ISO9126 Based Quality Model for Evaluating B2C e-Commerce Applications – A Saudi Market Perspective

Lilac A. Al-Safadi and Regina A. Garcia

Abstract—**In a business-to-consumer (B2C) electronic commerce (e-commerce) application, evaluation of the quality of their interactive shopping experience is significant to end users. However, quality is difficult to define and it is difficult to measure its impact on the end product and end users. A** *software quality model* **is a framework for evaluating the conformance of an application to requirements. An important concern in a software quality model is the exact quality attributes and their importance. E-commerce applications are user-intensive Web-based software systems. The identification of the factors that determine end-user acceptance of software systems is important in B2C e-commerce systems. Since the shopping behavior and requirements of users vary from one culture to another, this work proposes a quality evaluation model to measure the quality of B2C systems from a Saudi user perspective. This is done by adopting the ISO9126 quality model and decomposing the primary quality model criteria into sub-attributes customized for the B2C applications. The customization is done by extracting the quality factors from the B2C e-commerce system, weighting these factors from the viewpoints of both Saudi experts and end users, and adding them to the model. The result is a quality evaluation model that can help developers design and produce e-commerce systems of high quality targeted at Saudi end users. Finally, the proposed model is applied to the Amazon portal as a case study to evaluate its conformance to the Saudi market needs**

Index Terms— **B2C, e-commerce, ISO9126, Quality model, weighting scheme**

I. INTRODUCTION

More and more people are now using the Internet to purchase products or to hire services. Electronic commerce (e-commerce) is defined as the process of buying, selling, or exchanging products, services, and information via computer networks [5]. B2C (business-to-consumer) is an e-commerce model in which one of the participants is an individual and the other is an organization.

With the vast rate of growth of Internet connections in Saudi Arabia, online business has a very promising future in Saudi Arabia. An online survey carried out in 2010 by the Saudi Communication and Information Technology Commission (CITC) [30] indicated that 35% of the survey respondents buy products over the Internet and pay for services online through e-commerce services. An online article in Articles Base [31] indicated that 48.36% of Internet users in Saudi Arabia reported purchasing products and services online and through their mobile handsets in 2011. Electronics are the most popular products bought online, followed by software, with around 58% and 50% of customers buying them online, respectively. Around 84% of e-commerce users pay for services online for airline ticket bookings, while about 49% pay for hotel reservations. These users number around 3.5 million, which is around 14.26% of the total population of Saudi Arabia [29].

An e-commerce business is as successful as its business model, and its online system design and operation. Therefore, developing a high quality software system is a success factor for an online business. *Web Engineering* is a systematic and disciplined use of methods and tools for developing and evaluating Web-based systems [27]. Pressman [25] identified the evaluation of the quality of the end product as an approach that can be followed to ensure product quality. To evaluate the quality of the end product, a set of quality characteristics that describe the product and form the basis for the evaluation is required [4].

Yeh [8] defined quality as the ability to meet end-users' requirements. In other words, quality is associated with the end-user's perception. Unlike other online and offline software systems, total involvement of the end-user in e-commerce systems occurs at almost every stage of the purchasing process [20]. Therefore, a comprehensive specification of B2C e-commerce quality characteristics that takes into account the user requirements is a key factor in ensuring adequate quality. This set of characteristics and the relationships between them are referred to as the quality model [21].

The problem of identifying the factors that determine end-user acceptance in software systems is not new [15]. However, consumers from different cultures have different needs and consequently tend to conduct business differently [24]. Cultures creates basic expectations that consumers bring to the marketplace, such as what should be bought in different markets, how things should be bought, and how things should be paid for [14]. Therefore, a system that drives profit in the Western culture might drive losses in the Eastern culture and vice versa.

This paper focuses on identifying the factors that determine end-user acceptance of B2C systems from the Saudi user perspective. Limited studies on Saudi online consumers and their needs have been conducted. Eid [18] identifies the factors that influence the extent to which Saudi consumers trust, are satisfied with, and are loyal towards B2C

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e-commerce. Al-Otaibi and Al-Zahrani [16] analyze the practices and the characteristics of Saudi e-commerce websites to measure the tendencies of Saudi organizations towards e-commerce. Alabduljabbar and Mirza [24] identify the major factors required for successful online marketing in Saudi Arabia. These studies do not present a complete quality model and do not identify the quality criteria and their levels of importance from the online users' perspective.

This paper provides an end-user-centric model and quality measures for evaluating the quality of B2C e-commerce systems. The paper makes four main contributions focused on the Saudi culture: (1) it examines the major factors that influence the success of a B2C online commerce website, (2) it identifies the user ranking of these factors from most to least desirable, (3) it weights these factors based on their importance to end-users, and (4) it develops a validated or accepted quality model to evaluate B2C e-commerce applications. The aim of the model is to guide designers of e-commerce applications and to ensure the development of high quality applications that meet Saudi user requirements.

The rest of this paper is structured as follows: the existing quality models are reviewed in Section 2. In Section 3, the ISO912 quality model is discussed. In Section 4, our proposed model is described in detail. In Section 5, the proposed model is applied to a case study for evaluation. Finally, the conclusion and possible future works are presented in Section 6.

II. REVIEW OF QUALITY MODEL

A number of works have been done to define a software quality framework. Fitzpatrick [22] presents McCall's model of software quality, which combines eleven criteria regarding product operations, revisions, and transitions. McCall's model determines relationships between quality characteristics and metrics. One aspect that was neglected by this model is the functionality of software products.

Botella et al. [21] present the Boehm model. The work is an extension of McCall's model with emphasis on the maintainability of a software product. The work represents a hierarchical structure of characteristics, each of which contributes to the total quality. No clear measurements of the quality characteristics are introduced in the Boehm model.

Dromey's model [23] aims to increase understanding of the relationship between the characteristics and the sub-characteristics of quality. The objective of the presented model is to be broad enough to work on different systems. The model lacks criteria for the measurement of software quality.

Robert [7] presents the FURPS model. FURPS addresses five characteristics: Functionality, Usability, Reliability, Performance, and Supportability. The FURPS quality model was built and extended to be used in the IBM Rational Software Company [9]. FURPS is general purpose quality model developed to be used by software companies using IBM Rational Software development methods and tools and not for the benefits of a single company. The model fails to take into account the software product's portability.

In addition to the above listed limitations, the models do not take into account users' needs. *ISO9126 Part One*, referred to as ISO9126-1, defines a set of software quality characteristics. It provides a general purpose model with six broad categories of quality: functionality, reliability, usability, efficiency, maintainability, and portability [10]. In general, the ISO model seems to be more complete than the others and is free of their shortcomings [4]. Therefore, this paper adopts the ISO model as the basis of the proposed quality model for B2C systems. The following section discusses the ISO model in more detail.

III. ISO 9126 MODEL

With advances in information technology, the ISO/IEC 9126 standard has been revised, resulting in the ISO/IEC 9126-1 version. The standard includes quality characteristics and sub-characteristics as a guide to applying the model. The characteristics defined are applicable to every kind of software, including computer programs and data contained in firmware, and provide consistent terminology for software product quality. The main characteristics of the ISO9126-1 quality model are defined as follows.

A. Functionality

Functionality is "a set of attributes that bear on the existence of a set of functions and their specified properties; the functions are those that satisfy stated or implied needs" [10]. Functionality is the essential purpose of any product or service. E-commerce applications come with a comprehensive set of functions since their online system is their main source of customer interaction and revenue generation. Yet, the more functions a product has, the more complicated it becomes. Therefore, it is important to clearly identify the functions that are of greatest importance to users as these should be the focus during the application design and development. The aim of this paper is to identify the essential functions that B2C e-commerce websites must provide based on users' needs in Saudi Arabia.

B. Reliability

Reliability is "a set of attributes that bear on the capability of software to maintain its level of performance under stated conditions for a stated period of time" [10]. Once a software system is functioning, the reliability characteristic defines the capability of the system to maintain its service provision. Reliability is an extremely important factor for e-commerce applications. The reliability of an e-commerce system has a direct effect on customer satisfaction [6] and thus on customer purchase decisions.

C. Usability

Usability is "a set of attributes that bear on the effort needed for use, and on the individual assessment of such use, by a stated or implied set of users" [10]. Usability refers to the ease of use for a given function. Usability is an extremely important factor that determines the success of a website. It becomes even more critical in e-commerce since websites are the prime means of revenue. When visitors come to shop online, they expect easy and hassle-free navigation in addition to easy access to what they are looking for. Problems may cause visitors to leave the website. Quality usability ensures that the performance of a website meets user requirements, which affects the number of visits to the site made by users and consequently revenue generation positively.

D. Efficiency

Efficiency is "a set of attributes that bear on the relationship between the level of performance of the software and the amount of resources used, under stated conditions" [10]. This characteristic is concerned with the system resources used to provide the required functionality, such as the amount of disk space, memory, and network, which affects the overall level of performance. Based on the above definition it is clear that efficiency is also important to the quality of e-commerce systems. A system is efficient if the user can access the relevant website promptly.

E. Maintainability

Maintainability is "a set of attributes that bear on the effort needed to make specified modifications" [10]. The ability to identify and fix a fault within a software component is what the maintainability characteristic addresses. Anything that helps with fixing a fault or modifying website content is the concern of maintainability.

F. Portability

Portability is "a set of attributes that bear on the ability of software to be transferred from one environment to another" [10].

The above six criteria are further broken down into sub-criteria as illustrated in Figure 1 below. The listed ISO9126-1 criteria are very general and qualitative and do not address a specific type of software or application. ISO9126-1 explains the relationship between quality factors and sub-factors without considering their value.

ISO9126-1 criteria can be categorized into external criteria (functionality, reliability, efficiency, usability) and internal criteria (maintainability and portability) [2]. The external quality characteristics refer to whether the quality is appreciated from the user's perspective, while the internal quality characteristics are oriented by the developers to satisfy the end user's requirements.

A number of works have proposed quality models for e-commerce based on ISO9126-1. Yet some of these works do not measure the importance of the different quality factors as seen by the end-users [3], [11], while others focus on one criterion of ISO9126-1 in assessing the quality of e-commerce, for instance Nielsen [12] and Bertoa et al. [17] focus on usability. Colesca et al. [26] have organized a comprehensive set of software quality attributes structured hierarchically at different levels into sub-factors. The sub-factors are organized within ISO 9126-1 quality factors.

Our proposed model is end-user-centric, identifying measurable quality factors for a B2C e-commerce system focusing on the external criteria. The proposed model is achieved by adopting the ISO9126-1 quality model, decomposing the primary quality model criteria into sub-attributes customized to the B2C applications [26], and extending it with further research investigation and expert reviews as described below.
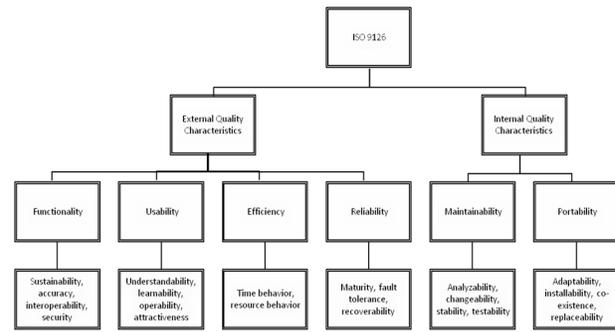

Fig. 1. Characteristics and sub-characteristics for the ISO 9126-1 quality model [2]

IV. DEVELOPING THE QUALITY EVALUATION MODEL FOR B2C E-COMMERCE APPLICATION

Behkamal et al. [4] identified three main methods of evaluating the quality of software, as listed below:
1) Expert review, where a specialist in the domain evaluates the aspects and factors of software that are important for quality.
2) Software metrics, a standard of measurements used for assessing the quality of a software product.
3) Quality model, defined as the set of characteristics and the relationships between them.

Our proposed quality model is developed based on ISO 9126 standards and customized for use with B2C applications. Weights are assigned to the quality factors by end users and experts in the field in Saudi Arabia. The weights were collected using an evaluation questionnaire. The result is a quality evaluation model for B2C e-commerce designers to guide them in their design and development process. In the next section, our approach to the development of the quality evaluation model is explained in more detail.

A. Steps for developing a software quality evaluation model

This paper follows five steps for developing a software quality evaluation model identified by [4] as follows:
1) Study a well-known quality model and choose a quality model as a basis; in our case ISO9126-1 model was chosen as a basis for the B2C proposed quality model.
2) Identify the quality factors of a particular application. The quality attributes of Colesca et al. [26] were adopted as a basis for B2C applications and other attributes were removed or added in the hierarchical structure of the model through further research and consultation with B2C expert reviewers.
3) Choose a group of software experts familiar with B2C ecommerce systems to assign values to the quality factors. Two groups were identified for this research, end users and e-commerce experts.
4) Assign weights to the quality factors and sub-factors based on the assigned values.
5) Develop the quality criteria.

This paper adds a sixth step that is important for developing a software quality model that is, testing the model.

B. Assigning values to the quality factors

It is essential to determine the importance of all quality aspects of any software product to identify the principles to develop a quality e-commerce application and to guide the e-commerce application designers. Weighting reflects the relative importance of the different sub-factors. Ranking is putting a set of factors in order from most to least desirable. Both ranking and weighting of factors require a rating system. To establish a rating system for the factors, a standard statistical rating scheme based on frequency of user and expert ratings was used to reflect the relative importance of the different sub-factors within a factor [19].

This paper develops the rating scheme based on questionnaire results obtained from consumers and specialists in e-commerce in Saudi Arabia. The questionnaire structures ISO9126 external criteria into a hierarchy of attributes in as many levels as required, each of which can be analyzed and evaluated independently. The same questionnaire was used for ranking the importance of the B2C attributes and for weighting the relative importance of the factors as described below. An expert was asked to participate in a pilot run to validate the content and style of the questionnaire. The objective of the pilot run was to make sure that the questions were clear, complete, and unambiguous; the questionnaire was then distributed to the participants. The questionnaire was administered during focused group sessions with the participants where the questionnaire's content was explained to the respondents. A total of 154 users and four experts were surveyed.

C. Ranking results

Each question in the questionnaire gave the respondents the option to rate the importance of a sub-factor. This was done using a five-point scale ('1' denotes the least importance and '5' denotes extreme importance). In handling missing values for sub-factors, the average of received responses was calculated to fill in the gaps of missing observations. Hardly any questionnaires with missing values were received. The participants were asked to respond to the questionnaire that asked them to rate each of the sub-factors in order of importance.

By analyzing the questionnaire results, which comprised the percentage importance of quality factors and sub-factors of the model determined from both of users' and experts' viewpoints, the quality factors of B2C applications have been ranked in Tables 1 and 2 in accordance with their importance to the Saudi culture. The rating scheme was applied to reflect the relative importance of the different sub-factors based on the following formula:

$$\text{Percentage Importance} = \sum_{i=1}^{N} Mi / (M_{max} * N) \quad (1)$$

With equation (1), M represents the scale received on a sub-factor, N represents the total number of respondents, and M_{max} represents the highest level of importance, which is 5 in our case.

The final rating achieved indicated the percentage importance given to each sub-factor.

TABLE I: RANKING OF THE B2C E-COMMERCE QUALITY FACTORS IN TERMS OF IMPORTANCE TO THE SAUDI END USERS

Functionality	Rating
Searching and retrieving	0.88
Purchase	0.86
Order management	0.86
Navigation and Browsing	0.83
Promotion	0.82
Customer	0.81
Product	0.77
Services	0.66
Usability	
Style issues	0.89
Miscellaneous Features (Foreign Language..)	0.86
Interface and Aesthetic Features	0.84
Global Site Understandability	0.84
Online Feedback and Help Features	0.79
Reliability	
Link Errors	0.67
Accuracy and Relevance of Information	0.60
Miscellaneous Errors and Drawbacks	0.59
Efficiency	
Accessibility	0.70
Performance	0.69

TABLE II: RANKING OF THE QUALITY FACTORS AND SUB-FACTOR OF B2C E-COMMERCE SITES

Functionality Factors	Rank
1. Searching and retrieving	**0.88**
1.1. Website search mechanisms	0.91
1.1.1. quick search	0.96
1.1.2. advanced search	0.85
1.2. Average level of retrieve customization	0.86
2. Navigation and Browsing	**0.83**
2.1. Navigability	0.78
2.1.1. orientation	0.81
2.1.2. average of links per page	0.76
2.2.Navigational control objects	0.81
2.2.1. Presentation permanence and stability of controls	0.88
2.2.1.1. presentation permanence	0.88
2.2.1.2. stability of sub-sites controls.	0.89
2.2.2. Level of scrolling	0.75
2.2.2.1. vertical scrolling	0.76
2.2.2.2. horizontal scrolling	0.74
2.3. Navigational prediction	0.85
2.3.1. link title with explanatory help	0.90
2.3.2. link comment or description	0.80
2.4. Quick browse	0.89
3. Product	**0.77**
3.1. Product description	0.94
3.1.1. Textual description	0.97
3.1.2. contents and structure	0.89
3.1.3. product image	0.97
3.2. product evaluation and comparison	0.73
3.3. product rating	0.77
3.4. related products recommendation	0.71
3.5. catalog download facility	0.73
3.6. product personalization	0.70
3.7. Product ranking	0.82
3.7.1. top products	0.83
3.7.2. best seller products.	0.81
4. Purchase	**0.86**
4.1. purchase mode	0.81
4.1.1.Online	0.83
4.1.1.1 shopping basket	0.85
4.1.1.1.1. shopping basket	0.93
4.1.1.1.2 continues buying feedback	0.76
4.1.1.1.3. edit/recalculate feature.	0.88
4.1.1.2. Payment provider	0.81
4.1.1.2.1. full integration of payment provider	0.85
4.1.1.2.2. forms of payment	0.77
4.1.1.2.2.1.Sadad	0.85
4.1.1.2.2.2. Credit card	0.89
4.1.1.2.2.3. Bank transfer	0.79
4.1.1.2.2.4. Paypal	0.71
4.1.1.2.2.5. Google Checkout	0.60
4.1.2 Offline	0.79
4.1.2.1. printable check-out form	0.81

4.1.2.2. fax/Telephone/E-mail purchase	0.77
4.2. quick purchase	0.85
4.3.check-out features	0.90
4.3.1. check-out security	0.90
4.3.2. canceling feedback	0.89
4.4. purchase policies	0.91
4.4.1. Purchase cancellation policy	0.92
4.4.2. Return policy	0.92
4.4.3. Shipping and handling policies	0.93
4.4.4. Payment policy	0.92
4.4.5. Recent purchase (gift service)	0.84
4.5. multiple delivery options	0.88
5. Customer	**0.81**
5.1. E-subscriptions	0.79
5.2. account facility	0.90
5.2.1. Account availability	0.88
5.2.2. Account security	0.95
5.2.3. Account setting	0.88
5.3. wish list	0.74
6.Promotion	**0.82**
6.1. with-sale	0.88
6.2. appetizer promotion (e.g. contests, miles, etc.)	0.76
7.Order management	**0.86**
7.1. order history	0.84
7.2. order tracking	0.87
8. Services	**0.66**
8.1. Discussion forums	0.65
8.2. Surveys/Polls	0.67
8.3. Newsletter	0.67

Usability Factors	Rank
1. Global Site Understandability	**0.84**
1.1. table of contents	0.82
1.2. sitemap	0.73
1.3. alphabetical/subject index	0.81
1.4. text labels	0.93
1.5. picture	0.87
1.6. clickable images	0.92
1.7. guided tour for first time visitors	0.76
2. Online Feedback and Help Features	**0.79**
2.1. Global Help	0.80
2.2.Help	0.79
2.2.1. Search Help	0.76
2.2.2. Purchase Help	0.81
2.2.3. Check-Out Help	0.79
2.3. Contact details	0.80
2.3.1. Email Directory	0.91
2.3.2. Telephone/Fax Directory	0.83
2.3.3. Post Mail List	0.67
2.4. FAQ Feature	0.79
2.5. Real-time customer service	0.84
2.6. Comments/Suggestions	0.74
3. Interface and Aesthetic Features	**0.83**
3.1. main control	
3.1.1. Presentation permanence and stability of main controls	0.76
3.1.1.1. Direct controls	0.89
3.1.1.1.1. Main control	0.93
3.1.1.1.2. Search control	0.88
3.1.1.1.3. Browse control	0.87
3.1.1.1.4. Account control	0.87
3.1.1.1.5. Shopping basket control	0.89
3.1.1.2. Indirect controls permanence	0.64
3.1.2. control's stability	0.75
3.2. Style issues	0.89
3.2.1. Link color style	0.87
3.2.2. Aesthetic designs	0.90
4. Miscellaneous Features	**0.86**
4.1. Foreign Language Support	0.88
4.2. What's New Feature	0.83

Reliability Factors	Rank
1. Link Errors	**0.67**
1.1. Broken links	0.66
1.2. Invalid links	0.68
1.3. Unimplemented links	0.66
2. Miscellaneous Errors and Drawbacks	**0.59**
2.1. different browsers	0.64
2.2. browser independent	0.61
2.3. dead-end web nodes	0.51
2.4. destination nodes under construction	0.60
3. Accuracy and Relevance of Information	**0.60**
3.1. testimonials	0.56
3.2. references or links	0.58
3.3. physical address of the office	0.65

Efficiency Factors	Rank
1. Performance	**0.69**
1.1. quick pages	0.68
1.2. quick checkout and payment	0.70
2. Accessibility	**0.70**
2.1. Information accessibility	0.66
2.1.1. text-only version.	0.63
2.1.2. readability by deactivating browser image feature	0.69
2.1.2.1. image title	0.69
2.1.2.2. global readability	0.70
2.2. browsers' version even those which do not support frames	0.73
2.3. mobile device accessibility	0.72

D. Weighting results

The weighting scheme was applied to reflect the relative importance of the different sub-factors. The analytic hierarchy process (AHP) method [1] is one of the most common methods for weighting criteria. AHP structures the main goal hierarchically into sub-criteria in as many levels as required, each of which can be analyzed and evaluated independently. Each sub-factor is compared pairwise against each of the other criteria under the same ISO9126-1 criteria for preference. Numerical priorities between zero and one are derived for each factor and sub-factor. The AHP converts these evaluations into numerical values, representing a numerical weight for each sub-criterion of the hierarchy that is processed. The numerical weight is derived for each element of the hierarchy and represents the criterion's relative importance in achieving the main goal. Weights are then distributed over a hierarchy according to its architecture, and their values depend on the information entered by end users and experts.

E. Quality evaluation model

The result of the weighting is a quality evaluation model for communicating expectations of quality of B2C e-commerce applications from the Saudi market point of view. Tables 3 and 4 include ISO9126-1 based criteria on which the performance of an e-commerce application is weighted for each criterion and attribute. As mentioned previously, the weight of a criterion reflects the importance of that criterion to Saudi users. The result of the quality evaluation model is interpreted as the percentage of requirements satisfied for a given attribute, and it is defined in the range between 0 and 1. Table 3 compares the importance of ISO9126-1 criteria for the Saudi culture versus the Romanian culture. It also shows that functionality and usability are the most important factors that determine the success of a B2C application. When visitors come to a website, they expect certain functions and a certain level of easy and hassle-free navigation to help them find what they are looking for. If they face any problems in this respect, they simply leave the website altogether rather than staying there and trying to figure out what to do. The second most important ISO factor is efficiency and the third, reliability.

TABLE III: WEIGHTS OF B2C QUALITY CRITERIA IN TERMS OF IMPORTANCE TO THE SAUDI END USERS

Factors	Weight	Weight in [25]
Usability	0.27	0.30
Functionality	0.27	0.30
Efficiency	0.24	0.15
Reliability	0.21	0.25

TABLE IV: WEIGHTS OF QUALITY FACTORS AND SUBFACTOR FOR E-COMMERCE SITES

Functionality Quality Factors	Weight
1. Searching and retrieving	**0.14**
1.1. Website search mechanisms	0.51
1.1.1. quick search	0.53
1.1.2. advanced search	0.47
1.2. Average level of retrieve customization	0.49
2. Navigation and Browsing	**0.13**
2.1. Navigability	0.23
2.1.1. orientation	0.52
2.1.2. average of links per page	0.48
2.2.Navigational control objects	0.24
2.2.1. Presentation permanence and stability of controls	0.54
2.2.1.1. presentation permanence	0.50
2.2.1.2. stability of sub-sites controls.	0.50
2.2.2. Level of scrolling	0.46
2.2.2.1. vertical scrolling	0.51
2.2.2.2. horizontal scrolling	0.49
2.3. Navigational prediction	0.25
2.3.1. link title with explanatory help	0.53
2.3.2. link comment or description	0.47
2.4. Quick browse	0.27
3. Product	**0.12**
3.1. Product description	0.17
3.1.1. Textual description	0.34
3.1.2. contents and structure	0.32
3.1.3. product image	0.34
3.2. product evaluation and comparison	0.14
3.3. product rating	0.14
3.4. related products recommendation	0.13
3.5. catalog download facility	0.13
3.6. product personalization	0.13
3.7. Product ranking	0.15
3.7.1. top products.	0.51
3.7.2. best seller products.	0.49
4. Purchase	**0.13**
4.1. purchase mode	0.19
4.1.1.Online	0.51
4.1.1.1 shopping basket	0.51
4.1.1.1.1. shopping basket	0.36
4.1.1.1.2 continues buying feedback	0.29
4.1.1.1.3. edit/recalculate feature.	0.34
4.1.1.2. Payment provider	0.49
4.1.1.2.1. full integration of payment provider	0.53
4.1.1.2.2. forms of payment	0.47
4.1.1.2.2.1.Sadad	0.22
4.1.1.2.2.2. Credit card	0.23
4.1.1.2.2.3. Bank transfer	0.21
4.1.1.2.2.4. Paypal	0.19
4.1.1.2.2.5. Google Checkout	0.16
4.1.2 Offline	0.49
4.1.2.1. printable check-out form	0.51
4.1.2.2. fax/Telephone/E-mail purchase	0.49
4.2. quick purchase	0.20
4.3.check-out features	0.21
4.3.1. check-out security	0.50
4.3.2. canceling feedback	0.50
4.4. purchase policies	0.21
4.4.1. Purchase cancellation policy	0.20
4.4.2. Return policy	0.20
4.4.3. Shipping and handling policies	0.21
4.4.4. Payment policy	0.20
4.4.5. Recent purchase (gift service)	0.19
4.5. multiple delivery options	0.20
5. Customer	**0.12**
5.1. E-subscriptions.	0.33
5.2. account facility	0.36
5.2.1. Account availability	0.32
5.2.2. Account security	0.35
5.2.3. Account setting	0.33
5.3. wish list	0.29
6.Promotion	**0.13**
6.1. with-sale	0.53
6.2. appetizer promotion (e.g. contests, miles, etc.)	0.47
7.Order management	**0.13**
7.1. order history	0.49
7.2. order tracking	0.51
8. Services	**0.10**
8.1. Discussion forums	0.33
8.2. Surveys/Polls	0.34
8.3. Newsletter	0.34

Usability Factors	Weight
1. Global Site Understandability	**0.25**
1.1. table of contents	0.14
1.2. sitemap	0.13
1.3. alphabetical/subject index	0.14
1.4. text labels	0.16
1.5. picture	0.15
1.6. clickable images	0.16
1.7. guided tour for first time visitors	0.13
2. Online Feedback and Help Features	**0.24**
2.1. Global Help	0.17
2.2.Help	0.17
2.2.1. Search Help	0.32
2.2.2. Purchase Help	0.34
2.2.3. Check-Out Help	0.33
2.3. Contact details	0.17
2.3.1. Email Directory	0.38
2.3.2. Telephone/Fax Directory	0.34
2.3.3. Post Mail List	0.28
2.4. FAQ Feature	0.17
2.5. Real-time customer service	0.18
2.6. Comments/Suggestions	0.16
3. Interface and Aesthetic Features	**0.25**
3.1. main control	
3.1.1. Presentation permanence and stability of main controls	0.50
3.1.1.1. Direct controls	0.58
3.1.1.1.1. Main control	0.21
3.1.1.1.2. Search control	0.20
3.1.1.1.3. Browse control	0.20
3.1.1.1.4. Account control	0.20
3.1.1.1.5. Shopping basket control	0.20
3.1.1.2. Indirect controls permanence	0.42
3.1.2. control's stability	0.50
3.2. Style issues	0.35
3.2.1. Link color style	0.49
3.2.2. Aesthetic designs	0.51
4. Miscellaneous Features	**0.26**
4.1. Foreign Language Support	0.51
4.2. What's New Feature	0.49

Reliability Factors	Weight
1. Link Errors	**0.36**
1.1. Broken links	0.33
1.2. Invalid links	0.34
1.3. Unimplemented links	0.33
2. Miscellaneous Errors and Drawbacks	**0.32**
2.1. different browsers	0.27
2.2. browser independent	0.26
2.3. dead-end web nodes	0.21
2.4. destination nodes under construction	0.26
3. Accuracy and Relevance of Information	**0.32**
3.1. testimonials	0.31
3.2. references or links	0.32
3.3. physical address of the office	0.36

Efficiency Factors	Weight
1. Performance	**0.49**
1.1. quick pages	0.49
1.2. quick checkout and payment	0.51
2. Accessibility	**0.51**
2.1. Information accessibility	0.31
2.1.1. text-only version	0.47
2.1.2. readability by deactivating browser image feature	0.53

2.1.2.1. image title	0.50
2.1.2.2. global readability	0.50
2.2. browsers' version even those which do not support frames	0.35
2.3. mobile device accessibility	0.34

V. APPLYING THE PROPOSED MODEL TO A CASE STUDY

To show that the proposed model can be used in practice, one of the top B2C e-commerce applications was evaluated using our proposed quality model to assess the application's level of conformance to the Saudi customers' needs. This B2C application is Amazon (www.amazon.com). Each sub-factor was evaluated independently and the aggregation of elementary preferences yields the global quality preference, which represents the global degree of satisfaction of all involved requirements.

The results show that overall the site received high scores in the evaluation. A number of factors affected the score of Amazon's functionalities: the navigation and browsing score was affected by the lack of a links title with explanatory help and the quick browsing functionality, and the purchase factor was affected by the lack of some form of payment, such as bank transfer, Paypal, or Google Checkout. As for the product factor, Amazon does not provide product evaluation and comparison, a catalogue download facility, or product personalization. The usability score was affected by the non-existence of a table of contents, and the efficiency score was affected by the lack of mobile accessibility of the application.

TABLE V: THE RESULTS OBTAINED USING THE PROPOSED QUALITY MODEL IN EVALUATING THE CONFORMATION OF AMAZON TO THE SAUDI MARKET NEEDS

Factors	Weight	Amazon Result
Functionality	0.26	0.22
1. Searching and retrieving	0.14	0.14
2. Navigation and Browsing	0.13	0.06
3. Product	0.12	0.07
4. Purchase	0.13	0.12
5. Customer	0.12	0.12
6. Promotion	0.13	0.13
7. Order management	0.13	0.13
8. Services	0.10	0.07
Usability	0.26	0.24
1. Global Site Understandability	0.25	0.22
2. Online Feedback and Help Features	0.24	0.24
3. Interface and Aesthetic Features	0.25	0.20
4. Miscellaneous Features	0.26	0.26
Reliability	0.25	0.22
1. Link Errors	0.36	0.36
2. Miscellaneous Errors and Drawbacks	0.32	0.32
3. Accuracy and Relevance of Information	0.32	0.22
Efficiency	0.23	0.17
1. Performance	0.49	0.49
2. Accessibility	0.51	0.26

VI. CONCLUSIONS AND FUTURE WORKS

Different cultures have different needs. The quality of software is the conformance of the software to user requirements. In this paper, the ISO 9126 quality model was adopted and extended for the evaluation of B2C applications.

By surveying e-commerce experts and end users, the most important quality factors of B2C systems were identified and ranked. After that the weight of each quality factor of the model was determined from the same viewpoints. This resulted in the development of a quality model for evaluating B2C applications from the Saudi perspective. At the end, a case study was evaluated by the proposed model.

In general, the contributions of this paper can be summarized into the following areas: the identification of B2C quality factors, the customization of ISO9126 for use with B2C e-commerce applications, and the presentation of a method for customizing a general quality model for evaluation of a particular domain as well as a method for weighting and ranking the quality factors.

A subsequent research could use the developed quality model to evaluate the quality of Saudi e-commerce applications and to rank these applications in terms of their conformance to the needs of the Saudi market.

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