Software Quality Assurance – E-commerce Customers Satisfaction in Requirements Engineering Process


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Abstract

In the requirement analysis phase, good quality requirements are needed to develop the foundation of good quality software. This paper proposes quality attributes from the SQA activities in requirement phase from the end users’ perspective in an e-commerce application. By analyzing SQA activities in requirement engineering process, we found out five quality attributes that most affect customer’s satisfaction: functionality, security, usability, reliability and efficiency. This paper describes the quality attributes that are gained from the requirements elicitation, requirements documentation, requirements validation, negotiation and the requirements management planning activities. The results show that functionality, security, usability, reliability and efficiency affect e-commerce customers’ satisfaction. Most of the online shopping websites comply with customer requirement and requirement expectations.

Keywords: Software quality assurance (SQA), software requirements, software quality, e-commerce

1. Introduction

In the constantly rising global economy, e-commerce has become a major component and catalyst for the world’s economic development. Organizations have revolutionized relationships between customers and organization with the integration information and communications technology. The organizations who have incorporated such in their business process have acquired an invaluable advantage over their rivals. E-commerce is defined as the buying, selling and exchanging of products, services and information via the computer network, primarily the Internet [1]. With a vast rate of growing internet users in Malaysia, e-commerce in Malaysia is projected to be making revenue of MYR5.7 billion by the year 2015 [2]. E-commerce introduces huge opportunities in Malaysia despite the challenges [3], but an e-commerce business is as successful as its business model, system development process and its operations. 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 [4]. Pressman [5] 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 [6].

The paradox of quality assurance is that, although “quality” is a key value for every organization, the actions taken to ensure it are often left until late in the software development lifecycle when budgets are scarce, time is short and there is high pressure to deliver to the market. Analyst reports [12, 14] indicate that the cost of fixing a defect...
Software product quality is heavily dependent on quality factors for targeted customers. This is done by:

- software product quality is heavily dependent on software requirements, customer involvement and allocated resources [17]. The main emphasis on software quality construction in the software organizations studied here [18, 19] was how the software could meet customers’ requirements. The customers/users are not completely sure of what is needed, have a poor understanding of the capabilities and limitations of their computing environment, do not have a full understanding of the problem domain, have trouble communicating needs to the system engineer, omit information that is believed to be obvious, and specify requirements that conflict with the needs of other customers/users. On the other hand, developers and system analysts need to play a big part in ensuring user’s understanding of requirements [21].

System quality have been identified and taken as the one of the antecedents of user satisfaction [7]. Customer satisfaction is defined as the number of customers, or percentage of total customers, whose reported experience with a product or service, exceeds specified satisfaction goals [8]. Yeh [29] defined quality as the ability to meet end-users’ needs. In other words, quality is connected with the end-user’s perception. This paper emphasize on quality attributes that conform the end users’ needs during the initial phase, requirement analysis. In ISO/IEC 9126 [23], “satisfaction” implies “the capability of the software product to satisfy users in a specified context of use.” Satisfaction in that sense refers to the user’s response to interaction with the product. It is the key indicator between businesses and is a definite key to competitive advantage in a business strategy. Therefore, a comprehensive system quality attributes need to be defined as a key factor in ensuring the appropriate quality standard. The objectives of this paper are:

1. To emphasize the importance of quality assurance in earlier phase of software development process.
2. To identify quality attributes in requirements phase of the software development process related to customer satisfaction.
3. To evaluate quality attributes those contribute to customer satisfaction.

This paper proposes a quality attribute model from the SQA activities in requirement phase from the end users’ perspective in an e-commerce web. This is done by: (1) analyzing SQA activities in requirement phase, (2) choosing the most suitable quality attributes, facilitate by adopting the ISO9126 quality model (3) decomposing the primary quality model criteria into sub-attributes customized for the online shopping applications, (4) extracting the quality factors from the online shopping applications, (5) conducting a survey to evaluate requirements conformance to the market needs and (6) finally the result will beneficial to the developers and customers. For developers, this paper will contribute a quality guideline for them to design and produce high quality online shopping systems for targeted customers, while for the customers, will find out the characteristics of the best quality factors in a good ecommerce sites. The practices described in this paper are easily applied to all types of development methodologies (waterfall, iterative, incremental, etc.). In this document, we will consider the earliest phase of the SDLC, which is the requirement engineering activities; including (1) requirements elicitation, (2) requirement analysis and documentation, (3) verification, validation and negotiation and 4) management planning. The rest of this paper is structured as follows: the quality attributes and sub-characteristics in requirement engineering process are discussed in Section 2. In
Section 3, the chosen quality attributes are reviewed. In Section 4, the selected quality attributes are applied to a case study for evaluation and is described in detail. In Section 5, the results of the evaluation are discussed. Finally, the conclusion is presented in Section 6.

2. Review of Software Quality Assurance Activities in Requirement Phases

Based on Dhirendra Pandey et al., [9] requirement engineering is the most crucial phase of software development process. It is essential for every organization to develop quality software products that can satisfy and fulfill user’s needs. Requirements engineering for software development process is a complex and critical practice that considers product demands from a vast number of viewpoints, roles, responsibilities, and objectives. Therefore, it becomes compulsory and relevant to apply requirement engineering practices in every phase of software development process and to produce quality requirements for software development. The successful execution of proposed requirement engineering process can have a great impact on the production of quality software product. Here, we determined four main activities in requirement engineering process as SQA activities in requirement phase, (a) requirements elicitation, (b) requirement analysis and documentation, (c) requirement verification, validation and negotiation, and (d) management planning. Each activity has its own quality attributes.

A. Requirements Elicitation and Development

Requirements elicitation and development phase concentrates on examining and gathering thorough user requirements and objectives of the system from various different perspectives of every single user involved in the system; i.e., business requirements, customer requirements, user requirements, constraints, security requirements, standards and etc. Requirements elicitation is considered to be the first stage in building an understanding of the problem that the software is required to solve. It is essentially a human activity where stakeholders are identified and relationships established between the acquirer, customer, user, and developer. It is [15, 20] emphasized that a proper requirements elicitation should not only capture the customer requirements, but also all the aspects of the context that can affect the system or its use in any way. According to Dhirendra et al., [9] the requirements elicitation and development process is broken down into requirements analysis and allocation and flow-down of requirements. In the requirements analysis phase, good quality requirements are needed to develop the foundation of good quality software. Requirements are first analyzed within a business context and later cross checked with raw requirements to ensure non-conflicting requirements. In this phase, the software allocation, builds models of the process, data and behavioral domains are also refined. In the allocation and flow-down of requirements, all the system requirements are ensured to be fulfilled by a subsystem or by a set of subsystems that is able to work together to achieve project objectives. Allocation of requirements results in an architectural design of the system structure while the flow-down of requirement ensures the subsystems are able to support the overall system structure as a whole.

Meanwhile, Mauger et al., [13] broke down the requirements elicitation process in regards to user satisfaction into five main activities. The first activity is to determine the application domain by understanding the purpose of a system and how it works. Second activity defined is to identify the sources of requirements. Different kinds of stakeholders are seen as different kind of sources for requirements. The third activity is to analyze only the relevant stakeholders of the project. The fourth activity is to select the techniques, approaches and tools to use for the requirements elicitation. It is highly critical to choose the right technique in eliciting requirements according to the situation. Last but not list is
to elicit the requirements from the determined stakeholders and other sources that deem relevant to the project. Structuring the elicitation process as described helped Mauger et. al., [13] to gather more information compared to a customer or business oriented approach as this permits the requirements team to generate information that are important and relevant to lead a better definition of what is required for the project. Dzung and Ohnichi [16] implemented an ontology-based approach to the requirements elicitation to ensure improved customer satisfaction. The ontology represents a functional hierarchy of a software system, relationships among the functional requirements and the attributes of the functional requirements which also include the non-functional requirements (NFR). They first parsed the initial requirements by adopting pair of “Verbs, Nouns” to represent the original requirement and map it to corresponding objects in ontology. After mapping, the requirements are then cross-checked with general rules to ensure that each function complements their non-functional requirements. In this sense a presence of domain knowledge that the systems assume will have a positive impact on efficiency and the completeness of the elicitation process.

B. Requirements Documentation

Requirements are often misinterpreted, misunderstood, and poorly documented [27]. A major issue is that requirements are often written at only one level of abstraction, or requirements at different levels of abstraction are mixed, which brings even more confusion to stakeholders. Requirements specifications for large systems should be specified at a number of levels of abstraction, as for instance, user requirements and systems requirements [28]. Another issue is that the majority of modeling languages are tailored to document requirements at only one level of abstraction. After gathering the requirements from the top-level and lower-level view, a formal document needs to be prepared. The document enlists a complete description of the external behavior of the software system [9]. Non-functional and functional requirements are combined to establish a software requirements specification document (SRS). Within the SRS, a software specification will be detailed for each component or software subsystem that has been already indentified in the requirements elicitation and development phase. There are two sub phases in the documentation of requirements that is defined by Dhirendra et. al., [9]; requirements identification and requirements specification. Requirements specification practices focus on the assignment of a unique identifier for each requirement [10]. The requirements specification document, the SRS [11], is only produced after the first sub-phase.

Smith [21] stated that in scientific computing, problems are complicated and with many sources of potential ambiguities in terminology and notation requires the proper documentation of requirements. Not only that, requirements documentation is critical as it is a way to judge the correctness and reliability of scientific software by comparing the specifications of their requirements. By thoroughly documenting requirements, the relative importance of various non-functional requirements is specified and criticism is avoided as they are explicitly documented. Smith [21] then introduces a methodology of documenting SRS specifically with different documents of different context by first determining the general purpose of software interest and applying a Commonality Analysis (CA) on specific tools. Through the application of this methodology the SRS includes a show of relative importance between different NFRs using the Analytic Hierarchy Process (AHP). Another important component of the SRS is the software validation strategies and design alternatives. This methodology addresses the challenge of writing valid requirements by introducing validation strategies in the documentation process.
C. Requirements Validation and Negotiation

Validation and negotiation during requirements engineering is meant to ensure that the documented requirements meet the predetermined quality criteria, such as correctness and agreement. It is necessary to review the quality of the requirements developed. The requirements are presented to the stakeholders with the goal to identify deviations between the requirements defined and the stakeholders’ actual wishes and needs. The goal of requirement validation is to discover errors in the documented requirements. Final refined requirements documents (commonly known as Software Requirements Specifications) are the main reference document for all further development activities, while the goal of negotiation is to gain a common and agreed-upon understanding of the requirements of the system to be developed among all relevant stakeholders.

Hagal and Alshareef [30] highlight on requirement engineers focusing their attention to achieve a solid system and user requirements nowadays. This involves requirement quality attributes such as completeness, accuracy and consistency of requirements. Basically the starting point of the development of any software system is the requirement engineering phase. Projects with inconsistent requirements face problems project containment, the reason for this risk is the difficulty to keep track on requirements during the development, and of course the evolution of descriptions and software requirement specifications without monitoring the changes in the development. In this paper, completeness, accuracy and consistency of requirement showed in step three requirement engineering, which is validation and negotiation. The requirements were validated, verified and negotiated with the user until the final and confirmed result achieved, and of course agreed by both parties. [32] Successful negotiation of project quality attributes often stands as a barrier between project success and failure. In correspondence with the overall goals of the requirements engineering process, the validation is carried out with the three (3) quality aspects: completeness, correctness and consistency as shown in Table 1.

<table>
<thead>
<tr>
<th>Table 1. Quality Attributes for V&amp;V Process</th>
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<tbody>
<tr>
<td><strong>Completeness</strong></td>
</tr>
<tr>
<td>a) Set of all requirements</td>
</tr>
<tr>
<td>Have all relevant requirements for the system to be developed (for the next system release) been documented?</td>
</tr>
<tr>
<td>b) Individual requirements</td>
</tr>
<tr>
<td>Does each requirement contain all necessary information?</td>
</tr>
<tr>
<td><strong>Correctness</strong></td>
</tr>
<tr>
<td>Do the requirements accurately reflect the wishes and needs of the stakeholders?</td>
</tr>
<tr>
<td><strong>Consistency</strong></td>
</tr>
<tr>
<td>Is it possible to implement all defined requirements for the system to be developed jointly? Are there no contradictions?</td>
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</table>

There are different techniques that can be selected and purposively combined for requirements validation, depending on the project characteristics and goals. Among the most common validation techniques for requirements are the different types of requirement reviews (e.g., commenting, inspection, walkthrough) as well as perspective-based reading and validation through prototypes and checklists. For requirements negotiation, it is necessary to identify conflicts between stakeholders, analyzed them and resolved them in a systematic conflict management support analysis and resolution.

D. Requirements Management

Requirement management is a [33] primary activity of requirement engineering. It involves prioritize, traceability, versioning and manage changes of requirements. This activity focus on traceability and verifiability as the quality attributes for requirement management. It’s the aim of this activity to maintain persistent availability of the
documented requirements as well as other relevant information over the course of entire system or development lifecycle. This means that new requirements are added and existing requirements are changed or removed. The evaluation of requirements changes, as well as the decision about performing the change, is usually the responsibilities of a Change Control Board (CCB). The management of requirements comprises techniques of five (5) categories as shown in Figure 1:

![Figure 1. Five Categories of Requirement Management Process](image)

3. Quality Attributes in e-commerce Web Application

Since the users are communicating and doing interaction mostly through the web interface, we are using the web interface as a measure of quality for the user satisfaction. In discussion the quality of e-commerce can be divided into a vast number of quality attributes but it is valid to say that the quality of e-commerce systems is related to these five quality factors, which are functionality, security, usability, reliability and efficiency. A brief discussion on the quality factors follows.

A. Functionality

Functionality is defined as [10] a set of attributes that bear on the existence of a set of functions and their specified properties. The functionality of a system is considered as the ability of the system or application to satisfy the purpose for which it was designed. It drives the initial decomposition of the system. According to ISO/IEC 9126 quality model, functionality subcategories include suitability, accurateness, interoperability, compliance and security. For e-commerce systems, functionality is related to the basic functions. Easy to understand navigation, user-friendly interface, compatibility with various browsers and the correctness and completeness of information also play an important role. The use of the electronic shopping cart can be said to be one of the most general function [26] of an e-commerce system. Users should be able to keep track of the merchandise that they plan to purchase while they continue to browse the websites. The action of inserting, removing and updating the items in their shopping cart is also a main function of an e-commerce system. Another important feature is that the user is able to find the right information and the right time, and the search engine should be able to be optimized to allow this to reduce user’s time in looking for the item or information that they needed.

B. Security

In e-commerce, security is considered a major quality factor. Quality is defined the ability to enforce authorization, authentication, and deliberate denial of service attacks [26]. Security plays the most in e-commerce systems in regards to the most important procedure that is a basic function for e-commerce systems is the payment gateway. Currently there are various methods of payment, and it is also up to the developers to ensure that the security of the customer’s financial transaction is done on a secure platform. Furthermore, the identification of the user (shopper) every time he visits the web site, as well as the provision of a district server for frequent users is functions that ensure user satisfaction [26]. Furthermore, the secure identification of the user (shopper)
every time he visits the web site, as well as the provision of a district server for frequent users is functions that ensure user satisfaction [26]. There are various methods of payment methods [33] such as online banking, digital currency, electronic credit card and electronic check payment. In all the above methods of payment, a very important parameter is security. The reversibility of user’s actions, the existence –in every stage of the transaction- of a clear exit and the confirmation, by e-mail, that the transaction has been completed are important e-commerce characteristics related to security.

Another basic characteristic of e-commerce systems is the security of electronic financial transactions. Five blocks of security have been identified [25], as far as Internet transactions are concerned. These are confidentiality, authentication, access control, data integrity and user’s accountability. For this purpose, means like digital certificates and the Secure Socket Layer (SSL) have been created and their role is to guarantee the security of transactions. The aforementioned means, using cryptographic methods, ensure the reliability of e-commerce systems and are meant to guarantee security of transactions, even in the case of system failure. While users are not aware of the existence of these security measures, it is the job of the developers to ensure the security of the customer is not breached while browsing the system. Another important characteristic of e-commerce systems, which should be provided to the user, is privacy of personal information. Certain users may want to limit the number of detailed personal information (such us buying habits, or financial resources) that they are required to provide to an e-commerce system, in order to complete a transaction. Others may allow the disclosure of personal information, only if they have access to the collected information, or may want to maintain a personal record and analysis of what personal information has been collected. A secured e-commerce system should provide the possibility of such actions.

C. Usability

Usability includes looking at, capturing, and stating requirements based around user interface issues, e.g., issues such as accessibility, interface aesthetics, and consistency within the user interface. It is defined as [10] a set of attributes that bear on the effort needed for use and on the individual assessment for of such use by a stated or implied set of users. According to ISO 9126 quality model, usability’s sub-characteristics are understandability, learnability and operability. Based on the definition, it is obvious that the quality factor of usability is related to characteristics of e-commerce systems, such as provision of accurate informative texts about products and services offered, as well as provision of thumbnails, photographs and videos presenting the services and products available. A well designed interface that attracts user’s attention and facilitate navigation, contributes to the usability of ecommerce systems [26]. Another important characteristic, related to usability, is easy and simple access to the web site of the virtual shop. Even an inexperienced user should be able to access and use the aforementioned services easily, while experienced users demand fast and easy access to the web pages that interest them, through clear paths (e.g., not having to pass through informative pages, such as the company’s history, or the company’s profile). Finally, a usable e-commerce system should enable the end user to adapt the web pages to his own personal profile and needs. Consequently, applications that process user profile and adjust the interaction based on one’s specific needs and preferences are desirable characteristics of ecommerce systems. The operability, attractiveness and understandability of all the aforementioned characteristics of e-commerce systems are important to the usability.

D. Reliability

Reliability is defined as [10] a set of attributes that bear on the capability of software to maintain its performance level under stated conditions for a stated period of time. Reliability includes aspects such as availability, accuracy, and recoverability, for example
recoverability of the system from shut-down failure. The reliability, as far as e-commerce systems are concerned, is related to the accuracy of the information (text, images, multimedia) provided about products and services, as well as the consistency of the services (shopping list, shopping cart, searching). The e-commerce system is reliable when it restores user transactions, even in the case of a system failure. The basic characteristic of e-commerce systems related to reliability is security of electronic financial transactions. Five blocks of security have been identified [25], as far as Internet transactions are concerned. These are confidentiality, authentication, access control, data integrity and user’s accountability. For this purpose, means like digital certificates and the Secure Socket Layer (SSL) have been created and their role is to guarantee the security of transactions. The aforementioned means, using cryptographic methods, ensure the reliability of e-commerce systems and are meant to guarantee security of transactions, even in the case of system failure. Another important characteristic of e-commerce systems, which should be provided to the user, is privacy of personal information. Certain users may want to limit the number of detailed personal information (such as buying habits, or financial resources) that they are required to provide to an e-commerce system, in order to complete a transaction. A reliable e-commerce system should provide the possibility of such actions [26].

E. Efficiency

Efficiency [10] is defined as a set of attributes that bear on the relationship between the software’s performance and the amount of resources used under stated conditions. Subcategories under reliability include the relation between time behavior and resource behavior. It can be the speed that a user finishes the tasks using the system and how many resources are allocated to finish the task. It is important to see efficiency from the user’s point of view rather than efficiency as a single interaction from the system. As an example, navigational elements such as the layout of keyboard shortcuts, menus and links plays a role on how fast can users finish their tasks. This example of efficiency somehow correlates to usability. It is important to make the right choices in designing the system for usability can also increase user’s efficiency. Based on the definition above it is argued that efficiency is also important to the quality of e-commerce systems. A system is efficient, if the user can access the relevant web pages promptly and easily. Additionally, navigation through the web pages should be completed at the minimum time possible, and access to the categories of products and relevant descriptive information (text and thumbnails) should be easy. Therefore, an efficient e-commerce system should rely on user personal profile, user preferences and other user information available [26].

4. Methodology

The purpose of this section is to explain the methodology used to gather end-user information on current online shopping websites. The purpose of this section is to provide a description of the research methodology, define sample selection and the steps taken by the research team in designing the data collections technique. Once completed, the methodology should be able to provide us with information that can be analyzed and a proper documentation on the results of the questionnaire will be provided in the next chapter. A survey with the use of questionnaires was used for this study. A survey from a sample population of adults who have ever or are still carrying out online shopping from different parts of Malaysia was administered. A survey can be described as a research methodology designed to collect data from a specific or a sample of a particular population, mainly using questionnaire or interview as the instrument of use [34]. The use of a survey is familiar with most adults however, an insight of the content and what the survey is about should be provided so that the participant may quickly realize if they are eligible for the research. Surveys are used to gather information from individuals about
various things, i.e. their preferences, personal information and also larger research areas in general. Sample surveys are crucial research tools for collecting and carrying out analysis from participants. Based on previous researchers, they are widely recognized as a key tool for conducting and applying basic social science research methodology. [35]

According to Leary [33], there are distinct advantages in using a questionnaire as compared to an interview. A questionnaire is cheaper and time effect in terms of being easy to administer in contrast to interviews. Interviews in most cases require an appointment; since an interview can’t be carried out with so many participants, they are more group administrator oriented and hence allowing confidentiality to be assured. [34] states that most surveys are extremely efficient at providing feedback in a relatively short period of time and at lower costs when mailed to participants. For these reasons, the research team chose to use the questionnaire approach so as to get much information from the end-user at the same time, minimizing costs. The research team used an online-based questionnaire whereby a link was sent to different shoppers in different parts of the world. The participants were meant to give feedback within a particular time period after which the link would be made unavailable. The collection of the necessary data was done with the use of a questionnaire where 25 questions were divided into two sections. The questions in the first section were to classify the demographic data related to age, gender, occupation level, income level, online shopping experience and whether the sample had purchased goods online in a multiple choice format. Questions in the second section were to ascertain whether particular quality attributes towards shopping online did raise concern amongst the online shoppers or not. The findings of this research will provide an analysis to customer satisfaction and online shopping based on various issues such as security, satisfaction, completeness, accuracy, efficiency and consistency.

5. Results and Discussion

In this section, we analyze the results of the questionnaire to evaluate the quality attributes of e-commerce. For this research objective, we have collected answers from 44 respondents. 75% of the respondents of this questionnaire are female, and 25% of the respondents are male. 34% of the respondents are students, 34% are employed, 23% are professionals, only 2% are self-employed, and 5% are retired workers. For this paper, we concentrate on the results from the students, employed and professionals. The age of the respondents concentrates between 24 and 41, which makes up 96% of the results, as seen on Figure 2.

![The distribution of age](image)

**Figure 2. The Distribution of Age**

In this survey, we also investigate the salary range of the respondents. From the results, we can see that the distribution is scattered, refer to Figure 3. Some of the online shopping websites that the users have experienced are Lazada, Groupon, Ebay, Zalora and etc. Based on the results, 55% of the respondents have experienced Groupon, and which makes it the most accessed online shopping website. 32% respondents have experienced
Lazada, 23% respondents have experienced Zalora, 20% respondents have experienced Ebay, and the remaining 45% respondents have selected other online shopping website. This shows that users’ online shopping website preference are scattered across many shopping websites, and no specific online shopping website can dominate the online market in Malaysia. For other online shopping websites, respondents have also included other websites, such as Taobao, Jingdong, Poplook, MyDeal, Mudah.my and Lelong.my.

![The salary range distribution](image)

**Figure 3. The Salary Range Distribution**

In e-commerce, security is considered a major quality factor. Some features that relate to security are HTTPS link, digital signature, data encryption. From this questionnaire, 73% of the respondents considered security as a deciding and significant factor, 20% respondents considered it is a small factor and only 7% respondents considered security not a factor. In this questionnaire, a total of 88% of the respondents are concerned with security, and 43% of the respondents are very concerned with security. Refer to Figure 4. However, 9% of the respondents who know they should be concerned, but they do not. Based on the results, we know that 98% of the respondents are concerned with security when they make purchases or do online banking over the internet. Among the concerned respondents, 55% respondents are very concerned security, as seen in Figure 3. Among the payment methods, there are 43% respondents choose credit/debit card, 64% respondents choose online banking, 27% respondents choose cash on delivery, 11% respondents choose PayPal. Hence, most users prefer to use online banking to do transactions over the internet as they consider it to be the most secure method of payment.
For this questionnaire, we mainly evaluate the operability of online shopping websites in terms of usability. Based on the results, the operability of e-commerce mainly refers to navigation, searching item, browsing catalog, editing item, etc. From the results, we can see that most users consider e-commerce systems are easy to use, refer to Figure 4. Most of the respondents find these e-commerce websites have easy website navigation, item searching functions, catalog browsing, adding items, removing items, and updating items from shopping carts to be very easy as seen in Figure 5.

In terms of reliability, we have analyzed that 80% of the respondents use their PC or laptops for online shopping. The second most preferred device is the smart phone, and the followed by tablet. 70% of the respondents prefer to use Google Chrome as their browser, which makes it the browser with the highest reliability rate. Second most preferred is Internet Explorer at 18%, and then followed by Mozilla Firefox and Safari, both at 14%. 82% of the respondents consider that the amount of content in the online shopping website is just right while 11% of the respondents considered that there weren’t enough content in the shopping website. 7% of the respondents considered that there were not enough content in the websites.

Most of the respondents prefer to browse the online shopping website at night, between 6PM to midnight. However, only 5% of the respondents browse the online shopping website in the early morning, between 1AM to 6AM. This helps us to determine when is most efficient to update and when to optimize the website for data traffic. When asked the easiness to follow the instructions of the website, 98% of the respondents do not find it difficult to follow the instructions of the website. On the efficiency of the user interface, almost all of the respondents find the interface of the website to be easy to use. Overall, 80% of the respondents have not faced any difficulties while doing the online shopping transactions. Some of the concerns that the respondents wish to have in the online shopping websites are more detailed item information and the inclusion of rewards and points for each purchase. Lastly, a new added feature that most of the respondents like to see is the comparison function between the website’s item and other competitor’s item.

Figure 4. The Degree of Concerned Security

![The degree of concerned security](image)

- Concerned security on internet
- Concerned security for purchases on internet
- Very concerned
- Somewhat concerned
- A little concerned
- No concerned

- Concerned security on internet: 43% very concerned, 14% somewhat concerned, 11% a little concerned, 2% no concerned
- Concerned security for purchases on internet: 55% very concerned, 27% somewhat concerned, 16% a little concerned, 2% no concerned.
6. Conclusion

In this paper, we illustrate the importance role of e-commerce for the development of our society. However, the development of e-commerce not only depends on the business environment, but also depends on the development and the techniques of web engineering and requirements engineering. In order to improve e-commerce development, we should resolve the challenges. It is sure that developing a high quality software system is a success factor for an online business. It is difficult for project team to get the correct and exact needs from the customers. There exist some communication problems, such as misunderstanding, communication problems, confusing requirements etc. To meet customers' requirements well, it needs to improve software quality in requirement phase, and identify software quality attributes which satisfy end-users. We discuss the quality attributes and sub-characteristics in requirement engineering process. There are four main activities in requirement engineering process as SQA activities in requirement phase: requirement elicitation, requirement analysis and documentation, requirement verification, validation and negotiation, management planning. There are five main quality factors related to the quality of e-commerce systems, which are functionality, security, usability, reliability and efficiency.

We design questionnaire to collect data for software quality attributes which can satisfy users. Then we analyze the results from the data collection. The results show that security, usability, reliability and efficiency are the main quality attributes related to requirement engineering process which play an important role in users’ satisfaction. However, there are some limits in this paper. First, the scopes of survey are limited. Second, the details of software quality attributes are limited. Third, this paper only focuses on the common quality factors which are possible to satisfy users, lack of comparison between different online shopping websites. In future work, we should expand the scope of survey. We should discuss and identify more relevant software quality attributes or factors that can satisfy users. Last, we should compare different online shopping websites in order to get more information of quality attributes.

References