility (C14)	5.77	0.110

5	E-usage	User friendly (C15)	6.20	0.097
6		Diversity of products and services (C16)	4.27	0.183
7	E-informations	Correctness (C21)	7.50	0.141
8		Presentability (C22)	4.16	0.228
9		Current (C23)	5.00	0.094
10		Relevant (C24)	7.13	0.096
11		Clarity (C25)	6.50	0.150
12		Richness (C26)	5.16	0.061
13		Trust on purchasing via credit cards or bank transfer (C27)	7.00	0.292
14	E-services	High responsiveness (C31)	3.27	0.296
15		Credibility (C32)	6.25	0.447
16		Enjoyable experience (C33)	1.83	0.190
17		Serviceability (C34)	5.83	0.627
18		Reliability (C35)	6.63	0.491
19	E-system	Navigability (C41)	5.35	0.157
20		Efficiency (C42)	4.63	0.549
21		Accessibility (C43)	5.63	0.231
22		Learnability (C44)	6.00	0.351
23		Understandability (C45)	6.63	0.480
24	E-company	Reputation (C51)	6.00	0.072
25		Enterprise features (C52)	2.50	0.137
26		Promotive activities (C53)	5.63	0.292

The above table shows that the highest score is achieved by criteria Correctness (7.50), Relevant (7.13), Trust on purchasing via credit cards or bank transfer (7.00), Reliability (6.63), Understandability (6.63), Clarity (6.50), Credibility (6.25), User friendly (6.20), Learnability (6.00), and Reputation (6.00). Other criteria scored less than 6.00; for more details see Table 6.14.

- **Result Analysis**

Based on the results shown in Table 6.14, the average score for each category is calculated. The average score was calculated by adding all the M(u)s for the criteria

under the same category and dividing the total by the number of category criteria. For example, E-Company was $[(6.00+2.50+6.63)/3]= 5.04$. Likewise, for the E-system was $[(5.35+4.63+5.63+6.00+6.63)/5]= 5.65$. This process was applied for the entire category. Table 6.15 shows the results.

Table 6.15
Score and Weight Obtained by Level One (Company B)

No.	Category Level One	Average Score	Weight
1	E-usage	4.66	0.449
2	E- informations	6.06	0.307
3	E-services	4.76	0.628
4	E-system	5.65	0.650
5	E-company	5.04	0.386

Result on the weight and Score were analyzed to identify the category need to be improved. i.e. by identifying weakest category in the website. In order to determine the weakest criteria weight variance analysis was used and plotted in Figure 6.5.

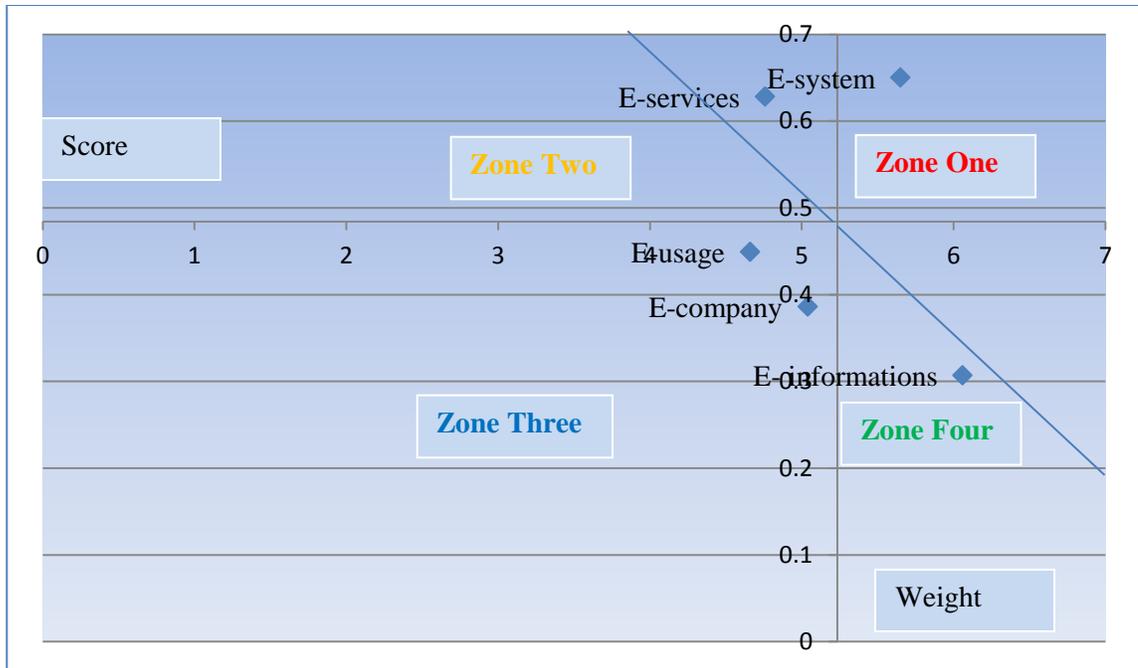


Figure 6.5. Category weight variance map (Company B)

The figure shows that E-system and E-services located in Zone One. This mean, these categories are perceived to be important for the consumers (evaluators); however, the rate of the performance variance is high in this Zone. E-system and E-services constitute the top priority for remedial action, and the necessity of improvement is proportional.

E-company and E-usage are falling in Zone Three. This mean, these categories contain criteria of low performance variance rate and low importance. Therefore, the high managements should not be overly concerned about the criteria fall in Zone Three. E-information is falling in Zone Four. Therefore, it not necessary to focus additional effort to the category in this zone because of E-information has low importance and high performance variance rate.

In addition, the result on the weight and Score were analyzed to identify the criteria need to be improved. I.e. by identifying weakest criteria in the website. In order to determine the weakest criteria weight variance analysis was used and plotted in Figure 6.6.

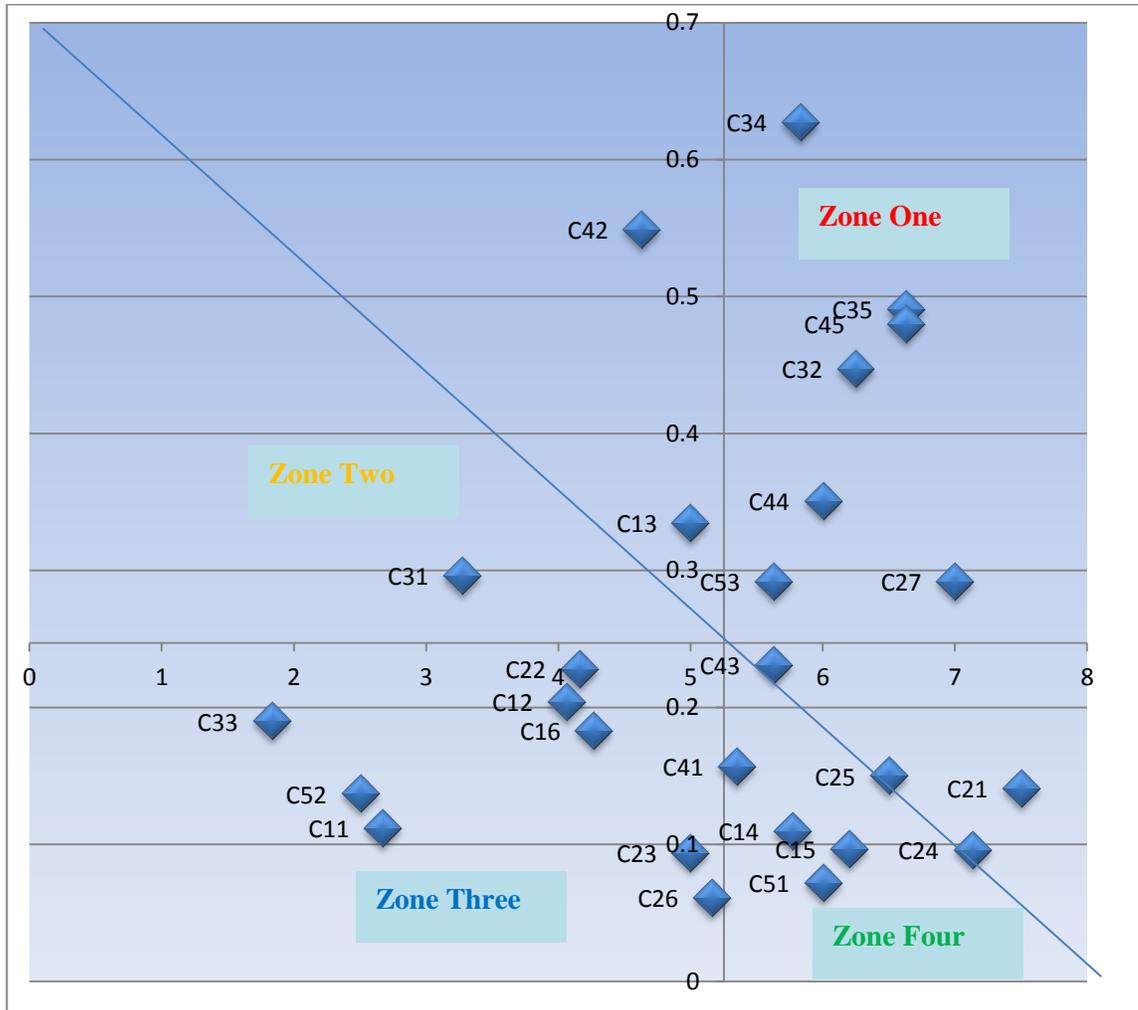


Figure 6.6. Criteria weight variance map (Company B)

Figure 6.5 shows the final result of each criterion. Based on this figure, the weakest criteria for company B were presented. The criteria needs to be improved were: C32, C34, C35, C43, C44, C45, C27, C53, C42, C13, C25, C24, and C21; Credibility,

Serviceability, Reliability, Accessibility, Learnability, Understandability, Trust on purchasing via credit cards or bank transfer, Promotive activities respectively, Efficiency, Safety, Clarity, Relevant, and Correctness. Thirteen criterions are falling in Zone One. These criteria constitute the top priority for remedial action. Whilst, one criterion falls in Zone Two. The criterion is C31, High responsiveness. This criterion requires careful monitoring to ensure that low variance rate levels are maintained.

In addition, eight criteria are falling in Zone Three. These criteria are: C11, C12, C16, C22, C23, C26, C33, and C52. The criteria Price saving, purchasing transaction, Diversity of products and services, Presentability, Current, Richness, Enjoyable experience, and Enterprise features. These eight criteria have low performance variance rate and low importance. Therefore, the high managements should not be overly concerned about the criteria fall in Zone Three. The rest of criteria are falling in Zone four. Remain criteria (C41, C14, C15, and C51) have high performance variance and low importance. Therefore, not necessary to focus additional effort or resources to criteria fall in this Zone.

Based on the Figure 6.5 and 6.6, E-system is falling in Zone One. As mentioned before, this category needs to be improved. However, not all the criteria of this category need improvements. As shown in the figure 6.6, C41 is falling in Zone Four while these criteria categorized under E-system category.

E-information is falling in Zone Four. However, the criteria C27, C25, C24, and C21 are falling in Zone One. Moreover, E-company is falling in Zone Three. While, the criterion

C53 is falling in Zone one which mean these two criteria need highly improvement although they are categorized under categories all falling in Zone Three and Four.

- **Prepare Evaluation Report**

Here, the results for BNP (weight) and M (u) for Company B website are presented. The weakest category and criteria are also presented.

Referring to Section 5.5.3 (Chapter Five), and based on Tables (6.14 and 6.15) also Figures (6.5 and 6.6). The evaluation report is presented in Table 6.16.

Table 6.1
Evaluation Report (Company B)

No.	Category Level One	Criteria	Zone Number	Comments
1	E-usage	Price saving (C11)	Three	Pay some attention
2		purchasing transaction (C12)	Three	Pay some attention
3		Safety (C13)	One	Need improvements
4		Visibility (C14)	Four	Do not worry
5		User friendly (C15)	Four	Do not worry
6		Diversity of products and services (C16)	Three	Pay some attention
7	E-information	Correctness (C21)	One	Need improvements
8		Presentability (C22)	Three	Pay some attention
9		Current (C23)	Three	Pay some attention
10		Relevant (C24)	One	Need improvements
11		Clarity (C25)	One	Need improvements
12		Richness (C26)	Three	Pay some attention
13		Trust on purchasing via credit cards or bank transfer (C27)	One	Need improvements
14		High responsiveness (C31)	Two	Require carefully monitor
15		Credibility (C32)	One	Need improvements
16		Enjoyable experience (C33)	Three	Pay some attention

17	E-services	Serviceability (C34)	One	Need improvements
18		Reliability (C35)	One	Need improvements
19	E-system	Navigability (C41)	Four	Do not worry
20		Efficiency (C42)	One	Need improvements
21		Accessibility (C43)	One	Need improvements
22		Learnability (C44)	One	Need improvements
23		Understandability (C45)	One	Need improvements
24	E-company	Reputation (C51)	Four	Do not worry
25		Enterprise features (C52)	Three	Pay some attention
26		Promotive activities (C53)	One	Need improvements

At this step, a report was prepared and a meeting was held to verify the report. All team members attended the meeting. The verified report was signed by the Manager of Information Technology Department (Mr. Rami) on 20 of November, 2013. This report helps the top management to know the company website performance situation and the criteria that need to be improved. The report was written in simple language (Appendix H). The management members were encouraged to study the details of the reports and provide feedback to improve the website in future.

6.3.3 Company C Profile

Company C is considered as one of the large semi-private sector B2C companies in Amman Jordan, It covers a large network area. Company C is a global transportation and logistics services company. Company C provides scheduled air-transport services. The company offers passengers and cargo schedules, baggage, and airmail services, as well as chartered flight services. Company C also provides a number of retail services, including mail-order, catalog services, and mail forwarding services. The consumers can book flights, select seat location, select destination, choose seat class, select mail

forwarding services, and pay online through Company C website. Company C applied several series of meetings, discussions, and online testing. These activities were done collaboratively among the Manager of Information Technology Department, Developers, and Website Owner.

6.3.3.1 Evaluation Process on Company C Website

The evaluation process on Company C involved three phases: Planning Phase, Examination Phase, and Decision-Making Phase. The activities conducted for each phase are presented below.

a) Planning Phase

This phase includes two main activities: (i) establish the goal of the evaluation, and (ii) brief the evaluation and prepare documents. First, the website owner of Company C contacted the Information Technology Department to hold a meeting. The purpose of the meeting was to evaluate the website of Company C. The meeting was held on the first Dec, 2013. The results of the meeting were:

- The Company's official website will be evaluated.
- Five consumers' were identified and agreed to participate in the evaluation process.
- The evaluation team members were identified as follows:-
 1. Manager of Information Technology Department (Mr. Ababneh),
Manager of Quality Assurance Department (Mr Ahmad), and Developer

(Mr Sattam). They were responsible to assign weight score for the criteria's.

2. Five organization consumers were identified in order to fill the score list and rate Company C website.
 3. Evaluation team leader, Mr Ababneh was responsible for distributing the responsibilities among the team members and giving the explanation and instructions to the evaluation team.
- The evaluation date assigned was on 6th Dec, 2013.

Second, after identifying the evaluation team, a second meeting was held after one week. The meeting was to give a briefing on the evaluation process and for preparing necessary documents for the team members. During the meeting, Mr. Hamza gave a short briefing about the evaluation schedule and activities. He provided information on Company C website and gave explanation and instruction about the evaluation schedule, such as the steps of evaluation and the team members' responsibilities. Next, he prepared the evaluation document needed for the evaluation. He provided the experts a website manual and evaluation score list form. The Manager of Information Technology, Manager of Quality Assurance, and the developer were provided with criteria weight score list form.

b) Examination Phase

This phase includes conducting the evaluation and collecting data.

- **Conduct the Evaluation**

First, the five consumers (evaluators) browsed the company website and then filled the evaluation score list form. In other words, the five evaluators filled the evaluation score list simultaneously with analysis of the website.

Second, the Manager of Information Technology Department, Quality Assurance Manager, and developer filled the criteria weight score list form. What they needed to do was to assign a linguistic weight score for each website criteria.

- **Collect Data**

At this stage, the filled evaluation score list form and the filled criteria weight list form were gathered by the team leader. The gathered evaluation score list form and the criteria's weight list form were checked and validated by the evaluation team members to ensure that all forms were completely answered. The forms were found to be complete and valid. Then, the team leader input all data into an Excel sheet.

The values from the criteria weight score list form and evaluation score list form were organized and presented as matrix formulation in order to calculate the weight for each criterion. The same procedure followed in pervious case study will be followed here too.

At this stage, the experts have assigned the weight score for the first and second level for the CEC. After obtaining the weight score from the experts, the evaluation score take its place. The filled evaluation score list were extracted from the score list form and listed on excel sheet.

c) Decision-Making Phase

As mentioned earlier, to identify the current situation for the criteria, the weight and the score for each criterion is needed. Therefore, this phase includes calculation of the weight and score for each criterion. Also, it includes the result analysis and evaluation report preparation.

- **Calculate the Weight for Each Criterion**

Based on Section 5.4.1, this section calculates the BNP (weight) for each criterion to Company C. The finding from the calculation is shown in Table 6.17.

Table 6.17
Criteria Weights for Level One and Two (Company C)

No.	Category Level One	level One Global Weight	Criteria	Level Two Global Weight	Criteria Final Weight
1	E-usage	0.497	Price saving	0.318	0.158
2			purchasing transaction	0.432	0.215
3			Safety	0.734	0.365
4			Visibility	0.206	0.102
5			User friendly	0.219	0.109
6			Diversity of products and services	0.350	0.174
7	E-information	0.483	Correctness	0.535	0.258
8			Presentability	0.419	0.202
9			Current	0.572	0.276

10			Relevant	0.592	0.286
11			Clarity	0.529	0.256
12			Richness	0.259	0.125
13			Trust on purchasing via credit cards or bank transfer	0.825	0.398
14	E-services	0.411	High responsiveness	0.522	0.215
15			Credibility	0.625	0.257
16			Enjoyable experience	0.291	0.120
17			Serviceability	0.920	0.378
18			Reliability	0.922	0.379
19	E-system	0.843	Navigability	0.302	0.255
20			Efficiency	0.742	0.626
21			Accessibility	0.403	0.340
22			Learnability	0.654	0.551
23			Understandability	0.880	0.742
24	E-company	0.321	Reputation	0.187	0.060
25			Enterprise features	0.356	0.114
26			Promotive activities	0.757	0.243

In addition, the CRs of Table 6.17 were calculated for level one and two based on Section 5.1.4.5. In Level One the CR for the Experts 1, 2, and 3 are 0.059, 0.026, and 0.049 respectively. While, the CRs for the second level to C1, C2, C3, C4, and C5 are: (0.049, 0.042, 0.024), (0.077, 0.087, 0.076), (0.056, 0.038, 0.009), (0.058, 0.018, 0.022), and (0.008, 0.033, 0.015) for the experts 1, 2, and 3 respectively. This indicates that all of the judgments of decision makers are consistent.

- **Calculate the Total Score for each Criterion**

Based on Section 5.4.2, the Total Score for each criterion was calculated and presented with the weight calculated for each criterion in Table 6.18.

Table 6.18
Score and Weight Obtained by criteria's (Company C)

No.	Category Level One	Criteria	Criteria Final Score	Criteria Final Weight
1	E-usage	Price saving (C11)	2.83	0.158
2		purchasing transaction (C12)	4.67	0.215
3		Safety (C13)	6.83	0.365
4		Visibility (C14)	6.30	0.102
5		User friendly (C15)	5.94	0.109
6		Diversity of products and services (C16)	3.00	0.174
7	E-information	Correctness (C21)	7.50	0.258
8		Presentability (C22)	6.33	0.202
9		Current (C23)	6.50	0.276
10		Relevant (C24)	8.05	0.286
11		Clarity (C25)	7.50	0.256
12		Richness (C26)	7.50	0.125
13		Trust on purchasing via credit cards or bank transfer (C27)	8.05	0.398
14	E-services	High responsiveness (C31)	7.30	0.215
15		Credibility (C32)	8.00	0.257
16		Enjoyable experience (C33)	3.00	0.120
17		Serviceability (C34)	6.67	0.378
18		Reliability (C35)	7.67	0.379
19	E-system	Navigability (C41)	5.43	0.255
20		Efficiency (C42)	7.20	0.626
21		Accessibility (C43)	7.50	0.340
22		Learnability (C44)	6.93	0.551
23		Understandability (C45)	7.25	0.742
24	E-company	Reputation (C51)	7.83	0.060
25		Enterprise features (C52)	3.83	0.114
26		Promotive activities (C53)	5.38	0.243

The Table shows that the highest score is achieved by criteria Relevant and Trust on purchasing via credit cards or bank transfer (8.05), Credibility (8.00), Reputation (7.83), Reliability (7.67), Correctness (7.50), Clarity (7.50), Richness (7.50), High responsiveness (7.30), Understandability (7.25), and Efficiency (7.20) respectively.

Followed by, Learnability (6.93), Safety (6.83), Serviceability (6.67), Current (6.50), Presentability (6.33), and Visibility (6.30). Other criteria scored less than 6.00; for more details see Table 6.18.

- **Result Analysis**

Based on the results shown in Table 6.18, the average score for each category is calculated. Table 6.19 shows the average score for each category results.

Table 6.19
Score and Weight Obtained by Level One (Company C)

No.	Category Level One	Average Score	Weight
1	E-usage	4.93	0.497
2	E- information	7.35	0.483
3	E-services	6.53	0.411
4	E-system	6.86	0.843
5	E-company	5.68	0.321

Result on the weight and Score were analyzed to identify the category need to be improved. I.e. by identifying weakest category in the website. In order to determine the weakest criteria weight variance analysis was used and plotted in Figure 6.7.

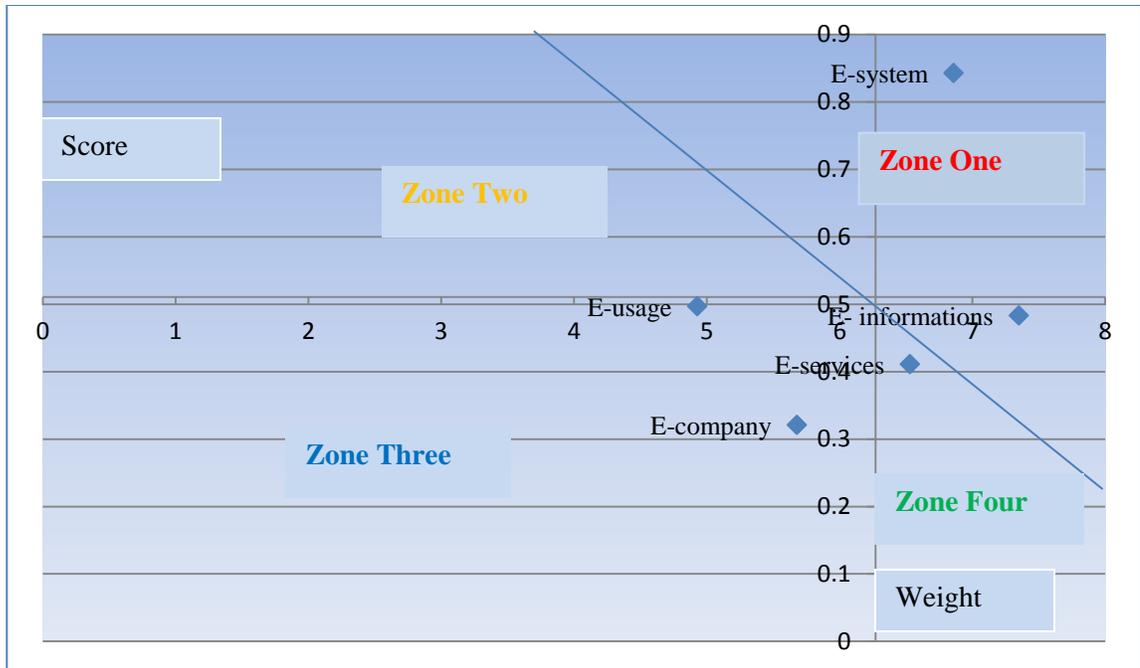


Figure 6.7. Category weight variance map (Company C)

The figure shows that E-system and E-information are falling in Zone One. This means, the category E-system and E-information are perceived to be important for the consumers (evaluators); however, the rate of the performance variance is high in this Zone. E-system and E-information constitute the top priority for remedial action, and the necessity of improvement is proportional.

E-company and E-usage are falling in Zone Three. This means, this category contains criteria of low performance variance rate and low importance. Therefore, the high managements should not be overly concerned about the criteria fall in Zone Three. E-services are falling in Zone Four. Therefore, it not necessary to focus additional effort to the category in this zone because of E-information has low importance and high performance variance rate.

transfer, Serviceability, Reliability, Efficiency, Accessibility, Learnability, Understandability, Credibility, High responsiveness, Current, and Clarity respectively. These criteria are falling in Zone One. These criteria constitute the top priority for remedial action.

Whilst, eleven criteria are falling in Zone Three. The three criteria are C11, C12, C14, C15, C16, C22, C33, C41, C52, and C53 from the other categories. The ten criteria are Price saving, Purchasing transaction, Visibility, User friendly, Diversity of products and services, Presentability, Enjoyable experience, Navigability, Enterprise features, and Promotive activities. These eleven criteria have low performance variance rate and low importance. Therefore, the high managements should not be overly concerned about the criteria fall in Zone Three. The rest of criteria are falling in Zone four. Remain criteria have height performance variance and low importance. Therefore, not necessary to focus additional effort or resources to criteria fall in this Zone. The criteria falling in Zone Four are C26 and C51; Richness and Reputation respectively.

Based on the Figures 6.7 and 6.8, E-system is falling in Zone One. As mentioned before, this category needs to be improved. But, the criteria (C41) Navigability is falling in Zone three. E-information is falling in Zone Four; but the criteria (C24, C27, C23, and C25) Relevant, Trust on purchasing via credit cards or bank transfer, Current, and Clarity are falling in Zone One. As well e-services, it falling in Zone Four but the criteria C34 and C35 are falling in Zone One. This mean some of the categories are falling in Zone (2,3, and 4) but they contain criteria falling in Zone One which need to

be improved. Also, E-system category is falling in Zone One but not all criteria are falling in that zone.

- **Prepare Evaluation Report**

Here, the results for BNP (weight) and M (u) for Company C website are presented. The weakest category and criteria are also presented. Referring to Section 5.5.3 (Chapter Five), and based on Tables 6.18 and Figures (6.7 and 6.8). The evaluation report is presented in Table 6.20.

*Table 6.20
Evaluation Report (Company C)*

No.	Category Level One	Criteria	Zone Number	Comments
1	E-usage	Price saving (C11)	Three	Pay some attention
2		purchasing transaction (C12)	Three	Pay some attention
3		Safety (C13)	One	Need improvements
4		Visibility (C14)	Three	Pay some attention
5		User friendly (C15)	Three	Pay some attention
6		Diversity of products and services (C16)	Three	Pay some attention
7	E-information	Correctness (C21)	Three	Pay some attention
8		Presentability (C22)	Three	Pay some attention
9		Current (C23)	One	Need improvements
10		Relevant (C24)	One	Need improvements
11		Clarity (C25)	One	Need improvements
12		Richness (C26)	Four	Do not worry
13		Trust on purchasing via credit cards or bank transfer (C27)	One	Need improvements
14	E-services	High responsiveness (C31)	One	Need improvements
15		Credibility (C32)	One	Need improvements
16		Enjoyable experience (C33)	Three	Pay some attention
17		Serviceability (C34)	One	Need improvements
18		Reliability (C35)	One	Need improvements
19		Navigability (C41)	Three	Pay some attention
20		Efficiency (C42)	One	Need improvements

21	E-system	Accessibility (C43)	One	Need improvements
22		Learnability (C44)	One	Need improvements
23		Understandability (C45)	One	Need improvements
24	E-company	Reputation (C51)	Four	Do not worry
25		Enterprise features (C52)	Three	Pay some attention
26		Promotive activities (C53)	Three	Pay some attention

At this step, a report was prepared and a meeting was held to verify the report. All team members attended the meeting. The verified report was signed by the Manager of Information Technology Department (Mr. Ababneh) on 8th Dec, 2013. This report helps the top management to know the company website performance situation and the criteria that need to be improved. The report was written in simple language (Appendix H). The management members were encouraged to study the details of the reports and provide feedback to improve the website in future.

6.3.4 Company D Profile

Company D is considered as one of the large Government organization in Malaysia. Company D is a global education and logistics services Company. Now, the consumers of this company can watch live (live streaming) as TV3 / RTM local television broadcast or any event which was held in Company through Company D.tv. The company offers e-ticketing method (smart card) were the consumers can use it for e-cash, bank card, consumer ID and also for library transactions. Prior to e-ticketing, all consumers were required to pay 42 RM per specific period of time for unlimited use for the card services. University websites considered as commercial websites (Jamaludin et al., 2013).

Company D also provides a number of retail services, including mail-order, catalog services, and mail forwarding services. The consumers can access the digital library for the company and download articles and books. The library has 1,042,871 items in its collections, including 292,538 volumes of printed materials, 654,139 items of non-printed materials and 96,194 items in electronic / digitized form. The library currently subscribes to 29,262 titles from prestigious electronic journals and 42,000 titles from electronic books. Online collections and services have helped to facilitate and promote the use of information by its clients. The online collection is also made available to registered members via the internet, anytime, anywhere. The consumers can register and select the subjects that he wants online. The consumer of Company D can online through the company websites or third party company.

Company D has department called Computer Center. This department is developing software products. The selling and buying process can be conducted via the internet were the buyer deposits the money electronically in the seller account. Company D applied several series of meetings, discussions, and workshops. These activities were done collaboratively among the Manager of Information Technology Department, Developers, and Computer Center Department.

6.3.4.1 Evaluation Process on Company D Website

The evaluation process on Company D involved three phases: Planning Phase, Examination Phase, and Decision-Making Phase. The activities conducted for each phase are presented below.

a) **Planning Phase**

This phase includes two main activities: (i) establish the goal of the evaluation, and (ii) brief the evaluation and prepare documents. First, the High management of Company D contacted the Information Technology Department to hold a meeting. The purpose of the meeting was to evaluate the website of Company D. The meeting was held on the first February, 2014. The results of the meeting were:

- The Company's official website will be evaluated.
- Five consumers' were identified and agreed to participate in the evaluation process.
- The evaluation team members were identified as follows:-
 1. Three Developer with good experience Developer (Nor Asiah Abdul Rahman), Developer (Fairuz Addnan), and Developer (Norazimah Mat Noh). They were responsible to assign weight score for the criteria's.
 2. Five organization consumers were identified in order to fill the score list and rate Company D website.
 3. Evaluation team leader, Madam Nor Asiah Abdul Rahman was responsible for distributing the responsibilities among the team members and giving the explanation and instructions to the evaluation team.
- The evaluation date assigned was on 6th February, 2014.

Second, after identifying the evaluation team, a second meeting was held after one week. The meeting was to give a briefing on the evaluation process and for preparing necessary documents for the team members. During the meeting, Madam Nor Asiah Abdul Rahman gave a short briefing about the evaluation schedule and activities. He

provided information on Company D website and gave explanation and instruction about the evaluation schedule, such as the steps of evaluation and the team members' responsibilities. Next, he prepared the evaluation document needed for the evaluation. He provided the experts a website manual and evaluation score list form. The Developers were provided with criteria weight score list form.

b) Examination Phase

This phase includes conducting the evaluation and collecting data.

- **Conduct the Evaluation**

First, the five consumers (evaluators) browsed the company website and then filled the evaluation score list form. In other words, the five evaluators filled the evaluation score list simultaneously with analysis of the website.

Three developers filled the criteria weight score list form. What they needed to do was to assign a linguistic weight score for each website criteria.

- **Collect Data**

The gathered evaluation score list form and the criteria's weight list form were checked and validated by the evaluation team members to ensure that all forms were completely answered. The forms were found to be complete and valid. Then, the team leader input all data into an Excel sheet. The same procedure followed in pervious case study will be followed here too.

At this stage, the experts have assigned the weight score for the first and second level for the CEC. After obtaining the weight score from the experts (developers), the evaluation score take its place. The filled evaluation score list were extracted from the score list form and listed on excel sheet.

c) Decision-Making Phase

As mentioned in pervious case studies, to identify the current situation for the criteria, the weight and the score for each criterion is needed. Therefore, this phase includes calculation of the weight and score for each criterion. Also, it includes the result analysis and evaluation report preparation.

- **Calculate the Weight for Each Criterion**

Based on Section 5.4.1, this section calculates the BNP (weight) for each criterion to Company D. The finding from the calculation is shown in Table 6.21.

Table 6.21
Criteria Weights for Level One and Two (Company D)

No.	Category Level One	level One Global Weight	Criteria	Level two Global Weight	Criteria Final Weight
1	E-usage	0.505	Price saving	0.448	0.2262
2			purchasing transaction	0.346	0.1747
3			Safety	0.639	0.3227
4			Visibility	0.496	0.2505
5			User friendly	0.857	0.4328
6			Diversity of products and services	1.214	0.6131
7		0.516	Correctness	0.623	0.3215

8	E-information		Presentability	0.203	0.1047
9			Current	0.578	0.2982
10			Relevant	0.553	0.2853
11			Clarity	0.658	0.3395
12			Richness	0.318	0.1641
13			Trust on purchasing via credit cards or bank transfer	0.285	0.1471
14	E-services	0.411	High responsiveness	0.710	0.2918
15			Credibility	0.448	0.1841
16			Enjoyable experience	0.296	0.1217
17			Serviceability	0.806	0.3313
18			Reliability	0.946	0.3888
19	E-system	0.689	Navigability	0.265	0.1826
20			Efficiency	0.777	0.5354
21			Accessibility	0.434	0.2990
22			Learnability	0.782	0.5388
23			Understandability	0.896	0.6173
24	E-company	0.412	Reputation	0.180	0.0742
25			Enterprise features	0.287	0.1182
26			Promotive activities	0.758	0.3123

In addition, the CRs of Table 6.21 were calculated for level one and two based on Section 5.1.4.5. In Level One the CR for the Experts 1, 2, and 3 are 0.058, 0.090, and 0.049 respectively. While, the CRs for the second level to C1, C2, C3, C4, and C5 are: (0.092, 0.075, 0.024), (0.075, 0.085, 0.079), (0.064, 0.062, 0.086), (0.068, 0.039, 0.045), and (0.021, 0.046, 0.063) for the experts 1, 2, and 3 respectively. This indicates that all of the judgments of decision makers are consistent.

- **Calculate the Total Score for each Criterion**

Based on Section 5.4.2, the Total Score for each criterion was calculated and presented with the weight calculated for each criterion in Table 6.22.

Table 6.22
Score and Weight Obtained by criteria's (Company D)

No.	Category Level One	Criteria	Criteria Final Score	Criteria Final Weight
1	E-usage	Price saving (C11)	4.50	0.2262
2		purchasing transaction (C12)	5.16	0.1747
3		Safety (C13)	4.66	0.3227
4		Visibility (C14)	6.80	0.2505
5		User friendly (C15)	4.41	0.4328
6		Diversity of products and services (C16)	2.83	0.6131
7	E-information	Correctness (C21)	6.50	0.3215
8		Presentability (C22)	5.33	0.1047
9		Current (C23)	7.00	0.2982
10		Relevant (C24)	8.00	0.2853
11		Clarity (C25)	6.00	0.3395
12		Richness (C26)	5.50	0.1641
13		Trust on purchasing via credit cards or bank transfer (C27)	7.60	0.1471
14	E-services	High responsiveness (C31)	5.43	0.2918
15		Credibility (C32)	7.83	0.1841
16		Enjoyable experience (C33)	5.00	0.1217
17		Serviceability (C34)	5.16	0.3313
18		Reliability (C35)	6.13	0.3888
19	E-system	Navigability (C41)	6.28	0.1826
20		Efficiency (C42)	6.60	0.5354
21		Accessibility (C43)	7.25	0.2990
22		Learnability (C44)	6.42	0.5388

23		Understandability (C45)	7.50	0.6173
24	E-company	Reputation (C51)	6.25	0.0742
25		Enterprise features (C52)	2.55	0.1182
26		Promotive activities (C53)	3.75	0.3123

The Table shows that the highest score is achieved by criteria Relevant (8.00), Credibility (7.83), Trust on purchasing via credit cards or bank transfer (7.60), Understandability (7.50), Accessibility (7.25), and Current (7.00). Followed by the criteria Visibility (6.80), Efficiency (6.60), Correctness (6.50), Learnability (6.42), Navigability (6.28), Reputation (6.25), Reliability (6.13), and Clarity (6.00). Other criteria were scored less than 6.00; for more details see Table 6.22.

- **Result Analysis**

Based on the results shown in Table 6.22, the average score for each category is calculated. Table 6.23 shows the average score for each category results.

Table 6.23
Score and Weight Obtained by Level One (Company D)

No.	Category Level One	Average Score	Weight
1	E-usage	4.73	0.505
2	E- information	6.56	0.516
3	E-services	5.91	0.411
4	E-system	6.81	0.689
5	E-company	4.18	0.412

Result on the weight and Score were analyzed to identify the category need to be improved. i.e. by identifying weakest category in the website. In order to determine the weakest criteria weight variance analysis was used and plotted in Figure 6.9.

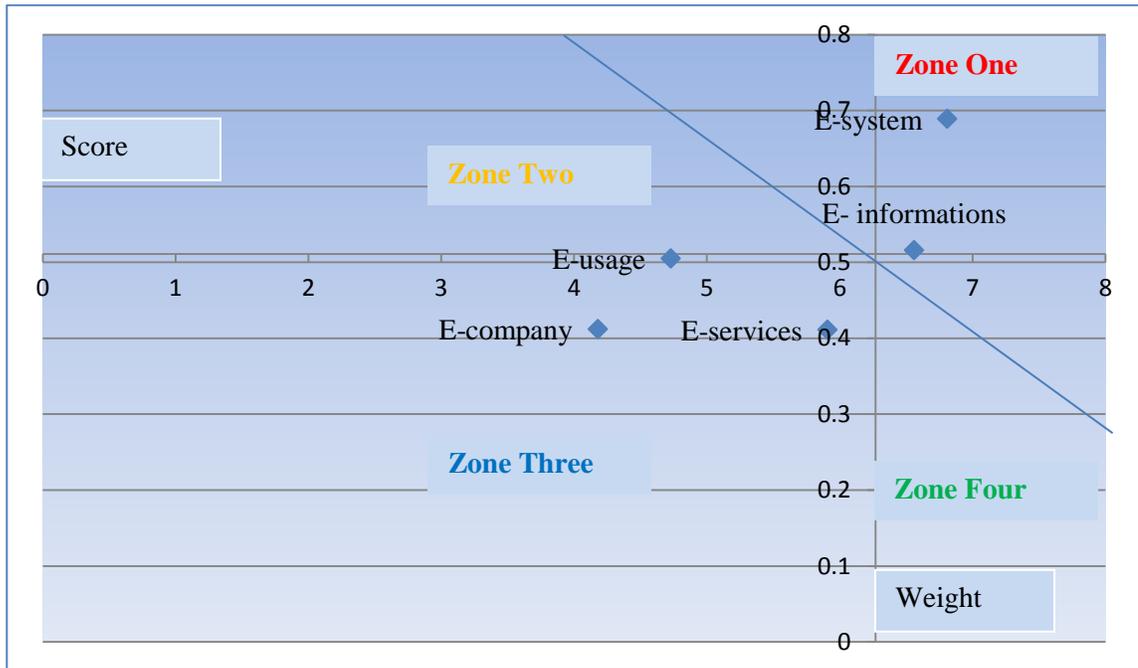


Figure 6.9. Category weight variance map (Company D)

The figure shows that E-system and E-information are falling in Zone One. This means, the category E-system and E-information are perceived to be important for the consumers. Therefore, E-system and E-information constitute the top priority for remedial action, and the necessity of improvement is proportional.

E-usage is falling in Zone Two. This means, E-usage criteria requires careful monitoring to ensure that low variance rate levels are maintained.

E-company and E-services are falling in Zone Three. This mean, this category contains criteria of low performance variance rate and low importance. Therefore, the high managements should not be overly concerned about the criteria fall in Zone Three. In order to determine the weakest criteria weight variance analysis was used and plotted in Figure 6.10.

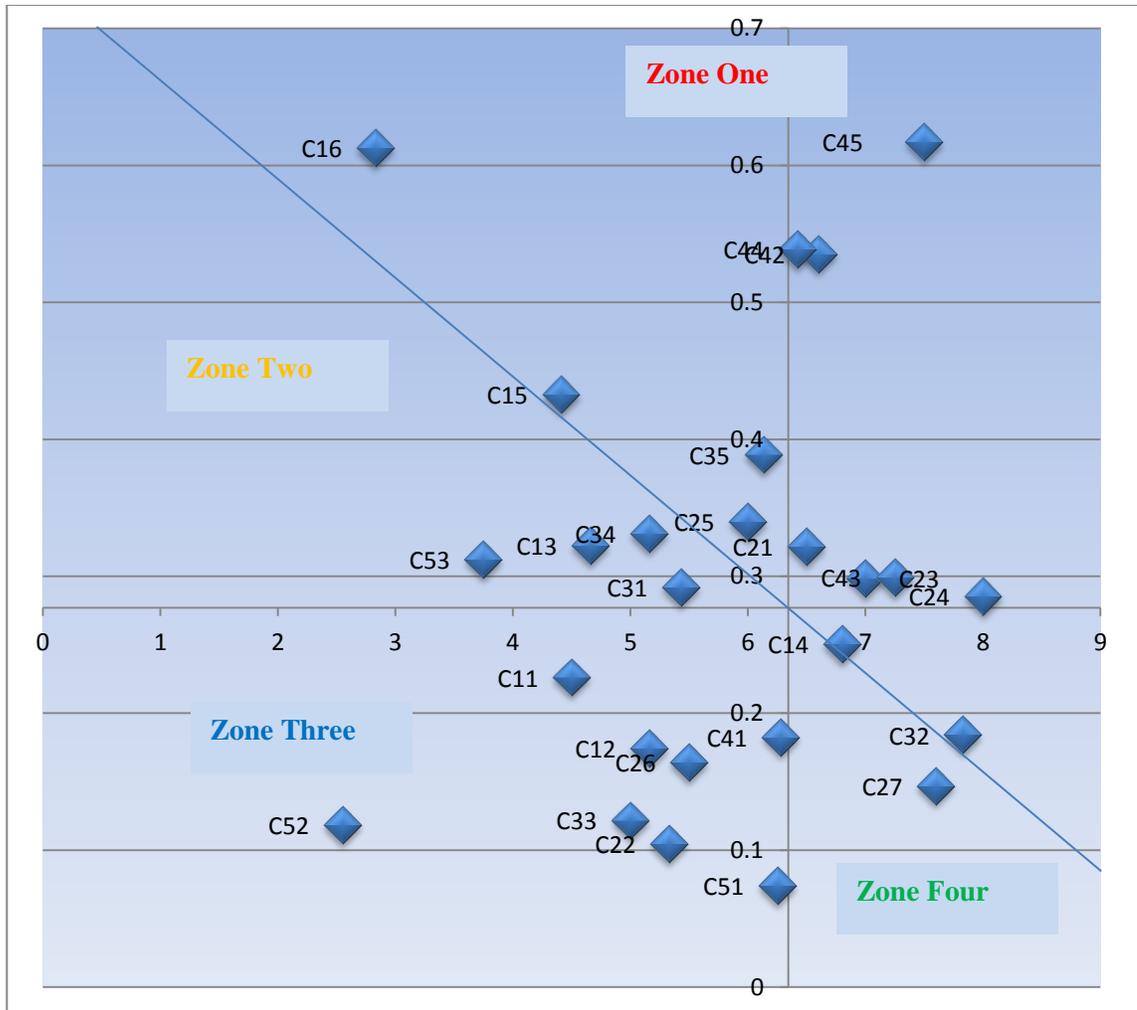


Figure 6.10. Criteria weight variance map (Company D)

Figure 6.10 shows the final result of each criterion. Based on this Figure 6.10, the weakest criteria needs to be improved were: C14, C16, C15, C21, C23, C24, C25, C32, C35, C42, C43, C44, and C45; Visibility , Diversity of products and services, User

friendly , Correctness, Current, Revelant, Clarity, Credibility, Reliability, Efficiency, Accessibility, Learnability, and Understandability respectively. These criteria are falling in Zone One. These criteria constitute the top priority for remedial action.

Four criteria are falling in Zone Two. The criteria are C13, C31, C34, and C53; Safety, High responsiveness, Serviceability, and Promotive activities. These four criteria require careful monitoring to ensure that low variance rate levels are maintained.

Zone Three contains eight criteria which are C11, C12, C41, C26, C33, C22, C51, and C52; price saving, purchasing transaction, navigability, richness, enjoyable experience, presentability, reputation, and enterprise features. These eight criteria have low performance variance rate and low importance. Therefore, the high managements should not be overly concerned about the criteria fall in Zone Three.

The criteria Trust on purchasing via credit cards or bank transfer (C27) fall is falling in Zone Four. This criterion has hight performance variance and low importance. Therefore, not necessary to focus additional effort or resources to criteria fall in this Zone.

Based on the Figures 6.9 and 6.10, E-usage is falling in Zone Two which means E-usage requires careful monitoring to ensure that low variance rate levels are maintained. But, the criteria under this category C14, C15, and C16 are falling in Zone which means these criteria constitute the top priority for remedial action. Likewise, E-information category is falling in Zone One, which means it need to be improved but some of the criteria under this category are falling in Zone Three such as C22 and C26.

- **Prepare Evaluation Report**

Here, the results for BNP (weight) and M (u) for Company C website are presented. The weakest category and criteria are also presented. Referring to Section 5.5.3 (Chapter Five), and based on Tables 6.22 and Figures (6.9 and 6.10). The evaluation report is presented in Table 6.24.

*Table 6.24
Evaluation Report (Company D)*

No.	Category Level One	Criteria	Zone Number	Comments
1	E-usage	Price saving (C11)	Three	Pay some attention
2		purchasing transaction (C12)	Three	Pay some attention
3		Safety (C13)	Two	Require carefully monitor
4		Visibility (C14)	One	Need improvements
5		User friendly (C15)	One	Need improvements
6		Diversity of products and services (C16)	One	Need improvements
7	E-information	Correctness (C21)	One	Need improvements
8		Presentability (C22)	Three	Pay some attention
9		Current (C23)	One	Need improvements
10		Relevant (C24)	One	Need improvements
11		Clarity (C25)	One	Need improvements
12		Richness (C26)	Three	Pay some attention
13		Trust on purchasing via credit cards or bank transfer (C27)	Four	Do not worry
14	E-services	High responsiveness (C31)	Two	Require carefully monitor
15		Credibility (C32)	One	Need improvements
16		Enjoyable experience (C33)	Three	Pay some attention
17		Serviceability (C34)	Two	Require carefully monitor
18		Reliability (C35)	One	Need improvements
19	E-system	Navigability (C41)	Three	Pay some attention
20		Efficiency (C42)	One	Need improvements
21		Accessibility (C43)	One	Need improvements
22		Learnability (C44)	One	Need improvements
23		Understandability (C45)	One	Need improvements

24	E-company	Reputation (C51)	Three	Pay some attention
25		Enterprise features (C52)	Three	Pay some attention
26		Promotive activities (C53)	Two	Require carefully monitor

At this step, a report was prepared and a meeting was held to verify the report. The team members verified the result in the report. This report helps the top management to know the company website performance situation and the criteria that need to be improved. The report was written in simple language. The management members were encouraged to study the details of the reports and provide feedback to improve the website in future.

6.4 Consumer Evaluation Model Verification and Validation

Four companies were involved to verify and evaluate the CREE Model in real environment. The goal of this method is to test the model applicability. The evaluation was conducted through an interview with the evaluation team in the four organizations based on a set of evaluation criteria that have been identified from the literature, as explained in Section 2.6 and 3.4. These criteria are gain, task support, and interface satisfactions.

It is worth mentioning here, that CREE components (criteria, evaluation mechanisms, and evaluation procedures) were verified by experts in Section 6.2. The experts agreed that the CREE model is theoretically practical and feasible. The criteria and the descriptive questions were found answerable and understandable by consumers.

1. Gain satisfaction

Gain satisfaction was used to measure whether the CREE model would be beneficial in the real life through the following criteria:

- **Perceived Usefulness:** The companies' committee agreed that CREE model is valuable to evaluate the e-commerce websites based on the results presented. Using more than two experts to obtain the weight and five consumers to obtain the score makes the evaluation more realistic and avoid the unfairness evaluation. The model was found to be very effective in terms of the time required to achieve the evaluation target.
- **Decision support satisfaction:** In this regard, the evaluation team from the case studies stressed that the model achieved the decision support satisfaction by providing a well-defined decision making mechanisms and process structure. Furthermore, the model has the potential to increase the experts that participate in the weight assigning. Using Mathematical program reduce the mistakes could be happened the calculation. It give a chance to other experts to share and give their opinions and release the appropriate judgments during the decision making process.
- **Comparison with the current evaluation method:** CREE model is more suitable and accurate for evaluating e-commerce websites compared to the traditional method that is currently used. This model is dealing with the imprecision and uncertainty of the linguistic evaluation. Give chance for more than three experts to participate in the process of evaluation. The evaluation teams admitted that the processes and activities of the model are clear, consistent, and easy to apply compared to other evaluation

model. Moreover, the evaluation criteria in this model provide a more accurate technique in evaluation of e-commerce websites compared to the traditional methods that rely only on specific criteria.

- **Clarity (clear and illuminate the process):** the CREE processes were found to be very clear and understandable to the evaluation teams, where each process clearly presents the required inputs, outputs, methods or techniques, and activities.
- **Task Appropriateness:** CREE model is appropriate for evaluating e-commerce websites in a very systematic and effective way compared to other models had been used before. In addition, the CEC in this model were found to be more suitable and comprehensive in evaluating e-commerce websites according to the user requirements.

2. Interface satisfaction

Interface satisfaction criteria are used to measure the interface characteristics in term of presentation, format, and processing efficiency. These criteria are discussed as follows:

- **Perceived ease of use:** According to the responses of the evaluation teams, the model was perceived as easy to use because it uses well-defined processes, activities, mechanisms, and techniques. Moreover, it is conducted using mathematical program as a tool which helps the evaluation team to calculate the weight for each criterion.
- **Internally consistent:** CREE model was internally consistent because the components of the model complement each other. Precisely, it starts with the planning process where the evaluation target is defined, the evaluation team is forming. After that, the Examination Phase takes its place. Here, the forms of

evaluation will be filled and collected. Then, Decision Making Phase is obtained to calculate the weight and the score for each criterion and checking the consistency answers for all the experts using the formulas and the mechanisms mentioned in earlier stage.

- **Organization (well organized):** CREE model was found to be well organized and structured where the flow of the information and the sequence of the model processes, activities and task, and the evaluation team roles were sorted and organized in a clear and understandable manner. This will surely ease the evaluation process even though the project is complicated.
- **Appropriate for audience:** The evaluation teams in both organizations indicated that the model was appropriate for the audience. Those audiences are referred to the team of evaluators that often have different skills.
- **Presentation (readable and useful format):** All respondents indicated that the model produced the results in a readable and useful format. The criteria located in different zones have different a managerial implications, and therefore require different actions for achieving an ideal performance.

3. Task Support Satisfaction

The task support satisfaction measures whether the model attains its anticipated objectives and satisfies its evaluators. The measurement includes the following criteria:

- **Ability to produce expected results:** The CREE model is able to produce expected results. This was stressed by all the evaluation teams whereby the model proved to reflect high capabilities in producing accurate results within a

short time compared to the previous methods. The accurate, reliable, and satisfied results are able to be delivered because the model provides a well-defined sequence of activities and tasks, a wide variety of evaluation criteria, mechanisms and formulas to perform the computations.

- **Completeness (adequate or sufficient):** The CREE model was found to be adequate and sufficient in evaluating the e-commerce websites in these organizations. The respondents indicated that the model provides a set of evaluation criteria that are sufficient for such evaluation. Among the criteria were the usage, information, services, system, and company characteristics; the model mechanisms and processes.
- **Ease of implementation:** The evaluation teams agreed that the model was easy to implement. The evaluation committee agreed that the input, output, and activities of the model made the model easier and more applicable evaluation process.
- **Understandability (simple to understand):** The model was found to be readable and understandable. The evaluation teams asserted that the processes in the model were organized and labeled in such a way that made them simple to understand. The CEC and the descriptive questions were found to be answerable and understood.

6.5 Summary

The CREE model are conceptualized in Chapter Four and constructed in Chapter Five. This chapter implements the CREE model in four companies. The data were collected from the evaluation score list form obtained by the consumers and the weight score form obtained by the organization insider experts. A set of evaluation mechanisms and procedures was applied to measure the performance of the criteria of the e-commerce websites. In conclusion, the model is definitive, as the results from the application and evaluation process have strongly verified the CREE model. The results from the three companies are that the model is a valuable and operational model to evaluate the e-commerce websites in the business environment.

CHAPTER SEVEN

CONCLUSION

7.1 Introduction

This chapter concludes the findings of the research. It includes with an overview of result, research contributions, model limitation, and future work.

7.2 Overview of Results

The main goal of this research was to develop a new hybrid consumer perspective e-commerce websites evaluation model based on integrated Fuzzy Analytical Hierarchy Process (FAHP) and Hardmard method. The research goal was achieved through five objectives. The overview results of each objective were presented accordingly in the following paragraphs.

- **To identify the consumer criteria for e-commerce website evaluation**

The research identified twenty six criteria from the consumers' perspective. The criteria were safety, serviceability, price, promotion, presentability, user friendly, trust on purchasing via credit card, reliability, credibility, purchasing transaction, richness, correctness, current, clarity, diversity of products and services, responsiveness, relevant, efficiency, accessibility, reputation, visibility, enjoyable experience, understandability, enterprise features, navigability, and learnability.

These criteria were categorized under new five groups: e-usage, e-information, e-services, e-system, and e-company. E-usage is related to how the users use a

website. E-usage category consists of the criteria that are related and connected to and touch the consumer in a direct way. In other words, it is related to consumer consideration such as the price and user friendly. In addition, this category included six criteria, which are price saving, purchasing transaction, safety, visibility, user friendly, and diversity of products and services; whilst, e-information reflects customers' perception on specific dimensions of information. E-information category consist of the criteria that are related to web information and web content, which are correctness, presentability, current/updated, relevant, trust, clarity, and richness. In addition, e-services category consist of the criteria that are related to services that can be provided by the web (E-service reflects the customers' perception of specific dimensions of service), which are reliability, high responsiveness, credibility, enjoyable experience, and serviceability. E-system category consists of the criteria that are related to the e-commerce system which are navigability, efficiency, accessibility, learnability, and understandability. E-company category consists of the criteria that related and touch the companies which are the reputation, enterprise features, and the promotion provided by the companies.

The inclusion of these criteria will give a balanced model because it includes the common evaluation criteria and cover the consumer perspective. In addition, the model includes new consumer evaluation criteria based on consumer perspective. Furthermore, it provides the e-commerce websites evaluation by new categorization mentioned above.

According to IEEE standard definitions, and supported by Albuquerque & Belchior (2002) and Tian (2004), failure of the dot.com companies occurs when the behavior of the websites deviates from user expectations or if the websites neglect consumers' needs.

Based on Table 2.1, most of previous evaluation models (Zhu & Tong, 2010; Wang et al., 2012; Li & Pang, 2011) did not incorporate the consumer criteria in their models. I.e. their model did not consider the user's requirements or needs.

Most of website's evaluation models concentrate on website's criteria itself and are less concerned about other criteria related to product and logistics companies (Yu et al., 2011). They just focus on the website's behavior in term of system and they less concerned about the product, company, and consumer criteria. Based on past literatures and the analysis in Chapter Two (Table 2.3), it was found that there is a lack and shortcoming on research of e-commerce evaluation that deals with consumers perspective (Hausman & Siekpe, 2009; Lee & Kozar, 2006; Song & Zahedi, 2005; Cheung et al., 2003; Gamon et al., 2005; Lee et al., 2006; Wang & Zhou 2009; Yahaya et al., 2008). This objective is achieved on Chapter Four.

- **To develop a hybrid e-commerce website evaluation model based on consumer's perspective.**

The CREE model consists of three components, i.e. new consumer evaluation criteria (CEC), new evaluation mechanism, and new evaluation procedure. The CREE model covers the consumer aspect. The criteria were identified and categorized based on the consumer perspective, which makes the model more reliable and get the consumer satisfaction. The criteria were verified by experts and were found to be understandable, and acceptable.

As mentioned earlier, the CREE model consists of important criteria from the consumers' perspective, supported by a set of mathematical formula and new mechanisms to evaluate the e-commerce website objectively. The new mechanism includes three main mechanisms: i) mechanism to calculate the weight for each criterion, ii) mechanism to calculate the total score for each criterion, and iii) mechanism to identify the current situation for each criterion.

CREE model provides a new mechanism to identify appropriate weights for each criterion using the integration between Fuzzy Analytical Hierarchy Process (FAHP) and Hardmard method. This new mechanism is carried out through five mechanisms, which are: i) mechanism to scale the relative importance of the criteria; ii) mechanism to construct the pairwise matrix; iii) mechanism to perform the judgments of pairwise comparisons; iv) mechanism to synthesis the pairwise comparison; and v) performing the consistency.

This mechanism contributes to the development of evaluation weight lists that were used to obtain the weight for the websites by the internal experts. The weight lists were developed based on CEC. It depended on translating the 9 fuzzy Linguistics point scale to Fuzzy Triangular Number to the websites by the internal experts. In other words, the mechanism converts the internal experts' expression of fuzzy value that will be used to calculate the weight for each criterion.

This mechanism contributes by providing an easy and a practical way to obtain the weight fuzzy number of the websites criteria by providing a weight list. Without this mechanism, obtaining the weight fuzzy number for the criteria will be difficult to do. The use of three internal experts working under the same organization removes any unfairness that may result from the evaluation process. The evaluation can be seen as a more reliable method.

CREE model contributes by including a set of new mathematical formulas to calculate the weight for each criterion. This mechanism allows more than three experts to participate in the process of evaluation because it constructed based on Hardmard method. Also, this mechanism deal with large categories such as node A has 10 or 20 Childs. In other words, it constricted bases on the matrix calculation, which make it easier and accurate than other mechanisms. The weight calculated for each criterion will be used to identify the current performance situation for each criterion. Without this mechanism, calculating the weight fuzzy score for the criteria will be difficult to do. The mathematical

formulas in the mechanism are transformed to semi program calculate the weight using mathematical software program.

This mechanism evaluates the websites objectively and deal with the imprecision or uncertainty of the linguistic evaluation, whilst most of evaluation models evaluate the website subjectively and do not take the uncertainty or imprecision in consideration. In other words, the mathematical formulas used to represent an objective way to evaluate the websites.

In addition, CREE model provides a mechanism to identify the total score for each criterion. It consists of four mechanisms, which are: i) mechanism to obtain the score for each descriptive question, ii) mechanisms to identify the average score for each descriptive question, iii) mechanism to identify the average score for each criterion, iv) mechanism to defuzzify the average score for each criterion to crisp value.

This mechanism contributes to the development of an evaluation score list that was used to obtain the fuzzy score for the websites by the consumers. The score list was developed based on CEC. It depended on translating the Linguistics expression of the consumers to score given to websites by the consumers. In other words, the mechanism converts the consumer's expression to the score that will be used to calculate the total score in the next stage. This mechanism provides an easy and a practical way to obtain the score for the websites criteria. Without this mechanism, obtaining the score for the criteria will be difficult to do. The use of five consumers removes any unfairness that may result from the

evaluation process. The evaluation can be seen as a more reliable method. Moreover, this mechanism includes a set of mathematical formulas to calculate the average score for each descriptive question and the average score for each criterion. The average score for each descriptive question will be used to calculate the average score for each criterion. This mechanism evaluates the website objectively, whilst most of evaluation models evaluate the website subjectively. In other words, the mathematical formulas used to represent an objective way to evaluate the websites.

Also, CREE model provides a mechanism contributes to identify the website criteria performance situation. Using weight variance analysis, the current situation for each criterion will be calculated and presented. The FAHP weight performs the vertical axis (y-axis), and the performance variance rate performs the horizontal axis (x-axis) of a coordinate diagram. This diagram is divided into four zone areas and the criteria located in different zones have different a managerial implications, and therefore require different actions for achieving an ideal performance. These four zone areas are: i) Zone One “need improvement”: The CEC’s in this zone area are rated as having a high performance variable rate and a high importance. Criteria falling in this zone area need to be improved, ii) Zone Two “need monitoring”: This zone area indicates that those criteria are considered important for evaluators and their performance variance rates are low. The CEC in this zone area need carefully monitor to ensure that low variance rate levels are maintained, iii) Zone Three “Redeploy resources”: the CEC falling in this zone area considered low importance, and the performance

variance rate is also relatively low. The developers and Managers should not be highly concerned about criteria in this Zone, and iv) Zone Four “Low priority/ Don’t worry”: CEC in Zone Four is rated as high performance variance rate and a low importance. It is therefore not necessary to focus additional effort or resources to the criteria in this zone. Based on this classification, an organization will know the criteria performance level of their websites. Without this mechanism, determining the criteria performance level of the website will be difficult. Therefore, this mechanism provides a clear and simple way of grading the website performance.

The CREE model was verified using expert reviews and validated using four case studies: Company A, Company B, Company C, and Company D. The validation was successful and proved that the proposed model can be implemented for evaluating the e-commerce websites. This objective achieved in Chapter Five.

- **To define a set of conducting procedures for the proposed model.**

In addition, the CREE model provides a set of procedures. The procedures explain how to implement the model in real environment. This makes the evaluation process applicable and realistic. The CREE model provides a guidance and standard procedure for website evaluation since the literature shows a lack of standard procedure for websites evaluation. Using a standard procedure can remove the unfairness in evaluation.

This study contributes to the development of evaluation by defining a set of conducting procedures for evaluating e-commerce websites. The procedure consisted of three phases: Planning Phase, Examination Phase, and Decision-Making Phase. Planning Phase discuss the activities before the start of the actual evaluation procedure. It includes a set of activities, which have established the goal of the evaluation and brief the evaluation team and prepare documents. Examination Phase includes conducting the evaluation and collecting data. Decision- Making Phase includes result analysis, and preparing evaluation report. Each phase includes a set of activities; each activity in turn includes a set of steps. The procedures provide a formal guideline to evaluate the e-commerce website. This can be used as a standard website evaluation practice. The procedures that consisted of a list of steps and activities make the evaluation systematic and easy to conduct.

Without a good mechanisms and clear procedures the evaluation will be subjective, unscientific, and difficult (Saeid et al., 2011; Wang, 2009). Defining a mechanism and procedure to evaluate the e-commerce websites will make the evaluation results more reliable and realistic. Therefore, there is an essential need to provide mechanisms and procedures that companies can follow to meet the consumers' needs. This objective achieved in Chapter Five.

- **To evaluate the proposed model.**

It is important to mention, that the CREE model components (CEC, Mechanism, and Procedure) were verified by experts. The process of verification consisted of identifying experts based on experiences, contacting the experts, and three rounds of interview with the experts. The criteria (CEC), mechanisms, and process were found reliable, understandable, appropriate, clear, coherent, and well organized. As a result of these rounds, all experts agreed to the proposed model criteria, mechanisms, and process.

The CREE model was validated based on three main factors mentioned in Section 2.6. The three main factors were gain satisfaction, interface satisfaction, and task support satisfaction.

In term of gain satisfaction, the CREE model was found perceived usefulness, decision support satisfaction, comparison with the current evaluation method, clarity, and task appropriateness. The companies' committee agreed that CREE model is valuable to evaluate the e-commerce websites based on the results presented. The weights that were given by the Manager of the Information Technology Department and the Manager of Quality Assurance and Developer for individual criteria in this model are useful for reflecting the business requirements. The committee approves that the validity of the weight values associated with CEC defined in this model is dependent on the maturity of the persons in charge of assigning the values. The CREE model provides a well-

defined decision making mechanisms and process structure. CREE model is more suitable and accurate for evaluating e-commerce websites compared to the traditional method that is currently used. This model is dealing with the imprecision and uncertainty of the linguistic evaluation. Give chance for more than three experts to participate in the process of evaluation. The evaluation teams admitted that the processes and activities of the model are clear, consistent, and easy to apply compared to other evaluation model. In addition, the CREE processes were found to be very clear and understandable to the evaluation teams, where each process clearly presents the required inputs, outputs, methods or techniques, and activities. CREE model is appropriate for evaluating e-commerce websites in a very systematic and effective way compared to other models had been used before

In term of interface satisfaction, the CREE model is found perceived ease of use, internally consistent, well organized, appropriate for audience, and readable and useful format. According to the responses of the evaluation teams, the model was perceived as easy to use because it uses well-defined processes, activities, mechanisms, and techniques. CREE model was internally consistent because the components of the model complement each other. CREE model was found to be well organized and structured where the flow of the information and the sequence of the model processes, activities and task, and the evaluation team roles were sorted and organized in a clear and understandable manner. Moreover, all respondents indicated that the model produced the results in a readable and useful format.

In term of support satisfaction, the CREE model is found has the ability to produce expected results, adequate, ease of implementation, and simple to understand. The CREE model is able to produce expected results. This was stressed by all the evaluation teams whereby the model proved to reflect high capabilities in producing accurate results within a short time compared to the previous methods. Also, the CREE model was found to be adequate and sufficient in evaluating the e-commerce websites in these organizations. The respondents indicated that the model provides a set of evaluation criteria that are sufficient for such evaluation. The evaluation teams agreed that the model was easy to implement. The evaluation committee agreed that the input, output, and activities of the model made the model easier and more applicable evaluation process. In addition, the model was found to be readable and understandable. This objective achieved in Chapter Six.

7.3 Research Contributions

1. **New Consumer Evaluation Criteria (CEC):** This research identifies twenty six criteria for website evaluation based on consumers' perspectives and these criteria can be used as guidelines during website development. In addition, the research includes more consumer criteria were not covered in the previous websites evaluation models. Also, this section provides five categorizations for the twenty six criteria which are e-information, e-services, e-system and new two categories which are e-usage, and e-company.

2. **Empirical Findings:** The main goal of this study is to obtain the important criteria need to be considered in the e-commerce website developments. This research presents empirical findings of Malaysian consumers. The objectives of the survey were:

1. To investigate consumers' satisfaction on e-commerce websites in Malaysia
2. To determine consumer criteria that need to be considered for websites
3. To rank the consumer criteria based on their importance degree.

It offers a view on the consumers satisfaction regard to website evaluation, particularly in Malaysian firms. Therefore, this research is useful as it provides e-commerce companies with an avenue to keep abreast of the facts surrounding the discipline of website evaluation in Malaysian firms. Also, it extracts and ranks the most important criteria that affect the e-commerce website evaluation from the consumers' perspective. This research is useful and beneficial to other researchers. Researchers will find this study useful for its contribution in literature and empirical findings related to evaluation of commercial websites.

2.1 New Constructed Questionnaire: This research contributes toward the websites evaluation area by providing a new constructed questionnaire to the domain area. The questionnaire was tested through pilot test, content test, and constructive test.

3. **New Evaluation Model:** It defines a new mechanism to evaluate the website objectively, thus making the evaluation scientific, realistic, and simple. Evaluating the websites objectively makes the evaluation measurements easy and understandable (Loiacono et al., 2002; Saeid et al., 2011; Wang, 2009). This model provides a new mechanism to identify appropriate weights for each criterion using the integration between Fuzzy Analytical Hierarchy Process (FAHP) and Hardmard method. This mechanism is carried out through five stages, which are: i) mechanism to scale the relative importance of the criteria ii) mechanism to construct the pairwise matrix, iii) mechanism to perform the judgments of pairwise comparisons, iv) mechanism to synthesize the pairwise comparison, and v) performing the consistency. This mechanism contributes by including a set of mathematical formulas to calculate the weight for each criterion. This mechanism allows more than three experts to participate in the process of evaluation because it constructed based on Hardmard method. In others words, it constricted based on the matrix calculation, which make it more easy and accurate that other mechanisms.

In addition, it provides a mechanism to identify the total score for each criterion. It consists of four mechanisms, which are: i) mechanisms to obtain the score for each descriptive question, ii) mechanisms to identify the average score for each descriptive question, iii) mechanism to identify the average score for each criterion, iv) mechanism to defuzzify the average score for each criterion to Crisp value. This mechanism evaluates the websites objectively and deal with the imprecision or uncertainty of the linguistic evaluation, whilst most of

evaluation model evaluate the website subjectively. In other words, the mathematical formulas used to represent an objective way to evaluate the websites.

Moreover, it provides a mechanism to identify the current situation for each criterion. This mechanism provides easy and suitable technique to collect the weight from the experts and the score from the consumers using weight list and score list forms.

Finally, the mechanism used in the CREE model are different from other mechanisms used by other evaluation models because of it can deal with big number with criteria. Generally, when the criteria numbers increased, the calculation will be so difficult and took long time. But, this new mechanism can deal with large criteria numbers because this mechanism integrated the FAHP with Hardmard product multiplication. Which make it more efficient that others mechanism. Moreover, in this mechanism many experts can participate by giving weight for the criteria. More expert participation will give more accurate evaluation.

4. **Evaluation Procedure:** It defines a new procedure to evaluate the website objectively, thus making the evaluation scientific, realistic, and simple. Evaluating the websites objectively makes the measurement of website weight and score easy and understandable (Saeid et al., 2011; Wang, 2009). Also, this research contributes toward the research area by providing a scheme describing the overall activities and steps of evaluation procedures. The steps in the

procedure explain how implements the model in real environments. This makes the evaluation process applicable and realistic. In addition, this research provides a simple and understandable technique for website evaluation. It uses a scoring list and weight list techniques for evaluation and transforms it from a fuzzy linguistic form to crisp score form. Most studies use experimental and inside organization evaluation technique and this is inadequate and impractical as the method could not be understood easily.

7.4 Model Limitation

This research aims to help dot.com companies reach their objectives and meet the consumers' needs by developing new hybrid consumer perspective e-commerce website evaluation model. Despite the results obtained, the research has some limitations.

Firstly, the e-commerce era is changing fast and thus, consumers' requirements also change with time. Therefore, the model must consider new criteria based on the consumers' needs and consumers' perspective accordingly.

Secondly, this CREE model is applicable and valuable for e-commerce websites and cannot be used on other types unless it is customized with criteria and processes suitable to the respective websites.

Finally, the CEC were gathered from the literature review but were ranked according to their importance from the Malaysian consumer' perspective. These criteria need to be ranked from other country consumer perspective in order to reach of global standard criteria for evaluation.

7.5 Future Work

The following suggestions can further enhance and improve works of similar interest:

- **An extensive research on different types of websites**

The evaluation model that has been developed in this research was tested based on three case studies in Jordan and one case study in Malaysia. The results from the case studies however do not represent the other types of websites. Therefore, the model does not have a capacity to provide information on evaluation for different types of websites. In the future, a further research can be conducted to improve the model to enable it to evaluate multiple types of websites.

As for the validation in this study, Jordanian and Malaysian organizations were the area of validation for the developed model. However, future research can be continued to validate the constructed model in other countries to make sure that the constructed model is suitable to be implemented in most countries. Also, this way of validation will reflect if there is a need for more modifications to the developmental model to be a comprehensive model all over the world.

- **Study on the integration of the consumer evaluation model (CREE) to other websites evaluation approaches**

Constructing consumer e-commerce websites evaluation model can be done through two approaches. The first approach guarantees the development process of the websites and the second approach evaluates the website as a final product (Pressman 2000; Behkamal et al., 2009). At this point, the model covers the

evaluation in end product view and does not include the development process view. The resulting consumer websites evaluation model can still be linked and integrated to another website/software evaluation approaches.

- **Refinement of Consumer website evaluation criteria (CEC)**

E-commerce is considered one of the most dynamic areas in business and the criteria that surround this area are constantly changing. Since the CEC are static and were extracted from empirical study, it is recommended future researchers explore the potential of flexibility and adaptation to changes of website evaluation model and criteria based on future requirements. Also, the model can be provided with new contributory criteria that are considered important in website evaluation.

- **Support the evaluation with evaluation tool**

The evaluation processes include set of equations and mathematical steps. However, this makes the evaluation difficult and needs time. These equations can be converted to programs to computerize the evaluation process.

7.6 Summary

This chapter concludes the findings of this study, as well as the answers to research questions and objectives. Furthermore, the implications of the consumer evaluation model have been presented. Section 7.2 presents the achievements of the research objectives. It looks at each objective separately and illustrates it clearly.

In conclusion, this thesis provides some insight on the current level of e-commerce website evaluation in Malaysia. It offers an insight into perspectives and perception on websites/software evaluation in Malaysia from the consumers' view. This model includes criteria, mechanisms, and procedures to formalize the standard way for evaluation. The consumer evaluation model was verified by experts and evaluated by three real case studies.

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