Usability Evaluation Framework for E-commerce Websites in Developing Countries

by

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Certificate of Originality

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Abstract

The importance of evaluating the usability of e-commerce websites is well recognised and this area has attracted research attention for more than a decade.

Nearly all the studies that evaluated the usability of e-commerce websites employed either user-based (i.e. user testing) or evaluator-based (i.e. heuristic evaluation) usability evaluation methods; but no research has employed software-based (i.e. *Google Analytics* software) in the evaluation of such sites. Furthermore, the studies which employed user testing and/or heuristic evaluation methods in the evaluation of the usability of e-commerce websites did not offer detail about the benefits and drawbacks of these methods with respect to the identification of specific types of usability problems.

This research developed a methodological framework for the usability evaluation of e-commerce websites which involved user testing and heuristic evaluation methods together with *Google Analytics* software. The framework was developed by comparing the benefits and drawbacks of these methods in terms of the specific areas of usability problems that they could or could not identify on e-commerce websites.

The framework involves Google Analytics software as a preliminary step to provide a quick, easy and cheap indication of general potential usability problem areas on an e-commerce website and its specific pages. Then, the framework enables evaluators to choose other methods to provide in-depth detail about specific

problems on the site. For instance, the framework suggests that user testing is good for identifying specific major usability problems related to four areas: navigation, design, the purchasing process and accessibility and customer service, while the heuristic evaluation is good for identifying a large number of specific minor usability problems related to eight areas including: navigation, internal search, the site architecture, the content, the design, accessibility and customer service, inconsistency and missing capabilities. The framework also suggests that the heuristic evaluation is good at identifying major security and privacy problems.

The framework was developed based on an extensive evaluation of the effectiveness of the three methods in identifying specific usability problems in three case studies (e-commerce websites) in Jordan. This highlighted the usefulness of the methods and therefore helps e-commerce retailers to determine the usability method that best matches their needs.

The framework was tested and the results indicated the usefulness of the suggested framework in raising awareness of usability and usability evaluation methods among e-commerce retailers in Jordan. This will help them address usability in the design of their websites, thus helping them to survive, grow and achieve success.

Keywords: framework, usability evaluation, e-commerce websites, developing countries, Jordan, user testing, heuristic evaluation, Google Analytics.

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Chapter One: Introduction

1.1 Background of the research study

The technological advances of the 21st century have led to an increasing use of the Internet for commercial purposes (Kraemer *et al*. 2006). E-commerce has grown rapidly since the development of the first commercial website in 1994. It is predicted that the use of e-commerce will increase rapidly during the next few years, so that sales will reach over $300 billion by 2010 (Johnson 2005). Laudon and Traver (2002) also predicted that, in the future, e-commerce will have an impact on all commerce and that all commerce will be e-commerce by the year 2050 or thereabouts.

There are many definitions of e-commerce. In this research, the following definition is used for its appropriateness. Electronic commerce (EC) or e-commerce is "an emerging concept that describes the process of buying, selling, or exchanging products, services, and information via computer networks, including the Internet" (Turban *et al*. 2002).

1.1.1 Types of e-commerce

These are several types of e-commerce. The following are examples of the most common classifications:

- Business-to-business (B2B): This type is defined as e-commerce between companies; the buyer and the seller are businesses or other organisations

(Andam 2003; Chan *et al*. 2001). Approximately 80% of e-commerce is of this type (Andam 2003).

- Business-to-consumer (B2C): In this type, the seller is a business organisation while the buyer is a consumer (Chan *et al*. 2001). This type imitates physical retailing and therefore it is commonly called electronic retailing (Chan *et al*. 2001). It is the second largest and the earliest form of e-commerce (Andam 2003).
- Consumer-to-consumer (C2C): This type involves consumers who sell directly to other consumers (Turban *et al*., 2002). The online auction is one form of this type of e-commerce (Andam 2003).
- Consumer-to-business (C2B): In this type, the consumer determines his/her requirements to a business so that the business can provide a product to meet these requirements (Chan *et al*. 2001). The requirements could involve the customisation of an existing product or the creation of a new one.
- Government-to-citizens (G2C): This type involves a government buying or selling products, services or information to businesses or individual citizens (Turban *et al*. 2002).
- Mobile commerce (m-commerce): This type involves performing e-commence through wireless technology such as handheld devices (i.e. cellular telephones) (Turban *et al*. 2002; Andam 2003). Japan is the global leader in m-commerce (Andam 2003).

This research focuses on B2C e-commerce.

1.1.2 Advantages of e-commerce

E-commerce provides several advantages to business organisations and to consumers (Turban *et al*. 2002; Tassabehji 2003). Examples of the common potential benefits that e-commerce could offer to organisations include:

- Extending the marketplace of a business into national and international markets so that the business will have access to all people around the world (Turban *et al*. 2002; Tassabehji 2003).

- Reducing the cost related to creating, processing, distributing, storing and retrieving paper-based information by using electronic documents (Turban *et al*. 2002; Tassabehji 2003).
- Minimising supply chain inefficiencies such as excessive inventories, overheads and delivery delay (Turban *et al*. 2002; Tassabehji 2003).
- Allowing the customisation of products and services according to customers' personal requirements (Tassabehji 2003).
- Enabling companies to interact more closely with their customers (Turban *et al*. 2002).

Examples of the common potential benefits that e-commerce provides to consumers include:

- Allowing consumers to shop or perform other transactions at any time from any location (Turban *et al*. 2002; Chan *et al*. 2001; Tassabehji 2003).
- Providing consumers with more choices; many international vendors offer a wide range of products (Turban *et al*. 2002; Tassabehji 2003).
- Giving the consumers the opportunity to perform price comparison and to evaluate products and services in the global market (Turban *et al*. 2002; Tassabehji 2003).
- Improving the delivery process. For example, e-commerce allows instant delivery of electronic products (i.e. software products) or the use of online tracking to monitor the progress of a product being delivered (Tassabehji 2003; Turban *et al*. 2002; Chan *et al*. 2001).
- Providing consumers with relevant and detailed product information in seconds rather than days or weeks (Turban *et al*. 2002).
- Facilitating participation in virtual auctions so that sellers can sell products quickly and buyers can collect items quickly (Turban *et al*. 2002). It also provides the opportunity for consumers to interact with other consumers in electronic communities, to exchange ideas and to compare experiences (Turban *et al*. 2002).

1.1.3 Benefits of e-commerce to developing countries

Developing countries have realised the advantages of e-commerce and companies have set up e-commerce sites in order to reap the potential benefits provided by e-commerce (United Nation 2002). Most, if not all, developing countries are already involved in e-commerce as sellers or buyers (Andam 2003). Examples of the specific advantages e-commerce provides to small- and medium-sized enterprises (SMEs) in developing countries include offering them the opportunity to access international markets, which were difficult to access otherwise because of the high transaction costs (United Nation 2002; Molla 2005). E-commerce also allows companies to deliver labour intensive services online, such as software development (United Nation 2002); access cheaper and better quality services, such as finance or business information (United Nation 2002); and reduce the cost of some intermediaries (middlemen) since organisations depend on direct linkages with consumers and suppliers using electronic networks (Molla 2005).

1.1.4 Challenges of adopting e-commerce in developing countries

Unfortunately, developing countries have faced significant challenges which have affected the development and diffusion of e-commerce in those countries. Several studies were found in the literature that identified the challenges of adopting e-commerce in developing countries. Although these studies were conducted in different countries with different conditions, results from these studies indicated that there are a number of common challenges in the adoption of e-commerce. These challenges have been divided into:

- **Undeveloped technological infrastructure**: This barrier involves inadequate telecommunications infrastructure (Elbeltagi 2007; Kapurubandara and Lawson 2007; Lane *et al*. 2004), low speed of accessing the Internet (Travica 2002; Kshetri 2007) and low penetration of Personal Computers (PCs) (Kurnia 2006).
- **Payment and delivery barriers**: These involve a lack of credit card diffusion (Elbeltagi 2007; Kshetri 2007; Andam 2003) and underdeveloped transportation infrastructures which result in slow and uncertain delivery of goods (Andam 2003, Travica 2002).

- **Social and cultural barriers**: These involve customers' preference to touch and see a product to check its characteristics before purchasing (Elbeltagi 2007); customers' preference to shop from well-known sellers with a good reputation (Travica 2002); customers' preference to use sites written in their local language rather than English (Elbeltagi 2007; Kshetri 2007); lack of trust and concerns about the security and privacy of their information when shopping online; and lack of awareness and understanding of the value of e-commerce (Kurnia 2006).
- **Economic and political barriers**: These involve the high cost of Internet access (including connection service fees and communication fees) in comparison to low average income levels (Kshetri 2007; Kurnia 2006; Tigre 2003; Andam 2003) and unstable economic climates and changing regulations with each governmental change (Kapurubandara and Lawson 2007).
- **Human resources barriers**: These involve a lack of skilled human resources in information technology (Kapurubandara and Lawson 2007; Kurnia 2006; Lane *et al*. 2004; Andam 2003) and general and computer illiteracy (Kshetri 2007).
- **Legal barriers**: These involve a lack of legal frameworks or e-commerce regulations to control and protect Internet purchases (Kapurubandara and Lawson 2007; Kshetri 2007; Tigre 2003).

Although the current challenges of adopting e-commerce in Jordan are significant, as a developing country, Jordanian companies have developed e-commerce websites and have achieved relative success in their businesses (Obeidat 2001). The following sections provide an overview of Jordan.

1.2 Overview of Jordan

The Hashemite Kingdom of Jordan is located at the heart of the Middle East. The latest population estimate for 2009, according to the Department of Statistics in Jordan, is 5,929,161 (Jordanian Department of Statistics 2009). Jordan covers an area of 89,342 sq km (Internetworldstats [n.d.]), its capital is Amman and the official language of Jordan is Arabic, while English is also spoken.

Jordan, like other developing countries, faces challenges which influence the growth of the number of households which own a PC or which have a subscription to the Internet, as well as the number of Internet users. Examples of these challenges include the high cost of computers and the high subscription fees for Internet services (Meddeh 2008; Rochester 2009). The language of the Internet represents another challenge in Jordan as most of the sites are written in English and not in the local language of Jordan (Arabic); this makes Internet users uncomfortable with browsing and using English sites (Meddeh 2008; Rochester 2009).

During the last decade, however, Jordan has witnessed an improvement in the Information and Communication Technology (ICT) sector as a result of several initiatives. These initiatives were a response to King Abduallah II's intention to turn Jordan into the high-technology capital of the Middle East (Reach 1.0 2000). In 1999, a national ICT strategy, called the Reach initiative, was launched. The Reach initiative outlined a five-years (2000-2004) clear action plan to support Jordan's IT sector, to maximise its ability to compete in local, regional and global markets, and to ensure a favourable place for Jordan in the Internet-based economy (Reach 1.0 2000). The plan specified the actions that should be implemented by the private sector, the government and other stakeholders. As a result of the Reach initiative, the ICT sector expanded rapidly, a number of innovative sites started up, and the demands on the labour force increased. However, despite the efforts of the Reach initiative, Jordan's ICT sector fell below the Reach targets (Anima 2008). For example, in late 2007, Jordan's ICT workforce remained at 16,000 instead of 23,000, as targeted by the Reach initiative, the Internet penetration (the number of people who use the Internet) was around 11%, PC ownership was only 7.1% and ADSL penetration was less than 1% (Anima 2008). The ICT sector of Jordan also suffers from "brain-drain" in which high Gulf salaries attract talented ICT staff (Anima 2008). Despite the fact that approximately 5000 ICT students graduate each year, skilled labour can be difficult to find.

To obtain further growth in the ICT sector in Jordan, the Ministry of Information and Communication Technologies (MOICT) issued a new ICT national strategy in 2007 which involved three objectives to be achieved in five years (National ICT Strategy of Jordan 2007-2011 2007). These objectives include increasing the size of the ICT sector to $3 billion, increasing the employment in the

ICT sector to 35,000, and increasing Internet penetration to 50% (National ICT Strategy of Jordan 2007-2011 2007).

In order to achieve the new national strategy, the government reduced the sales tax on Internet related services from 16% to 8% to help extend Internet services and to increase the number of Internet users in Jordan (Meddeh 2008). The government is also planning to reduce this sales tax to zero, as well as the tax on computers (McCullagh 2009). Also, the government, in partnership with the private sector, created a new initiative: a laptop for every university student (McCullagh 2009). A student can buy a laptop without paying a tax on it and can spread the payment over four years at a cost of approximately $15 per month. Furthermore, the Jordanian government has equipped all the schools in Jordan with computers and Internet connection. The government is working on building a fiber-optics network which will reach all the schools in Jordan to provide all the villages with Internet services (McCullagh 2009).

The telecommunication services in Jordan have also witnessed improvements due to the increased competition among Internet Service Providers (ISPs). This has resulted in reducing the prices of Internet services provided by the ISPs and broadening the range of services offered by them (Business Monitor International 2009). Currently, there are at least ten ISPs in Jordan which provide telecommunication services such as ADSL and leased lines (Business Monitor International 2009). ADSL is the most widely used telecommunication in Jordan and is expected to remain so for the next couple of years (Arab Advisors Group 2008). Due to the lowering of ADSL prices in Jordan, the country had over 102,200 ADSL line subscribers in 2008 (Jordan Telecom Group 2008). The percentage of Jordanian households which now have an ADSL subscription has increased to reach 11%, which represents 75% of all Internet subscriptions (Arab Advisors Group 2008; Rochester 2009). The ISPs in Jordan also provide wireless connection services such as WiMAX. An example of an ISP company which provides WiMAX is Kulacom Jordan. This is the latest company in Jordan to launch a WiMax-based broadband service and this network, after its launch, covered over 30% of the population of Amman (the capital of Jordan) (Business Monitor International 2009). It is expected that the WiMax services will help to achieve the government's target of 50% Internet user penetration by the end of 2012 (Arab Advisors Group 2008).

Fortunately, the national ICT strategies adopted in Jordan have increased both the number of Internet users and Internet penetration rates substantially since 2001. The number of Internet users has grown from 238,000 in 2001, which represents a penetration rate of 4.8% of the Jordanian population, to reach 1,500,000 in 2008; this represents a penetration of 26% (The Jordanian Telecommunications Regulatory Commission [n.a.]). The latest statistics also show that Internet penetration has increased to reach 36% in 2009; this growth is expected to continue (Rochester 2009). The number of e-commerce users in Jordan was estimated to be more than 198,000 in 2008 (3.42% of the total population) and those users spent a total of $181.2 in e-commerce transactions between November 2007 and November 2008 (Arab Advisors Group 2008).

1.3 Earlier e-commerce research in Jordan

There have been relatively few studies in Jordan regarding e-commerce. The focus of those that have been undertaken has been limited to identifying the challenges of adopting e-commence, reviewing how Jordan has adapted to some of the challenges, or recommending infrastructural changes to moderate the effect of these challenges. For example, three studies have been conducted in Jordan which reviewed the challenges faced by companies in Jordan while adopting e-commerce (Sahawneh *et al.* 2003; Sahawneh 2002; Obeidat 2001). These studies agreed that Jordanian companies are facing a number of barriers which affect the diffusion of e-commerce in Jordan and clarified the reasons for limited buying and selling through the Internet there. The identified barriers were: lack of cooperation between the public and private sectors, lack of payment systems, lack of awareness of the basics and importance of e-commerce (among individual and enterprises), lack of trust, the high cost of PCs, the high cost of connecting to the Internet, lack of training, cultural resistance, an absence of legislation and regulations that govern e-commerce transactions, lack of knowledge, and the weakness of e-commerce companies in promoting e-commerce efficiently.

Overcoming the challenges of adopting e-commerce in Jordan was also identified in earlier studies that were conducted there. The focus was on overcoming the challenges of the lack of payment systems, and the lack of legislation and regulations. To overcome the challenge of the lack of payment systems, Sahawneh

(2002) discussed how some Jordanian banks have issued special cards for online shopping, in addition to credit and visa cards. These are called Internet Shopping Cards (ISCs) and were specifically designed to provide convenient and easy access to on-line shopping, with small limits in Jordan. Also, in another study, Sahawneh (2005) discussed how a Jordanian company called e-dimension had developed a secure payment gateway to support online payment in Jordan. E-dimension is a subsidiary of the Jordan Telecom Group (JTG). It launched Jordan's first e-payment gateway service in 2003 to allow customers to pay their bills fully or partially on-line. The National Bank of Jordan supported the e-payment gateway as the acquiring bank for credit card payments. E-payment has secured layers, including a 1024 bit SSL, and has many security options to protect communications and to avoid fraud through online transactions (e-dimension [n.d.]; Jordan Times 2003; Global research telecommunications 2006).

To overcome challenges regarding the absence of legislation and regulations that govern e-commerce transactions in Jordan, Sahawneh (2005) investigated the effect of the electronic transaction law on e-commerce enterprises in Jordan. The electronic transaction law was issued in Jordan in 2001 to regulate e-commerce. This law is based on the United Nations' Commission on International Trade Law (UNCITRAL), the model law on e-commerce, which was developed in 1996. The electronic transaction law covers electronic transactions, electronic records, electronic signatures, any electronic data messages, and electronic transactions approved by any government department or official institution, in whole or in part. Sahawneh (2005) found that the electronic transaction law was one of the incentives for Jordanian Small and Medium Enterprises (SMEs) to develop e-commerce.

There has been a lack of research in Jordan, however, to suggest how e-commerce companies, which have already adopted e-commerce, can deal with the current challenges by improving their existing e-commerce websites in a way that will improve their success. Obviously, in order to improve the current situation of e-commerce websites in Jordan, important factors affecting the survival and success of e-commerce websites need to be investigated and addressed. Ease-of-use is one of the most important characteristics of websites, especially those provided by e-commerce organisations (Najjar, 2005).

1.4 Usability of e-commerce websites

Nielsen and Norman (2000) stressed the importance of making e-commerce sites usable. They do not regard good usability as a luxury but as an essential characteristic if a site is to survive. Nielsen (2003) explained the reasons behind this when he stated that the first law of e-commerce is that, if users are unable to find a product, they cannot buy it.

1.4.1 Awareness of e-commerce usability

Awareness of e-commerce usability is important since unusable websites will lead shoppers to abandon these sites, resulting in a loss of their sales. Forrester Research estimates that bad web design will result in an approximate loss of 50 percent of potential sales from visitors who cannot find what they want on the site, and a loss of 40 percent of repeat visits from visitors who had an initial bad experience with the site (Nielsen 1998). According to the results of the GUV (Graphic, Visualization, & Usability) Center's 9th WWW user survey, which covered over 10,000 web users from different countries, users reported three main reasons for leaving a website during shopping (Schaffer and Sorflaten 1999). These were: not being able to find the product, a confusing or disorganised site, and a slow download speed of pages. Schaffer and Sorflaten (1999) also indicated that bad usability prevents novice users from purchasing or reduces the number of products purchased by them.

1.4.2 Advantages of usable e-commerce websites

Research has offered some advantages that can be gained if the usability of e-commerce websites is considered or improved. Nielsen and Norman (2000) indicated that addressing the usability of sites could increase the percentage of visitors who purchased from a site and who could then turn into frequent and loyal customers. Lohse and Spiller (1998) also stated that designing an effective interface for an e-commerce website (i.e. an interface that enables users to find what they want) has a significant influence on traffic and sales. Tedeschi (1999) illustrated this with a real example using the IBM company. He proved that sales from the IBM website increased by 400% after the website was redesigned and its usability was improved (Tedeschi 1999).

An investigation into the current situation of e-commerce companies in Jordan was undertaken by the researcher in 2006-2007. The investigation revealed that e-commerce in Jordan is still in its infancy and there was an opportunity to improve the usability of those e-commerce websites. In retrospect, it was thought to be worthwhile to conduct a research study in Jordan that would raise awareness among e-commerce companies regarding how to investigate and improve the usability of their e-commerce websites by clarifying explicitly the role of specific usability methods in identifying usability problems. This would encourage e-commerce companies to employ specific usability methods in order to improve the usability of their websites. Therefore, this would help e-commerce companies in Jordan to survive and grow in the challenging environment.

1.5 Aims and objectives

The aim of this research was to develop a methodological framework to investigate the usability of e-commerce websites in Jordan. The proposed framework will include the examination of traffic flows and the use of usability testing to identify usability problem areas.

The specific objectives for the research were:

1. To use three different approaches to evaluate a selection of e-commerce websites from three different perspectives: evaluators, users and software tools. Using these approaches, the aim is to:
   a) Assess to what extent the three selected e-commerce websites have conformed to usability principles.
   b) Measure how real users interact with the three selected e-commerce sites and the actual actions that were taken by them on the sites.
   c) Track visitors' interactions with the three selected e-commerce sites.
2. Based on objective 1, to identify the main usability problem areas and opportunities for improving performance.
3. Based on objective 2, to determine which methods were the best in evaluating each usability problem area.
4. To create a framework to identify how to evaluate e-commerce sites in relation to specific areas.

1.6 Thesis outline

Chapter Two:

The aim of this chapter was to review previous studies which have contributed to the area of this research. This chapter reviews the following areas: usability and usability evaluation methods, the usability of e-commerce websites, design issues for e-commerce websites, and the effectiveness of usability evaluation methods in identifying usability problems.

Chapter Three:

The aim of this chapter was to discuss the research methods used in this study. This chapter presents an overview of the research philosophy, together with the design and the methods employed in this research. Justifications for selecting these concepts were also summarised in this chapter. The chapter then summarises the data collection techniques that were employed to collect the data and how the data obtained from using the techniques were analysed.

Chapter Four:

The aim of this chapter was to present the qualitative and quantitative findings obtained from the different methods employed in the research. The chapter summarises the lists of common usability problems identified by each method across the three cases (the e-commerce websites) involved in this research. The chapter also summarises the overall usability of the sites obtained from the analysis of each method.

Chapter Five:

The aim of this chapter was to illustrate the usability problem areas identified by the usability methods used in this research. The ten common usability problem areas (themes) that resulted from the analysis of the methods used in this research were used to structure this chapter. The effectiveness of each method in identifying specific usability problems related to each area is reviewed under each of the ten usability problem areas.

Chapter Six:

The aim of this chapter was to describe a proposed framework to evaluate the usability of e-commerce websites. The chapter summarises the cost of employing

the methods used in this research. Then, the chapter presents the suggested framework and summarises the results of testing its usefulness. Finally, the chapter explains an enhancement for the suggested framework.

Chapter Seven:

The aim of this chapter was to discuss the results obtained from the data analysis (i.e. Chapters Four, Five and Six) by referring to the literature review. The focus of the discussion in this chapter is to illustrate the value added by those findings to the literature. The discussion includes how the aims and objectives of this research have been accomplished.

Chapter Eight:

The aim of this chapter was to review the conclusions of this research study. The chapter explains how the aims and objectives of this research have been accomplished. Then the chapter summarises both the limitations of this research and the recommendations for future study.

Chapter Two: Literature Review

This chapter presents an overview of usability, together with an examination of common usability methods that can be used to evaluate the design of a user interface; the effectiveness of various usability evaluation methods is also presented. First of all the chapter reviews definitions of usability. The chapter then reviews common methods that can be used to evaluate the usability of websites before reviewing literature that considers how such methods have been used in the evaluation of e-commerce websites. This is followed by a summary of the literature that highlights the effectiveness of usability evaluation methods.

2.1 Introduction

The root of usability is in the field of Human Computer Interaction (HCI), which is a broad field related to all the aspects and ways in which people interact with computers (Stone *et al*. 2005). HCI has been defined as "A discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them" (Hewett *et al*. 2008). HCI encompasses many disciplines, including computer science, psychology, sociology, ergonomics and industrial design (Hewett *et al*. 2008; Stone *et al*. 2005). Humans interact with computers through a user interface. The design of this user interface and, specifically, the usability of the interface is a core area in the field of HCI (Gray and Salzman 1998). The concept of usability has been defined

and measured differently by different authors so the following section presents the concept of usability and reviews some definitions and measures of usability.

2.2 Definitions of usability

Nielsen (2003) indicated that usability is one of the most important attributes of any user interface and measures how easy the interface is to use. Others have indicated that: "Usability measures the quality of a user's experience when interacting with a product or system, whether a website, a software application, mobile technology, or any user-operated device" (Usability.gov [n.d.]).

Nielsen (2003; 1993) also stated that usability is not a single attribute; instead usability is defined in terms of five characteristics:

- Learnability: The system or product is easy to learn so that users can perform tasks the first time they interact with the interface.
- Efficiency: The system or product is efficient to use so that once users have learned the system, they will perform tasks quickly.
- Memorability: The system or product is easy to remember so that if users return to the system after a period of not using it, they can use it easily.
- Errors: The system or product has a lower error rate so that users make few errors while interacting with it and they can easily recover from these errors.
- Satisfaction: The system or product is pleasant to use and users are subjectively satisfied while using it.

Alternatively, Brinck *et al*. (2001) defined usability as "the degree to which users can perform a set of required tasks". They also indicated that usability is the product of several design goals, including the five attributes already indicated by Nielsen (2003; 1993), in addition to another goal named 'functionally correct'. This attribute means that the system or product provides the required functionality so that users can do what they need/want to do. Brink *et al*. (2001) explained that the design goals of usability are sometimes in conflict and therefore the priority given to these design goals is determined with regard to the context of the design. Sharp *et al*. (2007) added effectiveness and safety to the list of usability design goals/attributes; effectiveness means that the system or product is effective to use

and good at doing what it is supposed to do so that users can carry out their work accurately and successfully; safety means that the system or product is safe to use so that it protects users from dangerous conditions and undesirable situations.

These definitions indicate that usability is defined in terms of a set of attributes or design goals of a system/product. However, the International Standards (ISO 9241-11 1998) provide a broader definition of usability, stating that: "Usability is the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use" (ISO 9241-11 1998). This definition encompasses three important elements that describe the usability of any product: specified users, specified goals and specified context of use. ISO 9241-11 emphasises that the usability of a product is dependent on the context of use which includes users, tasks, equipment (hardware, software and materials), and the physical and social environment, all of which may influence the usability of a product. The ISO 9241-11 definition also indicates that three measures can be used to measure the extent to which a product is usable in a particular context. These three measures are effectiveness and efficiency (which measure the performance), and satisfaction.

2.3 Usability Evaluation Methods (UEMs)

Usability evaluation methods are a set of methods used to evaluate human interaction with a product; they are aimed at identifying issues or areas of improvement in this interaction in order to increase usability (Gray and Salzman 1998). These methods are one of the hallmarks of User-Center Design (UCD) (Lazar 2006). UCD is an approach and philosophy for designing and developing usable products and systems that place the user at the centre of the process (Rubin 1994). The UCD approach is based on receiving user feedback during each step of the design process (Rubin 1994). Obtaining such feedback can involve a variety of usability methods at any step of the design process (Rubin 1994; Pearrow 2000).

A variety of usability evaluation methods have been developed to identify usability problems. These methods have been categorised differently by different authors. For example, Nielsen and Mack (1994) classified usability evaluation methods into four general categories: automatic (this involves the use of software to evaluate a user interface), empirical (involving real users who interacted with a user

interface), formal (incorporating the use of models to evaluate a user interface), and informal (where evaluators use rules in addition to their skills, knowledge and experience to evaluate an interface). Alternatively, Gray and Salzman (1998) used two categories to describe such methods: analytic and empirical. The analytic aspect includes techniques such as heuristic evaluation and cognitive walkthrough, while empirical techniques include methods and procedures referred to as user testing.

In this research, the most well-known usability evaluation methods were classified into three categories in terms of how the usability problems were identified: for example, by users, evaluators or tools. This stems from the aims and objectives of this research which attempts to investigate and compare the usability problems identified from these three different perspectives.

2.3.1 Evaluator-Based usability evaluation methods

This category includes usability methods that involve evaluators in the process of identifying usability problems. These methods were called usability inspection methods by Nielsen and Mack (1994) who defined these as a set of methods based on having evaluators inspect or examine the usability aspects of a user interface. These methods are aimed at finding usability problems that users might encounter while interacting with an interface and then making recommendations to improve the usability of the interface. The following are some of the most well known methods in this category, which can be used to evaluate the usability of a user interface, including websites:

Heuristic evaluation

Heuristic evaluation is a usability method developed by Nielsen and Molich (1990). This method involves having a number of evaluators assess the user interface and judge whether it conforms to a set of usability principles (namely 'heuristics') (Nielsen and Molich 1990). Nielsen (1994) identified a set of ten usability heuristics which were: visibility of system status, match between the system and the real world, user control and freedom, consistency and standards, error prevention, recognition rather than recall, flexibility and efficiency of use, aesthetic and minimal design, helping users to recognise, diagnose and recover from errors, and help and documentation.

Some researchers, however, indicated that the original set of heuristics developed by Nielsen were too general and were too vague for evaluating new products such as web products because they were designed originally to evaluate screen-based products; they were also developed several years before the web was involved in user interface design (Sharp *et al*. 2007; Pearrow 2000; Brinck *et al*. 2001). Consequently, new heuristics were developed specifically for evaluating websites. For example, Nielsen (2000) suggested the following heuristics which he called HOMERUN: high quality content, often updated, minimal download time, ease of use, relevant to users' needs, unique to the online medium, and adhering to net-centric corporate culture.

However, despite the criticism of Nielsen's ten heuristics, it is worth mentioning that researchers advised including them as part of the design guidelines to evaluate usability of websites (Brinck *et al*. 2001, Sharp *et al*. 2007). For example, Sharp *et al.* (2007) advised evaluators who might wish to develop specific heuristics to evaluate websites to develop their own by tailoring Nilesen's heuristics (or usability principles) and by referring to other resources, such as design guidelines, market research and new research findings.

Pluralistic walkthrough

This is a usability inspection method that involves a group of evaluators, including representative users, developers and usability experts, evaluating a user interface by "walking through" the steps of a task scenario (Hollingsed and Novick 2007; Nielsen and Mack 1994). The group discusses the usability issues of an interface related to each step in a scenario (Nielsen and Mack 1994). The scenarios are presented in the form of a number of screens which represents a single path through the interface (Sharp *et al*. 2007).

As indicated by Hollingsed and Novick (2007), this method is defined by five characteristics: the involvement of various participants: representative users, developers and usability specialists; the interface screens are displayed during the evaluation in the same order in which they would be displayed in a web or computer interface; all the participants are asked to assume the role of a user; for each screen, participants write down what actions they, as users, would select in performing the

task and add their feedback in detail; finally, during the discussion of each screen, the representative users are those who speak first.

One of the benefits of the pluralistic walkthrough is related to the fact that it provides feedback from users who are directly involved in the evaluation (Hollingsed and Novick 2007). Another benefit is that it focuses on users' tasks (Sharp *et al*. 2007). However, this method has its limitations: for example, it is difficult to get all the participants together at once and then work at the rate of the slowest (Sharp *et al*. 2007). Also, only a few scenarios, and therefore paths through the interface, can usually be investigated because of time constraints (Sharp *et al*. 2007; Hollingsed and Novick 2007).

Research which has investigated the use of this method recently notes that this method is still used as a usability expert/inspection approach although usability experts continue to perform users-only walkthrough without their involvement (Hollingsed and Novick 2007).

Cognitive walkthrough

Cognitive walkthrough is a usability inspection method that focuses on evaluating whether an interface is easy to learn through exploration (Wharton *et al*. 1994). This method still appears to be in continual use although it was developed in the early nineties, because of its effectiveness; it is used in the evaluation of different interfaces including web-based applications (Hollingsed and Novick 2007).

This method involves a team of evaluators who evaluate an interface by "walking through" one or more specific representative tasks and their related steps/actions, step-by-step. The team usually involves developers, designers and programmers (Fichter 2004). For each step, the team attempts to offer a reasonable response or "story" to each of four questions determined by Wharton *et al*. (1994) (see Table 2.1) explaining why users would choose the correct action to perform the task (Spencer 2000; Fichter 2004). If the story cannot be told then suggestions for correcting the problems are noted (Fichter 2004).

Table 2.1: Four questions from Wharton *et al.* (1994)

Will the user try to achieve the right effect?
Will the user notice that the correct action is available?
Will the user associate the correct action with the effect that user is trying to achieve?
If the correct action is performed, will the user see that progress is being made toward the solution of the task?

The cognitive walkthrough method is useful for obtaining a large number of design ideas from the team members who usually have different backgrounds and perspectives (Fichter 2004). Also, this method focuses on users' problems in detail even though users do not need to be involved (Sharp *et al*. 2007). However, the major drawback of this method relates to the fact that it can be time consuming and tedious (Fichter 2004; Holzinger 2005). Furthermore, the selection of task scenarios can be difficult since, if the scenario is not appropriately described, then this results in an ineffective evaluation (Hollingsed and Novick 2007).

It is worth mentioning that Spencer (2000) suggested a modified cognitive walkthrough process called a streamlined cognitive walkthrough because he indicated that the original cognitive walkthrough method might be difficult to use in the evaluation of software in a large software development company. This is because of the social constraints faced by team members in the company such as time pressure, very long discussions concerning the design, and the fact that some team members might try to defend their design during the cognitive walkthrough process. Therefore, the suggested streamlined cognitive walkthrough can overcome such social constraints and provide useful data. This can be achieved by avoiding design discussion, defusing design defensiveness, and streamlining the method and data collection (Spencer 2000). The streamlined cognitive walkthrough method uses only two questions, instead of the four questions suggested by Wharton *et al*. (1994), in the evaluation of each step in the task analysis. See Table 2.2.

Table 2.2: Two questions from Spencer (2000)

Will the user know what to do at this step and if he/she has done the right thing?
Will the user know that he/she has done the right thing and is making progress towards his/her goal?

Guideline reviews

This is a usability method which contains comprehensive guidelines and involves checking an interface for conformance with these usability guidelines. This method is similar to the heuristic evaluation method, except for the length and details of the guidelines used by evaluators; heuristic evaluators use a short list (of less than a dozen items) while guideline reviewers use a longer and more detailed list (with several dozen or more guidelines) (Lazar 2006; Gray and Salzman 1998). Some organisations and companies have specific design guidelines (e.g. Microsoft design guidelines for Windows O.S) which can include hundreds of design rules (Lazar 2006). Therefore, this kind of review takes a long time to accomplish and hence is not commonly performed, in contrast to the heuristic review (Lazar 2006).

Consistency inspections

This is a usability method where an expert reviews all of the web pages on a site to ensure that its design is consistent in terms of layout, terminology and colour (Lazar 2006). This method could also be used to inspect consistency across multiple sites, examining, for example, whether common functions look and work in the same way across these sites (University of Minnesota Duluth [n.d.]). The consistency of an interface is important because inconsistent interfaces could reduce users' performance and satisfaction, thereby increasing the error rate, as indicated by Lazar (2006).

Standards inspection

Standards inspection is a usability method that involves an expert examining whether an interface complies with certain interface standards which are followed by other systems in the same market (Nielsen and Mack 1994). The standards are usually written in formal language and therefore, in order to perform this type of inspection, an expert who is familiar with the standard and its language is required (Stone *et al*. 2005). An example of a usability standard that can be used as a reference is the ISO 9241 (Stone *et al*. 2005). ISO 9241 includes requirements and recommendations regarding the attributes of the hardware, software and the environment which contribute to their usability and the ergonomic principles relating to them (Cost-Effective User Centred Design 2001).

2.3.2 User-Based usability evaluation methods

This category includes a set of methods that involves users. These methods aim to record users' performance while interacting with an interface and/or users' preferences or satisfaction with the interface being tested. The most common method in this category relates to user testing. The other methods are either variations of a user testing approach or supplementary techniques that could be used with a user testing method. The following section presents the most common methods in this category which can be used to evaluate the usability of websites:

User testing

The user testing method is considered to be the most important and useful approach since it provides direct information regarding how real users use the interface; it illustrates exactly what problems users encounter in their interaction (Nielsen and Mack 1994). Dumas and Redish (1999) defined the user testing method as "a systematic way of observing actual users trying out a product and collecting information about the specific ways in which the product is easy or difficult for them". Different supplementary techniques have been suggested for use during a user testing session, such as making different types of observation (e.g. notes, audio, video or interaction log file) to capture users' performance; questionnaires and interviews have also been suggested as ways of collecting data concerning users' satisfaction (Nielsen 1993; Sharp *et al*. 2007; Dumas and Redish 1999; Rubin 1994).

Capturing user performance can be automated using tools such as Camtasia. Camtasia is a screen capture software package, provided by TechSmith Company, that has proved to be an effective tool for capturing website usability data (Goodwin 2005). Camtasia records users' activities on screen (i.e. users' actions and movements that take place on the computer screen); it also has the capability to record users' voices along with their actions if a microphone is used (Goodwin 2005). Camtasia files, which include videos of each recorded session, are saved in Audio Video Interleaved (AVI) format that can be then compressed and played again to review and interpret users' actions with the interface being tested. Goodwin (2005) stated that Camtasia software is the best method for acquiring usability data in terms of minimising data loss and avoiding the bias of human recorders. This

therefore helps to reduce the workload of the observer during the user testing session.

Think-Aloud method

This is a user testing method with a condition: the condition of asking users to think aloud during their interaction with an interface (Lazar 2006; Nielsen 1993). Nielsen (1993) indicated that having users verbalising their thoughts using this method allows an understanding of how users view or interpret an interface; it also facilitates the major misconceptions of users to be identified. Holzinger (2005) indicated that this method might be the most valuable usability testing method. However, the think-aloud method has some disadvantages related to the fact that the test setting, with an observer and recording equipment, will not represent a natural setting; this therefore will not encourage users to act and talk naturally (van den Haak and de Jong 2005).

Constructive interaction (also known as co-discovery learning)

This method is a think-aloud method with one condition: the condition of having two users (instead of a single user) interacting with an interface together or working together to complete specific tasks (Holzinger 2005; Nielsen 1993). The main advantage of employing this technique is that the test situation is much more natural in comparison with the think-aloud tests because people are used to verbalise their thoughts when trying to solve a problem together (Holzinger 2005; Nielsen 1993). Therefore this technique is an appropriate usability testing method for testing an interface if the users are children because it is difficult for children to follow the standard think-aloud method (Nielsen 1993).

Holzinger (2005) indicated that by using the constructive interaction method, more comments may be obtained from users in comparison to the think-aloud method. This method is most suited to situations where it is easy to obtain a large number of users and where it is comparatively cheap for users to be recruited because it requires twice as many test users as the single-user thinking aloud technique (Nielsen 1993). However, the unnatural settings which are associated with the think-aloud method also constitute one of the drawbacks of the constructive interaction method.

It is worth mentioning that, despite the difference in the number of participants between the think-aloud and constructive interaction methods, research has found that these methods provided similar results in terms of the number and type of problems identified (van den Haak *et al*. 2004). These results therefore would encourage the think-aloud method to be employed in preference to the constructive interaction approach since the latter incurs the cost of recruiting the second participant to obtain the same results (van den Haak *et al*. 2004).

Retrospective testing

This is a user testing method that involves video-recording users' sessions and then collecting their comments while reviewing the recording (Lazar 2006; Nielsen 1993). While users are reviewing the tape, they may provide additional comprehensive comments in comparison to comments they made when working on the tasks; the experimenter can also stop the tape and ask users for more detailed information (Nielsen 1993).

This method has the advantage of gaining more information from each test user as indicated by Nielsen (1993). However, this method takes at least twice as long. Therefore it is not suitable for use if the users are highly paid or perform critical work which means that they are unable to spend long on the activity (Nielsen 1993).

Questionnaires and interviews

Different types of questionnaire (i.e. closed or open) and interviews (i.e. unstructured, semi-structured or structured) are considered useful and simple techniques that collect data regarding users' satisfaction with, or preferences on, a user interface, such as the features and the presentation of websites (Bidgoli 2004; Sharp *et al.* 2007; Rubin 1994). These could be used as supplementary techniques to the user testing method or they could be used alone.

However, if these techniques are used alone then they are considered as indirect usability methods because they do not study the user interface directly; instead, they reflect users' opinions about that interface (Holzinger 2005; Nielsen 1993). Dumas and Redish (1999) also indicated that surveys cannot be used to observe and record actual users' interactions with an interface but can be used to collect information regarding users' opinions, attitudes and preferences, as well as

self-reported data concerning behaviour. Therefore, data about users' actual behaviour should have precedence over users' preferences since users' statements cannot always be taken at face value (Holzinger 2005).

Furthermore, these techniques have other disadvantages: for example, a sufficient number of responses are needed to obtain significant results in the case of questionnaires (Holzinger 2005). Interviews can also be very time consuming for both the interviewer and the participants, and the quality of the information that is collected depends on the interviewer's experience in performing interviews (Lazar 2006). It is worth mentioning that using e-mail and online questionnaires allow preference data to be gathered quickly from small or large and/or dispersed users (Bidgoli 2004; Macro 2000). However, the response rate for questionnaires is typically low (Bidgoli 2004).

Focus groups

This is an informal method for collecting in-depth information regarding the needs, judgments and feelings of typical users about an interface (Nielsen 1993; Rubin 1994; Dumas and Redish 1999). In a focus group, about six to nine users discuss selected topics, such as the different functions and features of a website, with the assistance of a moderator, and then identify issues during their interaction.

This method allows diverse and relevant issues to be raised; it brings out users' spontaneous reactions, comments and ideas through their interaction (Sharp *et al*. 2007; Nielsen 1993). For example, it can provide information regarding what functions of the website have problems or are undesirable; it also allows discussion concerning how these problems can be solved (Bidgoli 2004). However, although this technique captures users' opinions and satisfaction, it does not measure users' actual interactions with an interface (Macro 2000; Nielsen 1993; Dumas and Redish 1999).

The focus group can also be conducted online and this can provide the same information as a face-to-face focus group (Macro 2000). Online focus groups have the advantage of eliminating distance and travel costs for both participants and the moderator and enables information from participants from different geographical locations to be collected (Macro 2000). However, participants must have computer access and a basic level of computer literacy; also, the moderator will not be able to

observe the facial expressions and body language of the group participants (Macro 2000).

2.3.3 Tool-Based usability evaluation methods

Rather than employing experts or users to evaluate the usability of an interface, software tools can be used to do this. The following section presents these methods.

Software tools: automatic usability evaluation

This method is related to tools that automatically assess whether a website conforms to a set of specific usability guidelines (Brinck *et al*. 2001). Most of these tools assess the quality of the HTML code of a website with regard to a number of guidelines. For example, they check if the images on a website's pages include the ALT attribute. Therefore, these tools are similar to the expert review/inspection methods (Lazar 2006). Most focus on the accessibility of a site rather than its general usability (Lazar 2006).

One of the best known of these tools is Bobby (Stone *et al*. 2005). The original Bobby tool was a free public web accessibility testing tool provided by the Centre for Applied Special Technology (CAST). It examined the source of a site to check its compliance with accessibility guidelines including Section 508 of the U.S Rehabilitation Act and the W3C'c Web Content Accessibility Guidelines. Later, in 2004, Bobby software was sold to Watchfire which provided the same free service in the WebXACT tool (Wikipedia [n.,d.]). However, Watchfire was then acquired by IBM in 2007 and consequently, in 2008, the Bobby tool was discontinued as a free tool or standalone product (Wikipedia [n.d.]; CAST [n.,d.]). It is now one of the tests included within the IBM Rational Policy Tester Accessibility Edition software (IBM [n.,d.]).

Software tools: transaction log file and web analytics tools

The transaction log file is related to tools that automatically collect statistics regarding the detailed use of systems, including websites. The server log file was developed originally to capture technical information concerning server performance (i.e. server error (404 error)) (Kaushik 2007). This method is also considered as an indirect observation method which helps to analyse users'

behaviour and which allows researchers to understand how users have worked on the tasks (Sharp *et al*. 2007).

Researchers suggested that the log file could be used as a supplementary technique to the user testing method or it could be used alone to collect data concerning the usage of system for a specific period (Nielsen 1993; Sharp *et al*. 2007; Dumas and Redish 1999). However, as log files, specifically web server log files, started to get larger and non-technical people became interested in the data captured by such files, scripts were programmed that automatically analysed the large-sized log files and thus web analytics tools were officially born (Kaushik 2007). The first documented log analyzer (GetSites) was written in June 1993 at Honolulu Community College (Website Measurement [n.d.]). The log file is one of the most common data sources of web analytics; however, there are other sources used by these tools such as page-tagging (JavaScript tagging) and network based approaches. The following section outlines web analytics tools and outlines other data sources used by these tools.

2.4 Web Analytics

This section offers a definition of web analytics and provides an overview regarding data sources of web analytics.

2.4.1 Definition of web analytics

Web analytics is an approach that involves collecting, measuring, monitoring, analysing and reporting web usage data to understand visitors' experiences (Web Analytics Association [n.d.]; Norguet 2004; McFadden 2005). Analytics can help to optimise the websites in order to accomplish business goals and/or to improve customer satisfaction and loyalty (Web Analytics Association [n.d.]; Norguet 2004; McFadden 2005). The optimisation process could concern any part of the website such as: content, product, navigation, the internal search, or the purchasing process (McFadden 2005).

2.4.2 Data sources of web analytics

There are six web traffic data sources of web analytics which are: server-based log file, client-based page-tagging, server plug-ins, web beacons approach, hybrid method and network based approach. However, the two most common methods

among all these data sources are: the server-based log file and the client-based page-tagging (JavaScript tagging) approaches.

Server-Based log file method

This method was the first data source used by web analytics tools. It involves the use of a server's log file to collect data. Each visitor's request, by typing a URL in a browser, results in a log entry created by the web server (Malacinski *et al*. 2001; Peterson 2004). The requested page is then sent from the server to the visitor's browser. The log entry is a piece of captured data that contains detailed information about the requested resource (Malacinski *et al*. 2001; Kaushik 2007). Examples of the most common data collected by web server log files regarding requests for information coming to a web server are shown in Table 2.3, adapted from Peterson (2004).

Table 2.3: Common data collected by web server log file. Source: Peterson (2004)

Request Property	Explanation
Resource requested	The actual file being requested via http-protocol, such as html, gif, jpg, or pdf
Date	Date of the request based on the serve time
Time	Time of the request based on the sever time
Client IP Address	IP address of the browser making the resource request
Referrer	The URL containing the link to the resource being requested
Server Name	Name of the web server serving the resources
Server IP	IP address of the web server serving the resources
HTTP Status	Numerical values describing the web server response. Common code includes '200' which means ok and '404' which means file not found.

The following reviews the most common advantages and disadvantages of this data source.

Advantages of the server log file method

- Ownership of data: As the log file is generated by the web server, all data are collected and kept on the web server itself. This facilitates accessing historical data at any time (Malacinski *et al*. 2001; Peterson 2004; Kaushik 2007).

- Ease of implementation: Logging capabilities are part of every web server process so the log files do not need additional setup to collect data (Peterson 2004; Kaushik 2007).
- Measurement of complete-downloaded data: The log file has the ability to report if non-html objects (i.e. executable files and pdf documents) have been successfully downloaded (Peterson 2004; Kaushik 2007).
- Capturing data from robots and spiders: The log file is the only data-capturing method that has the ability to capture and store visits to a site from robots and spiders. This helps in finding out if a site is indexed correctly (Peterson 2004; Kaushik 2007).

Disadvantages of the server log file method

- Page caching: The use of a caching technique (proxy and browser caching) causes the loss of requests to the server pages. This is related to the fact that the Internet Service Provider (ISP) and the visitor's browser keep a copy of the requested page on these machines (the ISP machine in the case of proxy caching and the user's hard drive in the case of browser caching) when this page is first requested over a period of time. When another request to the page occurs, then the page is served from the proxy server or from the hard disk, not from the web server (Peterson 2004; Kaushik 2007). Therefore the log file will not have an entry for the download.
- Inaccuracy in identifying unique visits: This is related to the fact that this method uses the IP address to identify unique visitors; this is inaccurate for many reasons. One reason is related to the common use of proxy servers which connect many users to a web server. The request of these different users, through the proxy servers, will be considered as only one request of one IP address; this is the address of the proxy instead of the IP address of the users' machines (Peterson 2004; Kaushik 2007). Therefore, the number of unique visits appears lower than the real value. Another example is the fact that an increasing number of users are assigned dynamic IP addresses by Internet Service Providers (ISPs) (Kaushik 2007). Those users will be counted multiple times which inflates the number of unique visitors.

- Including visits from search robots or indexing applications: Robots, spiders and crawlers frequently visit sites and therefore a non-user entry is inserted in the web server log file. This can cause significant inflation to the number of traffic and page requests (Peterson 2004; Kaushik 2007).

Client-Based approach- JavaScript tagging

Kaushik (2007) indicated that while the log file technique was used widely as a data source for web analytics, the disadvantages of using this approach were noticed by both web analytics vendors and customers. These challenges led to the emergence of page-tagging techniques as a new source for collecting data from websites. The page-tagging (JavaScript) technique involves collecting information by page view and not by hits, which is the method used by the log-file (Malacinski *et al*. 2001). It involves adding a few lines of script (JavaScript code) to the pages of a website to gather statistics from them. The data are collected when the pages load in the visitor's browser as the page tags (JavaScript code) are executed. This code captures information about the viewed page (i.e. a visitor's session) and sends this to a data collection centre. In most cases, the data collection centre is related to the web analytics vendor's servers (outsource vendors) where the data can be processed with reporting available online (Malacinski *et al*. 2001; Peterson 2004; Kaushik 2007).

An example of a web analytic tool that uses the page-tagging approach and which had a major effect on the web analytics' industry is *Google Analytics* (Kaushik 2007). In 2005 Google purchased a web analytics firm called Urchin software and subsequently released *Google Analytics* (GA) to the public in August 2006 as a free analytics tool. The major advantages and disadvantages of the page-tagging approach follow.

Advantages of the JavaScript tagging approach

- Accuracy: Researchers have stated that this method is typically much more accurate than web server log files (Peterson 2004; Kaushik 2007). The accuracy of this method of collecting data is due to several reasons: the data are collected directly from the users and not from the web server; most page tags that determine the uniqueness of a visitor are based on cookies; this method is not influenced by the cache technique because it collects information from every page as the code is executed every time the page is

viewed, regardless of where the page was served; and most of the requests from non-human user agents (such as search engines, indexing spiders and crawlers) are excluded from the measurement and reporting because these user agents do not execute the JavaScript page tags (Peterson 2004; Kaushik 2007).

- Real time reporting: This method has the ability to report data in real time or nearly so, which is quicker than the log file technique. The reason for this related to the fact that this method, unlike the log file technique, does not involve parsing a large-size log file periodically (i.e. monthly or weekly) to generate the necessary reports (Peterson 2004). Usually, once the data is collected, it is processed quickly and is translated into information that is available via reporting in a short time (Malacinski *et al*. 2001; Peterson 2004).
- Lower cost: This method does not require hardware to be purchased or expert people to be hired in order to maintain the hardware and software as, in most cases, the data are collected and processed externally by vendors rather than internally by the company's IT department (Peterson 2004; Kaushik 2007).

Disadvantages of the JavaScript tagging approach

- Dependence on JavaScript and cookies: This method depends on JavaScript and cookies for collecting data. Therefore, if visitors disable one or both of these technologies, then no data will be collected from those visitors. This influences the quality of the information that is collected (Peterson 2004; Kaushik 2007).
- Limited types of collected data: Unlike the web server log files, this method is limited in its ability to collect some data such as successful downloads of file types (pdfs, executables), error pages or redirecting (Peterson 2004; Kaushik 2007).
- Ownership/security of data: Unlike the web server log file, the data collected by this method are stored on web analytics vendors' servers. This could cause problems. For instance, limited length of time to keep the collected data as some vendors will not store the data for a site forever because of the

cost of disk space and database storage (Peterson 2006). Also, if an online business changes the vendor then there is another problem of storing and keeping historical data since there is no standard format to import data from one vendor to another (Peterson 2006). Security of the data collected by this method is another issue which should be taken into consideration as data collected and processed externally on vendors' web servers.

Other uncommon data sources of web analytics

There are four other data sources used by web analytics tools which are less common in comparison with the server log file and JavaScript tagging approaches. These sources include:

- **Server plug-ins (also called server monitors):** This method involves the use of server plug-ins which are integrated with the web server through a native Application Programming Interface (API) to monitor the events of the server (Sen *et al*. 2006). This method may also involve the use of application plug-ins in order to monitor the events of an application (i.e. data entry of the forms included in a web page) (Sen *et al*. 2006).
- **Web beacons approach:** This method is a type of client-based or page-tagging approach. It involves inserting transparent images into a web page to gather statistics from it using a special html tag (img src) instead of adding JavaScript code (as is the case with the JavaScript tagging approach). The data are collected, as noted by Kaushik, when these pages are loaded on the visitor's browser as this executes a call for the image from a third-party server and subsequently sends data about the page to the third-party server (Kaushik 2007). Then the third-party server sends the image back to the visitor's browser with a code that can read cookies and capture the visitor's data (i.e. the IP address and/or the time the page was viewed). This data-capturing mechanism was developed to capture information regarding banner ads and was specific for companies that run similar banner ads across many websites (Kaushik 2007).
- **Hybrid method:** This method is a recent method that combines both the web server log file and client-side page tagging approaches. This was created in order to take advantage of these two approaches (Peterson 2004).

Clifton (2008) indicated that by combining these two methods, the approach can use the advantages of one and avoid the disadvantages of the other. For example, this hybrid method takes advantage of the page-tagging approach in terms of providing a powerful and accurate way of capturing data by collecting them using page tagging; it also takes advantage of the log file as it offers flexibility and the ownership of data by using an in-house software solution (Peterson 2004).

- **A Network based approach:** This method involves the use of network or packet sniffers to monitor the data flow between a web server and a web client (visitors' web browsers) (Peterson 2004; Sen *et al*. 2006). A packet sniffer is software that can be installed on the web server. Alternatively, it can be hardware that is linked to a data centre; it captures all traffic and passes it to the web server (Kaushik 2007).

2.5 Evaluating the usability of e-commerce websites

Despite the importance of good usability in e-commerce websites, few studies were found in the literature that evaluated the usability of such sites. Those that were found employed usability methods that involved either users or evaluators in the process of identifying usability problems. This section reviews these studies.

Tilson *et al*.'s (1998) study is one that involved users in evaluating the usability of e-commerce websites and was aimed at investigating those factors that affect the usability of such websites. The researchers asked sixteen users to complete tasks on four e-commerce websites (two of these sites sold clothing and two sold products) and report what they liked and disliked, as well as what would encourage or discourage them from purchasing a product on each site. Major design problems encountered by users while interacting with the sites were identified and, based on them, the researchers provided suggestions for improving the usability of e-commerce sites.

Tilson *et al*. (1998) did not use the observation method despite its importance in identifying actual users' interaction with sites and despite the fact that it is the most efficient technique to evaluate the usability of such sites (Benbunan-Fish 2001). The study conducted by Freeman and Hyland (2003) also involved users in evaluating and comparing the usability of three supermarket sites that sold multiple

products. However, they employed observation as a user testing method followed by a post-test questionnaire. The results proved the success of the user testing method in identifying various usability problems on the three sites based on the observations and users' preferences; these results were used to establish guidelines for improving usability.

Other studies have involved evaluators using the heuristic method to evaluate the usability of e-commerce websites (Chen and Macredie 2005). Chen and Macredie (2005) employed this method to investigate the usability of four electronic supermarkets. The heuristic guidelines that were used included the ten heuristics developed by Nielsen (mentioned in Section 3.4.1) in addition to three new heuristics: support for and extending the user's current skills, pleasurable and respectful interaction with the user, and protection of personal information. Criteria were developed for each heuristic to facilitate a detailed evaluation of the sites. A checklist was also developed from the set of criteria to obtain quantitative results regarding the seriousness of each interface's usability problem. The results demonstrated the usefulness of the heuristic evaluation method regarding its ability to identify a large number of usability problems (weaknesses) and a large number of good design features (strengths) of the sites.

Barnard and Wesson (2003; 2004) employed both the user testing and heuristic evaluation methods together to investigate and identify usability problems and also to determine design issues that were of high significance for e-commerce sites in South Africa from the perspective of both experts and users. They developed a comprehensive set of e-commerce design guidelines that were used as heuristics by web experts to evaluate the usability of e-commerce sites. Several usability problems were identified by experts and users by means of employing heuristic evaluation and the user testing method (using post-test questionnaires) on the selected South African e-commerce sites which proved the success of these methods in identifying a comprehensive set of usability problems. Then, significant usability problems were identified by considering the positive correlation between the problems identified by each method. The authors indicated that these addressed design issues that should be taken into consideration when designing any e-commerce site in South Africa.

However, these studies considered only the post-test questionnaire in order to identify usability problems from the users' points of view. Also, the heuristic guidelines that were developed concentrated on the usability of e-commerce transactions (i.e. category pages, product pages, customer support) and placed less focus on general usability guidelines, such as content and navigation, which must be included in order to design usable e-commerce websites, as indicated by earlier studies (for example, Nielsen 2000; Sharp *et al*. 2007; Pearrow 2000; Brinck *et al*. 2001; Najjar 2005).

It is worth mentioning that the earlier studies reviewed above which evaluated the usability of e-commerce websites are similar in the fact that, based on their results, and regardless of the method they employed to evaluate usability, they suggested a framework or a set of usability design guidelines and recommended the use of them to design and evaluate e-commerce websites (Tilson *et al*. 1998; Freeman and Hyland 2003; Chen and Macredie 2005; Barnard and Wesson 2003; Barnard and Wesson 2004). Examples of these design guidelines include: effective categorisation of products, detailed information about products, obvious order links, an obvious and accessible running total of the shopping cart, a visible and usable search function, and a clear method for product selection (Tilson *et al*. 1998; Freeman and Hyland 2003; Chen and Macredie 2005).

These results are a valuable source of guidelines in the design of usable e-commerce websites. The literature is also rich in other sources that provided valuable information regarding important design issues in the context of designing a usable e-commerce site. The next section reviews research that focused on these issues.

2.6 Design issues for e-commerce websites

Design issues for websites have been reviewed extensively in the literature; these explain how to design usable websites (Nielsen 2000; Sharp *et al*. 2007; Pearrow 2000; Brinck *et al*. 2001) and the researchers indicate that good design is an aspect of good usability (Pearrow 2000). In the context of e-commerce websites, various studies have contributed to the literature by identifying detailed design issues that should be included for e-commerce sites. These studies can be divided into three types. The first type relates to studies that have investigated design features of

specific e-commerce websites that influence users to purchase from these sites. The second type concerns studies that have identified design criteria that have been developed with the aim of evaluating e-commerce websites, while the third type relates to studies that have investigated the relative importance of design issues in the design of usable e-commerce websites.

2.6.1 Preferable characteristics of e-commerce sites from users' viewpoint

Different studies have been conducted on different types of e-commerce websites, in terms of the type of products provided by these sites, in order to identify the design characteristics that influence the online purchase behaviour of their users. These studies, which adopted different investigative approaches, resulted in the identification of important design characteristics from the viewpoint of users. For example, Claudio and Antonio ([n.d.]) developed a model by adapting the Technology Acceptance Model (TAM) to identify the design characteristics of CD e-retailing websites that would influence a user's intention to buy from these sites. Other studies compiled a set of design issues and used them to investigate which were preferable for users. The websites that were investigated included chocolate websites (Oppenheim and Ward 2006), food and drink websites (White and Manning 1998), clothing and product websites (Tilson *et al*. 1998) and supermarket websites (Freeman and Hyland 2003).

Although the studies identified above investigated different types of e-commerce website, there were a number of common design features preferred by users for inclusion in the sites. Examples of the common features included:

- Ease of use, ease of navigation and finding products (Claudio and Antonio [n.d.]; Tilson *et al*. 1998; Freeman and Hyland 2003).
- Simple and successful search facilities (Tilson *et al*. 1998; Oppenheim and Ward 2006; Freeman and Hyland 2003).
- Customer service or help functions (Tilson *et al*. 1998; Oppenheim and Ward 2006).
- Secure sites (Tilson *et al*. 1998; Oppenheim and Ward 2006).
- Site support and personalisation/customisation (White and Manning 1998; Oppenheim and Ward 2006).

- Pleasurable/interesting sites (Claudio and Antonio [n.d.]; Oppenheim and Ward 2006).
- Attractive/innovative sites (Claudio and Antonio [n.d.]; White and Manning 1998).

Furthermore, additional design issues were identified uniquely by each study. Some of these issues related to the ability to purchase without registering with the site (Tilson *et al*. 1998); the availability of multilingual options; the clear provision of error messages on pages providing feedback on users' input (Oppenheim and Ward 2006); and the need for a fun, useful, clear, concise and informative design (White and Manning 1998).

2.6.2 Design criteria for evaluating e-commerce websites

Earlier research that developed design criteria and used them in evaluating e-commerce websites are important sources for identifying design criteria. However, some of these studies did not use design criteria alone in evaluating e-commerce websites; instead, the criteria were used as part of an instrument/method that was proposed to evaluate e-commerce websites. For example, Elliott *et al.* (2000) developed a general design framework to evaluate commercial websites; this is the Centre for Electronic Commerce (CEC) website evaluation framework. This framework aims to evaluate a website and compare it to other sites in different industries to identify areas for improvement. It includes key characteristics and facilities of e-commerce sites. Davidson and Lambert (2005) indicated that studies that developed a design framework for evaluating websites in various industries, including Elliott *et al*.'s study, included broad categories with very little detail. These broad categories did not explain in detail the areas for improvement on the site being evaluated.

In contrast, Davidson and Lambert (2005) developed a specific B2C website design framework that aimed to evaluate Australian winery websites rather than e-commerce sites in a variety of industries. This framework includes ten categories and 65 elements. However, the authors reported some limitations of this framework related to the fact that customers were not asked to report additional issues/features that they required in the design but which were not included in the framework's elements. Also, the authors indicated that this framework was designed according to

the needs/requirements of local Australians. Therefore, these customers did not consider a currency converter or foreign language as important characteristics in the developed framework; consequently these elements were not included despite their importance to potential overseas customers. To conclude, despite the fact that the specific e-commerce framework developed by Davidson and Lambert (2005) includes a large number of design elements, it can be used only to evaluate some websites that specifically sell wine and that are located in Australia.

Oppenheim and Ward (2006) also developed comprehensive criteria to evaluate e-commerce websites. Although these criteria were used to evaluate ten chocolate websites, results proved that these criteria could be used to achieve a comprehensive evaluation of any e-commerce site. The developed criteria included eight categories and 125 statements. Interestingly, these criteria indicate factors/features that are critical for e-commerce sites. Such indications can be noted since Oppenheim and Ward (2006) developed two five-point scoring systems for use by the evaluators. The first ranged from -2 to 2 (-2,-1,0,1,2) and the second ranged from -4 to 4 (-4,-2,0,2,4). The second scoring system was suggested for use with very important factors where the level of importance was determined by the literature. Therefore, the statements associated with the second scoring system are the most important factors which could be selected when developing design guidelines for e-commerce sites. However, despite the fact that the developed criteria are comprehensive and can be used to evaluate the effectiveness of websites in terms of their design features, using these criteria in the evaluation has limitations. Oppenheim and Ward (2006) stated that one of the criteria's limitations related to the involvement of personal judgment which made the criteria subjective. This was inferred based on inconsistencies in the evaluators' results. The reason for this relates to the fact that different users usually have different preferences, which indicates that a website designer will never be able to satisfy the preferences of all the users at the same time (Oppenheim and Ward 2006).

Similarly, Van der Merwe and Bekker (2003) developed a framework of criteria which included 100 items for carrying out a comprehensive evaluation of e-commerce websites. The method developed aimed to evaluate e-commerce websites and to compare the performance of a site with other sites in the same industry. The method involves three steps and requires at least three evaluators to carry out the

evaluation. Step one involves collecting input data for each site by evaluating each site using the 100 criteria and then presenting them in a two-way contingency matrix. Step two involves performing a corresponding analysis of the data presented in the matrix and presenting the results graphically. Step three involves interpreting the results and making recommendations.

Hung and McQueen (2004) developed criteria and instruments to evaluate e-commerce websites from the viewpoint of first-time buyers. This was different from the previous studies mentioned above with regard to two issues. The first is that the developed criteria were based on a proposed model, which explains how an e-commerce website can satisfy its first-time buyers, while the second issue is that the developed instrument not only included criteria, but also included specific web functions (i.e. customer support, privacy policy). These web functions represent the required information or functions that should be included in any e-commerce website to support users' activities while performing any transaction process. Therefore, the authors suggested using the developed criteria to check to what extent an e-commerce site supported users' activities, instead of checking to what extent an element of the criteria is included in the design of the tested site.

Although all the criteria reviewed in this subsection used a different number of categories with different names, and had different elements and categorisations of the design elements of each category, they included common design issues or elements. These related to company information, product information, transaction/order, customer service, security and privacy, and payment/financial information (Elliott *et al*. 2000; Davidson and Lambert 2005 ; Oppenheim and Ward 2006; Van der Merwe and Bekker 2003; Hung and McQueen 2004). Also, these criteria included other design issues such as content, navigation and aesthetics that had been recommended in earlier studies for the design of a usable website in general (for example, Nielsen 2000; Sharp *et al*. 2007; Pearrow 2000; Brinck *et al*. 2001; Najjar 2005).

2.6.3 Designing usable e-commerce websites

The previous two subsections provided an outline of the design characteristics that are important and that need to be included in the design of e-commerce websites. However, they did not indicate the relative importance of these issues in the design

of a usable site. This subsection reviews studies that have investigated certain design criteria and determines which of these criteria are important and which are less so for the usability of e-commerce websites from the point of view of users.

The study conducted by Pearson *et al*. (2007) investigated the importance of five design criteria in the evaluation of the usability of an e-commerce site from the viewpoint of 178 web users. These criteria related to navigation, download speed, personalisation and customisation, ease of use and accessibility. The results showed that the five criteria were significant predictors of website usability from the point of view of website users. Ease of use and navigation were the most important criteria in determining website usability, while personalisation and customisation were the least important.

Tarafdar and Zhang (2005) investigated the influence of six web design issues on the usability of websites using different criteria related to information content, ease of navigation, download speed, customisation and personalisation, security, and availability and accessibility. The investigation was carried out by two web users only who evaluated a total of 200 websites using the six design factors. These sites were selected from five different domains: portals and search engines, retail, entertainment, news and information, and financial services (40 sites in each industry). Interestingly, the results showed that the four design factors that influenced website usability were: information content, ease of navigation, download speed, and availability and accessibility. However, the results showed that security and customisation did not influence a website's usability. The findings of this study could be explained by two issues: the first is the limited number of evaluators (only two) and the second is the fact that retail sites accounted for only 40 of the 200 sites that were investigated. This could explain why security was not considered important when this feature was found to be one of the most important features of e-commerce websites for users in earlier studies (for example, Tilson *et al*. 1998; Oppenheim and Ward 2006).

2.7 Effectiveness of usability evaluation methods (UEMs)

Earlier studies agreed that despite the fact that usability evaluation methods have a similar aim, which is to identify usability problems that prevent users from interacting easily with an interface, these methods varied with regard to the number

and type of problems identified by them and the cost of employing these methods. This section outlines earlier research that has investigated the effectiveness of user-based, evaluator-based and software-based usability evaluation methods in identifying usability problems. The empirical findings of these comparative methodological studies highlighted which methods were more effective in identifying usability problems with regard to a number of criteria: the number of usability problems, the type of usability problems, and the cost of employing each method. This section reviews findings in terms of the identified criteria.

2.7.1 Number of problems identified by UEMs

Earlier research was undertaken that compared the number of problems identified by evaluator-based and by user-based usability evaluation methods. This section outlines the findings of these studies with regard to the number of unique and common usability problems and the number of major and minor usability problems identified by employing these usability methods.

2.7.1.1 Number of unique and common usability problems

Consensus was found between studies which compared evaluator-based UEMs (heuristic evaluation or cognitive walkthrough methods) with user testing that evaluator-based methods identified uniquely a larger number of usability problems than user testing (Doubleday *et al*. 1997; Fu *et al*. 2002; Desurvire *et al*. 1992a, 1992b; Law and Hvannberg 2002). For example, Doubleday *et al*. (1997) reported the results of their study that employed a methodological comparison between heuristic evaluation and user testing for evaluating an information retrieval interface. They found that heuristic evaluation identified 86 usability problems while user testing identified only 38. A total of 39% (15 out of 38) of the usability problems identified by user testing were not identified by the heuristic evaluation and about 40% (34 out of 86) of usability problems identified by the heuristic evaluators were not identified by user testing.

Similarly, Fu *et al*. (2002), who compared the effectiveness of the user testing and heuristic evaluation methods, found that heuristic evaluation identified the largest number of problems in comparison with user testing. Results showed that there were 39 distinctive usability problems identified by users and experts. The heuristic evaluation identified 87% (34 out of 39) of problems, while user testing

identified 54% (21 out of 39) of problems. Of the problems identified by heuristic evaluation, 18 (46%) were unique and 16 (41%) were problems found to be in common with user testing. The problems noted using user testing included 5 (13%) that were unique and 16 (41%) that were in common with the heuristic evaluations.

The study undertaken by Desurvire *et al*. (1992a, 1992b) differed in its aim from the two studies reviewed above but agreed with them in the sense that heuristic evaluation was more effective than user testing in identifying a large number of usability problems. This study employed two usability evaluation methods (heuristic evaluation and cognitive walkthrough) using three groups of evaluators with various levels of experience (usability specialists, non-experts and software engineers) to evaluate a telephone-based interface. The number of participants in each of the six groups (the three groups of evaluators who were assigned to the two afore-mentioned methods) was three. They compared the results of these evaluations to results acquired from user testing. This study aimed to find out what contribution was made by each of the employed methods and what would be missing if these methods were employed instead of user testing. Results indicated that experts using heuristic evaluation were more effective in predicting usability testing problems than the cognitive walkthrough method, as they predicted the highest percentage of these problems. These problems were less than half of the problems identified in the user testing 44% (11 out of 25) and varied in their severity (minor problems that caused annoyance or confusion, problems that caused errors, and problems that caused task failure). However, the evaluators identified a large number of usability problems that were not identified in the user testing including potential problems and problems that represented improvements to the interface. Experts using heuristic evaluation and cognitive walkthrough identified the highest percentages of potential problems and experts using heuristic evaluation identified the highest percentages of improvements to the interface.

Two issues are worth mentioning regarding the study of Desurvire *et al*. (1992a, 1992b). The first is that the evaluators who evaluated the interface and predicted its usability problems used a paper flowchart that was organised for each task of the study. This might have a negative influence on their ability to predict usability problems as they did not interact with the interface. Secondly, the validity of this study was questioned by Gray and Salzman (1998). Gray and Salzman

(1998) indicated that the study of Desurvire at al. (1992) had two validity problems: low statistical power and a selection problem. This study used too few participants (three participants per group) and the same software development engineers evaluated the same tasks using two methods (heuristic evaluation and cognitive walkthrough).

2.7.1.2 The number of major and minor usability problems

All the studies mentioned above did not explain the distribution of usability problems identified by evaluator-based and user testing methods in terms of their seriousness: i.e. major and minor problems. This issue was discussed in other studies with various findings (Jeffries *et al*. 1991; Law and Hvannberg 2002; Tan *et al*. 2009; Molich and Dumas 2008).

Jeffries *et al.* (1991) in their study compared three evaluator-based methods with user testing methods in their evaluation of a user interface for a software product. The evaluator-based methods were heuristic evaluation, guideline reviews, and cognitive walkthrough. It is worth mentioning that Gray and Salzman (1998) criticised the fact that Jeffries *et al* claimed to use the heuristic evaluation method in their study. This is because four usability specialists evaluated the interface based on their own experience rather than using specific guidelines. Gray and Salzman (1998) suggested that this method should be considered as an expert review rather than as heuristic evaluation. Jeffries *et al.* (1991) found that their defined heuristic evaluation identified a larger number of serious and minor problems (improvement) in comparison with the two other evaluator-based methods (guidelines and cognitive walkthrough) and user testing.

Jeffries *et al.*'s study indicated the following results regarding the number of very severe problems identified by the four methods: heuristic evaluation identified the largest number of these problems (28), followed by user testing (18), then guidelines (12), and finally cognitive walkthrough (9). Concerning the number of less severe problems identified by the four methods in this study, it was found that heuristic evaluation also identified the largest number of these problems (52), followed by guidelines (11), then cognitive walkthrough (10), and finally user testing (2). This study suggests that heuristic evaluation and user testing were the best methods for identifying major problems, and the three evaluator-based methods

were better than user testing in identifying minor problems; thus, heuristic evaluation was the best among them.

The authors of the previous study clarified and stressed the limitations of their findings regarding the large number of problems (serious and minor) identified by heuristic evaluation in comparison with user testing in another study (Jeffries and Desurvire 1992). They warned of the use of the heuristic evaluation method as a substitute for usability testing and explained that each method has its own strengths. The most important limitation of their studies was that all the evaluators involved in the heuristic evaluation were usability professionals. Recruiting such experts was not an easy task as they are considered a scarce resource. Another limitation was that several evaluators carried out the heuristic evaluation and therefore a single evaluator would produce less robust results. In addition, they mentioned certain benefits of the user testing method, such as its ability to identify problems faced by real users; some problems identified by user testing cannot be uncovered by heuristic evaluation. It is worth mentioning that the heuristic evaluators were given a two-week period to complete their evaluation. This might explain the larger number of problems identified by them in comparison to user testing.

Gray and Salzman (1998) criticised the design of the study conducted by Jeffries *et al*. (1991) saying that it had many validity problems. Examples of some of these problems were: low statistical power due to the use of a small number of participants per group (between 3 to six participants), lack of statistical analysis, and internal validity problems related to differences in the skills and experience of the participants assigned to each group (i.e. usability specialists and software engineers). Another problem was the high variation in the conditions/settings of each group; the heuristic evaluation group evaluated the interface over two weeks while the user testing group was given three hours training on the interface and then conducted the user testing for three hours; it appeared that guidelines and cognitive walkthrough groups assessed the interface in one sitting.

By contrast, Law and Hvannberg (2002), who compared the effectiveness of heuristic evaluation and usability testing in the evaluation of a universal brokerage platform, reported results different from those in the study carried out by Jeffries *et al*. (1991) regarding the distribution of major and minor problems identified by these methods. Results indicated that, despite the fact that a larger number of

usability problems was identified by heuristic evaluation than was identified by user testing, more unique major problems were identified by the latter method. The heuristic method, however, was better at uniquely identifying minor problems compared to user testing. A total of 43 problems were identified using heuristic evaluation: 25 major and 18 minor. A total of 39 problems were identified by user testing: 31 major and 8 minor. The distribution of major problems identified by heuristic evaluation was 16 common and 9 unique major problems while there were 3 common and 15 unique minor problems. User testing identified 16 common and 15 unique major problems and 3 common and 5 unique minor problems.

Tan *et al*. (2009) compared the efficiency and effectiveness of user testing and heuristic evaluation and also provided different results compared to the previous research reviewed above. They evaluated four commercial websites that were divided into two groups The first included two websites that had an average number of usability problems while the second included two websites that had a high number of problems. They found that the heuristic evaluation identified about 60% of the problems across the two groups of sites, the user testing identified 30% of problems, and 10% of the problems were identified by both the methods. On the basis of severity, where three severity levels were used (severe, medium and mild), the results showed that the two methods identified similar respective proportions of usability problems of the severe, medium and mild types.

Although heuristic evaluation failed to identify some major problems identified by user testing, because experts with their high levels of knowledge cannot act like actual users (Doubleday *et al*. 1997; Fu *et al*. 2002 and Simeral and Branaghan 1997), the results obtained from the study by Law and Hvannberg (2002) should not be interpreted as indicating that heuristic evaluation concentrated on finding minor rather than major problems. Nielsen (1992) explained this issue when he reported the results of evaluating six interfaces using heuristic evaluation; this identified a total of 59 major and 152 minor usability problems. Nielsen (1992) indicated that heuristic evaluation is likely to find significantly higher percentages of major usability problems than minor ones as the probability of finding major problems is higher than finding those that are minor. However, because interfaces will have a larger number of minor problems than major ones, the minor problems will represent the highest proportion of problems found by any heuristic evaluation.

Nielsen also indicated that the minor problems identified by heuristic evaluators might represent real problems even if these were not identified during user testing. He gave an example of a consistency problem that might not be observed in user testing, but which might slow down the user while interacting with an interface. Other studies also stressed that all usability problems uncovered by heuristic evaluation are genuine problems in the interface and recommended correcting them (Doubleday *et al*. 1997).

By contrast, some studies claimed that heuristic evaluation misidentified some usability problems by identifying issues that, if implemented/corrected in the evaluated design, would not improve its usability (Simeral and Branaghan 1997; Jeffries and Desurvire 1992; Bailey 2001). These issues were called false alarms. Producing false alarms was considered one of the weaknesses of heuristic evaluation (Simeral and Branaghan 1997).

Based on the claim of these false alarms, Bailey (2001) criticised heuristic evaluation and indicated that this method identified more false alarms than actual usability problems; it also missed some usability problems. Bailey (2001) summarised the results of three previous studies that included comparisons of usability testing and heuristic evaluation methods in terms of the problems identified by each. He reported that by comparing problems identified by heuristic evaluation with problems identified by user testing it was found that heuristic evaluation identified 36% of actual usability problems (serious and minor), missed identifying 21% of problems, and reported 43% of issues that did not represent usability problems (i.e. false alarms). Therefore, Bailey (2001) concluded that: “for every actual usability problem identified by heuristic evaluation, there will be more than one false alarm (1.2) and approximately half a missed problem (0.6)”. He indicated that heuristic evaluation might lead to changes being made in a design that would not improve its performance; some of these changes might even have new usability problems.

Regarding the claim of false alarms being made in heuristic evaluation, Law and Hvannberg (2002) tried to find evidence for this. In their study, they raised questions regarding whether the minor problems that were not confirmed by user testing represented false alarms or whether the participants were unable to identify them. However, the researchers did not confirm or come to the definite conclusion

that the heuristic evaluation method produced false alarms or misidentified usability problems.

The findings of Molich and Dumas (2008) were in contrast to all the studies reviewed above regarding the number and seriousness of usability problems identified by user testing and evaluator-based methods. The results of this study showed that there was no empirical difference between the results obtained from usability testing and expert reviews. Expert reviewers reported somewhat more serious or critical usability issues than usability testers. However, they reported somewhat fewer minor problems. It was also found that usability testing overlooked critical usability problems. The study did not prove that expert reviewers missed problems or identified false alarms of problems that were not confirmed by usability tests. Before presenting the results of this study, the study's design is worth considering as this may have played a role in the results that were achieved.

Molich and Dumas (2008) carried out a comparative usability evaluation using 17 teams of experienced usability specialists who independently evaluated the usability of a hotel website. Nine of the 17 teams employed usability testing with test sessions including between 5 and 15 participants. Eight of the 17 teams employed expert reviews. The number of expert reviewers varied from 1 to 2 and the heuristics used by these evaluators were based on one or more of the following: specific domain literature, general literature, general personal experience and domain-specific personal experience. Results showed that user testing teams classified 38% of their issues as either serious or critical problems, and 40% of the issues as minor usability problems, while the expert review teams identified 42% of their issues as either serious or critical problems, and 36% of the issues as minor. Results also showed that the number of problems reported by single-user testing teams was 32.3% of all problems, while the number of problems reported by single-expert reviews teams was only 27.9% of problems.

Molich and Dumas (2008) justified the reason for obtaining different results in comparison with the previous studies. For example, they indicated that earlier studies conducted one-user tests while this study employed nine user tests concurrently with a varied number of participants and tasks.

However, two issues should be considered regarding the study of Molich and Dumas (2008). The first is that each of the usability testing and expert review teams received a test scenario which specifically included the three tasks and four areas that were important to consider in the evaluation. The second issue was that each team was asked to report a maximum of 50 usability comments using a standard reporting format with a specific classification of problem categories (i.e. minor problems, severe problems, critical problems) to classify the problems found by each team. Therefore, these issues might have limited the number of problems identified by expert reviewer teams as they concentrated on specific issues and areas on the tested site. Also, the limited number of comments requested from each team might have made them cautious and reticent about producing a large number of comments.

Cockton and Woolrych (2001) criticised the assessment of usability inspection methods (e.g. the heuristic evaluation method) that focused only on calculating simple percentages of usability problems that they identified. They conducted an evaluation of the heuristic evaluation method by comparing *predictions* of usability problems identified by 99 analyst with *actual* problems identified by user testing. To assess the effectiveness of heuristic evaluation, the researchers used advanced analysis which classified problems into three types; by impact (severe, nuisance and minor); frequency (high, medium and low) and by the efforts required to discover the problems (perceivable, actionable and constructable (i.e. problems that required several interaction steps to be discovered)). The results showed that heuristic evaluation missed a large number of severe problems and problems that occurred very frequently. The results also showed that the heuristic evaluation missed relatively more constructable problems (80%) than were successfully identified (7%). Furthermore, the results showed that 65% of the problem predictions by the heuristic evaluators were false-alarms where the users did not consider them to be problems..

2.7.2 Types/Area of problems identified by UEMs

Few studies were found in the literature that described and compared the content of usability problems identified by usability evaluation methods; those which were found compared only user-based and evaluator-based methods, while no studies

have been undertaken to compare software-based methods with user- or evaluator-based methods. However, earlier studies which used software-based methods, specifically the web analytics tool, were useful in highlighting usability problems areas for improvement. This section is divided into two parts. Part one highlights types of usability problems identified by user-based and evaluator-based methods while part two reviews how web analytics tools were employed by earlier studies to evaluate and improve different design areas of websites.

2.7.2.1 Problem areas identified by user-based and evaluator-based UEM

The studies that were found in the literature that described and compared the type of usability problems identified by user-based and evaluator-based usability evaluation methods varied in their descriptions of these problems; some were general and others were specific and detailed.

Research that described usability problems in general terms, found that the heuristic evaluation method identified usability problems related to interface features (Nielsen and Phillips 1993; Doubleday *et al*. 1997; Nielsen 1992; Law and Hvannberg 2002), whereas user testing methods identified usability problems related to user performance (Simeral and Branaghan 1997). Problems related to interface quality were not identified in user testing (Simeral and Branaghan 1997).

Jeffries *et al*. (1991) also used a general categorisation to classify usability problems picked up by usability evaluation methods. Three main categories were used: consistency, recurring and general. Consistency problems related to aspects on the interface that were in conflict with some other aspects on the tested interface; recurring problems were those that appeared with each interaction with the interface, not only during the first interaction; and general problems were problems that affected many parts of the interface. This study found that heuristic evaluation identified a large number of specific (as opposed to general) problems and one-time (non-recurring) problems, while 70% of the problems identified by the user testing method were of the recurring type and approximately equal numbers of general and specific problems; however, only 6% of the problems identified by the user testing were of the consistency type. This study also found that 70% of the problems identified by the guidelines review method were of the recurring type and 60% of the problems identified by this method were of the general type. However, it was

found that the cognitive walkthrough method identified less general and recurring problems compared to the other methods.

Other studies provided more detail regarding the characteristics of usability problems identified by user testing and heuristic evaluation methods (Doubleday *et al*. 1997; Fu *et al*. 2002; Law and Hvannberg 2002). These studies showed that the user testing method was more effective in picking up usability problems related to a lack of clear feedback and poor help facilities (Doubleday *et al*. 1997; Fu *et al*. 2002). User studies were also helpful in identifying functionality and learnability problems (Doubleday *et al*. 1997; Fu *et al*. 2002; Law and Hvannberg 2002) as well as those concerned with navigation and excessive use of complex terminology (technical jargon) (Law and Hvannberg 2002). In contrast, these studies also showed that the heuristic evaluation method was more effective in identifying problems related to the appearance or layout of an interface (i.e. the use of flash graphics that distract the attention), inconsistency problems with the interface and slow response time of the interface to display results (Doubleday *et al*. 1997; Fu *et al*. 2002).

Only a few studies, however, have highlighted the types of specific usability problems identified by user testing and heuristic evaluation methods. One such study by Mariage and Vanderdonckt (2000) evaluated an electronic newspaper. Mariage and Vanderdonckt's study reported examples of the usability problems that were uniquely identified by user testing and missed by heuristic evaluation. Examples included inappropriate choice of font size, the use of an inappropriate format for links, and consistency problems. Mariage and Vanderdonckt's study also reported problems that were identified by heuristic evaluation and confirmed by user testing, such as: home page layout that was long; navigation problems that were related to the use of images and buttons that were not clear enough so that users did not see that these images/button were clickable; and a lack of navigational support. However, Mariage and Vanderdonckt's study did not report examples related to the unique usability problems that were identified by heuristic evaluation and missed by user testing.

Tan *et al*. (2009), who compared user testing and heuristic evaluation by evaluating four commercial websites, also classified usability problems by their types. They identified seven categories of problems and classified the usability

problems identified by the user testing and heuristic evaluation methods with regard to these seven categories. The categories included: navigation, compatibility, information content, layout organisation and structure, usability and availability of tools, common look and feel, and security and privacy. The results showed that the user testing and heuristic evaluation methods were equally effective in identifying the different usability problems related to the seven categories with the exception of two: compatibility, and security and privacy issues. The user testing did not identify these two issues. The two methods identified different problems associated with different levels of severity. The researchers also found that heuristic evaluation identified more problems with regard to the seven categories compared to user testing. However, Tan *et al*. (2009)'s study did not provide details regarding specific types of problems related to the seven categories.

Studies that highlighted the types or content of usability problems identified by heuristic evaluation and user testing methods concluded that heuristic evaluation helped in identifying the existence of potential usability problems but did not have the ability to provide specific details concerning these problems, while user testing identified and provided details of usability problems (Law and Hvannberg 2002; Mariage and Vanderdonckt 2000). Conversely, Doubleday *et al*. (1997) indicated that user testing has the ability to identify evidence of usability problems using observation although this method provides little information about the causes of the observed problems. Heuristic evaluation, on the other hand, identified accurately the cause of the observed problems and suggested solutions for solving such problems. Doubleday *et al*. (1997) stressed the importance of heuristic evaluation in helping with the analysis of observed usability problems.

2.7.2.2 Problem areas identified by web analytics

Research has used web analytics as a successful tool for evaluating and improving different design aspects of different types of website: a government library website (Xue 2004), a health care organisation website (Ong *et al*. 2003), a learning and information services website (Yeadon 2001), an energy and resources institute's website (Jana and Chatterjee 2004), a museum website (Peacock 2003), a library website (Fang 2007), and an archival services website (Prom 2007). Each of these studies offered a case study which covered the employment of web analytics

metrics. These studies can be divided in terms of the data collection method employed by the web analytics tool. These are the log file and page-tagging approaches which specifically employ the *Google Analytics* tool. This section reviews how a web analytics tool was employed in these studies to evaluate websites. The first part concerns studies that used log file based web analytics and the second part reviews studies that employed the *Google Analytics* method.

2.7.2.2.1 Using log file based web analytics

Nearly all of the earlier studies that used web analytics to evaluate and improve the design and functionality of websites used log file based web analytics and therefore employed traditional metrics based on log file analysis (Jana and Chatterjee 2004; Xue 2004; Ong *et al*. 2003; Peacock 2003; Yeadon, 2001). Various metrics were employed by these studies in their evaluation of the design of the chosen websites. The design areas that were discussed in these studies can be divided into four categories: content, navigation, accessibility and design. This section reviews which metrics were employed in the evaluation of each of the website design areas.

Evaluating and improving content

Earlier studies employed nine metrics in evaluating and improving the content of the studied websites: hits, page views, user sessions, geographic information, entry pages, exit pages, error pages, search terms and the most downloaded statistics.

Jana and Chatterjee (2004) used four metrics (hits, page views, user sessions and the geographic profile of users) to evaluate the content of The Energy and Resources Institute's (TERI) website. Data were collected for 13 months and statistical analysis (linear regression analysis) was used to investigate the trend of three metrics (hits, page views and users sessions) for the time period of the study and to predict future usage of the site. Based on the high number of successful hits and page views, and the increasing number of hits (as indicated by the trend line), they concluded that the content of the TERI website was rich and attracted large numbers of people. The trend line also predicted a possible future increase in user sessions. The researchers concluded that TERI's content was international and had a good international reputation as the geographic statistics of the TERI website indicated a variety of visitors.

Rubin (2004) provided examples of some reports generated by log-analysis packages where carrying out an analysis of them is useful in providing indications of possible design problems on websites. These reports included entry, exit and error pages. Regarding entry pages, Rubin (2004) stated that, if more than five percent of visitors to a site enter on particular pages, then the content of these pages should be improved and be viewed as 'home pages'. Regarding the exit page report, Rubin (2004) indicated that if the exit pages of a site were not destination pages (i.e. pages that list categories of products) then this might point to problems in their content or architecture: for example, a page that was too long, too short, or which contained large-sized images which required time to be downloaded. Alternatively, the page might have uninteresting content. Finally, the error report (which displays errors such as error 404: file not found) shows the particular pages that have errors or problems (e.g. broken links) which prevents a visitor from getting to them.

Xue (2004) used statistics regarding the top 20 search terms and the most downloaded files, not only to evaluate, but also to improve the content of the studied website. Using the top 20 'search terms', she found that the content in the most accessed pages was unique and overlooked by many other websites; therefore, she suggested broadening the content of these pages. The statistics of the most downloaded files showed that research guides were the most frequently downloaded files. Therefore, she recommended keeping the guides up-to-date and accurate, and also recommended the development of new guides.

Evaluating and improving navigation

Three metrics have been used by earlier studies to evaluate the navigation of websites: top entry pages, top exit pages, and path analysis.

Xue (2004) used top entry and top exit page statistics together to evaluate and suggest improvements to a government library website. The statistics showed that the most entry pages were also the pages that were most exited (i.e. visitors exited the site from the entrance page). The home page of the site was the second most popular entry and exit page. This result suggested that some changes should be made to the home page of the site in order to improve its navigation. Suggestions included adding a mouse-over dropdown message box to the home page of the website that described each category, adding links on the home page to the most

used pages in the site, and displaying each major category together with its sub-categories.

Yeadon (2001) used another metric, path analysis, to improve the navigation of the Learning and Information Services website at South Bank University (LISA). Path Analysis is "a process of determining a sequence of pages visited in a visitor session prior to some desired outcome (a purchase, a sign up, visiting a certain part of site etc)" (Kaushik 2007). The path analysis proved that the LISA structure was difficult to navigate. This resulted in a re-organisation of the structure of LISA and thus improved the navigation within this site. Peacock (2003) also suggested using the path analysis metric to evaluate the navigation of museum websites.

Evaluating and improving accessibility

Earlier studies discussed evaluating and improving accessibility from two perspectives: the first concerned the accessibility of the whole website while the second concerned the accessibility of the most viewed pages. Three metrics have been used for the first perspective: search terms, search engines and referrer; three other metrics have been used for the second perspective: path analysis, most viewed pages and entry pages.

The accessibility of the TERI website was evaluated using search terms/keywords by Jana and Chatterjee (2004). They evaluated the number of times a search engine sent a user to the TERI website by way of specific search terms. Jana and Chatterjee chose six keywords/terms from the complete set of the meta tags of the TERI website and measured how many times this website had been retrieved through three search engines (Google, Yahoo and Alta Vista) using each search term/keyword. They also measured how the three search engines ranked the TERI website against the selected search terms/keywords by investigating the relative position of the site in the search results list of these search engines. These statistics suggested that the appropriateness and relevance of TERI's key words should be checked.

The studies of both Peacock (2003) and Yeadon (2001) also indicated the importance of search terms in evaluating the accessibility of the studied websites. Yeadon (2001) stated that search terms are useful in deciding on the meta data, such as key words, for a site.

Xue (2004) used search engine statistics to evaluate and suggest improvements to the accessibility of a website (a government library site) in her study. The statistics showed that the studied site was accessed mostly by Google (51.50%), followed by Yahoo. The ranking of the studied site, in terms of Google search results, was also investigated by searching Google using the phrase 'government publications'. The findings showed that it was ranked tenth on the first results page of Google. Therefore, the researcher suggested considering factors affecting Google's page-ranking to improve the website in order to keep it at the top of the search results list. Based on understanding Google's ranking approach/technique, the following suggestions were made concerning the studied site: re-organising the content of the home page of the site and facilitating access from the website's homepage to other pages. These suggestions also improved the navigation of the website as well as improving its accessibility.

Peacock (2003), Ong *et al*. (2003) and Yeadon (2001) suggested the use of another metric which included search engine statistics. The suggested metric was the referring sites statistic. Peacock (2003) indicated that referring sites can be used to evaluate the strength of the registration of search engines and other websites that have links to the studied website. This study found that eight of the top traffic sources of the website under investigation were popular search engines; the other two traffic sources were two organisations which had an agreement with the studied website.

Ong *et al*. (2003), using referral statistics, found that Google and Yahoo accounted for the majority of references that were made to the studied website out of the seven search engines and open directories with which the site was registered. This suggested that the site needed only to be registered with the Google and Yahoo engines. Yeadon (2001) also used the referring sites statistic, not only to evaluate the accessibility of LISA, but also to recommend accessibility improvements. The researcher suggested re-submitting the LISA website to several major search engines in order to improve the accessibility and referral rate of this site.

It is worth mentioning here that the studies conducted by Peacock (2003), Xue (2004), Yeadon (2001) and Ong *et al*. (2003) not only employed metrics to evaluate the accessibility of the websites as a whole, (as discussed above), but they also

employed three metrics (entry pages, most viewed pages and path analysis) to improve the accessibility of some of the pages in the studied websites:

- Peacock (2003) used entry page statistics to evaluate and improve the accessibility of the website of the National Museum of Australia. She found that the most popular entry page was the museum's daily events page. Using this finding, she suggested adding a link on the home page to facilitate access to this daily events page.
- Yeadon (2001) used path analysis to improve the accessibility of the LISA website. This analysis showed that large numbers of visitors followed the same paths in order to arrive at frequently used resources. This result led to the addition of a quick menu to the home page of the studied website which had links to the site's most used resources. This menu facilitated access to the most used resources using only one click.
- Ong *et al*. (2003) improved accessibility to the top ten most viewed pages, using the top ten most viewed pages statistics, by reducing the number of links needed to access them.

Providing advice on design compatibility

Earlier studies suggested that two metrics (browser and platform statistics) could be used to provide advice regarding the design of websites and their compatibility.

Ong *et al*. (2003) and Yeadon (2001) used browser statistics in their case studies, while Peacock (2003) used both browser and platform (operating systems) statistics. The findings and recommendations of these studies regarding the metrics used were:

- Ong *et al*. (2003) found that the most frequently used browsers were: AOL, Internet Explorer and Netscape. The researchers therefore suggested considering the compatibility of the design of the website they had studied with these most frequently used browsers.
- Yeadon (2001) found that over 99 percent of the visitors to the website that was the subject of his study were using Netscape or Internet Explorer (version 4 or above). He suggested redesigning the website to incorporate

highly technical features such as Java script. Java script requires a level 4 browser or above if it is to work appropriately.

- Peacock (2003) also found that the most popular browser for the website in her study was Internet Explorer version 5 and above. She stated that such statistics could be considered in the design of the site.

Summary of the studies of the log file based web analytics

There are a number of issues that are worth considering regarding the studies reviewed above that used log file based web analytics:

- These studies suggested that metrics are useful in evaluating different aspects of websites' design. However, some of these studies indicated that metrics need to be augmented by further investigation involving actual users of a website (Yeadon 2001). Ong *et al*. (2003) also indicated that other methods, such as usability guidelines, should be used alongside log file statistics.

- Only one of these studies suggested a framework or matrix of metrics for evaluating websites; Peacock's study (2003) suggested a framework of twenty log file-based metrics for evaluating and improving users' experience of museum websites. This framework was an initial step towards creating an evaluation model for online museum services. This framework adapted the idea of Maslow's hierarchy of needs to meet the requirements of visitors to museum websites. The 20 metrics were categorised into two groups. The first group was used to show the volume and origin of page requests. The second group consisted of four levels related to the four levels of the hierarchy of users' needs: level 1 (can I find it?) concerned the ways visitors used to access the site; level 2 (does it work?) examined the site's performance from the user's point of view; level 3 (does it have what I am looking for?) examined the navigation of a site using four metrics and level 4 (does it satisfy my needs?) examined whether or not users were satisfied with a site.

- The metrics employed by these studies constituted part of the reports generated by the web log analyser. Eisenberg *et al*. (2002) indicated that such metrics (i.e. page views, browsers etc.) are raw data which can be

converted into useful information by using them as input for advanced metrics. In contrast to all the studies that used log-based metrics, Eisenberg *et al*. (2002) suggested 22 advanced metrics which can be calculated based on the raw data provided by server log analysis. They called these "actionable metrics" since they can be used to examine the relationship between a site and its visitors; they are based on the interaction and actions that can be taken. The suggested metrics were categorised into two areas: content and commerce. The content area metrics helped to optimise a site's navigation, layout and design, and content, and also helped to improve users' activities within a site. An example of such metrics is the *reject rate for all pages*, which is called the *bounce rate*[1]. The commerce metrics helped to measure the effectiveness and efficiency of a site in generating sales by converting visitors. An example of these metrics is the conversion rate. Eisenberg *et al*. (2002), in their report, presented these 22 advanced metrics together with their formulae; they also showed how to calculate each and how to use each in any type of website. However, no empirical study was undertaken to investigate how these advanced metrics could evaluate and improve the design of websites.

2.7.2.2.2 Using the page-tagging approach of web analytics (Google Analytics)

At least two studies have recognised the appearance of *Google Analytics* (GA) software, which uses the page-tagging approach, and have used this tool to evaluate and improve the design and content of websites (Fang 2007; Prom 2007). Both used the standard reports from GA without deriving specific metrics.

For example, Fang (2007) used seven GA reports to identify potential design problems and to improve the design and content of a library website. The usage of the site was tracked by GA for 44 days. The information that was collected and analysed by GA reports was interpreted and then, based on this analysis, suggestions for improving the design of the website were implemented. After this, the GA tool was used for a second time for 22 days to monitor whether the modified design was useful in terms of increasing the number of visitors who came and

[1] Bounce rate: Percentage of single page visits, i.e. visits in which a visitor left the site after visiting only the entrance page (Peterson 2006).

returned, together with recording the number of pages viewed during each visit. The seven GA reports were:

- Site overlay: This report, which displays summarised clicking information for each link on a page, was used to find those links that had few clicks. It showed that links on the site's right-menu generated very few clicks. This result was used to make decisions regarding changing the layout of the home page of the site. The left and right menus of the site were re-organised and re-formatted by adding a mouse-over effect; the font size was also increased and the items were bullet-pointed so that they could be easily differentiated.
- Content by titles: This report, which lists the most popular content on a site, showed the pages that were most popular during the tracking period. Based on this report, the most viewed items were added in a new section in the right-hand menu of the site to facilitate accessing.
- Funnel navigation: This report, which shows the number of visitors following a pre-defined path, showed that very few visitors to the site (2.33%) followed the defined path by clicking on the specific link (a link to the page for the council and affordable housing) from the home page.
- Visitor segmentation: This report, which shows the geographical location of visitors, showed that most visitors to the site (83%) came from different cities in the United States.
- Visualised summary reports: These reports, which provide a quick summary of a site, were used to monitor some metrics of the site before and after the redesign. These metrics included the number of visitors, the number of pages viewed, and the number of new and returning visitors.
- Information on visitors' connection speed: These reports showed that 15% of the site's visitors used a low-speed connection network. As a result, it was decided not to add more graphics to the new design.
- Computer configuration: The screen resolution report showed that 21% of visitors used 800X600 screen resolution; this finding lead to keeping the site's template (800X600) as it was. Regarding the browser type, the reports showed that most visitors (96%) used Internet Explorer or Firefox. These

browsers were suitable for the site's components (JavaScript and a cascading style sheet) so the layout of the style was not changed.

The results obtained from the GA reports after redesigning the site showed that the modified design improved the site in terms of attracting more return visitors and attaining better loyalty. For example, the researchers found that new visitors increased by 21%, returning visitors increased by 44%, and the number of people who viewed more than three pages increased by 29%.

Similarly, Prom (2007) used three reports of the GA tool and explained how this tool had the potential to improve archival services at the University of Illinois' archives. Based on interpreting the analysis of GA reports, some design problems were noted. Then, changes were suggested to correct these problems. The GA reports that were used included referrals, funnel navigation and landing pages. For example, the funnel navigation reports showed that:

- Few visitors followed the expected defined path; they followed different paths and few of them achieved the defined goal (sending an email message).
- Few visitors (approximately 12%) entered the site from the home page; instead they entered the site from other pages directly from Google or from another search engine.
- Many visitors (approximately 71%) exited directly from the site after viewing only the page on which they entered the site.

The suggested changes of the design of the database software included: changing the subject terms and the page title of the site's pages by including better information to improve the indexing terms used by the Google search engine and the results obtained during searches; and changing the content of the most common landing pages to include more important information.

The studies reviewed above, which used the GA tool, suggested that the GA tool could be useful and have specific relevance to user-centred design since GA's reports enable problems to be identified quickly and help determine whether a site provides the necessary information to its visitors.

2.7.2.2.3 Using web analytics to evaluate the performance of websites

Web analytics can be used to measure the success and performance of websites in terms of the extent to which they achieve their objectives. This section discusses the use of web analytics to evaluate success and performance.

Welling and White (2006) investigated the performance measurement activities of websites in 25 organisations from Australia, New Zealand, Hong Kong and the USA; these represented different types of business (e.g. retailing, government/not-for-profit, business to business, and manufacturing services). They found that site traffic (particularly the visitors' metric) was the only common measure among the companies; most companies considered a general upward trend in terms of the number of visitors as sufficient.

However, Inan (2006) and Phippen *et al*. (2004) criticised the use of standard basic metrics (i.e. visitors' visits) to measure the success of websites. They indicated that these metrics are not useful in this context because of their simplicity (they address only some aspects of web measurement) and their ambiguous nature (related to their inaccuracy and visits from robots and spiders). These problems led to incorrect interpretation, the taking of incorrect decisions or not being able to take decisions at all (Inan 2006; Phippen 2004). Instead, they suggested using advanced metrics which focus on measuring the relationship between a site and its customers. The advanced metrics, which are also called Key performance Indicators (KPIs), are metrics which are expressed in ratios, rates, percentages or averages instead of raw numbers and are designed to simplify the presentation of web data, to guide actions to optimise online business, and to describe the success of an online business (Peterson 2006). Phippen *et al*. (2004) indicated that advanced metrics should include some basic metrics in their formulae since the basic metrics are useful if employed as part of specific and defined formulae instead of using them alone.

A large number of advanced web metrics were suggested in the literature and these were assigned to different models and frameworks. Inan (2006) suggested a customer-centric framework, including three layers, to measure the success of websites. The first layer concerned measuring the effectiveness of the customer engagement process in a site. This included four stages: reach, acquire, convert and retain. The second layer concerned the dropout of customers that might occur at any

stage of the engagement (i.e. leakage from the acquire stage, abandonment from the conversion stage, and attrition from the retain stage). The third layer concerned factors that influence customer dropout which related to the usability of the site. These were specifically related to content appropriateness, design effectiveness and the website's performance efficiency. Inan (2006) suggested metrics and analysis techniques (i.e. path analysis) for each stage of the framework, for each stage of the customer engagement process, for dropout stages and for those usability factors influencing dropouts.

Peterson (2004) also used the customer life-cycle framework, which includes four stages: reach, acquire, conversion and retention. He suggested metrics for each of these stages and also recommended KPIs (Key Performance Indicators) to measure each stage. Furthermore, Peterson suggested KPIs for online business models: online commerce (i.e. *order conversion rate*, *average order value*), advertising (i.e. *percent new visitors*, *ratio of new to returning visitors*), lead generation (i.e. *lead conversion rate*), customer support (i.e. *information find conversion rate*) (Peterson 2004), retail, content and advertising, marketing and customer support sites (Peterson 2006).

A few studies, however, investigated the use of advanced web metrics to evaluate the success of websites. For example, Phippen *et al*. (2004) reviewed a study carried out in a multinational airlines company in the UK which used advanced metrics. He found that the company employed a wide variety of metrics to understand customer behaviour, to measure the success and performance of their site and also to plan future strategy. Examples of the common reports and their metrics that were employed by this company include:

- Monthly summary: These reports were aimed to indicate the monthly level of the site's activity using page views, visits, visitors, average time per visit, and average page views per visit metrics.
- Monthly dashboard: These reports helped to evaluate the monthly performance of a site using visits, visitors, registration and visits to booking metrics.
- Post implementation analysis: These reports were used to evaluate the success of any change to the site, including specific activities or events, for

example, to measure the success of a campaign. The metrics that were used included page views to the campaign page and page views of the rest of the site.

It is worth mentioning that Inan (2006) and Peterson (2004), who suggested the employment of advanced web metrics to evaluate the success and performance of websites, indicated that web analytic tools and usability testing complement each other in the sense of understanding and improving customer experience with a site, as well as measuring the overall success of the site. They indicated that, despite the fact that usability testing illustrates how real users interact with a site, it cannot measure the success of a site or describe the interactions of large number of users with it. This is in agreement with Kaushik (2007) who suggests that the new world of web analytics involves, not only quantitative data (collected by web analytics), but also qualitative data. The quantitative data provide an idea of what is going on in a site (i.e. visitors' count) but the qualitative data provide the reasons behind users' interactions with a site (Kaushik 2007). Kaushik stated that the combination of these data would lead to meaningful changes and improvements in customers' experiences of a site. The methods that Kaushik suggested could be used to obtain qualitative data were user testing, heuristic evaluation, site visits, and surveys.

2.7.3 Cost of employing usability evaluation methods

Some earlier studies, which conducted a comparison between evaluator-based and user testing methods, compared the cost of employing those methods. Most of these studies agreed that user testing was more costly in terms of designing and analysing in comparison with the evaluator-based methods:

- Jeffries *et al*. (1991) compared the cost of employing four usability methods including three evaluator-based methods (heuristic evaluation, guidelines review and cognitive walkthrough) and user testing in terms of the number of person-hours spent by the evaluators for each method. This time included time spent on analysis, on learning the method and on becoming familiar with the interface under investigation. Results showed that the heuristic evaluation method incurred the lowest cost (35 hours), followed by the cognitive walkthrough method (43 hours) and then the guidelines review

method (86 hours). However, the user testing method incurred the highest cost which was 199 hours.

- Law and Hvannberg (2002), who compared the cost of employing user testing and heuristic evaluation methods in terms of the time required by them, found that the heuristic evaluation method was less costly compared to user testing. Results showed that heuristic evaluation required a total of nine hours (including 6 and 3 hours spent by the two evaluators, respectively) in the design and conduction of this method. However, user testing required a total of 200 hours (where each session lasted on average 48 minutes) which were spent on the design and application of this method.
- Doubleday *et al*. (1997) compared heuristic evaluation with user testing and presented the approximate cost of employing these two methods. They indicated that the time required by the heuristic evaluation method was a total of 33.5 hours (including 6.25 hours of five experts' time in the evaluation, 6.25 hours of evaluators' time taking notes and 21 hours transcription of the experts' comments and analysis), while the total time required by the user testing was 125 hours (including 25 hours conducting 20 users' sessions, 25 hours of evaluator time supporting during users' sessions and 75 hours of statistical analysis).
- Molich and Dumas (2008), who reported the results of comparative usability evaluation using 17 teams, found that the maximum and minimum person hours used by single user-testing teams were 199 and 17 hours respectively. However, the maximum and minimum person hours used by single expert-reviews teams were 67 and 3 hours respectively.

However, these studies did not mention the cost of implementing/correcting usability problems that might be undertaken after conducting heuristic evaluation or employing a user testing method. This issue was discussed by Jeffries and Desurvire (1992). They indicated that heuristic evaluation had a higher cost, that would be incurred after the evaluation, in comparison with user testing since heuristic evaluation usually identified a large number of problems, most of them minor. Another cost was that the heuristic evaluation might produce false alarms and implementing these would be impractical or would even lead to interfaces with new

usability problems (Bailey 2001; Jeffries and Desurvire 1992). It is worth noting that none of the studies suggested how to reduce the cost of employing user testing or evaluator-based methods.

2.8 Conclusion

This chapter reviewed a variety of usability evaluation methods that can be used to evaluate the usability of e-commerce websites from three different perspectives: users, evaluators and tools. The review showed that few studies were found in the literature that evaluated the usability of e-commerce websites. Those that were found employed user-based or evaluator-based usability evaluation methods. However, little research has employed web analytic tools which automatically collect statistics regarding the detailed use of a site, in the evaluation of e-commerce websites, although these tools have been employed to evaluate other types of website and have proved to be useful in identifying potential design and functionality problems.

The chapter then reviewed research which has been undertaken to compare usability evaluation methods. These methodological studies were undertaken to compare evaluator-based and user-based usability evaluation methods. They either compared specifically the two most common methods in each category (user testing and heuristic evaluation) or included these two methods in their comparison among others. However, no comparisons have been undertaken between web analytics software and user- or evaluator-based usability methods to investigate the potential problem areas that are identified by these tools.

The literature outlined in this chapter indicated that comparative research provided useful findings regarding which of the two approaches (user-based and evaluator-based usability evaluation methods) was more effective in identifying the largest number of usability problems and which cost the least to employ. A few studies provided some examples of the usability problems identified by these methods. However, previous research offered little detail about the benefits and drawbacks of each method with respect to the identification of specific types of problem.

This chapter also showed, regarding the use of web analytics to improve the design of websites, that it is suggested that advanced or actionable metrics should be

employed regardless of the data collection source of the analytics. These aim to improve customers' interactions and the overall usability of the site. The *Google Analytics* tool was employed by a few studies as a useful tool to evaluate and improve the design of websites. However, there is a lack of research to illustrate the value of using *Google Analytics* for evaluating the usability of e-commerce websites by employing advanced web metrics.

The literature outlined above indicates that there has been a lack of research that evaluates the usability of e-commerce websites by employing user-based, evaluator-based and software-based (*Google Analytics*) usability evaluation methods together. Furthermore, it is clear from the literature that there is a lack of research that compares issues identified by these methods in order to investigate detailed types of specific usability problems that could be identified by them. An awareness of the type of usability problem that could be identified by these methods would be valuable for researchers who wish to uncover usability problems related to a specific area; it could also help researchers determine the method that best matches their needs.

Chapter Three: Research Methods

This chapter discusses the research methods employed to achieve the aims and objectives of this research. The chapter includes an overview of the research's philosophy, design and methods; it then discusses the data collection techniques that were used to collect different types of data. This is followed by a discussion into how the collected data were analysed.

3.1 Research philosophy

The design of any research starts with the selection of a topic and a paradigm or philosophy (Creswell 1994). The paradigm refers to "the progress of scientific practice based on people's philosophies and assumptions about the world and the nature of knowledge" (Collis and Hussey 2003). The research paradigm/philosophy offers a framework, consisting of theories, methods and ways of defining data, which explains the relationship between data and theory (Collis and Hussey 2003; Easterby-Smith *et al*. 1991). Easterby-Smith *et al*. (1991) stated that understanding the philosophical issues in a research study is very useful for the following three reasons:

- It can help to define the research design in terms of considering what type of evidence is required, how it will be gathered and interpreted, and how this will provide answers to the research questions.

- It can help the researcher to identify which research design will work and which will not. Furthermore, it helps him/her to reveal the limitations of particular approaches.
- It can help the researcher to determine, and even to develop, designs that may be not related to his/her experience; it may also suggest how to adjust research designs with regard to the limitations of different knowledge structures.

There are two main research philosophies or paradigms that guide the design and methods of research. These are positivism and interpretivism. These approaches have different propositions regarding common assumptions concerning obtaining knowledge and the process of research. The most common assumptions are termed epistemology, ontology and the logic of the research. Epistemology concerns how a researcher will obtain knowledge during his/her inquiry/research; ontology concerns how each paradigm views reality (knowledge), or what is considered reality from the viewpoint of the researcher; and the logic of a research describes the nature of the relationship between social research and theory, which could be, according to Bryman (2008), either deductive or inductive. The following sections outline the two approaches in terms of their assumptions.

3.1.1 The positivist philosophy

The positivism approach believes that: "the study of human behaviour should be conducted in the same way as studies conducted in natural sciences" (Collis and Hussey 2003). This implies using the scientific method approach of research, or the same methods, principles, procedures and ethos as the natural sciences (Creswell 2003; Bryman 2008).

Studies claiming to adopt a positivism paradigm or a scientific method of research are those that involve an inquiry process in order to understand social or human problems based on testing a theory. The theory consists of variables that are measured by numbers and analysed using statistical analysis in order to decide whether or not to generalise the theory (Creswell 1994). Therefore, knowledge is obtained, according to this approach, by observing and measuring the phenomena using the developed numeric measures (Collis and Hussey 2003).

Positivism employs an objective approach to test theories and to ascertain cause and effect, and scientific laws (Nicholas 2006). Therefore, the reality in this paradigm is objective and is independent of or external to the researcher; it can be measured objectively using a questionnaire or instrument (Collis and Hussey 2003; Creswell 1994).

With positivism, the deductive approach is used in order to obtain knowledge (Nicholas 2006). Research employing a deductive approach is guided by a theory, which is usually expressed as statements called hypotheses which are generally based on earlier research. Creswell (2003) called this type of research 'reductionistic" as it aims to reduce ideas into a small, discrete set of ideas to be tested (i.e. the variables that are part of the hypothesis). Therefore, the developed hypotheses give rise to the process of data collection. Findings in this research are used either to confirm or reject hypotheses, therefore making a revision of theory (Bryman 2008).

3.1.2 The interpretivist philosophy

There is a debate regarding the appropriateness of applying natural science methods to the study of society (Bryman 2008). Therefore, the interpretivist approach was developed in response to criticism of the positivism paradigm/philosophy (Collis and Hussey 2003). The interpretivist philosophy is based on the belief that a strategy is needed to differentiate between people and objects in the natural sciences; therefore, this philosophy requires the researcher to understand the subjective meaning of social action (Bryman 2008).

Studies claiming to adopt an interpretivist paradigm are those which represent an inquiry process for understanding a social or human problem based on developing a holistic picture formed from words and detailed views of information. Such studies are conducted in natural settings (Creswell 1994). This approach believes that subjective meaning is an important issue in social actions and therefore, this philosophy is concerned with disclosing interpretations and meanings of such actions (Nicholas 2006). It concentrates on the meaning of a social phenomenon and not on the measurement of that phenomenon (Collis and Hussey 2003). The researcher is involved in the interpretation of the social phenomena being studied on more than one level; he/she provides an interpretation of how the

members of a social group interpret the phenomenon being studied, while his/her interpretation is interpreted with regard to the concepts and literature of a discipline (Bryman 2008).

Interpretivists believe that: "what is researched can't be unaffected by the process of research" (Collis and Hussey 2003). The researcher is not observing phenomena from outside the system, like the natural sciences, but he/she is involved with what is being researched (Nicholas 2006; Collis and Hussey 2003). Reality is subjective and socially constructed and can be understood by examining and investigating participants in the study (Collis and Hussey 2003). In this paradigm, the researcher, rather than keeping a distance between him/herself and what is being researched, as is the case with positivism, he/she tries to minimise the distance by interacting with what is studied (i.e. living with or observing information or an actual collaboration) (Creswell 1994).

Obtaining knowledge according to the interpretivist philosophy is undertaken using an inductive or empiricist approach (Nicholas 2006). The inductive research approach starts from specific observations where conclusions are derived from researchers' experiences (Nicholas 2006). Theoretical ideas are derived from data and are not derived before collecting data, as is the case with the deductive approach (Bryman 2008). Inductive studies provide the opportunity to elicit insightful empirical generalisation but offer little theory (Bryman 2008).

3.1.3 Selection of the research philosophy

Following the philosophical observations made above, and by referring to the aims and objectives of this research, as mentioned in Chapter 1, this research has adopted an interpretivist approach. This selection can be justified for a number of reasons. Interpretivism is an appropriate approach with regard to this type of research problem. For example, regarding this issue, Creswell (1994) showed that a research problem is related to a positivist approach if it evolves from the literature where variables and theories may exist that need to be tested and verified, while a research problem is related to an interpretivist approach when little information exists on the topic and more exploration is needed since the variables are largely unknown. Therefore, it is clear that the interpretivism approach is an appropriate one to be adopted in this research as it is not guided by theory which must be tested

objectively during the research process. Instead, it is aimed at finding an understanding regarding which usability methods are the best in evaluating each usability problem area. Then a methodological framework can be developed that will illustrate how to evaluate the usability of e-commerce sites in relation to specific areas. Furthermore, the researcher was involved in this research, and the knowledge obtained from this research, which was used to develop a framework of usability methods, was constructed by way of an interpretation of the three methods involved in this research. Specifically, in order to develop the supposed framework, and to identify usability issues obtained from the usability evaluation methods, the researcher was involved in interpreting users' actions while interacting with the websites, evaluator's comments, and the statistics obtained from the analytics approach. Also, the inductive approach was adopted while developing the framework in this research; this is the dominant approach for interpretivists.

3.2 Research design

The research design, as indicated by Bryman (2008), represents a structure or a framework which guides the execution of a research method and an analysis of the data. Alternatively, Yin (1984) defined a research design as: "an action plan for getting from *here* to *there*, where *here* may be defined as the initial set of questions to be answered, and *there* as some set of conclusions (answers) about these questions. Between *here* and *there* there may be a number of major steps, including the collection and analysis of relevant data" (Yin 1984). The research philosophy guides the selection of the research design. Examples of common research designs associated with the interpretivist philosophy include action research, case study, ethnography and grounded theory (Collis and Hussey 2003). However, it is worth mentioning here that the case study is listed also as a research design within the positivist approach (Alhalalat 2005). The case study approach was chosen as the research design for investigating the problem in this research because it is the most appropriate plan for addressing the research problem. The suitability of other research designs was investigated, compared and evaluated before selecting the most appropriate design. This section illustrates the case study design and then provides a justification for choosing such a design.

3.2.1 Case study design

The case study design involves carrying out a detailed and intensive examination and analysis of a case (setting); this is then used to obtain an in-depth understanding of the situation and meaning of the phenomena (Bryman 2008; Merriam 1998). Yin (1984) identified a case study as: "an empirical inquiry that investigates a contemporary phenomenon within its real-life context; when the boundaries between phenomenon and context are not clearly evident; and in which multiple sources of evidence are used".

Stake (1995) classified cases into three categories with regard to the focus of the study or the use of the case study:

- **The intrinsic case study**: This is the case that is selected because the researcher is interested in learning about it as a particular case, not because by studying it learning will be achieved about other cases or about some general problem.
- **The instrumental case study**: This is used when the focus of a study is on understanding issues within a case or obtaining something; it does not apply to a particular case. This can be used when there is a need to obtain a general understanding of a research question which can be achieved by studying a particular case.
- **The collaborative case study**: This type of case is used when the focus of a study is on more than one instrumental case at the same time and where it is important for there to be coordination between the individual cases.

Yin (1984) identified four types of designs for case studies. These are based on two assumptions:

- **Single- or multiple- case studies**: A primary characteristic in designing case studies, before collecting data, is between single- and multiple-case designs that will be used in order to address the research questions (Yin 1984). A single case study design involves studying a single case, while multiple-case studies involve studying more than one case at the same time.
- **Single- or multiple- unit of analysis within a case**: If a case study examines only the global nature of phenomena (i.e. when no logical sub-

units can be identified within the case) then this design is called a holistic case study. If a case study, on the other hand, involves more than one unit of analysis (i.e. the case includes subunits of analyses) then this design is called an embedded case study.

According to these assumptions, a single case study can be either holistic or embedded, and a multiple-case study may consist of multiple holistic cases or of multiple embedded cases, depending on the phenomenon being studied.

Multiple case study design

As outlined above, Yin (1984) indicated that case study research includes both single- and multiple- case studies. According to Yin (1984), single- and multiple-case designs come within the same methodological framework or under case study research. However, Bryman (2008) considered the multiple-case design as a different methodology/design from the single-case study; he called it the comparative design. Bryman (2008) stated that the comparative design is an extension of the case study design. Comparative design (or multiple-case study design) involves studying two or more case studies and conducting a comparison among them. This is based on the belief that a better understanding of phenomena can be achieved by comparing them with regard to two or more meaningfully contrasting cases (Bryman 2008). Multiple case studies are important if the case studies are used for inductive purposes (De Vaus 2001).

Yin (1984) stated that, in order to gain a major insight, multiple cases must be considered as multiple experiments in the sense that they follow "replication" logic. This means that the research design involves employing the same experiments in each case; so, the same results are predicted for each case and evidence will be produced from all the cases. In this situation, each case is considered as a single experiment, and the analysis must follow cross-experiment rather than within-experiment design and logic (Yin, 1984). De Vaus (2001) stated that while a single replication tells something, the repeated replication provides confident findings.

The replication approach to multiple-case studies was illustrated by Yin (1984) in Figure 3.1. This figure shows that the first step in designing a multiple-case study is related to the development of theory; this is followed by selecting cases and defining data collection methods. Each case represents a "whole" study

where convergent evidence is needed from the facts and conclusions of the case. The conclusions of each case are then treated as the information that needs to be replicated by other cases (Yin 1984).

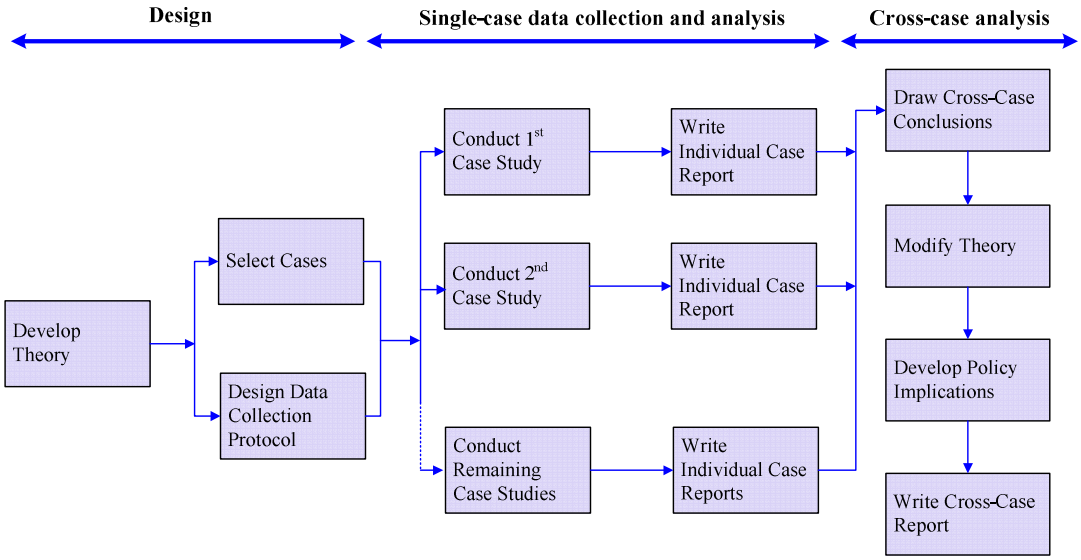

Figure 3.1: Case study design. Source: Yin (1984)

3.2.2 Selection of a research design

This research involves conducting a comparison of three usability methods on the evaluation of e-commerce websites in order to determine which methods were best in evaluating each usability problem area; a framework from the results was also created. Therefore, in order to examine the problems identified by the three usability methods, a multiple-case study or comparative design was selected as a research design where the logic of replication was considered; the same experiments were employed in each case.

Although the literature showed that earlier studies which compared usability evaluation methods conducted the comparison on a single interface (see Chapter 2, Section 2.7), this research employed a multiple-case study design. A case study research, as mentioned above, helps to obtain a rich picture of a particular case as it involves a detailed and thorough examination. This was required in this research but a multiple case study design was also selected because of its distinct advantages in comparison with the single-case study. For example, Yin (1984) stated that the evidence from a multiple-case design is usually considered more compelling and

therefore the whole study is considered to be stronger. De Vaus (2001) also indicated that multiple-case designs with sufficient resources are more powerful and convincing and provide a greater sense of understanding compared to single-case designs. Furthermore, Bryman (2008) stated that one of the advantages of employing a multiple-case study design is to improve theory building. "By comparing two or more cases, the researcher is in a better position to establish the circumstances in which a theory will or will not hold" (Bryman 2008). Finally, using multiple cases in a study is a common strategy that enhances the external validity or generalisability of findings (Merriam 1998). Therefore, in order to achieve robust, powerful and convincing findings that could be generalised regarding the comparison between the usability testing methods, the multiple case design was selected.

In this research design, the cases were holistic and not embedded. There was only one unit of analysis regarding the cases (e-commerce sites): that is, the sites themselves. The usability methods investigated the whole e-commerce site. With regard to the focus of this research, the collaborative case study was used as it involved more than one instrumental case study. This is because this study did not focus on selecting a specific case study (in this research, an e-commerce website) as a particular case, but on illustrating issues within the case studies. These issues related to conducting usability evaluation methods in order to undertake the comparison between them.

3.2.3 Selection of case studies

Stake (1995) indicated that case study research is not sampling research; thus, a case study is not studied primarily to understand other cases. Regarding the selection of case studies, Stake (1995) advised researchers, if possible, to select cases that are both easy to get to and hospitable to the research inquiry. Purposeful sampling is the most common sampling method to use in selecting such a case (Merriam 1998). Merriam (1998) provided a definition regarding the purposeful sample and an example of this is called the convenience sample. This is defined as follows: Purposeful sampling includes determining selection criteria that are essential in choosing cases to be studied as the criteria reflect the purpose of the study and guide the researcher to the identification of information-rich cases. Convenience sampling

is one type of purposeful sampling in which the selection of a sample is based on time, money, location and/or the availability of case studies.

Merriam (1998) suggested following two steps in order to find the best case to study: first, setting-up or deciding criteria that will guide case selection and, second, selecting a case that fits those criteria.

In order to employ and compare usability methodologies on e-commerce websites in Jordan and obtain a comprehensive identification of usability problems, three e-commerce vendors were approached. Hence, the intention was to employ the same methods (i.e. the same usability testing sessions involving the same users, the same heuristic evaluators and *Google Analytics* software) in each case. This number of cases was considered appropriate within the time and resources available for the research.

A picture of the current situation regarding e-commerce activities in Jordan was acquired. Twenty seven e-commerce companies that sell products in Jordan were identified from five electronic Jordanian and Arab directories and a Google search. The intended criteria for selecting the three case studies was to involve e-commerce sites that had a large number of usability problems in order to obtain a comprehensive identification of different types of usability problem. This would help to achieve the aim of this research regarding creating the supposed methodological framework. Therefore, the usability of the twenty seven e-commerce sites was examined by the researcher using Nielsen's ten heuristic evaluation guidelines. Numbers were then assigned to these sites according to their conformity to these heuristics which reflected their usability. It is worth mentioning that using only one inspector, which was the researcher in this case, to evaluate the usability of the twenty seven sites had limitations, relating to her experience, that influenced the number of problems identified. However, this can be justified by the following: The researcher's first degree was in computer science and she had ten years' experience in designing and developing websites. Moreover, during the process of this research, she gained some knowledge regarding usability issues. Also, because the aim of the inspection was only to obtain a general idea regarding the usability of the sites, rather than to conduct a thorough inspection, using the researcher was considered to be appropriate.

After determining the usability of the sites, the procedure for selecting three e-commerce websites began. A covering letter was prepared (see Appendix 1) and sent in December 2006 to the three companies that had the largest number of usability problems asking them to participate in the research. However, only one of the companies agreed at that time. Later, the covering letter was sent to other companies. Again, each time, companies with the largest number of usability problems were considered. The letter was followed by more than one reminder over different time periods in order to obtain agreement from three companies. Gaining the agreement from three companies to participate in this research took a long time; the acceptance letter from the first company included in the research was received on December 5th 2006, while the acceptance letter from the third company was received on July 28th 2007. This long time period was due to different reasons, such as trust and security issues (since to use *Google Analytics*, each company was asked to add script code to their server), and changes at the companies (one company was in the process of moving to Lebanon). Two of the three companies that agreed to participate in this research sell women's clothes and the third sells hand-crafted gifts.

Therefore, the cases were selected on the basis of their availability and not because they had the largest number of usability problems. However, since all the companies, as investigated, had usability problems they were considered to be suitable. This represents a convenience/purposeful sample.

3.3 Research methods

A research method refers to the techniques that are used for collecting data (Bryman 2008). Despite the fact that the dominant research methods associated with research that claims to adopt an interpretivist philosophy are qualitative, Collis and Hussey (2003) stated that it is possible for such a philosophy to produce quantitative data. The case study design has a unique strength which is related to its ability to deal with many sources of evidence or data collection methods, such as documents, artifacts, interviews and observations (Yin 1984). Furthermore, Collis and Hussey (2003) stated that, in the case study, it is usually best to combine data collection methods so that the evidence may be both qualitative and quantitative. The use of more than one data collection method is known as triangulation; this indicates the

use of different research approaches, methods and techniques in the same study (Collis and Hussey 2003).

To achieve the aims of this research, triangulation evaluation methods and techniques were employed. Three methodologies were used. These were: heuristics evaluation, user testing and web analytics (the tool used was *Google Analytics*). Qualitative and quantitative data collection techniques were used while employing the first two usability evaluation methods, whereas the third usability evaluation method involved the use of quantitative data only. The data collection section below illustrates the quantitative and qualitative methods involved in this research.

The selection of the three usability evaluation methods stemmed from the aim of the research (which is related to developing a framework that identifies comprehensive usability problems) and based on a thorough analysis of usability evaluation methods of the literature (see Chapter 2). These usability evaluation methods were selected with regard to two issues: first, because they complement each other and second, because these methods were able to identify usability problems from three different perspectives. Therefore, these two issues resulted in a comprehensive identification of usability problems which helped to develop the supposed framework and provided flexibility for the supposed evaluation framework.

Complementary methods

The user testing and heuristic evaluation methods have been frequently used to evaluate the usability of websites, including e-commerce websites (Kantner and Rosenbaum 1997; Freeman and Hyland 2003; Chen and Macredie 2005; Barnard and Wesson 2003; 2004). Stone *et al*. (2005) indicated that if more than one evaluation technique/method are to be employed, then these methods should be chosen so that they complement each other. Earlier research found that user testing and heuristic evaluation methods are complementary to evaluation and these methods are complementary to web analytics tools (Law and Hvannberg 2002; Fu *et al*. 2002; Jeffries and Desurvire 1992; Desurvire *et al*. 1991, Nielsen and Mack 1994; Kantner and Rosenbaum 1997; Peterson 2004; Kaushik 2007). Earlier studies, as reviewed in Chapter 2, Section 2.7, found that both heuristic evaluation and user testing methods varied with regard to the number of usability problems identified by

each and in the kind of usability problems discovered. Therefore, these studies recommended using these two methods together in order to obtain the best results with regard to finding large numbers of usability problems of different kinds (Law and Hvannberg 2002; Fu *et al*. 2002; Jeffries and Desurvire 1992; Desurvire *et al*. 1991, Nielsen and Mack 1994; Kantner and Rosenbaum 1997). Regarding the use of the *Google Analytics* approach, it was obvious that the literature, as mentioned in Chapter 2, stressed the importance of employing other methods, such as usability methods, alongside the web analytics approach. Web analytics monitors users' behaviour over a long time period relative to user testing and identifies issues, often missed by user testing, that could help in identifying additional usability problems. Furthermore, despite the fact that usability testing illustrates how real users interact with a site, it cannot measure the success of a site or describe the interactions with it of large numbers of users (Inan 2006 ; Peterson 2004).

Providing various perspectives

Involving user testing, heuristic evaluation and *Google Analytics* resulted in the identification of usability problems from various perspectives: actual or real users identified accurately usability problems using the user testing method and web experts identified usability problems based on their experience and therefore provided a large number of usability problems. *Google Analytics* was used to provide a different picture of the users' behaviour while interacting with the sites. The following section describes the strengths and limitations of the three selected methods.

User testing was used in this research among the other user testing methods, as mentioned in Chapter 2, since it is the most fundamental usability evaluation method. It is irreplaceable because it provides direct information about how real users interact with an interface and the exact problems they face during their interaction (Nielsen 1993). This method provides an accurate and unique identification of usability problems which prevent real users from interacting with an interface. However, the user testing method has some limitations which relate to the high cost of conducting such testing in terms of maintaining or renting a lab, the cost of recruiting and paying test participants, and the length of time it takes to analyse results (Simeral and Branaghan 1997). Furthermore, Rubin (1994) indicated that such testing does not reflect the actual interaction between a user and an

interface because it is an artificial situation and thus, this can affect the results of the test.

The heuristic evaluation method was used in this research alongside the other inspection methods as mentioned in Chapter 2, because it is the most common usability inspection method and because of its speed and affordability in identifying large numbers of usability problems, as indicated by Simeral and Branghan (1997). This method can be conducted at a relatively low cost and requires little preparation (Pearrow 2000). The inspectors usually suggest solutions to the usability problems they identify during the inspection (Stone *et al*. 2005). However, the heuristic evaluation method has some limitations including the fact that the inspectors do not represent real or representative users and so may not predict correctly how users will interact with an interface; they may miss some problems and they may be overly concerned about issues that do not represent a problem to real users (Stone *et al*. 2005). The evaluation data are highly dependent on the experience and skills of the inspectors. Therefore, if the inspectors have insufficient skills, this will affect the validity of the evaluation data (Stone *et al*. 2005).

The *Google Analytics* method was used in this research since it is a valuable tool which was recommended for use because of the wide range of features and benefits provided by this tool. In addition it is freely available (Azam 2006). Examples of the key issues which encouraged the employment of this tool in this research included: *Google Analytics* has a usable and simple interface and it is very easy to implement and use; this encourages users to get started with web analytics (Jasra 2006; Burby 2005). *Google Analytics* has proved to be beneficial for both small- and medium-sized companies which cannot use web analytics or afford to pay for such a service but still wish to improve their business (Azam 2006). *Google Analytics* is a recommended tool for users who need to determine the performance of their site (Jasra 2006). It also provides a useful first step with web analytics if a site does not have access to its web log file, which is often the case with many businesses (Kaushik 2007).

Furthermore, *Google Analytics* is concerned with the privacy of users and requires each site that uses *Google Analytics* to abide by its privacy provisions that are displayed in the *Google Analytics* Terms of Services (Google Analytics [n.d]). The privacy section indicates that *Google Analytics* does not collect any personal

information such as addresses, names or credit card numbers and Google reports include aggregate and non-personally identifiable information. The privacy section also assures users that *Google Analytics* recommends that a site using this service should post a privacy policy that must include a notice of the site's use of cookies that collect anonymous traffic data. However, *Google Analytics*, as indicated in its terms and conditions, may transfer the information collected from a site to third parties. This was considered as one of the issues or criticisms of this tool since it collects a great deal of critical business data. Fang (2007) indicated that, for this reason, sites with high security are not recommended to use this service. Another limitation of *Google Analytics* is related to the lack of support it offers as it is a free tool (Burby 2005). However, Burby (2005) stated that, despite the fact that this tool has limited capabilities compared to other tools, 95 percent of businesses do not use all its features and these features are also not required to begin optimising sites.

The three methodologies were applied to the three Jordanian e-commerce companies studied in this research. The following section discusses the three methodologies and the procedures used for collecting data.

3.4 Data collection

This section illustrates how quantitative and qualitative data were collected from the different methods used in this research. The first section illustrates the data collection methods used while conducting the user testing method, the second section illustrates the methods used while employing the heuristic evaluation, and finally the third section concerns how data were collected using the *Google Analytics* software.

3.4.1 User testing

To conduct the user testing method, several supplementary techniques were used. This involved using different types of observation, including the observer taking notes and using Camtasia software to capture performance data while questionnaires were used to assess users' satisfaction with the tested sites. A think aloud protocol is one of the techniques that can be used during user testing. This has several advantages such as obtaining immediate feedback regarding what the participants think about the interface and any problems or surprises they face (Stone *et al*. 2005). However, this technique was not used in this research because it was believed that,

according to its stated disadvantages, it might influence the performance of the users who were expected to perform tasks on three websites. These disadvantages included: this technique is considered by some participants unnatural and distracting (Stone *et al*. 2005); it can slow the participant's thought processes which therefore influences their performance of the task; also, users' problem-solving behaviour can be influenced as users verbalise their thoughts (Stone *et al*. 2005; Nielsen 1993). Furthermore, sometimes it is very exhausting for the participants to verbalise their thought processes during the evaluation session (Stone *et al*. 2005).

User testing does not have to be conducted in an extensive lab setting since most web development projects do not have the budget to rent a usability lab (Lazar 2005). In this research, the user testing sessions were conducted at an office in one of the universities in Jordan where the researcher has access. The office was equipped with one desktop computer. This was connected to the Internet and the Camtasia software was installed on it.

Since it was estimated that the user testing session would take a long time (3 hours), incentives were paid to the participants. Incentives were a small amount of money (10 Jordanian Dinar (JD)) which is less than £10 for travel expenses (basic expenses). This section discusses the user testing materials that were developed for the user testing, the pilot study, and the recruitment and evaluation procedures.

3.4.1.1 Testing script and consent form

A testing script was developed in order to welcome the users and to provide an introduction to the research (see Appendix 2). A consent form acknowledging the user's agreement to participate in the test and to be observed through the testing session was also developed (see Appendix 3). The consent form was required to be read and signed by users.

3.4.1.2 Pre-Test questionnaire

A pre-test questionnaire was developed and had to be filled out by the users after they had signed the consent form (see Appendix 4). The pre-test questionnaire was designed to gather users' background information. It involved three sections: background and experience, online shopping experience and perceptions of online shopping. Questions in the first section were based on two earlier studies (Barnard

and Wesson 2003; Brinck *et al*. 2001). The questions in the second and third sections were based on earlier studies regarding consumer attitudes or perceptions towards online shopping or e-commerce (Alsmadi 2002; Obeidat 2001; Aladwani 2003; May So *et al*. 2005; Shergill and Chen 2005). Two questions in the second and third sections of the questionnaire were based only on studies regarding Arab countries. These questions were related to the cost of using the Internet and the cost of online shopping, since the cost of using the Internet is still high in comparison with developed countries.

3.4.1.3 Task scenario

A task scenario was developed for each of the three studied websites (see Appendix 5). This included typical tasks for the three e-commerce websites that represented their actual use. When preparing the tasks, the recommendations of Nielsen (1993) and Preece *et al*. (2002) were taken into consideration regarding the beginning and ending tasks. Easy tasks were chosen for the first and last tasks in order to allow the user to feel confident and comfortable at the beginning, and to let him/her feel good when they achieved something at the end of the test (Nielsen 1993; Preece *et al*. 2002). Task number 7 was derived from Brinck *et al*. (2001). Both Brinck *et al*. (2001) and Kuniavsky (2003) suggested avoiding the use of terms in the tasks that matched the screen terms so, rather than asking a direct question about the contact details of the e-commerce company, other questions were used as part of the task.

The task scenario involved some typical tasks suggested for e-commerce websites in earlier studies, such as finding information and products (Kuniavsky 2003; Brinck *et al*. 2001), using the site's search (Kuniavsky, 2003), purchasing products (Kuniavsky 2003; Brinck *et al*. 2001), changing the content of the shopping cart, and changing the user profile. It is worth mentioning that Task 10 for sites 1 and 2 involved asking users to use the advanced internal search facilities of these sites. However, since site 3 did not have an advanced search function, Task 10 asked users to find information on this site.

3.4.1.4 Post-Test questionnaire

In order to gather preference information from the users regarding the tested websites, three post-test questionnaires were developed (see Appendix 6). Each user responded to the appropriate post-test questionnaire after interacting with each

website. The post-test questionnaires were based on the Computer System Usability Questionnaire (CSUQ) (Lewis 1995) and other questions proposed in earlier studies (Barnard and Wesson 2003; Pearrow 2000). The questionnaires were organised into four sections: the first section related to the usability of the user tasks, which were finding specific information, using the site's search, and purchasing a product. The second section related to the site's general appearance and navigation while the third section related to the user's confidence in the security and privacy. Finally, the fourth section related to the user's general feelings about the website using four open-ended questions.

3.4.1.5 Post evaluation questionnaire

A post-evaluation questionnaire was developed to be filled out by the users after performing all three evaluation tasks and after filling out the three post-test questionnaires (see Appendix 7). The post-evaluation questionnaire consisted of seven questions that required the user to compare the usability of the three tested websites by remembering his/her experience while performing the different tasks. The questions asked the user to determine the website that had the best features and to clarify the reason for this preference. This questionnaire was designed by referring to two earlier studies: Freeman and Hyland (2003) and Tilson *et al*. (1998).

3.4.1.6 Compliance with ethical principles

Before collecting the data, an ethical clearance checklist was completed since the method involves human participants. The investigation conformed to the ethical principles specified by Loughborough University.

3.4.1.7 Pilot

A pilot test was conducted before the main test to test the user testing methods. This is an essential step which helps to practice the test and to discover and refine any bugs in the testing process, such as un-applicable tasks or ambiguous questionnaire (Rubin 1994).

Before conducting the pilot study, the user testing materials were translated into Arabic. They were then sent to two checkers. The technical checker checked

the accuracy of translating the different terms and the grammar checker checked the grammatical accuracy of the translated materials.

The testing materials were pilot tested using two Jordanian Internet users, one a postgraduate and one an undergraduate student at Loughborough University, using both the English and the Arabic language versions. The number of pilot users and the method for selecting them (by convenience sampling) coincided with Nielsen's (1993) recommendation.

The pilot study identified ambiguity in the questionnaires and the user tasks, and helped to confirm the time limit which was assigned for each task. Results from the pilot test were taken into consideration and changes were made to the user testing materials.

3.4.1.8 Number of users and users' profile

In order to determine the number of users to perform the user testing, an investigation into the literature was undertaken. For example, Brinck *et al*. (2002) suggested, if the budget allowed, recruiting eight to ten users to perform user testing. Rubin (1994) also suggested testing with more than five users, suggesting at least eight participants. It is worth noting that, in order to obtain statistically valid results, enough participants should be tested to perform the appropriate analysis and to generalise to a target population (Rubin 1994). In this context, Nielsen (2006) recommended testing 20 users in quantitative studies that included collecting quantitative usability metrics such as learning time, efficiency of use, memorability, user errors, and subjective satisfaction. However, while performing the user testing, it is suggested that there is a need to balance acquiring participants with the practical constraints of time and resources so issues such as the availability of the type of participants required and the duration of the test session need to be considered. Based on the illustration above, it was decided that twenty users would be recruited in this research.

Regarding users' profiles, it was decided that information about the target users of the websites would be helpful to identify typical users for user testing (Preece *et al*. 2002). Therefore, an email was sent to each of the studied companies asking them to provide information about their current and prospective users (such

as demographic information, experience using the computer, and experience using the Internet). This method was used by Barnard and Wesson (2003) in their study.

Based on the answers from the three companies, a matrix of users' characteristics was designed (see Appendix 8). The matrix was similar to a table suggested by Rubin (1994) to identify the user profile for a tested product. The designed matrix included five characteristics of the studied websites' users: gender, education level, age, experience in using a computer, and experience in using the Internet. Company three provided two different profiles so four profiles were considered.

Based on the three companies' answers, an approximate percentage was calculated regarding each characteristic; then the average of those approximate percentages was calculated. From the calculated percentage, an approximate number of users who should match each characteristic was also calculated. Since two of the companies were selling specific products that were targeted at females (women's clothes), they identified their current users as 99% female. This influenced the number of males and females chosen to participate in the testing; thus, 16 females and 4 males were chosen.

3.4.1.9 Sources of recruitment

Three sources were used to recruit the participants of the user testing.

- An advertisement was prepared (see Appendix 9). It was translated into Arabic and sent to a grammar checker to assure its accuracy. Then it was published twice in a public newsletter. The advertisement indicated the necessary qualifications of the volunteers and the amount of money to be paid to them, as suggested by Rubin (1994).
- Email broadcasting to different Internet groups.
- Email broadcasting to the local email addresses of the place in which the user testing was conducted (one of the universities in Jordan).

Each of the above sources was directed to a different e-mail address so that the number of volunteers replying from each source could be calculated. The volunteers from the first two sources were asked to fill out an online questionnaire. The online questionnaire aimed to obtain background information about the

volunteers (name, phone number, city, age, gender, education level, experience in using a computer, experience in using the Internet). The online questionnaire was based on Rubin's suggestion (1994) of developing a screening questionnaire before selecting suitable participants that matched the required profile. The volunteers from the third source were asked to reply to an email containing background information. This was done to facilitate counting and to limit the number of volunteers from the same place.

Twenty participants were recruited for the usability testing; only five of them were selected from the third source. Telephone calls were made to provide details of the place of the study and to schedule the time of the test.

Based on the matrix of the users' characteristics, a sample of 20 users was selected in order to match the matrix as closely as possible. There was some match between the planned users' characteristics and the actual users who were recruited for the study. The two characteristics that were matched were gender and experience of using the Internet. Other characteristics were not totally matched because of the lack of availability of suitable participants. This is quota sampling where participants are selected to meet the target number for relevant characteristics.

3.4.1.10 Evaluation procedure

All user testing sessions followed the same procedure. Data were gathered using screen capture software (Camtasia) with five questionnaires and observations of the users working through the tasks.

The user session began with the researcher welcoming the user and reading the test script that explained the objectives of the study, the number of websites that would be evaluated, number of questionnaires that needed to be filled out, and the user's right to withdraw from the session at any time. It was also explained to the user that that he/she would be observed and his/her screen would be recorded using screen capture software (Camtasia) during the session. The user was then asked to read and sign the consent form. After signing the consent form, a pre-test questionnaire was given to the user to fill out in order to obtain information regarding his/her background and experience.

Before beginning the tasks related to each website, the user was asked to explore the website for a maximum of 10 minutes, as suggested by Preece *et al*.

(2002). They suggested using a familiarisation task at the beginning of the usability tests so that the user would get used to the tested site before the session started. After the exploration, the user was given the tasks for a particular website from the three tested sites. The time for each task was determined beforehand and checked throughout the pilot study. As the user worked on each task, the observer noted the sequence of pages, the time taken to complete each task, and any comments made by the user.

After completing the tasks for the tested website, the user was given the post-test questionnaire to fill out in order to get his/her feedback. Then the user took a break before beginning to test the second website. A similar procedure was followed by the user while testing the second and third sites.

After completing the post-test questionnaire for the third website, the user was asked to explore each website for a maximum of five minutes and to remember his/her experience of evaluating each website. Then, he/she was given the post-evaluation questionnaire to fill out in order to get his/her feedback about the usability of three tested websites.

At the end, the user was thanked and given the 10 JD. For each session, the order of the three websites that were evaluated was changed so that each website was tested fairly by all the users since, while testing the first website, the user might be slow and unfamiliar with the testing tasks.

3.4.2 Heuristic evaluation

This section discusses the guidelines and checklist that were developed for the heuristic evaluation method, the pilot study and the recruitment and evaluation procedures.

3.4.2.1 Heuristic guidelines and checklist

In order to evaluate the studied e-commerce websites, a set of comprehensive heuristics, specific to e-commerce websites, was developed based on an extensive review of the literature. The developed heuristics were organised into five major categories: architecture and navigation, content, accessibility and customer service, design, and purchasing process. Table 3.1 displays the categories and the subcategories of the developed heuristics. Appendix 10 displays the categories, the

subcategories and the references of the developed heuristics, while Appendix 11 displays the developed heuristics and their explanations.

Table 3.1: Categories and subcategories of the developed heuristics

Heuristic Categories	Heuristic Subcategories
Architecture and Navigation	Consistency; navigation support; internal search; working links; resourceful links; no orphan pages; logical structure of site; simple navigation menu.
Content	Up-to-date information; relevant information; accurate information; grammatical accuracy; information about the company; information about the products.
Accessibility and Customer Service	Finding and accessing website; contact us information; help/customer service; compatibility; foreign language and currency support.
Design	Aesthetic design; use of images; choice of fonts and colours; page design.
Purchasing Process	Ordering process; ordering information; delivery information; order/delivery status provision; alternative methods of ordering/ payment/ delivery; security and privacy.

A heuristic checklist was also developed (see Appendix 12) based on the developed heuristic guidelines. The checklist aimed to produce quantitative data on the conformance rating of each studied website to each heuristic. It includes statements that were derived from the developed heuristics' explanations.

3.4.2.2 Pilot

Before conducting the pilot study, both the heuristic guidelines and the heuristic checklist were translated into Arabic. They were then sent to two checkers. The technical checker checked the accuracy of the translations of the different heuristic terms and the grammar checker checked the grammatical accuracy of the translated materials.

A pilot study was undertaken to assess the clarity and suitability of the developed heuristic guidelines and checklist using one research student who had knowledge of usability and design issues. He was selected for convenience as it was difficult for the researcher to gain access to actual experts. An English copy of the heuristic guidelines and checklist was used. The pilot study identified ambiguity and repetition in some statements of the heuristic checklist. Results from the pilot study were taken into consideration and changes were made to both the heuristic guidelines and the heuristic checklist.

3.4.2.3 Recruitment

Regarding the experience of evaluators who are supposed to perform heuristic evaluations, research has found that usability specialists (i.e. people who have experience in user interface and evaluation issues) were better at finding usability problems than people without such usability experience; double specialists, who have experience in both usability and in the interface being investigated perform even better as they have both usability and domain expertise (Nielsen 1992). Nielsen (1992) indicated that while there is no official certification for usability specialists, he defined them as people with graduate degrees who had several years of work experience in the usability area. However, recruiting inspectors who are experts in HCI and the interface is usually difficult; these skills are rarely available in one person and usability experts are usually scarce as they are hard to find and expensive to recruit (Stone *et al*. 2005). Therefore, Stone *et al*. (2005) indicated that it is more usual to find inspectors from different backgrounds. An inspector could be a usability expert, a domain expert, a designer with extensive design experience, a developer or a non-expert.

In order to determine the number of evaluators for the heuristic evaluation, research has found that this number depends on the experience of those evaluators (Nielsen 1990). Nielsen (1990) provided recommendations regarding the number of evaluators depending on their experience as follows: if the evaluators are usability specialists then employing three to five will result in the identification of between 74% and 87% of usability problems. If the evaluators are double specialists then it is sufficient to use between two and three evaluators in order to identify between 81% and 90% of the problems. Finally, if the evaluators are novices, that is, they do not have usability expertise, then using five evaluators results in finding 51% of the problems while 14 evaluators are necessary to find more than 75% of the problems.

In this research, there were both time and resource limitations regarding recruiting ideal evaluators with experience in usability issues and e-commerce sites, to perform the heuristic evaluation. It was difficult to find evaluators who were experts in usability and in e-commerce websites in Jordan. At the present time, the HCI field is new to Jordan as an area for study in universities and therefore it is unusual to find people with graduate degrees in this area. The target experts, therefore, were people who had extensive design experience in e-commerce

websites, as suggested by Stone *et al*. (2005) in cases when it was impossible to find experts with the ideal experience. Extensive experience in this research was identified as more than ten years. An investigation into companies in Jordan using electronic Jordanian and Arab directories and a Google search Internet resulted in identifying 17 companies which were developing and designing e-commerce sites. All these companies were contacted by email asking them to recommend a web expert who had at least ten years' experience in designing e-commerce sites. Only five companies agreed and therefore five web experts participated in this research as heuristic evaluators. This method of sampling is known as convenience sampling as participants were involved in this research based on their availability but taking into consideration their experience. These evaluators with their extensive expertise were considered appropriate as there was a lack of evaluators who were usability specialists in Jordan.

3.4.2.4 Evaluation Procedure

Each of the five web experts evaluated the three e-commerce websites in three different sessions. The heuristic sessions followed a similar procedure. As Nielsen (1994) recommended, the web experts in each session were asked to visit the website twice. At the beginning of each session, the web expert was asked to explore the studied website for 15 minutes and then to try buying anything from this site. After the exploration, the heuristic guidelines (Appendix 11) were given to him/her to be used as guidelines while evaluating each website. The web expert was asked to read each category and subcategory of the heuristic and its explanation, and to write down his/her comments concerning whether the website complied or not to each heuristic principle and to give any additional comments. After evaluating the website, using the heuristic guidelines, a heuristics checklist (Appendix 12) was given to the web expert to rate the website based on the degree of conformance to each statement in the heuristic guidelines. The ratings were based on a seven point rating scale (Likert scale).

3.4.3 Web analytics (Google Analytics)

The final method used was web analytics and for this *Google Analytics* software was utilised. Prior to installing this software on the companies' websites, a familiarisation process was followed. A *Google Analytics* account was set up and

the investigator created a fully functioning e-commerce website that could be used to test the analytics software. The scripts that were required to enable *Google Analytics* to collect data were added to this test e-commerce site and the investigator assessed the site. During this process, the investigator acquired detailed knowledge of *Google Analytics* and its setup.

In order to use *Google Analytics* to track the usage of the three studied e-commerce websites, a document was prepared that contained the codes that needed to be added to the web pages. This document included the required scripts which needed to be installed on the companies' websites together with the instructions on how to add these scripts. This was sent to the three companies. In each case, the script code was added successfully to the pages of the three websites. However, two of the companies did not agree to add code that was related to e-commerce transactions. This meant that, although the web pages that users viewed when using the sites would be obtained, the number of products purchased in each transaction could not be captured.

Using *Google Analytics*, each company could identify important or target pages of their e-commerce website and track the usage of those pages (important pages are called 'goals' in *Google Analytics*). *Google Analytics* also enables the sequence of pages that users followed to reach the important pages to be identified (The sequence of pages is called a 'funnel' in *Google Analytics*).

In order to determine the important pages on the studied websites and the paths that had to be followed by users from the point view of the three companies, an email was sent to the three companies asking them to identify their target pages and the logical paths to those pages. The email also included a request for the IP addresses of each company in order to identify filters to be set in *Google Analytics*. This enabled certain IP addresses (such as company addresses) to be filtered out to achieve more accurate measurements of the traffic. A meeting with each of the three companies was organised in order to discuss how to add the defined target pages, paths and IP addresses to the settings of *Google Analytics* of each website. *Google Analytics* was set up successfully for the three companies. The usage of the three sites was monitored for three months.

3.5 Data analysis

The data were analysed to determine which methods identified the area of each usability problem; the analysis was undertaken in three stages. The first two stages followed the analysis procedure of the multiple case study design by Yin (1984), as illustrated in Figure 3.1. This design starts by analysing the individual methods within each single case and interpreting the results at the single case level. This is followed by making a comparison across the cases which, in turn, results in drawing conclusions for the overall study from the multiple cases. Therefore, in this research, the first stage involved analysing each usability method separately for each case (i.e. each e-commerce website) and identifying the usability problems obtained from each method within each case. The second stage aimed to identify a list of common usability problems pinpointed by each method. This was achieved by performing a comparison of each usability evaluation method across the three cases (i.e. the three e-commerce sites). A third stage of analysis was undertaken in order to generate a list of standardised usability problem themes and sub-themes to facilitate comparisons among the various methods. Problem themes and sub-themes were identified from the common usability problem areas which were generated by each method. These were then used to classify the problems which had been identified. The list was generated gradually, starting from an analysis of the first method (the performance data and observation). Then, after an analysis of most of the aforementioned methods, new problem themes and/or sub-themes were added to the list from problems that were not covered in the standardised themes. The analysis of each method also described the overall usability of the sites.

This section explains how the quantitative and qualitative data obtained from the different methods used in the research were analysed at each stage.

3.5.1 User testing analysis

The data collected during the user testing were analysed in several ways. It is worth mentioning that the participants of the user testing were categorised into two groups: novice and expert, as suggested by Nielsen (1993). He stated that: “one of the main distinctions between categories of users is that between novice and expert users”. The participants’ experience in using the Internet was used as a criterion to categorise the participants. Participants in the novice group had less than three

years' experience using the Internet and those in the expert group had more than three years'. In the analysis of each user testing method, allocation to the novice or expert groups was taken into consideration. This section presents the analysis of the five user testing methods.

3.5.1.1 Pre-Test questionnaires

Data collected from the pre-test questionnaires were analysed in various ways. Descriptive analysis was used for Sections 1 and 2 to describe the characteristics of the novice and expert participants and their experience in online shopping. Likert scores were calculated for each statement in Sections 2 and 3 to describe participants' overall perceptions and experiences regarding online shopping.

It is worth mentioning that, for the purpose of the analysis in this research that used the Likert scale, a Likert score of 1-3 was regarded as a negative response, 5-7 a positive response and 4 a neutral one. The response values for the negative statements were reversed before calculating the Likert score. This was taken into consideration in the analysis of the pre-test questionnaires, the post-test (satisfaction) questionnaires and the heuristic checklist statements.

To determine if there was a statistically significant difference between novices' and expert users' ratings regarding the perception of the online shopping statements, the Mann-Whitney test was used. This test is a nonparametric test and was the most appropriate statistical technique to use since the statements were measured on an ordinal scale (Conover 1971). The Likert score of seven points was considered as an ordinal scale because it cannot specify if the differences between the scores will be identical. This was illustrated by May (2001) who stated that the differences between 'agree and strongly-agree' are not the same as the differences between 'disagree and strongly-disagree'.

3.5.1.2 Performance data and the observation method

The performance data were summarised in different ways. The task timing (in seconds) was computed, and descriptive statistics were used to obtain the mean time (in seconds) and the standard deviation. The tasks' accuracy was also determined. This represents the percentage of users who completed each task successfully within the time benchmark.

It is important to note that the average of the performance data includes values from users who performed the tasks within the time limit and users who exceeded the time limit. Users who exceeded the time limit of a task were asked to stop performing the task and the benchmark time was used for this task.

In order to identify the usability problems from the performance data, two steps were used, as suggested by Rubin (1994):

A. Identifying the problematic tasks

In order to compile a comprehensive list of usability problems for each site, all the problematic tasks were considered. Instead of identifying the most problematic tasks (e.g. the tasks that have success rates below 70 percentage as suggested by Rubin (1994)), all the tasks that one or more users could not complete successfully within the time benchmark were considered.

B. Identifying users' problems and conducting a source of error analysis

In order to identify users' problems/obstacles/difficulties with the problematic tasks, and to investigate the usability problems behind these, different sources were examined. These included the in-session observation notes, notes taken from reviewing the sixty Camtasia sessions, and users' comments noted during the test.

These sources identified a large number of usability problems. The problems were examined and categorised. They generated sixteen common usability problem areas from the three sites. These sixteen common usability problems generated sixteen problem sub-themes and a seven corresponding problem themes. The list of the problem themes and sub-themes that was generated from the analysis of this method is explained in the Results Chapter (Chapter 4).

To explain the overall usability of the sites, the summary of the total number of tasks successfully performed by all users was used, as well as the sources that identified the different usability problems. Inferential statistics were also used. The analysis of variance (ANOVA) test was used to obtain statistically significant results. The one-way within-subjects ANOVA test and the mixed ANOVA design were also used.

The one-way within-subjects ANOVA test was employed for each of the ten tasks. This was used to determine if the time spent performing each task was

significantly different. The within-subject factor, the sites, had three levels: site 1, site 2 and site 3. The dependent variable was the total time in seconds taken by users to perform a task. However, this test does not provide detailed analysis.

A mixed ANOVA design test was employed to obtain a more detailed analysis of the data. This type of analysis is used to analyse data from studies with many factors as it can investigate both the effects of each factor individually and the interaction between factors (Brace 2006). This design was used to determine:

- If the time for performing all the tasks on the three sites was significantly different for novice and expert users.
- If the time spent on each site to perform all the tasks was significantly different for the three sites.

The mixed design employed was a 2*3*10 mixed ANOVA. The first factor was the between-subjects factor of group with two levels: novices and experts. The second factor was the within-subjects factor of sites with three levels: site 1, site 2 and site 3. The third factor was the within-subjects factor of tasks with ten levels: the ten tasks: task 1 to task 10. The dependent factor was the time in seconds the user took to perform a task.

3.5.1.3 Post-Test questionnaires - quantitative data

Data collected from the post-test questionnaires were used to find evidence of usability problems with the sites.

Likert scores were calculated for each statement in Section 1 of the post-test questionnaire for each site in order to obtain the overall results concerning the participants' satisfaction with the sites.

The post-test statements were grouped under four categories from the developed heuristic guidelines: (architecture and navigation, content, design, and purchasing process), and their corresponding sub-categories with the exception of three statements (17, 26, 28). These statements related to the overall evaluation of the tested sites and were grouped under a new sub-category: the overall evaluation of the sites. The statements were grouped to facilitate the pinpointing of usability problems. The post-test questionnaire did not include statements related to the accessibility and customer service category of the heuristic guidelines and its sub-

categories and therefore this category was not considered for grouping the post-test questionnaire statements.

A Likert score rating of 1 to 3 (negative) on a post-test questionnaire statement was interpreted as indicating there was a usability problem from the users' point of view. Negative statements identified a number of usability problems with the sites. These statements were mapped to the problem themes and sub-themes identified by the previous method. Four statements identified three new problem sub-themes.

To explain the overall usability of the sites, two inferential statistical tests were used for each statement of the post-test questionnaire:

- The Mann-Whitney test was used to determine if there was a statistically significant difference between the ratings of novice and expert users.
- The Friedman test was used to determine if there was a statistically significant difference between users' ratings of the three sites.

The Friedman test and the Mann-Whitney test are nonparametric tests and were the most appropriate statistical techniques due to the ordinal scale of measurement that was used with the collected data (as explained in Section 3.5.1.1).

3.5.1.4 Post-Test questionnaires - qualitative data

Qualitative data obtained from users' responses to the open-ended questions on the post-test questionnaires were taken into account in determining the usability problems. Users' answers were translated into English from Arabic and were then combined for each site and grouped under five categories from the heuristic guideline categories that had been developed: (i.e. architecture and navigation, content, accessibility and customer service, design, and purchasing process), and their corresponding sub-categories.

Several usability problems were identified from the answers of users. These answers were mapped to the problem themes and sub-themes identified by the previous methods; nine new sub-themes were generated. Seven of these sub-themes were mapped to appropriate problem themes and the other two sub-themes generated new problem themes.

3.5.1.5 Post-Evaluation questionnaires - qualitative data

Data obtained from the post-evaluation questionnaires were translated into English from Arabic. These data represented answers to questions that asked users to indicate the site with the best six features. The answers were grouped under the six features of the sites that related to: navigation, internal search, architecture, design, purchasing process, and security and privacy.

3.5.2 Heuristic evaluation analysis

Qualitative and quantitative data collected from the heuristic evaluators were analysed in different ways. This section presents the analysis of the two heuristic evaluation methods.

3.5.2.1 Heuristic evaluation analysis - qualitative data

The heuristic evaluators' comments, obtained during the fifteen sessions on the compliance of each site to each heuristic principle, were translated into English. They were then grouped together for each site and categorised under the categories and sub-categories of the designed heuristic guidelines.

Forty common usability problem areas were identified across the three sites from examining the heuristic sub-categories. Twenty-four problems were mapped to the appropriate themes and sub-themes identified by the user testing methods. However, fifteen new problem sub-themes were identified and one sub-theme identified one new problem theme.

3.5.2.2 Heuristic evaluation checklist

Likert scores were calculated for each statement of the heuristic checklist for each site to obtain the overall ratings of the five heuristic evaluators. Statements from the heuristic checklist were mapped to five of the heuristic categories that had been identified and their corresponding sub-categories. Three statements were excluded (87-89) because they required purchasing from a site.

The Likert score rating of 1 to 3 (negative) of the heuristic checklist statements was interpreted to indicate a significant/serious usability problem. A list of usability problems was extracted from the negative statements. These statements were mapped to the identified problem themes and sub-themes.

To obtain information regarding the overall usability of the sites, the Friedman test was used. The aim of using this test was to determine if there was a statistically significant difference among the ratings of the heuristic evaluators of the three sites regarding each statement in the heuristic checklist. The reasons behind using this test were explained in Sections 3.5.1.1 and 3.5.1.3.

3.5.3 Google Analytics analysis

The web usage of the three sites, tracked using *Google Analytics*, was measured using 41 web metrics. This section explains the metrics and how these were selected.

3.5.3.1 Selecting web metrics

As mentioned in Chapter 2, if a web analytics approach is to be used to improve the design of websites, then it is advisable to employ advanced or actionable metrics that measure users' interactions with a site to improve customers' interactions and the overall usability of the site (Eisenberg *et al*. 2002; Inan 2006; Phippen 2004; Peterson 2006). Consequently, an investigation was undertaken to find advanced but appropriate web metrics to use in this research. The literature offered a large number of advanced web metrics that could be used to measure the usage of a site (Eisenberg *et al*. 2002; Inan 2006; Phippen 2004; Peterson 2006). Unfortunately, no empirical studies were found that suggested or recommended a matrix of such metrics for use in describing the usability of a site. Therefore, to analyse the GA results, a matrix of 41 advanced web metrics was suggested.

3.5.3.2 The trial matrix of web metrics

The matrix was built with the intention of maximising the use of web metrics (which could be calculated by using *Google Analytics* data) to produce a detailed understanding of the overall usability of an e-commerce site. The most common advanced web metrics defined in the literature were included. However, some metrics could not be included due limitations in *Google Analytics*. Examples of the advanced metrics that could not be included: *percent new and returning visitors*, *percent revenue from new and returning visitors*, *percent order from new and returning visitors*, *new and returning visitors conversion rate*, *search to purchase conversion rate* and *repeat visitor share*.

The matrix was divided into nine categories, as shown in Table 3.2. The first seven categories included metrics that were selected to describe the overall usability of a site while the last two categories included metrics that were selected to describe other issues. These helped to provide an understanding of the usability of an e-commerce site. The nine categories were:

- General usability metrics: Five metrics were selected to describe the general usability of a site in terms of its architecture, navigation and content.
- Internal search metrics: Three metrics were selected to describe the usability of the internal search of a site; this is an important component of any site.
- Top landing pages metrics: Three metrics were selected to describe the usability of the top landing pages. The landing page, which is also called the entry page, is the page that appears when a user clicks on a search-engine result link or on an advertisement (Wikipedia [n.d]). Therefore, investigating the usability of the landing pages is important to examine how effectively the landing pages of a site attract visitors to click deeper into the site rather than leaving it immediately.
- Top content pages metrics: Three metrics were selected to describe the usability of the top content pages, which are also called the mostly viewed pages of a site.
- Top exit pages metrics: One metric was selected to describe the usability of the top exit pages; exit pages are the pages from which visitors left the site.
- Finding customer support information metrics: Two metrics were selected to investigate the usability of a site regarding the finding of customer support information. It is important for a site to have customer support information that is easy to find rather than visitors having to make high-cost telephone calls (Peterson 2006).
- Purchasing (checkout) process metrics: Six metrics were selected to describe the usability of a site's purchasing process.
- Visitors' metrics: Four metrics were selected to describe the return behaviour of a site's visitors, while another eight metrics were used to describe the characteristics of the computers and Internet browsers used by

those visitors, and the connection speed of their network. These metrics add supplementary information to the understanding of the usability of a site.

- Financial performance metrics: Six metrics were selected to describe a site's ability to generate revenue and to cross-sell. Cross-selling means selling additional products or services to a customer.

Table 3.2: Trial matrix of web metrics

No.	Metrics Category	Metrics
1	General usability metrics	Average time on site, average page views per visit, percentage of high, medium and low time spent visits, percentage of high, medium and low click depth (page view) visits, bounce rate for all pages[2] (also known as reject rate for all pages).
2	Internal search metrics	Average searches per visit, percent visits using search, search results to site exits ratio.
3	Top landing pages metrics	Bounce rate for each top landing page, entrance sources for each top landing page, entrance keywords for each top landing page.
4	Top content pages (also called most viewed pages) metrics	Bounce rate for each top content page, average time for each top content page, percentage of site exits from each top content page.
5	Top exit pages metrics	Percentage of site exits from each top exit page.
6	Finding customer support information metrics	Information find conversion rate, feedback form conversion rate (also known as completion rate).
7	Purchasing process metrics	Cart start rate[3], cart completion rate, checkout start rate[4], checkout completion rate, ratio of checkout starts to cart starts, funnel report.
8	Visitors' metrics	Ratio of new to returning visits, visitor engagement index (also known as average visits per visitor), percentage of high, medium and low frequency visits (also known as visitor loyalty), percentage of high, medium and low recency visits, language, operating systems, browsers, screen colours, screen resolutions, flash versions, Java support, connection speed.
9	Financial performance metrics	Average order value (AOV) (also known as average order amount (AOA)), order conversion rate (OCR), average revenue per visit (also known as sales per visit (SPV)), average visits to purchase, average days to purchase, average items per cart completed (also known as average items per order).

The trial matrix was used to measure the tracked usage of the three sites. The metrics, their equations, meanings and results for each metric (together with the data for each site) are shown in Appendices 13-19. It is worth mentioning that most (26 out of the 41) of these metrics were calculated manually using Microsoft Excel since *Google Analytics* did not have the ability to measure and display these metrics; it only provides raw data for the calculation. The metrics which were

[2] Bounce rate: Percentage of single page visits, i.e. visits in which a visitor left the site after visiting only the entrance page (Peterson 2006).
[3] Cart start rate metric: Percentage of visits that involve visitors who added at least one item to their shopping cart (Peterson 2006).
[4] Checkout start rate metric: Percentage of visits that involve visitors who clicked at checkout button (Peterson 2006).

provided automatically by *Google Analytics* software include: *Average time on site*, *average page views per visit*, *bounce rate for all pages*, *bounce rate for each top landing page*, *entrance sources for each top landing page*, *entrance keywords for each top landing page*, *bounce rate for each top content page*, *average time for each top content page*, *percentage of site exits from each top content page*, *percentage of site exits from each top exit page*, *funnel report*, *average order value*, *order conversion rate*, *average days to purchase* and *average days purchase*.

3.6 Reliability and validity

The validity of an evaluation technique concerns whether a technique measures what it is supposed to measure; this involves the technique itself and how it is performed (Preece *et al*. 2002). For example, the validity of the user testing method, according to Nielsen (1993), relates to if the results actually reflect the usability issues the researcher wishes to test. Nielsen (1993) provided examples regarding typical validity problems which included involving the wrong users, or designing the wrong tasks, or not including time constraints and social influences.

Furthermore, Gray and Salzman (1998) defined threats to validity of experimental studies within the context of HCI research. They examined the design of five experiments that compared usability evaluation methods and provided recommendations for addressing different types of validity that are most relevant to HCI research. For example:

- To ensure internal validity, they recommended considering three issues which are instrumentation, selection and setting:
    a. Instrumentation for usability evaluation methods concerns biases in how human observers identify or rate the severity of usability problems. In the case of comparing methods or groups, the instrumentation is only valid if there is a way of rating the results that do not inappropriately favour one condition over the others. This means that the same evaluators or experimenters should not be assigned to different UEMs and asked to identify, classify or rate usability problems. Also, usability problem categories that are defined by one UEM should not be used by the experimenter to categorise problems found by another UEM.

b. Selection concerns the characteristics of the participants: whether they are related to the manipulation of interest and whether the participants assigned to different groups are equal in terms of certain characteristics (e.g. knowledge or experience) related to conditions of the experiment.
c. Setting concerns the conditions and location of an experiment where a researcher should ensure that all participants in each UEM perform the experiment under the same conditions and in the same location.

- To ensure causal construct validity, a researcher should provide explicit information regarding the exact operation and method used so that a UEM should be applied according to the understanding of the reader of that method. For example, in the case of heuristic evaluation, evaluators should use guidelines and should explain whether evaluators work together or independently in the process of identifying the usability problems. Furthermore, in order to avoid the problem of interactions of different treatments, it is highly recommended not to use the same participants to conduct two or more UEMs; each group of participants should conduct only one UEM.

These recommendations were considered in this research in order to ensure its validity. The internal validity of this research concerned instrumentation, selection and setting. The researcher/experimenter was not assigned to different UEMs and identified usability problems. Despite the fact that the researcher was involved in the collection of data and played the role of observer in the user testing sessions and heuristic evaluation sessions, the web experts in the heuristic evaluation sessions identified the usability problems themselves. The researcher only reported the results of the experts. Furthermore, the categorisation of usability problems identified by each method was not the basis for categorising the usability problems obtained from the other methods. Each method was analysed separately then problems that were identified by each method were compared to generate the problem themes and sub-themes which were generated gradually, as mentioned in Section 3.5.

The selection issue was also considered while recruiting participants in the user testing and heuristic evaluation methods. The characteristics of the participants

in the user testing were based on the companies' profiles of their users. Also, the web experts who participated in the heuristic evaluation all had approximately similar experience (i.e. more than 10 years) in designing e-commerce sites. Unexpected characteristics of participants in the two experiments were not included.

The 'setting' issue was also considered in this research, where all the participants in the user testing performed the testing in the same location under the same conditions and all followed the same procedure, as illustrated in Section 3.4.1.10. All the experts in the heuristic evaluation performed the inspection under the same conditions and followed the same procedure, as mentioned in Section 3.4.2.4. Even though every web expert evaluated the sites in his/her office in his/her company, similar conditions existed in each company.

Causal construct validity was also taken into consideration in this research. The data collection sections explicitly describe how each method was used in this research while these methods represent the usability methods that were identified and described in the literature. The problem of interactions was avoided since the participants in the user testing were not the same as those who carried out the heuristic evaluation.

It is worth mentioning that the multiple case study design which was used in this research would enhance the external validity or the generalisation of the findings, as stated by Merriam (1998).

The reliability or consistency of an evaluation technique, as indicated by Preece *et al*. (2002), is related to "how well a technique produces the same results on separate occasions under the same circumstances". For example, in the case of user testing, reliability is related to whether the same result would be obtained if the test were to be repeated (Nielsen 1993). Preece *et al*. (2002) stated that, in the case of experiments, if an experiment is controlled carefully then it will have high reliability so that if another evaluator follows exactly the same process then they should achieve the same results. In this research, it was difficult to employ the same methods for a second time in order to investigate whether the same results would be achieved because of the time limitation. However, the reliability of some techniques used in this research can be measured, such as the reliability of the post-test questionnaire.

In the case of questionnaires, reliability means that "a measure should consistency reflect the construct that it is measuring" (Field 2009). The most common measure of reliability is Cronbach's alpha, where a value of 0.7 to 0.8 is acceptable, and indicates a reliable measure while values that are substantially lower indicate an unreliable measure (Field 2009).

The post-test questionnaire was based on a reliable measure (CSUQ), in addition to other questions proposed in earlier research, as mentioned in Section 3.4.1.4, that are specifically designed to measure users' satisfaction with an interface. The Cronbach's alpha for this measure exceeded 0.89 (Lewis 1993). However, this measure was adapted to evaluate e-commerce websites in Jordan. The reliability of the developed post-test questionnaire was calculated using the overall Cronbach's alpha for each site. It showed that this measure had high reliability since all Cronbach's alpha for each site were higher than 0.8. The value of Cronbach's Alpha for sites 1, 2 and 3 were: .939, .937 and .931, respectively.

3.7 Conclusion

This chapter presented an illustration and justification of the selected research philosophy, design and methods which helped to achieve the aims and objectives of this research. The chapter also discussed the techniques that were employed to collect and analyse data related to the three main methodologies used in this research: user testing, heuristic evaluation and *Google Analytics*.

Chapter Four: Qualitative and Quantitative Results

This chapter presents the results from employing the different methods used in the research. The chapter provides an idea regarding the usability problems that were identified by each method on each website and illustrates common usability problems that were identified by each method across the three websites. The chapter also shows how these common areas of usability problems contributed to the generation of a standardised list of usability problem themes and sub-themes that were then used in the comparison of the effectiveness of the various methods in identifying usability problem areas. A description of the overall usability of the sites is included in this chapter, as well as a matrix of web metrics calculated using *Google Analytics*, which is suggested for identifying potential usability problems on an e-commerce website.

4.1 User testing results

This section presents the findings obtained from the analysis of the different user testing methods. It presents an overview of the users in terms of their characteristics, and their perceptions and experience of online shopping. This is followed by a presentation of the findings from the performance data and

observations; the quantitative and qualitative analysis of the post-test (satisfaction) questionnaires; and the post-evaluation questionnaires.

4.1.1 Pre-Test questionnaires

Sections 1 and 3 of the pre-test questionnaire were answered by all the users, while Section 2 was only answered by users experienced in online shopping.

4.1.1.1 Participants' characteristics

- There were ten novice participants: eight females and two males. The majority (seven) had more than three years' experience using computers, while only three participants had less experience. All had less than three years' experience using the Internet and none reported having used the Internet for purchasing.
- There were ten expert participants: eight females and two males. All had more than three years' experience using computers and the Internet. Less than half (four) reported having used the Internet for purchasing.

Neither novices nor experts reported having explored the three sites prior to the usability testing. For full details of the users' characteristics and the frequency distribution, see Appendix 20.

4.1.1.2 Participants' perceptions of online shopping

The Mann-Whitney test showed that there were no statistically significant differences between novice and expert users in their ratings regarding their perceptions towards the online shopping statements, except for one. That statement related to users' interest in information about companies presented on the sites. Novices were not interested whilst experts were.

The Likert scores for the other statements (Appendix 21) showed that novice and expert users:

- Considered the cost of using the Internet as generally unreasonable.
- Liked websites to be easy to navigate and to be well organised.
- Considered compulsory registration frustrating when shopping online.

- Worried about the security of their financial information, the privacy of their personal information, and the absence of legal regulations that govern online transactions when shopping online.

4.1.1.3 Participants' experience in online shopping

The four expert users who had purchased from the Internet provided information about their experience of online shopping (Appendix 22):

- Two thirds (three) used the Internet annually for purchases, whilst one participant indicated his/her usage was monthly.
- The first purchase from the Internet was made less than a year ago for two participants and between one and two years for the others.
- Two thirds (three) used their credit card as the method of payment, whilst one used the cash on delivery method.
- The products bought in their last purchase were a mobile phone, a digital camera, books and a video card.
- Two thirds (three) purchased from international sites, whilst one purchased from a Jordanian site.

The Likert scores for the online shopping experience (Appendix 23) showed that these four users:

- Shopped online because it saved time and they were able to buy products at any time of day from any location.
- Preferred to shop online from: well known sites with a good reputation; sites that provided alternative methods of ordering/payment/delivery; and sites that did not have limited delivery areas.
- Found the website's search function useful when shopping online. A detailed description of the products was also important. They preferred to research products in detail before purchasing and were encouraged to shop online from sites with a clear return and refund policy.

- Received the products within the time period specified by the company and were satisfied with the goods received. The products were accurately represented by the websites.
- Obtained good customer service from online companies. They felt more comfortable with sites which kept them informed about the status of their order.
- Did not find delivery costs reasonable. It was not important for a shopping site to have the ability to deliver the order to an address different from their own.

4.1.2 Performance data and observation method

The summary of the performance data is presented in two tables (Appendices 24 and 25). Appendix 24 presents the mean time in seconds and the standard deviation for each task for novice and expert users. Appendix 25 presents the accuracy of the tasks for each task across the sites.

The problematic tasks, as shaded in the tasks accuracy table, were:

- Tasks 3, 5, 6 and 8 across the three sites. These related to changing the content of the shopping cart, changing the shipping address, using the internal search of the site, and finding shipping information.
- Using the advanced internal search on site 1 (Task 10).
- Purchasing a product from sites 2 and 3 (Task 2 for sites 2 and 3 and Task 4 for site 3).
- Finding a product and finding information on site 3 (Tasks 1, 4, 9 and 10).

The observation notes, the notes generated from reviewing the sixty Camtasia files, and users' comments from the user testing were summarised in terms of tasks. This summary presents a snapshot of each task and highlights the critical incidents that occurred during each task across the sites (Appendix 26 displays two snapshots as examples). These incidents represent potential problems with users' interactions with the sites and the problems were divided into three types:

- Critical problems/obstacles: The user made a mistake/error and was unable to recover and complete the task on time. The user might or might not have realised the mistake/error.
- Non-critical problems/obstacles: The user made a mistake/error but was able to recover and complete the task within the time limit.
- Other problems: These were noted when the user had difficulties, or when unusual behaviour was observed, or when a user made a comment while performing the task.

Problems that related to specific pages in each site were listed under the title of each page in the summary table (Appendix 26). To ensure clarity, the summary table is called the observation summary throughout.

Using the observation summary, a large number of usability problems were identified on each site for each task. These problems related to problematic, as well as non-problematic tasks. For example, novice and expert users faced obstacles or difficulties while purchasing a product from a site 1 (Tasks 2 and 4). However, despite these obstacles users were still able to complete the tasks required of them (Appendix 25).

Similar problems in each site were grouped together to generate a list of problems for each. The three lists then generated were examined to identify similar problems across the three sites. Consequently, sixteen common areas of usability problems were identified which suggested identifying sixteen problem sub-themes. These sixteen problem sub-themes suggested identifying seven problem themes based on the types of the identified problems. The seven problem themes related to: navigation, content, design, architecture, internal search, purchasing process and accessibility and customer service. Table 4.1 shows the sixteen problem sub-themes, their themes and the description of each. Appendix 27 shows the common areas of usability problems, the tasks that identified each problem, and the location of each problem on each site. The location of the problems was named either “entire-site” or by the title of the page with the problem. Entire site problems were identified as problems users faced in any page on the site. Appendix 27 also shows that during some tasks more than one problem was identified.

Table 4.1: Usability problem themes and sub-themes that were identified by the performance data and observations, together with their descriptions

Problem Theme	Problem Sub-Theme	Description of the Problem
Navigation	Misleading links	The destination page, which was opened by the link, was not expected by users because the link name did not match the content of the destination page.
	Links were not obvious	Link was not situated in an obvious location on a page for it to be recognised by users.
	Weak navigation support	A page did not have a navigational menu or links to other pages in a site.
Content	Irrelevant content	The content of a page was not clear to users because the page displayed an unclear message or had repetitive content or had empty content (i.e. the page was under construction).
Design	Misleading images	An image did not function as users expected. For example, it did not have a link when it suggested to users that it had one.
	Inappropriate page design	A page did not clearly represent its content or it had an inappropriate design such as being long and/or displaying large numbers of images, or was cluttered, or had inappropriate headings.
Architecture	Poor structure	The structure or architecture of a site was not simple nor straightforward enough to find information or products.
Internal Search	Inaccurate results	The results of the internal search were inaccurate.
Purchasing Process	Difficulty in knowing what was required for some fields	The site had pages with some entry fields where the required information to be entered was not clear to users.
	Difficulty in distinguishing between required and non required fields	The site had pages with some entry fields where there was no clear distinction between required and non-required fields.
	Difficulty in knowing what links were needed to be clicked	The site had pages with information that could be updated. Links had to be clicked in order to confirm this update but the links did not reveal that users had to click them to update the information.
	Session problem	The site had a session problem in which it did not save users' information, so users had to enter their information for each transaction during the same session.
	Required fields were not logical	The site had pages with some entry fields where the required fields were not logical.
	Expected information not displayed after adding products to cart	The site did not display expected information (i.e. confirmation) after users had added products to their cart.
Accessibility and Customer Service	Not easy to find help/customer support information	The site did not display the help/customer service information in an obvious location to be noticed and accessed by users.
	Inappropriate information provided within a help section/customer service	Some pages that displayed help /customer information had inappropriate content that did not match users' needs or expectations.

Description of the overall usability of the sites

Analysis of the performance data and observations provided the following general findings regarding the overall usability of the sites:

- The observation summary showed that expert and novice users experienced many similar problems, obstacles or difficulties performing the different tasks across the sites. The difference between experts and novices is the fact that experts recover faster. This explains why novice users had a larger number of problematic tasks, as shown in Appendix 25.

- The total number of tasks successfully performed by all the users (experts and novices) was lowest in site 3 (Appendix 25). This indicates that sites 1 and 2 were noticeably better than site 3.
- As expected, the percentage of experts who successfully completed each task was higher than the percentage of novices. This was due to their higher level of knowledge.
- A one-way within-subjects ANOVA test showed the time spent performing the majority (eight) of the ten tasks was significantly different for the three sites. Appendix 28 shows the results of the ANOVA test for each task.
- A mixed ANOVA design test showed (Appendix 29):
    - Experts performed all the tasks significantly faster than novices; this was determined by assessing the effect of the Group factor: $F(1,18) = 13.644$, $p = .002$.
    - The total time spent on each site to perform all the tasks was not significantly different, demonstrated by the assessment of the effect of Sites factor $F(2,36) = 2.010$, $p = .149$.
    - The time spent on performing each of the ten tasks was significantly different for the three sites, determined by assessing the interaction between Sites and Tasks factors $F(18,324) = 16.439$, $p = .000$. This result is consistent with the one-way within-subjects ANOVA analysis.

4.1.3 Post-Test questionnaires - quantitative data

A list of usability problems were identified from the negative statements (statements with Likert score rating of 1 to 3) in the satisfaction questionnaires. Each problem in the list and the problem sub-themes which were identified by the performance data and observation method, were compared for agreement. Consequently, these statements were mapped to the identified problem themes and sub-themes. Four statements identified three new problem sub-themes that were mapped to the navigation, design and purchasing process problem themes. These problems, as well as their description, are shown in Table 4.2. The negative statements, their Likert

scores and the problem themes and sub-themes identified by these statements, are shown in Appendix 30.

Table 4.2: New problem themes and sub-themes that were identified by the quantitative data of the post-test questionnaires, together with their descriptions

Problem Theme	Problem Sub-Theme	Description of the Problem
Navigation	Broken links	The site had pages with broken links.
Design	Unaesthetic design	The site did not have an aesthetically pleasing nor attractive interface.
Purchasing Process	Compulsory registration	The site requires users to register to the site to proceed in the checkout process

Description of the overall usability of the sites

The following points represent the general findings for the overall usability of the sites:

- The Mann-Whitney test showed there were no significant differences between novice and expert users for a large number of the post-test statements (Appendix 31). Consequently, the ratings of novice and expert users were combined for each statement concerning the post-test questionnaire.
- The Friedman test was used after combining the ratings of novice and expert users. This showed that there were statistically significant differences between users' ratings of the three sites for all the statements, as shown in Appendix 32. In these statements, site 3 had the lowest ratings for all the following aspects except one: navigation and architecture, content, design and purchasing process. Site 1 had the lowest rating for one statement (21) that related to navigation. The Likert scores for the overall evaluation statements also showed that site 3 rated negatively with the lowest rating for all statements. Site 1 rated positively with the highest rating and site 2 rated neutral.

However, the Friedman test was not used for seven statements. For these statements, site 3 had no ratings for six statements and sites 1 and 2 had no ratings for one statement. Site 3 had no rating for four statements (3, 11, 12, 13) concerning the internal search as it did not have such a facility and for two statements (4, 15) as it did not enable registration. Sites 1 and 2 had no ratings for one statement (16) as they did not have optional registration.

4.1.4 Post-Test questionnaires - qualitative data

Analysis of the qualitative data from the post-test questionnaires showed novice and expert users experienced similar usability problems in the sites. For this reason (and since the results of the Mann-Whitney test showed no significant difference between novice and expert users for many of the post-test statements (Appendix 31), answers from novice and expert users for each question of the post-test questionnaire were combined. However, usability problems identified only by expert users were highlighted by noting 'expert' next to these answers.

These problems were compared and then mapped to the appropriate problem themes and sub-themes identified by the previous two methods (performance data and observation, and the quantitative data from the satisfaction questionnaires). No match was found between nine problems and the identified problem sub-themes. Therefore, two new problem sub-themes identified two new problem themes relating to an inconsistency problem and missing capabilities. Seven new sub-themes were also identified. These sub-themes were mapped to six appropriate problem themes (navigation, internal search, content, design, purchasing process and accessibility and customer service). Table 4.3 shows the new problem themes and sub-themes and their descriptions. Appendix 33 summarises all the usability problem themes and sub-themes identified by the qualitative data of the post-test questionnaires and their location on the sites.

Table 4.3: New problem themes and sub-themes that were identified by the qualitative data of the post-test questionnaires, together with their descriptions

Problem Theme	Problem Sub-Theme	Description of the Problem
Navigation	Orphan pages	The site had dead-end pages that did not have any link.
Internal Search	Limited options	The internal search facility had limited options to search the site.
Content	Inaccurate information	The site displayed inaccurate information. For example, it displayed out of stock products or gave an inaccurate description for some products.
	Missing information about the products	Adequate information about the products was not displayed, such as: availability/stock indication, fabric, representative (large) images, length and width of some products, size guide.
Design	Inappropriate choice of fonts and colours	The site used an inappropriate font size (i.e. small size) or inappropriate font style (i.e. bold font style for many sentences on the same page) or inappropriate combination of background and link colours.
Purchasing Process	Long ordering process	Ordering process pages included more than one page with similar content which increased the number of steps required to purchase from a site.
Accessibility and Customer Service	Not supporting more than one language	The site did not display its content in languages other than English.
Inconsistency	Inconsistent design/layout/content.	The site's design, layout or content was inconsistent throughout the site. For example, the content on Arabic and English interfaces was inconsistent.
Missing Capabilities	Missing functions/information	The site did not have some functions or capabilities (i.e. an internal search facility) or it did not display adequate information.

Description of the overall usability of the sites

Question 35 on the post-test questionnaire was designed to gather users' opinions regarding the overall usability of the sites and showed that the majority (sixteen) of the twenty users were not satisfied with the performance of site 3. They indicated that the general performance of site 3 would discourage them from purchasing from it in the future. However, all the users indicated that there were personal issues, which did not relate to the usability of sites, but which would discourage them from purchasing a product from all three sites. These issues related to feeling that the security of their financial information would not be protected. The preference for physically touching a product before purchasing it was another reason.

4.1.5 Post-Evaluation questionnaires - qualitative data

The qualitative data obtained from experts and novices were combined (as explained in Section 4.1.4). Analysis of the seven open-ended questions on the post-evaluation questionnaire (relating to the site with the best features from the users'

point of view) did not explicitly identify specific usability problems. It only provided information on the overall usability of the sites from the users' point of view in terms of six features of the sites:

- Navigation: The answers to two questions (2, 6) indicated that the navigation support of sites 1 and 2 enabled users to find products and information easily. The number of users who recommended site 1 was higher than the number who recommended site 2. Site 1 had the most obvious and simplest methods for finding products and was the easiest site to find information related to the tasks. A few users (two) who used the Arabic interface of site 3 recommended it as the easiest site to navigate and find products or information. The English and Arabic interfaces were similar in terms of their design and architecture. Users preferred the Arabic interface because it used their first language.

- Internal Search: Answers to two questions (2, 6) indicated that the internal searches of sites 1 and 2 enabled products and information to be easily located.

- Architecture: Answers to two questions (2, 6) on the post-evaluation questionnaire indicated that the simple, straightforward architecture of sites 1 and 2 enabled users to find products and information easily. More users recommended site 1 than site 2. A few users (two) preferred the architecture of the Arabic interface of site 3 to the architecture of the other two sites because it used their first language.

- Design: The answer to one question (1) on the post-evaluation questionnaire indicated that site 1 had the most professional appearance. Few users recommended site 2 and none recommended site 3.

- Purchasing Process: The answers to three questions (3, 4, 7) showed that most users recommended site 1 as the site with the most obvious method for ordering items. Most users recommended site 1 as having the best support for customers (to continue shopping) and to change the contents of their shopping cart. Most users recommended site 2 as the easiest for changing customer information. No user recommended site 3.

- Security and Privacy: The answers to question 5 (related to the site users trusted the most) recommended site 1. Few users recommended site 2 and none recommended site 3. Only two users indicated that their reason for trusting sites 1 and 2 related to the sites' use of the secure socket layer. All the users who recommended site 1 indicated other reasons for their recommendations which did not relate to the site's design issues. They mentioned that this site is a famous and well-known company with a good reputation.

4.2 Heuristic Evaluation Results

This section introduces the qualitative and quantitative findings from the analysis of the heuristic evaluation methods.

4.2.1 Heuristic evaluation analysis - qualitative data

An analysis of the qualitative data obtained from the fifteen sessions with the heuristic evaluators provided comprehensive and detailed comments regarding the compliance of each site to each heuristic principle.

Each heuristic sub-category of each site was examined to identify problems with each site. These problems were classified and similar problems grouped together to identify common areas of usability problems on each site. These were examined to identify common areas of usability problems across the three sites. Consequently, forty problem areas were identified and these were then mapped to the problem themes and sub-themes identified by the user testing methods explained in Tables 4.1-4.3. One new problem theme was identified, which was security and privacy. Fifteen new problem sub-themes were also identified and mapped to appropriate problem themes. Table 4.4 shows the newly identified problem themes and sub-themes and their descriptions. Appendix 34 shows the common areas of usability problems that were identified and the location of each problem on each site after mapping them to their corresponding problem themes and sub-themes.

Table 4.4: New problem themes and sub-themes that were identified by qualitative data of the heuristic evaluation, together with their descriptions

Problem Theme	Problem Sub-Themes	Description of the Problem
Content	Grammatical accuracy problems	The site's content was not free from errors. For example, it had spelling errors, grammatical errors, or its punctuation was inaccurate.
	Missing information about the company	Basic facts about the company were not displayed. For example, year founded, type of business, purpose of its website, etc.
Design	Inappropriate quality of images	The site had images of poor quality in which the text that was displayed was not clear/readable.
	Missing alternative texts	The site did not use the alternative text for its images.
	Broken images	The site had some broken images on some pages (i.e. images were not displayed).
	Inappropriate page titles	The site's pages had inappropriate page titles that did not describe the content of pages and that did not include the company name.
Architecture	Illogical order of menu items	Menu items were not ordered in a logical way. For example, the home page item was not situated at the top of the menu items.
	Illogical categorisation of menu items	Menu items were not categorised in a logical way. For example, three different menu items opened the same page.
Internal Search	Poor visibility of search position	The internal search facility was not situated in an obvious location identifiable by users.
Purchasing Process	Not easy to log on to the site	The site required users to log on using their account number instead of their password which was not easy to remember.
	Lack of confirmation if users deleted an item from their shopping cart	The site did not display a warning message to users before deleting an item from their cart.
	Long registration page	The registration page had a large number of required fields to be filled by users.
Security and Privacy	Lack of confidence in security and privacy	The site did not display either a security guarantee or a privacy statement policy.
Accessibility and Customer Service	Not easy to find and access the site from search engines	The site was not found in the first ten pages of the search engine's (Google) results.
	Not supporting more than one currency	The site did not display the prices of its products or other expenses in currencies other than dollars ($).
	Not supporting the sending of comments from customers	The site did not have a feedback form to facilitate sending comments from users.

Description of the overall usability of the sites

Despite the fact that the heuristic evaluators identified a large number of usability problems on the three sites, they succeeded in identifying the site which had the best usability compared to the other sites; this was site 1. The evaluators also indicated that site 3 had the worst usability compared to the other sites.

4.2.2 Heuristic checklist

The analysis of the qualitative data obtained from the heuristic evaluators identified a large number of usability problems and the analysis of the quantitative data obtained from the heuristic checklist served the purpose of identifying usability problems that might have been overlooked by the heuristic evaluators.

Several usability problems were extracted from the negative statements from the heuristic checklist. A match was examined between each problem in the list and the problem sub-themes, identified by the previous methods, and their descriptions. All these statements were mapped to the appropriate problem themes and sub-themes. Neither new problem themes nor new sub-themes were identified from the negative statements in the heuristic checklist. This means that the heuristic evaluators did not fail to investigate the conformance of any subcategory of the heuristic guidelines in their inspection of the websites. The negative statements, their Likert scores, and the problem themes and sub-themes that were identified, are shown in Appendix 35.

Description of the overall usability of the sites

Regarding the overall usability of the sites, the Friedman test showed that there were statistically significant differences in the heuristic evaluators' ratings of the sites for most statements in the heuristic checklist (Appendix 36). In these statements:

- Site 3 had the lowest ratings for: two (out of six) navigation statements (statements 8, 13 out of statements 8, 10, 13, 15, 16, 17); all the architecture statements (statements 19-24); all the content statements (statements 25, 27-29, 33-35); eight (out of eleven) design statements (statements 18, 54, 55, 58, 60, 61, 64, 66 out of statements 18, 54, 55, 58, 59, 60, 61, 63, 64, 66, 67); eight (out of nine) purchasing process statements (statements 70, 72, 73, 74, 75, 76, 81, 86 out of statements 70, 72, 73, 74, 75, 76, 81, 86, 92); a statement concerning security and privacy (95); four (out of seven) accessibility and customer service statements (statements 38, 44, 50, 51 out of statements 38, 41, 42, 44, 50, 51, 52); and all the consistency statements (statements 1-5).

- Site 2 had the lowest ratings for: one (out of six) navigation statements (statement 16) and one (out of eleven) design statements (statement 63).
- Site 1 had the lowest ratings for: one (out of six) navigation statements (statement 17); two (out of eleven) design statements (statements 59, 67); one (out of nine) purchasing process statements (statement 92); and one (out of seven) accessibility and customer service statements (statement 42).

Appendix 36 showed that the Friedman test was not used for a number of statements in the heuristic checklist since no rating was obtained for one or more sites:

- Site 3 had no rating for: two statements (11, 12) of the internal search since it did not have such a facility; two statements (69, 71) of the purchasing process since this site did not support registration and therefore did not require users to log in; one statement (93) that related to the use of the secure socket layer since this site did not support online payment and this capability/option was not relevant; and five of the accessibility and customer service statements (45-49) because it did not have a help/customer service section.
- Sites 1 and 2 were not rated for one statement (7) that related to the consistency of their content among the difference interfaces because they only had one language interface.

4.3 Google Analytics results

The results obtained from the trial matrix of web metrics, which are shown in Appendix 13, were investigated. The intention was to determine the most appropriate web metrics that could then be used to investigate usability problems in an e-commerce site. As a result, specific web metrics that were useful and that could be used to offer a clear picture of the overall usability of an e-commerce website were suggested. Also, web metrics that were not useful or did not add meaning to the usability problems, in the context of *Google Analytics*, were determined and excluded.

4.3.1 Suggesting a matrix of web metrics

It was noticed (from the testing of the trial matrix) that the result of a single metric was often not enough to obtain an indication of the usability problems in a site. Instead, considering more than one web metric together helped to obtain a complete picture of the usability of the e-commerce site. A single metric, if used alone, may provide, either an incomplete picture, or a contradictory usability indication because it provides both a negative and a positive usability indication at the same time. For example, a high value of *average page views per visit* metric might indicate the content of a site was interesting and that visitors therefore viewed many pages, or it might indicate a site was difficult to navigate and that therefore visitors viewed many pages to reach their information. Using more than one metric at the same time can reduce the contradictions and give greater weight to one of the indications. The following examples show how some metrics, when added to other metrics, offer a clear picture of potential usability problems.

- The *average time on site* metric gave an indication of the average time visitors interacted with a site. However, using it alone would not give a complete picture regarding the usage since it did not state how many pages visitors viewed. Therefore, the *average page views per visit* metric added more information to the *average time on site* metric (see Appendix 13, metrics 1 and 2). Despite the fact that the integration of the *average time on site* and the *average page views per visit* metrics provided a picture of a site's usage, they did not give an indication of the users' activities. These two metrics only provided the average time and the average number of pages visitors viewed. In order to understand the activities of visitors, a categorisation of visits, in terms of the average time visitors spent interacting with the site and the average number of pages visitors viewed during their visit, was needed. This categorisation was obtained by using the *percentage of time spent visits* and the *percentage of click depth visits* metrics. These metrics together provided an indication of the percentage of visitors with regard to three segments (low, medium and high) and therefore helped to achieve an understanding of the activities of each segment (i.e. browsing, searching, purchasing, etc.) as indicated by Peterson (2006). For example, if a site had a high value in the low percentage segment of these metrics, this

would indicate that visitors spent a short time on the site and viewed few pages. Therefore, this might indicate that visitors did not purchase from a site but instead were browsing or searching for a product. The equations and meaning of each metric are given in Appendix 13, metrics 3 and 4.

- The *bounce rate* metric was used to investigate the usability of each of the top landing pages of a site by measuring the percentage of visitors who left the site from each of these pages. However, using this metric alone was not enough because the *bounce rate* might indicate that the landing page under investigation had either usability problems (such as design problems or inappropriate content) or targeting problems (e.g. the content of this page did not match the users' needs or expectations). To understand whether the reasons behind the bounce rate related to usability problems or targeting problems, the *entrance sources* and the *entrance keywords* metrics were used. Using these two metrics for each of the top landing pages gave greater weight either to the usability problem or to the targeting problem. The *entrance sources* involve the search engines, sites, etc. that visitors use to arrive at each of the top landing pages. If the entrance sources of a top landing page are not related sites or advertisements, then this gives greater weight to a targeting problem. If the entrance sources of a top landing page are related sites or advertisements, then this give greater weight to a usability problem in the landing page under investigation. The *entrance keywords* involve the keyword searches that visitors use to arrive at each page of the top landing pages. In order to understand the significance of the keyword searches (and, for the purpose of this research, expected and unexpected keywords were identified), their percentages were calculated for each page of the top landing pages. Expected keywords were identified as those that included products or information displayed on a landing page. Unexpected keywords were identified as those that did not include products or information displayed on a landing page. The percentage of expected keywords for a landing page could indicate that the landing page under investigation might be confusing or had usability problems because, in spite of the fact that it displayed products or information that were needed by visitors, visitors left the site. The percentage of unexpected keywords for a

landing page could indicate that the landing page had targeting problems because it did not display information or products needed by visitors and therefore visitors left the site.

- The *funnel report* shows how many visitors start at the first step of the funnel. In e-commerce sites, the first step of the funnel is usually the shopping cart page or any page that is displayed after products have been added to the shopping cart. However, the funnel report does not indicate the percentage of all the visits to a site that started at this step (i.e. added something to a shopping cart). Therefore, the *cart start rate* metric added meaning to the funnel report and subsequently to the usability of the purchasing process. The *cart start rate* metric was useful in indicating the usability of the page that precedes the shopping cart page (usually a product page). This metric showed the percentage of visits that involved visitors who added at least one item to their shopping cart (see Appendix 13, metric 24).

More examples regarding how a combination of metrics helped to obtain a clearer picture of the usability of the sites are presented in the next chapter (Chapter 5).

Therefore, the results suggested a matrix of web metrics that could be employed to understand the usability of an e-commerce site. This matrix includes specific metrics (from the trial matrix metrics shown in Chapter 3) that could either individually or in combination identify potential usability problems on an e-commerce website in relation to six areas: navigation, architecture, content/design, internal search, customer service and the purchasing process. Figure 4.1 shows the suggested matrix and the combination of metrics that could be used in each area. The suggested matrix also includes specific metrics which can help to provide useful information about the site's visitors and its financial performance. These metrics add meaning to the understanding of the overall usability of a site. The detailed results, which showed how the combination of metrics provided potential indications of usability problems in the six areas, are discussed in the next chapter (Chapter 5).

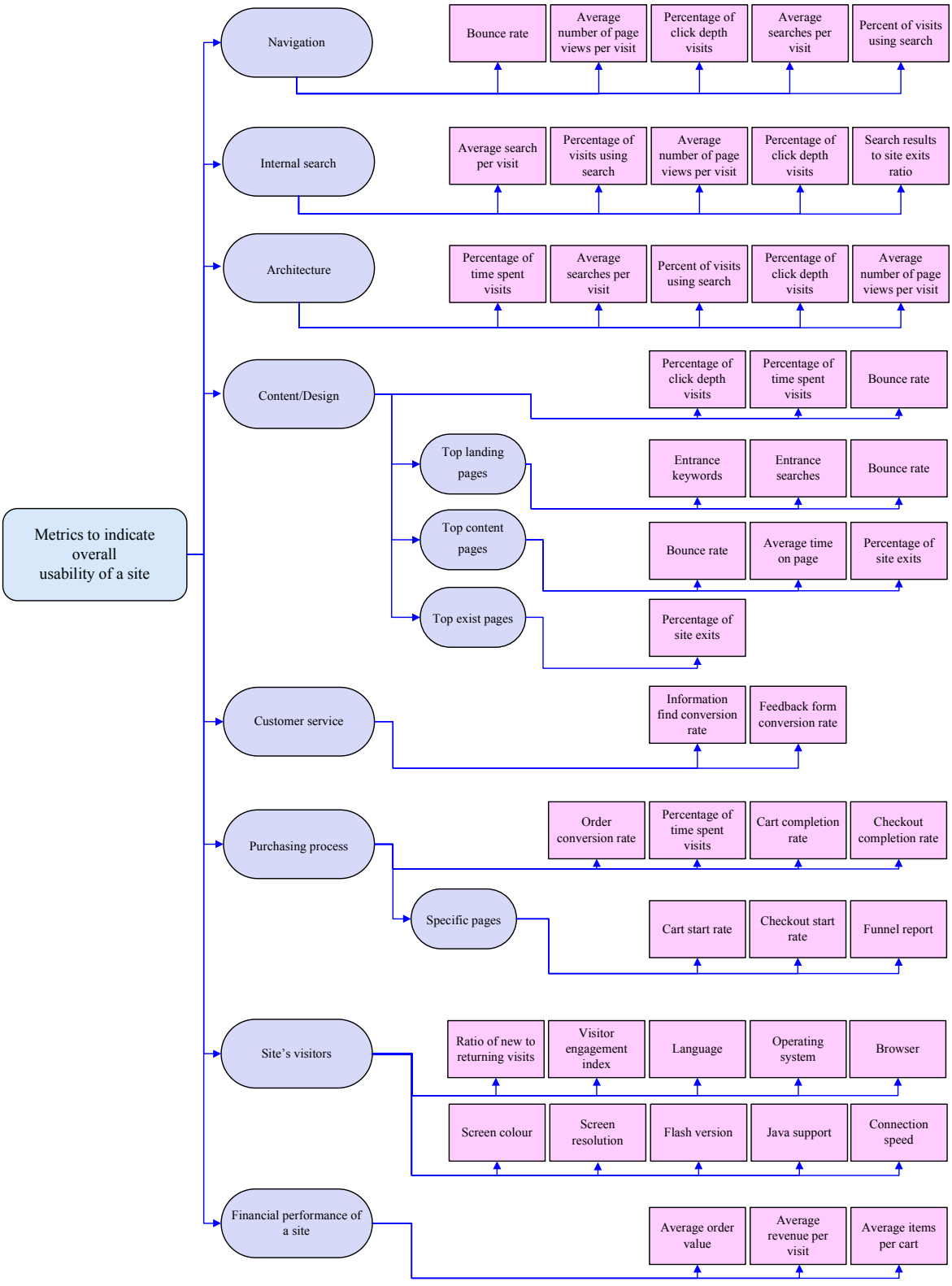

Figure 4.1: The suggested web matrix

4.3.2 Metrics that were disregarded

Based on the results, five web metrics from the 41 trial metrics were disregarded. Only one of these metrics (*ratio of checkout starts to cart starts* metric) was useful in indicating potential usability problems in the sites. Specifically, this metric was useful for identifying if the page that included the checkout button of a site had potential usability problems. However, this metric was excluded since it provided similar indications to those already obtained from other metrics (*checkout start rate* and cart *start rate* metrics). The other four metrics that were disregarded were not useful, in the context of *Google Analytics*, in indicating potential usability problems in the sites. These were:

- Metric 8 (*percentage of frequency/loyalty visits*) (Appendix 13) showed that the three sites had a high percentage of low frequency visits where most visitors visited the sites only once. However, before taking these results for granted, the method used by *Google Analytics* in calculating this metric and presenting it in the loyalty report was considered, as indicated by LunaMetrics (2007): "The loyalty report in *Google Analytics* measures visits, not unique visitors; the loyalty chart, which can be generated for any time period, computes how many times the visitor visited the site using the cookies of the visitor's browser and this computation includes all the visits of the visitor even if some of them are not in the range of the time period of the generated report".
- Metric 9 (*percentage of recency visits*) (Appendix 13) showed that the three sites had a high percentage of low recency visits where the last visit for most visitors was 0 days ago. These results were interpreted by referring to how *Google Analytics* calculates the recency metric and presents it in the recency report, as indicated by LunaMetrics (2007): "The recency report measure visits, not visitors; recency computes time (in seconds) between each visit from the same visitor. If the time between visits is less than 24 hours, it will show up as zero days ago; the recency chart includes visits outside the time being investigated, as long as they are affiliated with a visit that is inside the time period and the recency chart puts frequent visits in the same 'zero days' bucket as new visits".

- Metrics 13 and 14 (*visits to purchase* and *days to purchase*) for the three sites (Appendix 13) showed that most purchases occurred after one visit and after 0 days. This indicated that visitors to the sites were converted into customers on the same day as their first visit to each site, which perhaps implies good usability. However, this indication contradicted indications from all the metrics which investigated both the usability of the overall purchasing process of the sites and the specific pages that make up the purchasing process. For instance, the low values of the *order conversion rate*, *cart completion rate* and *checkout completion rate* metrics (Appendix 13, metrics 11, 25, 27) of all sites indicated that few visits resulted in an order and that users had difficulty in completing purchasing process of the sites. Furthermore, the low values of the *cart start rates* and *checkout start rates* metrics (Appendix 13, metrics 24 and 26) indicated that users were also having difficulty in starting the purchasing process. The funnel report also identified possible usability problems regarding specific pages in the purchasing process of the sites. The purchasing process metrics together with the indications provided by them are discussed in details in Section 5.6.6. Therefore, the exceptional contradictory indication provided by *visits to purchase* and *days to purchase* metrics suggests that the values of these metrics were inaccurate and not useful in the context of this research.

Therefore, because of the method that *Google Analytics* uses in calculating the loyalty and recency reports, and because of the contradictory indications provided by *visits to purchase* and *days to purchase* metrics, these four metrics were not considered in this research.

4.3.3 Usability indications provided by the web metrics

The potential usability problems indicated in the metrics in the six areas were mapped to the appropriate problem themes and sub-themes that were identified by the user testing and the heuristic evaluation methods; no metric identified a new problem theme or sub-theme. Appendix 37 shows the metrics after mapping them to the problem themes and sub-themes, and the location of the potential problems identified by each metric. Appendix 37 shows that some metrics were mapped to specific problem sub-themes while most of the metrics were mapped only to

problem themes; in these cases a "?" symbol appears beside these metrics. This symbol was used to indicate that these metrics indicated only a potential usability problem area which could relate to one or more specific problem sub-themes in this area. These specific problem sub-themes were identified by the user testing and/or the heuristic methods.

4.3.4 Description of the overall usability of the sites

Generally speaking, the metrics indicated that all three sites had potential usability problems related to six areas: navigation, internal search, architecture, content/design, customer service, and the purchasing process. The metrics also indicated the significance of the usability problems on these sites. The metrics provided evidence to infer that the larger number of problems and the most serious problems were on site 3, while the smaller number of problems was on site 1. The usability problems and their significance that were identified by the metrics on the sites are explained in the next chapter (Chapter 5).

4.3.5 Supplementary information provided by the metrics

Unlike the user testing and heuristic evaluation methods, web metrics provided a picture regarding visitors to the sites and the sites' financial performance. The following sections report the results of the metrics that describe these two issues.

4.3.5.1 Visitors' characteristics

The results of the eight metrics that described the characteristics of the computers and Internet browsers used by the sites' visitors, together with the connection speed of their network, as shown in Appendix 13 (Tables 13-36), indicated that:

- The *en-us* language was the language most preferred and used by the visitors to the three sites. Specifically, the percentage of visitors who had configured the *en-us* language on their computers for site 1, site 2 and site 3 was 79.55%, 86.49% and 63.94%, respectively.
- The *Internet Explorer* browser was the most frequently used browser by the visitors to the three sites. Specifically, the percentage of visitors who used the *Internet Explorer* browser for site 1, site 2 and site 3 was 79.39%, 76.59% and 85.77%, respectively.

- The *Windows* operating system was the operating system most often used by the visitors to the three sites. Specifically, the percentage of visitors who used the *Windows* operating system for site 1, site 2 and site 3 was 96.80%, 95.88% and 96.13%, respectively.
- *32-bit* screen colours were the most frequently used by the visitors to the three sites. Specifically, the percentage of visitors who used the *32-bit* screen colour for site 1, site 2 and site 3 was 90.42%, 89.99% and 87.97%, respectively.
- A *1024x768* screen resolution was the screen resolution most often used by the visitors to the three sites. Specifically, the percentage of visitors who used a *1024x76* screen resolution for site 1, site 2 and site 3 was 47.76%, 47.59% and 49.79%, respectively.
- Flash version *9* was the Flash version most frequently installed by the visitors to the three sites. Specifically, the percentage of visitors who had installed version *9* for site 1, site 2 and site 3 was 73.24%, 71.30% and 72.49%, respectively.
- The platform of the majority of visitors to the three sites supported Java. Specifically, the percentage of visitors whose platform supported Java for site 1, site 2 and site 3 was 98.91%, 99.25% and 99.37%, respectively.
- The highest percentages of visitors to three sites used the DSL connection speed. Specifically, the percentage of visitors who used the DSL connection speed for site 1, site 2 and site 3 was 32.80%, 32.93% and 55.33%, respectively.

The results of the metrics that described the behaviour of visitors to the sites showed that site 3 had the highest value for the *ratio of new to returning visits* metric (4.75), while the value of this metric was 1.54 and 1.48 for sites 1 and 2, respectively. These metrics might indicate that site 3 acquired a large number of new visits in comparison to the number of returning visits. Sites 1 and 2 also acquired new visitors, although the number of new visits of these two sites was close to the number of their returning visits (see Appendix 13, metric 6). The metrics also showed that site 3 had the lowest value for the *visitor engagement index* metric (1.2), while the value of this metric for sites 1 and 2 was 1.54 and 1.55,

respectively (see Appendix 13, metric 7). These metrics may indicate that, despite the three sites having few repeat visitors who were engaged and therefore came back to the sites, sites 1 and 2 had a higher engagement index than site 3.

4.3.5.2 The financial performance of the sites

The results of the metrics that described the sites' ability to generate revenue and to cross-sell provided useful information regarding the financial performance of site 1. This site was the only site that supported data to measure these metrics and therefore more information was obtained regarding its financial position. This additional information helped to add meaning to other metrics such as the funnel report metrics. The metrics of site 1 showed that:

- The value of the *average order value* metric was $106.20 (see Appendix 13, metric 10). Since the site sells a variety of products with prices that range between $4.99 and $199.00, the *average order value* metric could indicate that visitors to site 1 bought products in the mid price range.
- It had a low value for the *average revenue per visit* metric (see Appendix 13, metric 12). This low value was expected, given that 1.07% of the visits resulted in a purchase (i.e. the value of the *order conversion rate* metric was 1.07 %) (see Appendix 26, metric 11).
- The value of the *average items per cart* metric was 4 (see Appendix 13, metric 15). This means that most visitors to site 1 purchased more than one item per order. This was higher than the norm (see Appendix 13, metric 15). This could be expected given that the value of the *average order value* metric was $106.2, and the number of products that sold at an average price less than $100 was considerably more than the number of products at an average price of more than $100 (during the three tested months). (See Table 4.5).

Table 4.5: Summary of quantities and average prices of products

	Average Price of Products < $100	**Average Price of Products > $100**
Total Quantities	2,862	15

4.4 Conclusion

This chapter summarised the qualitative and quantitative results obtained from the analysis of each method employed in this research. The common usability problem areas identified by each method across the three sites are described while the list of standardised usability problem themes and sub-themes identified from the common usability problem areas is also explained. This chapter also presented a suggested matrix of web metrics that could be used for evaluating the usability of an e-commerce website.

Chapter Five: Usability Problem Areas

This chapter reviews the problems identified in the six usability methods employed in this research. It uses the problem themes that were generated from the analysis of the methods to explain (by giving examples of each problem sub-theme) which methods were able to identify usability problems related to each problem theme. The problem themes have been used to provide a structure to explain the usability problems. Under each problem theme, each usability method has been reviewed and sub-themes identified. Problems common to the different methods and problems missed by some methods are also highlighted.

5.1 Navigation problems

All six methods identified problems related to the navigation of the sites.

5.1.1 Performance data and observation

These methods identified three common navigation problems (Appendix 27):

- Misleading links were identified on all three sites (there were four problems on site 1 and two on sites 2 and 3). These related to links with names that did not meet users' expectations as the name of this link did not match the content of its destination page. For example, on site 1, users did not expect

the advanced search link to let them only search the site by colour and price (Figure 5.1). This may relate to the users' low levels of experience with sites as they expected each link to indicate the content of its destination page. This link therefore constitutes a problem as the link name ('Advanced Search') did not match the content of the destination page (Figure 5.1). Users expected this page to have search boxes with many options available to search the site. However, this page included only combo boxes that allowed users to only search the site on limited criteria. It did not allow users to search by keywords or within a specific category.

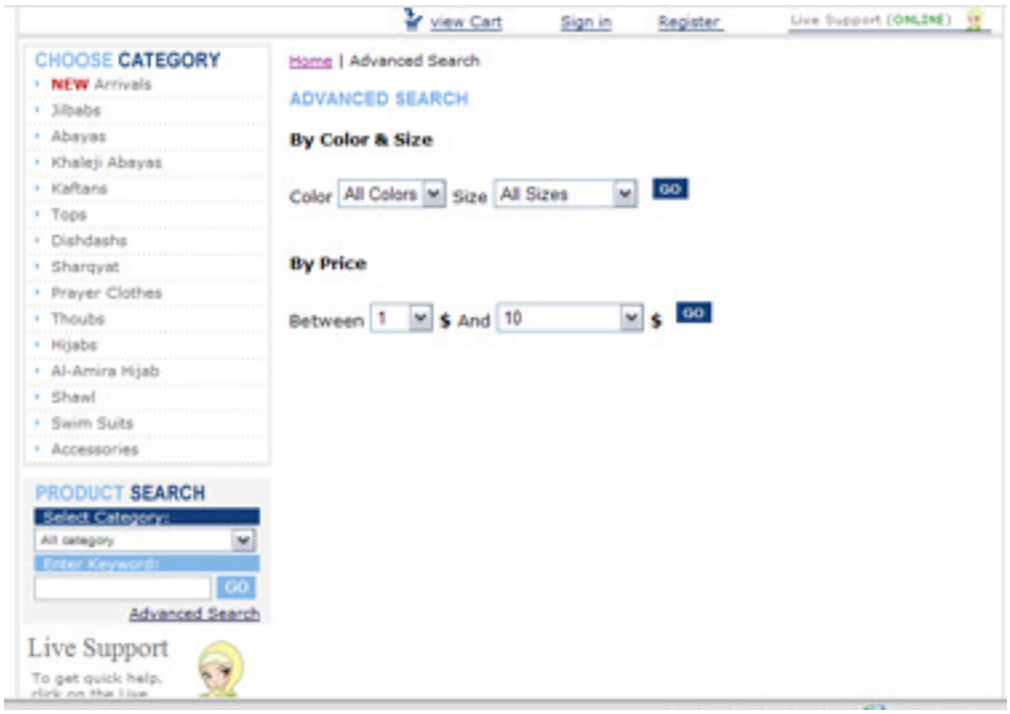

Figure 5.1: Advanced search link and advanced search page on Site 1

Another example of a problem concerning a misleading link was identified on site 2. This related to the 'go' link located on the Shipping page (Figure 5.2). Users expected this link to provide them with a hint regarding the information they had to enter in the 'Redeem a Gift Certificate' field. However, this link did not provide any additional information. Instead, it displayed a message box (Figure 5.2) that asked users to enter their gift certificate number in the required field.

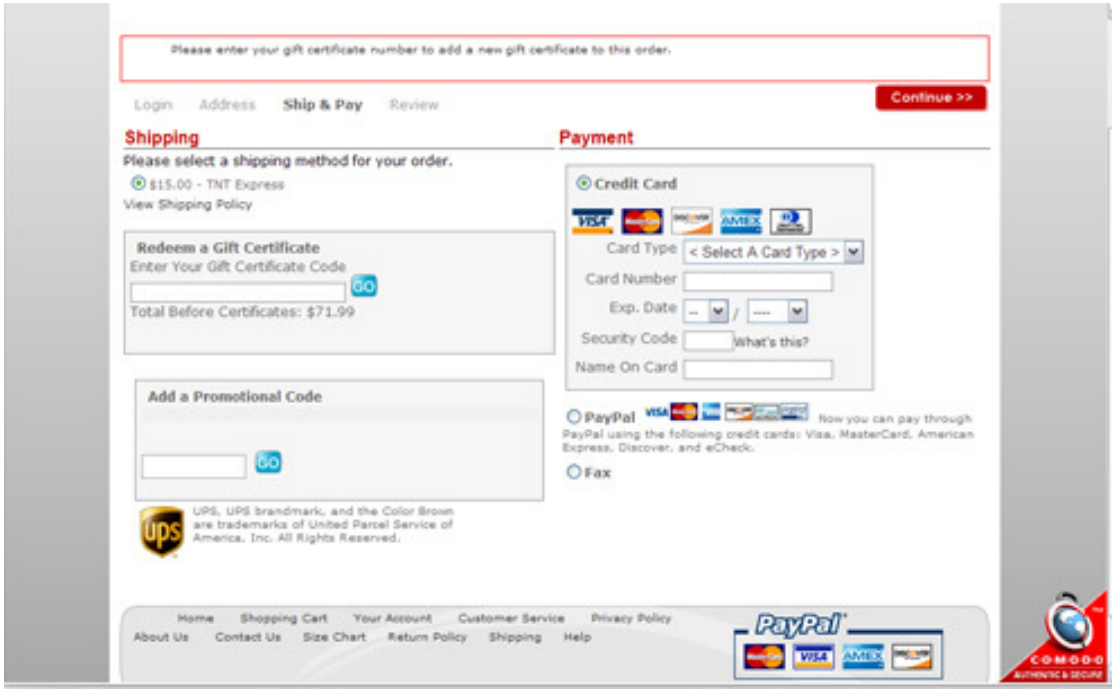

Figure 5.2: Go link and the message displayed after clicking it on Site 2

- A problem concerning links that were not obvious was identified on all three sites (one problem was found with site 1, two on site 2 and three on site 3). This related to links that were not situated in obvious locations on the sites.
- A weak navigation support problem was identified on sites 1 and 3 (with one problem on site 1 and two on site 3). This related to pages without a navigation menu or links.

5.1.2 Satisfaction questionnaire

Site 3 had a negative rating for three navigation statements (9, 10, 24), which identified two significant navigation problems with this site. These problems related to weak navigation support and broken links (Appendix 30).

5.1.3 Open-Ended questions (satisfaction questionnaire)

The open ended questions identified problems that were also pin-pointed by the performance data and observation of the three sites, such as misleading links, links that were not obvious and weak navigation support (Appendix 33). This method also identified other problems that were not revealed by the performance data and/or by observation:

- On site 3, two navigation problems were identified. The first problem related to pages with broken links and the second problem concerned orphan pages (i.e. pages that did not have any links). Appendix 33 lists examples of the problems identified by users.
- On site 2, a weak navigation support problem was also identified. This related to the main menu on the left of this site (that included the main product categories) not being displayed on some pages (purchasing process pages) (Figure 5.2). Users also identified a problem with links that were not obvious on this site being in different locations (Appendix 33).

5.1.4 Heuristic evaluation

The heuristic evaluators identified large numbers of navigation problems on the three sites. These included some problems identified by the user testing and related to: misleading links; links that were not obvious; weak navigation support; broken links and orphan pages (Appendix 34).

The heuristic evaluators identified problems on pages that users were not able to explore during their tasks. Most of these were comprehensive and detailed problems. For example, the user-testing method identified two misleading link problems on two pages of site 3, while the heuristic evaluators indicated numerous misleading link problems on the entire site, not just on two pages (Appendix 34).

The heuristic evaluators, however, missed seven problems on the sites that were identified by the user testing. These problems related to five misleading link problems (one on site 1 and two on sites 2 and 3) including the advanced search link on site 1 and the 'go' link on site 2 that were explained with examples in Section 5.1.1. The other two problems related to two pages with links that were not obvious on sites 2 and 3.

5.1.5 Heuristic checklist rating

The negative ratings of all the navigation statements (8, 10, 16) identified significantly weak navigation support problems (Appendix 35):

- Site 3 was not easy to navigate.

- The index, and the navigation bar or the table of contents for sites 2 and 3 were not situated in appropriate places.
- Sites 1 and 2 did not have an acceptable number of links to external resources (16). This problem was listed in the missing capabilities category in Appendices 34 and 35.

The heuristic evaluators considered most of the problems identified through the heuristic evaluation procedure for the three sites to be minor ones. However, some of these problems caused failures in many of the tasks during the users testing.

5.1.6 Google Analytics

The metrics used to investigate the general usability of a site indicated that all three sites had potential navigational problems, as shown by *bounce rate* (Appendix 13, metric 5). Site 1 had the lowest value for this metric among the three sites, whilst site 3 had the highest value. Further evidence of navigational problems on site 3 was obtained due to the low average number of page views per visit (Appendix 13. metric 2).

However, other metrics seemed to contradict the notion of navigational problems on sites 1 and 2, for example:

- The low values for metrics 16 and 17 (Appendix 13, *average searches per visit* and *percent of visits using search*) could suggest that these two sites either had good navigation so that a search facility was not needed or alternatively that there were problems with the search facilities (see Section 5.2.6).
- Metric 4 (Appendix 13, *percentage of click depth visits*) showed that sites 1 and 2 received high percentages of medium click depth visits (between 3 to 17 and 3 to 12, respectively).
- Metric 2 (Appendix 13, *average page views per visit*) showed that site 1 and 2 had a relatively high number of pages views per visit (17 and 12.56 respectively) compared to site 3 (5.62).

The user testing and heuristic evaluation methods confirmed these findings; although all the sites had some navigation problems (such as misleading links) a

smaller number of problems were identified on sites 1 and 2, while a larger number of problems and the most serious problems were identified on site 3. The total number of problems that were identified by the user testing on site 1, 2 and 3 was 6, 9 and 12, respectively, and the total number of problems that were identified by the heuristic evaluators on site 1, 2 and 3 was 7, 11 and 42, respectively.

5.1.7 Summary of Navigation Problems

The three user testing methods used together constituted the best method for identifying all the navigation problems because they complemented each other, taking into consideration that these methods identified navigation problems only on pages that users explored during the user testing. The performance data and observation method was the best in identifying misleading links and links that were not obvious. This method was also good for identifying weak navigation support problems. The qualitative data from the satisfaction questionnaire were good for identifying other problems that were not pin-pointed by the performance data and observation and related to links that were not obvious, links that were broken, as well as for identifying weak navigation support and having problems with orphan pages. The quantitative data from the satisfaction questionnaire were also good for identifying broken link problems.

The heuristic evaluation method was good for identifying large numbers of navigation problems, including most of the problems identified by the user testing methods. However, this method failed to identify some of the links that were misleading and not obvious. The heuristic checklist only identified one navigation problem related to having weak navigation support in sites that had this problem on many pages.

The analytics method, using specific metrics, was good for indicating the existence of general navigation problems in the sites, but this method required other methods to explain what kind of navigation problems these sites had.

5.2 Internal search problems

Five of the six methods identified problems related to the internal searches of the sites. Section 5.2.2 explains why the satisfaction questionnaire did not identify problems related to this area.

5.2.1 Performance data and observation

Sites 1 and 2 had two internal search' facilities: a product search and a second internal search (site 1 called this the 'advanced search', while site 2 called it 'shop-by-size' search). To aid clarity, the first internal search facility will be called a 'basic search' and the second an 'advanced search' during this analysis.

These methods found that sites 1 and 2 had the same two usability problems with their basic search facility; this related to inaccurate results (Appendix 27). Observation showed that most users did not perform the task related to the basic search facility successfully (Task 6) due to the inaccurate results they obtained from these searches on sites 1 and 2. The basic search facility of these two sites (1 and 2) provided inaccurate results if users searched the site using a name (i.e. a product name) but provided accurate results if users searched the site using a number (i.e. a product number). Task 6 asked users to obtain a list of products after providing them with the name of the product category. Sixty-five percent of users did not complete this task successfully on site 1 and fifty percent failed on site 2 (Appendix 25).

These methods also found that site 1 had a usability problem with its advanced search facility; this related to a misleading link problem. This problem is explained in Sections 5.1.1. However, this was missed as a navigation problem by the heuristic evaluators. Observation showed that some users also failed in performing the task related to the advanced search on site 1 (Task 10) because of this problem. Thirty percent of users did not perform this task successfully (Appendix 25).

Site 3 did not have an internal search facility for the whole site; instead, it had an internal search for one subsection (the online-catalogue). However, the site had a usability problem regarding accessing this subsection and therefore in trying to use the internal search facility. This problem was related to the link which was not obvious as the 'online-catalogue' link was not situated in an obvious location and therefore most users did not even see it. This problem was categorised as a navigation problem on this site. Observation showed this problem was the reason why all users did not complete successfully the internal search task related to this subsection (Task 6).

5.2.2 Satisfaction questionnaire

Despite the internal search problems that were identified on sites 1 and 2 by the performance data and by observation, the internal search statements in the satisfaction questionnaire did not indicate any problems with these sites. These statements (3, 11, 12, 13) rated positively for sites 1 and 2 (Appendix 32). This apparent contradiction could be explained by the observation. The observation showed that most users used the basic search facility of both sites to find the products for the related tasks (Tasks 1, 4, 9). Those users who searched the site by product number (as this was included with each task) were successful since the basic search facility provided accurate results if users searched the site by product number. Thus, the users were satisfied using these search facilities as they enabled them to find the required products easily.

Site 3 had no rating regarding statements concerning the internal search since it did not have such a facility.

5.2.3 Open-Ended questions (satisfaction questionnaire)

Only two expert users indicated that they experienced problems in terms of inaccurate results with the basic search facilities of sites 1 and 2 (Appendix 33). Problems were also identified by the performance data and by observation. This explained the high rating of the internal search statements in the satisfaction questionnaire which is related to the users' low level of experience since such users often do not recognise this problem.

Users indicated a usability problem with the basic and advanced internal search facilities for sites 1 and 2; this was not identified in the performance data and observation. This problem was a limited option problem and related to the limited options provided by the searches (i.e. users cannot search the site by product type and product name concurrently) (Appendix 33).

5.2.4 Heuristic evaluation

The heuristic evaluators identified all the problems regarding the internal search facilities of sites 1 and 2 that were also identified by the user testing (inaccurate results and limited options). They also identified the lack of availability of an internal search facility on site 3 (Appendix 34).

The heuristic evaluators also identified a further usability problem with the internal search facilities on site 1 which was not identified by the user testing. This related to the position of its basic and advanced internal search facilities which were not obvious. The heuristic evaluators indicated that most users expect to see the internal search box at the top of the home page whereas it was actually located under the left-hand navigation menu (see Figure 5.3). However, the observation showed that most users relied on the internal search facility rather than the navigation for site 1 when performing tasks related to finding products (Tasks 1, 4, 9). This might indicate that the non-obvious position of the internal search facility of site 1 was not a major problem for users.

Figure 5.3: Basic and advanced internal searches on Site 1

The heuristic evaluators, through their extensive evaluation, tried most of the links on each site. Therefore they tested the 'online-catalogue' link on site 3 that opened the online-catalogue subsection. The internal search facility of this subsection was tried. This internal search facility was reported to provide inaccurate results. Therefore the inaccurate-results problem was identified as a usability problem on site 3, as shown in Appendix 34.

5.2.5 Heuristic checklist rating

There were only two statements in the heuristic checklist to evaluate the internal search of a site. The negative rating of one of these statements identified the significance of the inaccurate results problem of the internal search facilities on sites 1 and 2 (12) (Appendix 35). The other statement (11) rated positively for the two sites which indicated that the response time of the internal search facilities was good.

Site 3 had no rating regarding the statements of the internal search since it did not have such a facility.

5.2.6 Google Analytics

The metrics used to examine the usability of the internal search and the general usability of a site indicated that the internal search facilities of sites 1 and 2 had usability problems. Metric 16 (Appendix 13, *average searches per visit*) and metric 17 (Appendix 13, *percent of visits using search*) showed that the usage level of the internal search facilities of sites 1 and 2 was low. However, the relatively high number of pages viewed on sites 1 and 2 (Appendix 13, metrics 2 and 4) could mean that visitors relied on navigation rather than the internal search of the sites to find what they needed. To determine if there were problems with the internal search on these sites, the value of metric 18 (Appendix 13, *search results to site exits ratio)* for sites 1 and 2 was considered. This indicated that users were leaving the sites immediately after conducting a search and that these sites probably did have usability problems related to the inaccuracy of the search results.

The user testing and the heuristic evaluation methods confirmed that the internal search facilities of these sites had usability problems. The performance data and observations, the qualitative data from the satisfaction questionnaire, the heuristic evaluation, and the heuristic checklist identified a problem regarding the results provided by the search facilitates of sites 1 and 2 which were often inaccurate. The qualitative data from the satisfaction questionnaire, together with data from the heuristic evaluation method, identified a limited options problem; and only the heuristic evaluation method identified the not-obvious-position problem.

5.2.7 Summary of internal search problems

The best method for identifying all the internal search problems was the heuristic evaluation. This method was the only method that identified a problem related to the fact that the location of the internal search facility was not obvious. This method was also good for identifying problems related to the inaccurate results, limited options and the unavailability of the internal search facility. Finally, the heuristic checklist was good in identifying the problem of inaccurate results.

Two of the user testing methods were good in identifying three internal search problems if they were used together. The observation and performance data method was good in identifying only one problem related to inaccurate results. Only the expert users also identified this problem via the qualitative data of the satisfaction questionnaire in addition to two problems related to limited options and the unavailability of an internal search facility. The quantitative data from the satisfaction questionnaire did not identify any problems.

The analytics method, using specific metrics, was good in indicating potential usability problems concerning the internal search facility of the sites.

5.3 Architecture problems

All six methods identified usability problems related to the architecture of the sites.

5.3.1 Performance data and observation

These methods did not identify any usability problems on sites 1 and 2 regarding their structure, as shown in Appendix 27. However, they identified one usability problem on site 3, which was the problem of its structure being non simple. This problem related to the structure of its information and products as the categorisation of the products was neither simple nor straightforward. This was obvious in the accuracy results for the tasks which showed that it was difficult for users to find products on this site (Appendix 25, Tasks 1, 4, 9).

These three tasks had statistically significant differences among the three sites as illustrated by the *p* values. The ANOVA test results for these tasks were (Appendix 28):

- Task 1: $F(2,38) = 6.021$, $p=.005$.

- Task 4: $F(2,38) = 10.873$, p=.000.
- Task 9: $F(2,38) = 40.407$, p=.000.

In all these tasks site 3 had the highest mean time (Appendix 24). Site 3 also had the lowest total number of tasks performed successfully by all users (experts and novices) (Appendix 25).

5.3.2 Satisfaction questionnaire

Site 3 was the only site with a negative rating for all the architecture statements. The negative rating of these statements indicated significant architecture problems with this site (Appendix 30). These related to it not being easy to find information related to the tasks, not being easy to find products, and the unclear organisation of information. These findings agreed with the findings from the performance data and observation.

5.3.3 Open-ended questions (satisfaction questionnaire)

The users identified a non simple structure problem on site 3 but did not indicate any architecture problems on sites 1 and 2 (see Appendix 33). This agreed with the findings of the performance data and observation.

5.3.4 Heuristic evaluation

The heuristic evaluators also identified the same problem with the architecture on site 3 (a non simple structure), which was identified by the user testing methods (performance data and observation, satisfaction questionnaire and open-ended questions), as shown in Appendix 34.

The heuristic evaluators also identified two architecture problems that were not identified by the user testing. The first problem that was identified on sites 2 and 3 was that the order of the items on the menu was illogical. The second problem, which was identified on site 3, was that the categorisation of menu items was illogical (Appendix 34). The heuristic evaluators identified these problems because they used comprehensive guidelines and checked the compliance of the tested sites with each guideline.

5.3.5 Heuristic checklist rating

The negative rating of all the architecture statements identified the three architecture problems on site 3 that were identified through the heuristic evaluation. These were explained in Section 5.3.4.

The architecture problem identified on site 2 by the heuristic evaluators did not influence the rating of this site. What did influence it was the illogical order of the menu items of one submenu of the site's menus (the bottom menu). Therefore, the heuristic evaluators rated this site positively considering this a minor problem.

5.3.6 Google Analytics

The metrics used to investigate the general usability of a site indicated that all the sites had potential usability problems with their information architecture. This was indicated by the large number of visitors who spent little time on the sites (i.e. their visits did not exceed 3 minutes in duration) (Appendix 13, metric 3). Other metrics explained the significance of the architectural problems on these sites. For example, the low rate of usage of the internal search facilities of sites 1 and 2 (Appendix 13, metrics 16 and 17), together with the high percentages of visits with medium click depth for sites 1 and 2 (Appendix 13, metric 4) provided a potential indication that the architecture of sites 1 and 2 had fewer problems as visitors were able to navigate through these sites, implying that their search facilities may not be needed. However, the low value of the *average page views per visits* metric for site 3 (Appendix 13, metric 2), together with the high percentage of visits with low click depth for site 3 (Appendix 13, metric 4) provided a potential indication that site 3 had a complex architecture and that users could not navigate within it.

The findings from the metrics agreed with the user testing and the heuristic evaluation methods. They found major problems with the overly complex architecture of site 3, while they did not report major problems with the architecture of sites 1 and 2

5.3.7 Summary of architecture problems

The heuristic evaluation was the best method in identifying architecture problems as it identified structure problems in a site and its menus. The heuristic checklist was good in identifying structure problems on a site but it identified problems with a

menu's structure only on the site that had this problem on its main menu. All the user testing methods were only good in identifying structure problem on the sites.

The analytics method, using specific metrics, was good in indicating potential usability problems with the overall architecture of the sites.

5.4 Content problems

All six methods identified usability problems related to the content of the sites.

5.4.1 Performance data and observation

These methods identified one content problem on sites 1 and 3, which was that some content was irrelevant (Appendix 27):

- Site 1 had some irrelevant content on its Shipping Information page. An error was displayed at the top of this page in red with the following message: "P.O. Box address is not accepted" (Figure 5.4). This message was not clear and confused the user, since the form that was displayed on the Shipping Information page did not have a P. O. Box field.

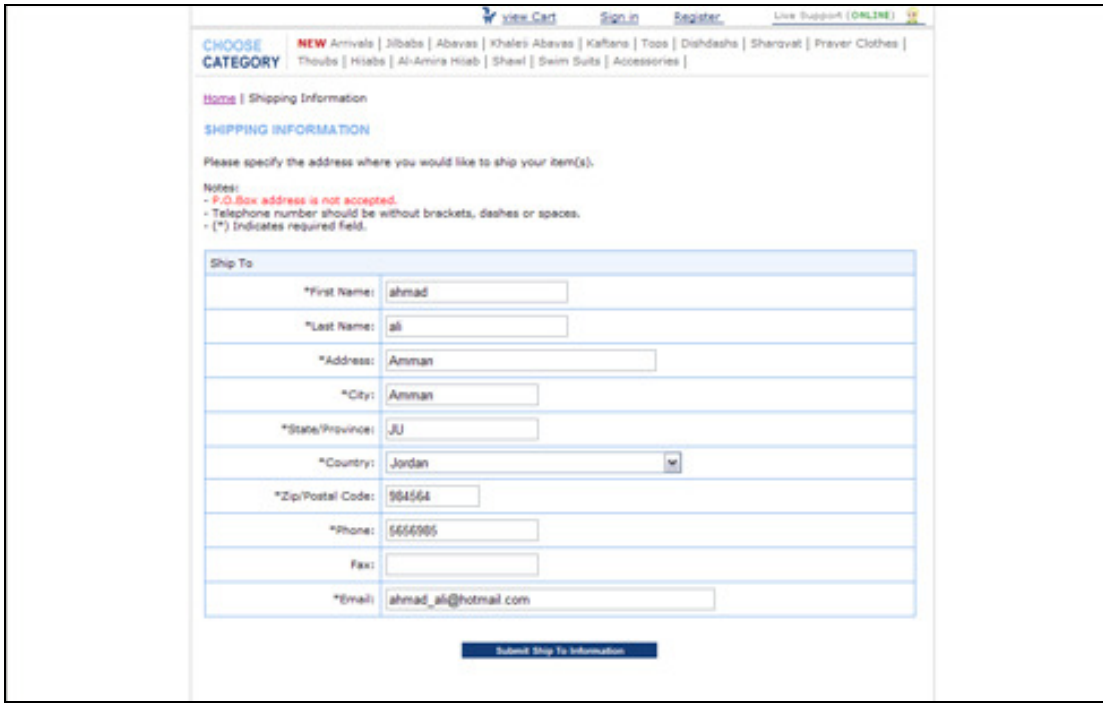

Figure 5.4: Shipping information page on Site 1

- Site 3 had a problem with irrelevant content on two pages. The first page had some empty content (Search Mall page) while the second page had some

unclear content (Online Catalogue subsection page). The unclear content related to the fact that this page displayed products but did not allow users to purchase them (or add them to their shopping carts). One of the pages in this subsection, which was not easy to access due to the difficult architecture of this site, informed users that these products were not ready for purchasing.

5.4.2 Satisfaction questionnaire

Site 3 was the only site with a negative rating for the content statements. This indicated that the site had significant problems in its content that related to ineffective information that failed to help users complete their purchasing tasks. Another issue was unclear terminology/terms throughout this site (Appendix 30).

5.4.3 Open-Ended questions (satisfaction questionnaire)

The users identified one irrelevant content problem on site 3 which was not identified by the performance data and observation. Users indicated that most pages on this site had repetitive content or content that was not concise (Appendix 33).

Users identified two new content problems: inaccurate information and missing information about products. These were not identified by the performance data and observation:

- The problem concerning inaccurate information was identified on sites 1 and 2 and related to the product pages on these sites displaying out of stock products. For example, images for these products were displayed on the product page but when a user added a product to his/ her cart, a message was displayed informing the user that the item was not in stock.
- The problem concerning information about products that was missing was identified on all three sites. The sites did not display the availability of their products on the product pages.

5.4.4 Heuristic evaluation

All the content problems identified by the user testing were also identified by the heuristic evaluators. However, the heuristic evaluators identified additional problems: problems with irrelevant content on sites 2 and 3; one problem concerning inaccurate information on site 3; they also identified ten problems

regarding missing information about products on the three sites (Appendix 34). The heuristic evaluators identified these problems because they explored more pages than the users.

The heuristic evaluators reported problems on each site regarding grammatical accuracy and information about the company that was missing (Appendix 34). However, they could not check the compliance of each subcategory (i.e. the subcategories of grammatical accuracy and pages under construction) because of time limitations. Therefore, they reported only a few problems that they observed quickly.

5.4.5 Heuristic checklist rating

The negative rating of all the content statements identified significant content problems on the three sites (Appendix 35):

- Site 3's problems related to: information not being up-to-date nor current; no new information being visible or obvious; content not concise; an appropriate overview of the company not displayed, and no adequate product photographs.
- Site 2 had significant content problems related to: no new information being visible or obvious; nor did it display an appropriate overview of the company.
- The three sites had two significant common content problems. These related to the fact that the sites did not display the status of their products adequately (i.e. their availability) and they displayed inaccurate information (explained in Sections 5.4.3 and 5.4.4).
- Despite the heuristic evaluators rated one content statement negatively for all the sites, (this related to an obvious date of the last update not being included), this was not considered by the heuristic evaluators to be a usability problem.

5.4.6 Google Analytics

The indications provided by the metrics regarding this area were divided into two parts; content problems and content or design problems.

5.4.6.1 Content problems

The metrics used to examine the general usability of a site indicated that the three sites had potential usability problems with some of their content. The percentages of visits in terms of the number of pages viewed (Appendix 13, metric 4) indicated that visitors to the three sites did not appear to be interested in the content of the sites, however the degree to which content was found to be uninteresting differed among the sites. Site 3 had a high percentage of low depth visits where most visitors viewed 2 pages or fewer, indicating that most visitors were not interested in its content. Conversely, sites 1 and 2 had high percentages of medium depth visits (most visitors to sites 1 and 2 viewed between 3 and 17 pages, and between 3 and 12 pages respectively), indicating that visitors to these sites were more interested in the sites' content or products. Although more pages were viewed on sites 1 and 2, the metrics indicate that most visitors spent less than 3 minutes on all three sites (Appendix 13, metric 3). Taken together these metrics imply that there are content problems on all three sites, but that the problems are worse on site 3.

These findings agreed with the user testing and heuristic evaluation methods. They identified content problems on all the sites but the largest number of content problems were found on site 3 compared to sites 1 and 2 (Appendices 27, 33, 34).

5.4.6.2 Content/Design problems

The *bounce rate* metric, which is used to investigate the global design flaws in a site's page layout, also indicated that all the sites had potential usability problems in their content or design (Appendix 13, metric 5). Bounce rate is the percentage of visits where visitors left the site after visiting only its entrance page. High bounce rate implies that either users are uninterested in the sites' content or that the design is unsuitable for the users. From the metrics it is difficult to determine if a high bounce rate is due to content or design problems. By contrast user testing and heuristic evaluation were able to identify a large number of design-specific problems with the three sites. Examples of these problems are explained in Sections 5.5.1-5.5.5. This is an area where user testing and heuristic evaluation are more precise than analytics. The analytics were able to identify potential issues, but the user testing and heuristics were able to be more specific in identifying whether problems were content or design specific.

The metrics of the top ten landing pages (*bounce rate*, *entrance searches* and *entrance keywords*), top content pages (*bounce rate*, *average time on page* and *percentage of exits*) and top exit pages (*percentage of exits*) (Appendix 13, Tables 1-9) also identified specific pages within the sites that had possible usability problems:

- The top ten landing pages in each site included the home page in each site, various pages illustrating products (nine in site 1, seven in site 2 and six in site 3) and other pages (the *size chart* and *how to measure* pages on site 2 and the *home page of the mall* on site 3). The entrance keywords/searches metrics indicated that users had arrived at these pages with specific intentions, yet the high bounce rates from them suggests that the users were unimpressed with either the content or the design of the pages.
- The top exit pages in each site included the home page in each site, various pages illustrating products (nine in site 1, five in site 2 and two in site 3) and other pages (the *size chart*, *how to measure* and *wholesale* pages on site 2 and the *guest book*, *complete order*, *home page of the mall* and *links* pages on site 3). The high percentage of site exit from these pages suggest that the users left the sites from these pages because they were not interested with either the content or design of these pages.
- The top content pages included the home page of each site, various pages illustrating products (nine in site 1, nine in site 2 and four in site 3) and other pages (the *guest book* and the *home page of the mall* pages on site 3). The low average time on these pages, the high bounce rates from these pages together with the high percentage of site exits from these pages suggest that these pages had potential content or design problems.

The user testing (qualitative data from the satisfaction questionnaire) and heuristic evaluation methods confirmed the existence of specific content and design problems in the product category pages, in the home pages of the three sites and in the other pages. These related to irrelevant content, inappropriate page design and unaesthetic design (Appendices 33, 34).

5.4.7 Summary of content problems

The heuristic evaluation was the best method to use for identifying all the content problems and for providing a detailed explanation of them. This method was the best and only method that identified two problems related to information that was missing about the company and problems of grammatical accuracy. This method also identified many content problems related to irrelevant content, and inaccurate and missing information about products. The heuristic checklist was good for identifying all the content problems except one, which was the problem of grammatical accuracy.

Two user testing methods were good in identifying three content problems. The performance data and observation were good in terms of identifying the problem of irrelevant content related to pages that either were not clear or were empty of content. The qualitative data from the satisfaction questionnaire were good in identifying pages with repetitive content, and problems related to inaccurate information and missing information about products. However, the quantitative data from the satisfaction questionnaire were good in identifying the problem of irrelevant content only on the site that had the largest number of problems.

The analytics method, using specific metrics, was good in indicating the existence of general content or design problems in the sites. This method was also good in indicating potential content or design problems in some specific pages on the sites using the metrics of: top landing pages, top exits pages and top content pages. However, other methods offered details regarding these content or design problems.

5.5 Design problems

All six methods identified usability problems related to the design of the sites.

5.5.1 Performance data and observation

These methods identified two design problems: misleading images and inappropriate page design. The misleading images problem was identified on sites 1 and 3 and related to the logo image which did not link to the home page as users expected. Observation showed that most users kept clicking this image to return to

the home page. This problem was identified on one page of site 1 and on all the pages of site 3 (Appendix 27).

The problem of inappropriate page design was identified on site 2 on three pages: the any product's page, the Login page, and the Address page:

- The method of displaying product information (i.e., colour, size, price and quantity) was inappropriate and not clear for users. The description was displayed using a table. A textbox was displayed beside each product with a zero initial value so that the user could enter the required quantity that he/she wanted to buy from the selected product. See Figure 5.5.

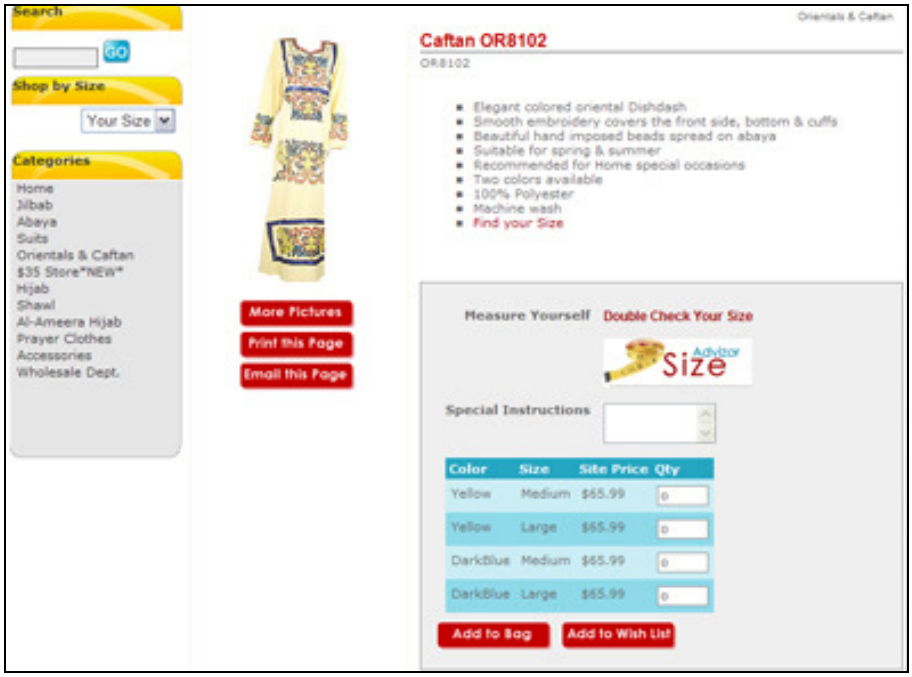

Figure 5.5: Product page on Site 2

- The Login page, which was designed to be used by current and new users, was designed in a way that was not clear. It was divided into two parts, the left part to be completed by current users and the right by new users. Observation showed that all users entered their information in the current users' fields instead of the fields for new users and therefore there were data entry problems (Figure 5.6).

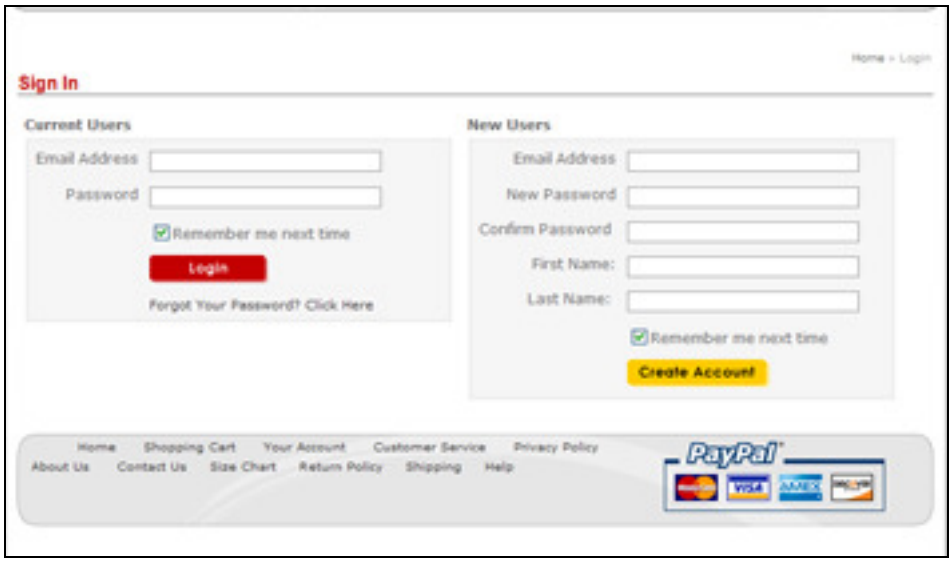

Figure 5.6: Login page on Site 2

- The Address page was also designed in a way that was not clear for users. This page included two columns which had similar fields: the shipping address and the billing address (Figure 5.7). The aim of this design was to provide the user with an option to send his/her bill to an address that differed from his/her shipping address. A checkbox labeled 'bill to the same address' was displayed on this page. However, this checkbox was not obvious to users. It was observed that none of the users noticed this checkbox and they were confused by entering similar information twice in the shipping and billing fields.

These three problems, in addition to the purchasing process problems, influenced the performance of users while performing the purchasing tasks on site 2. Section 5.6.1 explains the purchasing process problems and the performance data for the three sites regarding the purchasing process tasks.

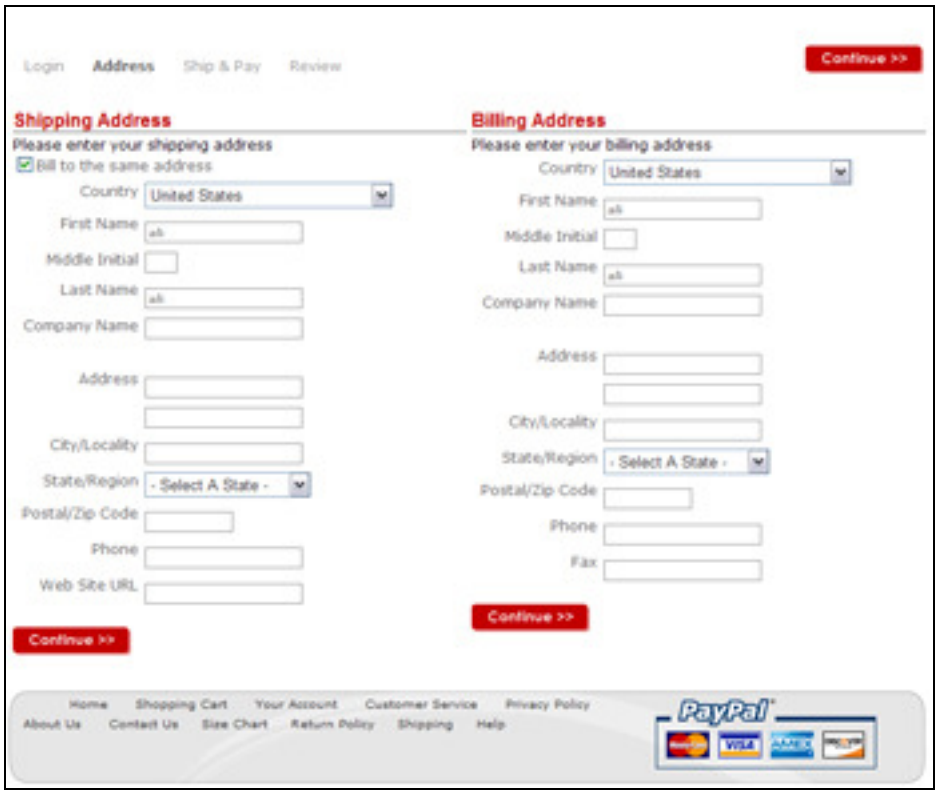

Figure 5.7: Address page on Site 2

5.5.2 Satisfaction questionnaire

Site 3 was the only site with a negative rating for two design statements which indicated that the site had significant problems in its design (Appendix 30). They related to using an unaesthetic interface and using inappropriate page design that related to the site's inappropriate headings so users did not know the position of any page on this site.

5.5.3 Open-Ended questions (satisfaction questionnaire)

The performance data and observation did not identify any inappropriate page design problem on site 1 but the users did identify problems. Users indicated that the product category pages on this site were long and displayed a large number of images. The default number of products displayed per product category page totalled 30 and therefore 30 images were displayed. Users also indicated that one of the product category pages on this site (Best/Most Selling page) displayed its products at the bottom of the page, which was not obvious for users. The upper part of this page was empty.

For site 2, users identified a new design problem that was not identified by performance data and observation. This related to an inappropriate choice of fonts and colours throughout the site. Users felt that this site used too small a font size for the menus and text. The combination of background and link colours was also considered to be inappropriate (Appendix 33).

5.5.4 Heuristic evaluation

The heuristic evaluators identified a large number of design problems with the three sites. They identified fourteen problems in sites 1 and 3 and nine in site 2 (Appendix 34). These problems included all the design problems identified by the user testing except for two. These two problems related to the inappropriate page design of the Login and Address pages on site 2 that were explained by examples in Section 5.5.1.

The other design problems identified by the heuristic evaluators were:

- Either located on pages not visited/explored by the users during the user testing but observed by the heuristic evaluators because of their extensive examination of the sites. For example, the broken image problem was identified on many pages on site 3 (Appendix 34).
- Or related to problems that might not be noticed by users but identified by the heuristic evaluators because of their experience or the comprehensive guidelines used by them. These problems included missing alternative text; inappropriate page titles; inappropriate quality of images; or inappropriate headings (which was categorised as inappropriate page design problems). For example, the heuristic evaluators identified a problem regarding an inappropriate heading on site 1. This problem was identified on two pages (Shipping Information and Order Preview pages) which had the same heading. On another page (Shipping Method page), there was no heading. These pages were explored by users since they were part of the purchasing pages but the users did not notice this problem. This might mean that users were concentrating on the content of these pages while they were entering information rather than noticing the headings. Also, the low level of experience of users might explain their ignorance of this problem.

The heuristic evaluators identified unaesthetic design on the three sites.

5.5.5 Heuristic checklist rating

The negative rating of the design statements identified significant design problems on the three sites (Appendix 35):

- Site 3's design problems related to its unaesthetic, unattractive and unappealing design; the inappropriate quality of its images; no alternative text being used for images; and the inappropriate page design (pages which did not have a clear indication of their position within the site).
- Site 1's design problems related to its inappropriate page design (many pages containing images whose size affected the loading time of these pages and the site also had many long pages that required scrolling).
- In addition to the problems listed above, the sites had a common significant design problem (inappropriate page titles). This related to the fact that the page titles of the three sites did not describe appropriately the company's name nor the content of these pages.

5.5.6 Google Analytics

See Section 5.4.6.2.

5.5.7 Summary of design problems

Neither the user testing methods, if they were considered together, nor the heuristic evaluation methods were best in identifying all the design problems.

The user testing methods together identified only some of the design problems. The performance data and observation were the best in identifying problems regarding inappropriate page design related to having pages that did not clearly represent their content. This method was also good in identifying problems concerning misleading images. The qualitative data from the satisfaction questionnaire were good in identifying problems regarding long pages that displayed a large number of images, together with an inappropriate choice of fonts and colours. The quantitative data from the satisfaction questionnaire were good for identifying the problem of inappropriate headings but only in the site that had the

largest number of problems. This method was also good in identifying unaesthetic design.

The heuristic evaluation was the best and only method which identified design problems related to the inappropriate quality of images, missing alternative text, broken images, inappropriate page titles and inappropriate page headings. This method was also good for identifying detailed design problems which related to misleading images, inappropriate page design, unaesthetic design and an inappropriate choice of fonts and colours. However, this method failed to identify some of the problems concerning inappropriate page design which related to pages that did not clearly present their content.

The heuristic checklist was good in identifying inappropriate page design related to having a long page with a large number of images, inappropriate quality of images, and inappropriate page titles. This method identified two problems related to unaesthetic design and missing alternative text but only on sites that had the largest number of problems.

5.6 Purchasing process problems

All six methods identified usability problems related to the purchasing processes of the sites.

5.6.1 Performance data and observation

Four tasks, tasks 2, 3, 4 and 5, were related to the purchasing process of the sites. Tasks 2 and 4 asked users to purchase a product from the site while task 3 asked users to change the content of their shopping cart and task 5 asked users to change their shipping address.

Tasks 2, 3 and 4 showed statistically significant differences among the three sites while task 5 did not, as illustrated by the *p* values. The ANOVA test results for these tasks were (Appendix 28):

- Task 2: $F(2,38) = 33.183$, $p=.000$.
- Task 3: $F(2,38) = 4.471$, $p=.018$.
- Task 4: $F(2,38) = 10.873$, $p=.000$.

- Task 5: $F(2,38) = .502$, $p=.609$.

Site 2 had the highest mean time for one of the purchasing tasks and for the tasks related to changing the content of the shopping cart and changing the shipping address (Tasks 2, 3 and 5) (Appendix 24).

It was also found that (Appendix 25):

- All the users performed the purchasing task successfully on site 1 (Tasks 2 and 4).
- Site 2 had the lowest number of users who performed one of the purchasing tasks and changing the content of the shopping cart successfully (Tasks 2 and 3).
- The same number of users successfully changed the shipping address in all three sites (Task 5).

Appendix 27 explains the usability problems that were behind the difficulties that users faced in these tasks. These related to navigation, content, design and purchasing process problems. The navigation, content, design problems were explained in the previous sections but, regarding the purchasing process, six usability problems were identified on the three sites:

- The first problem was the difficulty in knowing what information was required for some fields. This was identified on sites 1 and 2. It was observed that most users faced this problem during the purchasing process. In site 1, when users went to the Free Shipping Coupon page they were asked to enter this coupon in the 'free shipping coupon' field. In site 2, when users went to the Shipping page, they were asked to enter their gift certificate code in the 'gift certificate code' field. In both pages it was not clear to users what to enter in these fields.
- The second problem was the difficulty in distinguishing between required and non required fields. This was identified on sites 2 and 3. The Login and Address pages on site 2 did not indicate which fields were required and which were not (Figures 5.6 and 5.7). The same problem was also identified on the Personal Information page on site 3.

- The third problem was the difficulty in knowing what was the required link to click to update information. This was identified on sites 1 and 3. On site 1, users did not recognise that they had to click on the 'update order' link located on the Shopping Cart page to confirm the shopping cart update. The same problem was identified on the Shopping Cart page on site 3, as users could not identify the 'ok' link.

- The fourth problem was only identified on site 3. This was a session problem as users had to enter their information for each transaction during the same session because the site did not save their information.

- The fifth problem was that some fields that were required were illogical. This was identified on sites 1 and 2. The Registration page on site 1 and the Address page on site 2 included 'state/province' and 'state/region' fields respectively. These fields were required even if the selected country had no states/regions/provinces.

- The sixth problem concerned information that was expected but which was not displayed after adding the product to the cart. It related to the fact that sites 1 and 3 did not display the expected information after users had added products to their carts. Site 1 did not display the content of the shopping cart directly on the page which was displayed after users had added products to their cart (Add to Cart End page) (Figure 5.8). Instead, it only displayed a message that confirmed the addition of the items(s) to the cart. It was observed that most users, instead of checking out from the Add to Cart End page, viewed their shopping cart and checkout from it. Site 3 did not display any confirmation message after users had added products to their cart. No new page was displayed because the product page had, in the top menu, a link that was required to complete the order after users had added products to their cart. This link was named 'complete order'. It was observed that most users clicked more than once on the 'Add to Cart' link (Figure 5.9).

Figure 5.8: Add to cart end page on Site 1

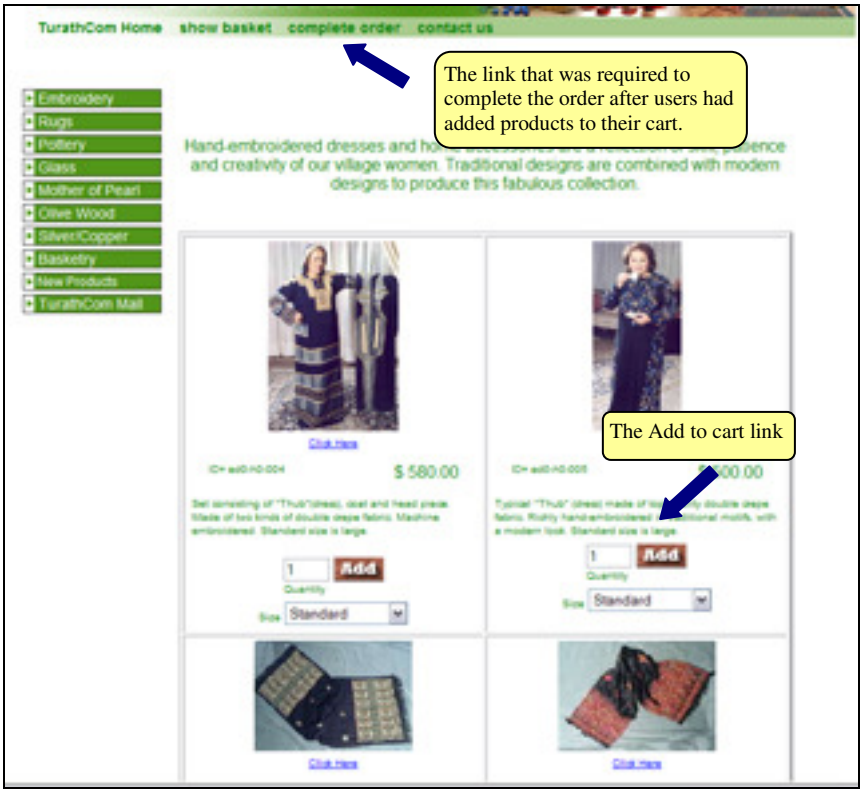

Figure 5.9: Product page on Site 3

5.6.2 Satisfaction questionnaire

Site 3 was the only site with a negative rating for two of the purchasing process statements. These related to difficulties in changing customer information and difficulties in altering the content of the shopping cart. However, Appendix 25 shows that site 3 had the highest number of users who successfully completed the task of changing the content of the shopping cart (Task 3). The same number of users successfully changed the shipping address (Task 5). These findings mean that

users were not satisfied with site 3 even though most of them performed the related tasks on it more successfully than on the other sites.

Users were more satisfied with site 1 in comparison to site 2 regarding two statements: having an easy purchase process, and being easy to change the content of their shopping cart.

Users identified a significant problem in sites 1 and 2 that related to their compulsory registration (Appendix 30). Users preferred not to register on the site before purchasing as indicated from the rating of two statements (15, 16).

5.6.3 Open-Ended questions (satisfaction questionnaire)

The users identified two usability problems that were also identified by the performance data and observation (the difficulty in distinguishing between required and non required fields, and the session problem) (Appendix 33). These are explained in Section 5.6.1.

However, users identified a further usability problem on site 1 that was not identified by the performance data and observation. This was that the ordering process was long and users found the 'checkout' link was displayed twice on two different successive pages (the Add to Cart End and Checkout pages). They indicated that this increased the number of pages in the purchasing process.

5.6.4 Heuristic evaluation

The heuristic evaluators identified a number of usability problems regarding obstacles and difficulties that users might face while interacting (i.e. entering, updating or deleting information) with each site (Appendix 34). Problems were also identified by the user testing. The common problems identified were: the difficulty in knowing what information was required for some fields on site 2; the long ordering process on site 1; the session problem on site 3; and the illogical required fields on sites 1 and 3.

However, the heuristic evaluators did not identify several usability problems that were identified by the user testing. These included:

- The heuristic evaluators identified the difficulty in knowing what information was required for some fields on site 2, but they did not identify

this problem on site 1 with the 'free shipping coupon' field. The reason for this was because this coupon information was displayed on site 1 after a new user registered on the site (after thanking the user for his/her registration) in a small font (Figure 5.10). The heuristic evaluators considered this information to be clear and felt that it did not represent a problem while most users did not even notice it. The location of the coupon information, or the font, or users' experience might be reasons behind the coupon information being missed by users.

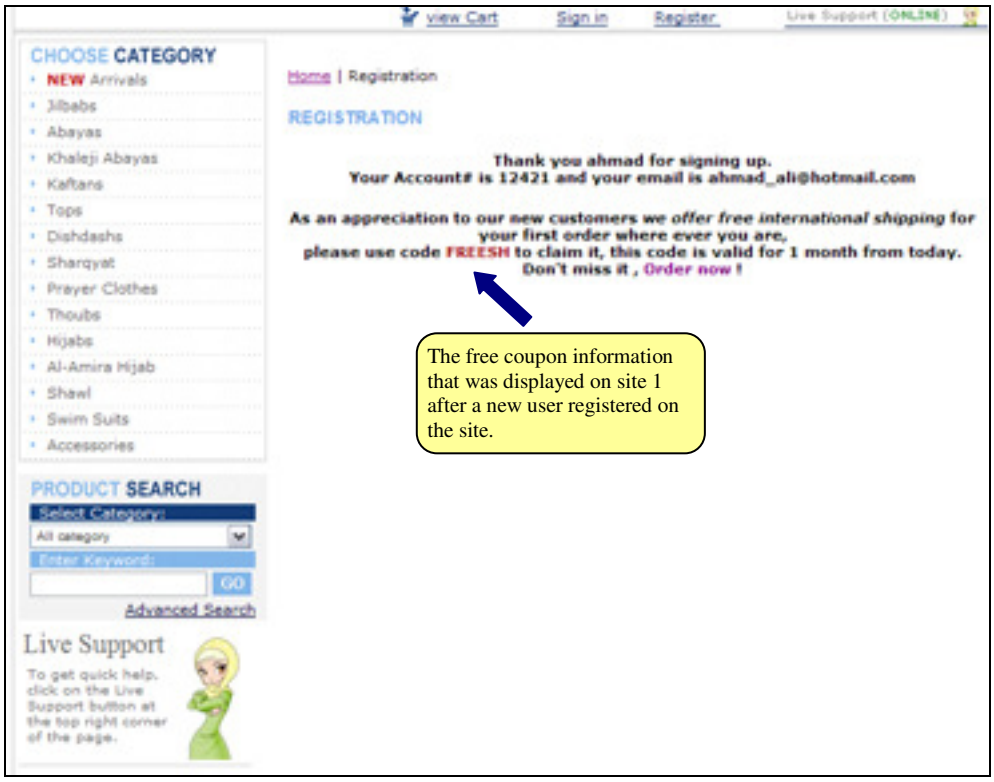

Figure 5.10: Thank you for registration page on Site 1

- The difficulty in distinguishing between required and non required fields on sites 2 and 3. This problem is explained in Section 5.6.1.
- The problem regarding the difficulty in knowing what was the required link to click on sites 1 and 3. This problem is explained in Section 5.6.1.
- The problem that expected information was not displayed after adding the product to the cart on sites 1 and 3. This problem is explained in Section 5.6.1.

The heuristic evaluators identified additional problems regarding the purchasing process that were not identified by the user testing. These included:

- The fact that it was not easy to logon to the site on site 1. This problem related to the fact that site 1 used both an account number and an email for logging on to the site. This could be inconvenient as well as problematic for users to remember their account number. The heuristic evaluators indicated that it would be better for the site to use a password as it is easy to forget account numbers. This problem was not identified by users because all the users were new users who registered and were automatically logged on to the site after their registration. They did not try subsequently to log on to the site.
- The problem that no confirmation was required if users deleted an item from their cart was identified on the three sites. This problem was not identified by users because users did not try to delete an item during the user testing.
- The long registration page problem was identified on site 1. The registration form had many fields which had to be filled in by the users. This problem was not identified by the user testing because either users did not have the experience to provide this comment or users were not asked specifically about their opinion of the registration form.

The heuristic evaluators reported additional functions/information that were not included in the three sites regarding the purchasing process. These functions are listed in the missing capabilities category in Appendix 34.

5.6.5 Heuristic checklist rating

The negative rating of all the purchasing process statements indicated either obstacles/difficulties that users might face while interacting with a site (by purchasing or updating information) or missing capabilities in the site:

- Site 3 had obstacles related to not having an easy purchasing process, not being easy to change customer information and not being easy to change the content of the shopping cart. The reasons behind these obstacles related to the purchasing problems identified by the heuristic evaluators on this site, as well as to other problems that influenced users' interactions (i.e. navigation,

content, design and architecture problems) (Appendix 34). Site 3 did not display important information such as how to order, what to do if there were problems with delivery, and the procedure for cancelling an order. Also, this site did not support a variety of delivery methods.

- Site 2 did not display appropriate clarification about problems with delivery (i.e. non-delivery or late delivery).
- Site 1 had obstacles that related to not having an easy purchasing process. The reasons behind these obstacles were identified by the heuristic evaluators and listed in the purchasing process problem category (Appendix 34). Site 1 did not display how to order information. The site also did not support a variety of delivery and ordering methods, as well as not supporting sending a product to another address.

5.6.6 Google Analytics

Metrics related to the purchasing process provided potential indications of usability problems in the overall purchasing process of the three sites. For example, the low values of the *order conversion rate* metrics (Appendix 13, metric 11) of all sites indicated that few visits resulted in an order. When viewed alongside, the relatively low values of the *percentage of high time spent visits* metrics (Appendix 13, metric 3), this suggests that few visitors were engaged in purchasing activity on the three sites. The low *cart completion rate* and *checkout completion rate* metrics (Appendix 13, metrics 25 and 27) also suggest that the three sites had usability problems in their purchasing processes.

These findings agreed with the user testing and heuristic evaluation methods as discussed in the previous sections (Sections 5.6.1-5.6.5), where the users and the heuristic evaluators experienced problems with the purchasing process of all three sites. However, the user testing and heuristic evaluation methods identified the specific usability problems regarding obstacles and difficulties that users might face while trying to make a purchase.

A similar issue was found with specific pages that make up the purchasing process. The metrics indicated that users were not only having difficulty in completing the purchasing process, but that they were also having difficulty in

beginning or starting the process. Two purchasing process metrics (*cart start rate* and *checkout start rate*) and the funnel report indicated potential usability problems in this area:

- The low value of the *cart start rate* metric (which showed few users added anything to the shopping cart) (Appendix 13, metric 24) suggests that sites 1 and 2 had usability problems on their product pages. This was confirmed by the user testing and the heuristic evaluation methods. The performance data and observation, and the heuristic evaluation methods identified a navigation problem (misleading link) in this page (on site 1). The performance data and observation, the qualitative data from the satisfaction questionnaire and the heuristic evaluation methods identified an inappropriate design problem in this page (on site 2). The qualitative data of the satisfaction questionnaire, together with the heuristic evaluation methods, identified two content problems in this page related to inaccurate information and missing information concerning products (on sites 1 and 2).
- The values of the *checkout start rate* metrics were lower than the values of the *cart start rate* metrics (Appendix 13, metrics 26 and 24). This means that some customers, who added a product to a shopping cart, did not begin the checkout/payment process. This suggests that the pages containing the 'go to checkout' button had usability problems. Although site 3 did not support data to enable comparisons to be made between its *cart start rate* and its *checkout start rate*, the low value of its *checkout start rate* metric indicated potential usability problems on the page that included the checkout button. These findings indeed confirmed by the user testing and heuristic evaluators. The performance data and observation, the qualitative data from the satisfaction questionnaire and the heuristic evaluation methods confirmed that pages in all the sites that included the checkout button had usability problems. These problems related to navigation, content and the purchasing process.

More information about the purchasing process was obtained by the funnel reports, which were used to identify possible usability problems regarding specific pages in the purchasing process of the three sites; these were confirmed by the user

testing and heuristic evaluators. An example of how the funnel was used is illustrated in the following example: The statistics of the sign-in page of site 1 showed that few visitors (33%) proceeded to the next step in the purchasing process (Appendices 14 and 17). Instead, many visitors went to the 'forgot account number' page to get their account number (18%); left the site (13%); or went to the 'login error' page by entering wrong login information (11%). Therefore, the usability problem inferred from these statistics was that it was not easy for visitors to log into the site through the sign-in page. The heuristic evaluators also had difficulties logging into site 1 because the process requires both an account number and an email address, as discussed in Section 5.6.4. The evaluators indicated that this is cumbersome and that users may have difficulty remembering their account details.

The funnel report provided indications of other potential usability problems on other specific pages on the three sites (Appendices 38-40). These problems were also identified by the user testing and heuristic evaluators. The following are the potential specific usability problems that were identified using the funnel report:

- The funnel report indicated that site 1 had two potential usability problems related to difficulty in knowing what was required for some fields and not displaying information that was expected after adding products to the cart. These two problems were identified only by the performance data and the observation method. However, the funnel report also identified the first of these problems in the last page of the purchasing process of site 1. This page was not investigated either by the users or the heuristic evaluators because it required the insertion of credit card data.
- The funnel report indicated two potential problems that were identified only by the heuristic evaluation method. These problems related to the fact that site 1 had a long registration page, and that the Shipping Method page on site 1 had inappropriate page design.
- The funnel report indicated a potential problem that was identified by the qualitative data of the satisfaction questionnaire and the heuristic evaluation methods; this related to the long ordering process of site 1.

- The funnel report indicated that site 1 had illogical required fields. This problem was also identified by the performance data and observations, as well as by the heuristic evaluation methods.
- The funnel report indicated potential problems related to the fact that site 1 had compulsory registration. This problem was also identified by the quantitative data from the satisfaction questionnaire and the heuristic evaluation methods.

5.6.7 Summary of purchasing process problems

No method was the best in identifying purchasing process problems because no method identified all such problems.

The user testing methods identified eight (out of eleven) purchasing process problems. The performance data and observation method were the best and only methods that identified problems related to entering and updating information, and the problem of not displaying a confirmation after users had added products to their cart. This method was also good in identifying the session problems and the existence of required fields that were illogical. The quantitative data from the satisfaction questionnaire were good in identifying one problem that related to compulsory registration while the qualitative questionnaire data were good in identifying problems related to the long ordering process, in addition to the session problem and some of the entering-information problems.

The heuristic evaluation method identified seven (out of eleven) purchasing process problems. This method was the best and only method that identified problems related to it not being easy to log into the site, problems when deleting items from the cart, and long registration pages. This method was also good in identifying session problems, long ordering processes, illogical required fields and problems regarding compulsory registration.

The analytics method was good in indicating the existence of usability problems in the overall purchasing process and in the specific purchasing process pages of the sites. This method was also good in indicating some specific usability problems using the funnel report. However, other methods are needed to provide

more detail about the specific problems on the sites overall and on the specific pages.

5.7 Security and privacy problems

Only two of the six methods identified usability problems related to security and privacy of the sites. These problems could not be identified from the behaviour of users while interacting with the sites as they related to users' feelings about their confidence in the sites. Therefore, the performance data and observations, and the analytics methods, were not able to identify this problem area. However, despite the fact that the satisfaction questionnaire included statements regarding security and privacy (statements 29,30, 31), this method did not identify any problems. These statements indicated that users were confident concerning the security and privacy of any site because these statements were either rated neutral or positive. The open-ended questions of this questionnaire did not include a question regarding this.

5.7.1 Heuristic evaluation

The heuristic evaluators reported that site 3 did not indicate it was secure and protected users' privacy. This related to the fact that it did not display a security guarantee or a privacy statement policy (Appendix 34). The heuristic evaluators indicated that the current weak design of this site would prevent users from feeling it is secure. The heuristic evaluators indicated that sites 1 and 2 displayed adequate information regarding privacy and security statements. These sites used the secure socket layer which reflects a good level of protection of privacy and security.

Comparing users' ratings of the satisfaction questionnaire (regarding security and privacy) with the heuristic evaluators' comments, showed that users did not have enough experience to judge the privacy and security of the sites. This is also obvious in the answers in the users' post evaluation questionnaires, as presented in the previous chapter, Section 4.1.5.

5.7.2 Heuristic checklist rating

The negative rating of the two statements regarding security and privacy identified the significant problem in site 3 that was identified through the heuristic evaluation (Appendix 35). This related to missing information, which is explained in Section 5.7.1.

5.7.3 Summary of security and privacy problems

The heuristic evaluation and the heuristic checklist methods were the best methods for identifying problems related to security and privacy. None of the user testing methods identified this problem. The analytics also did not identify this problem.

5.8 Accessibility and customer service problems

Five of the six methods identified problems related to the accessibility and customer service of the sites. The satisfaction questionnaire did not identify any problems regarding this area because this questionnaire did not include any statements related to this topic.

5.8.1 Performance data and observation

Two tasks, 7 and 8, were related to finding customer support information. Task 7 related to finding 'contact us' information while Task 8 related to finding the shipping information for a site.

In Task 7, there were statistically significant differences between the three sites: $F(2,38) = 4.369$, p=.020. Site 1 had the highest mean time for this task and all users successfully performed it (Appendices 24, 25, 28).

However, there were no statistically significant differences in Task 8, $F(2,38) = 2.364$, p=.108 which most users failed to perform successfully (Appendices 25 and 28).

Task 8 asked users to find out how long it would take for them to receive their order. Observation showed that users did not know where to find this information. They did not recognise that this information was displayed on the Shipping Information page. Users kept navigating, displaying different pages to try to find the required information without success. Users went to the order preview page on each site since they expected to find this information there. This shows that even though most users lacked sufficient knowledge in dealing with e-commerce sites and therefore in recognising the location of this information in such sites, the sites did not make it clear where this information should be found. Therefore the performance data and observation method identified a problems on the three sites related to not being easy to find customer support information.

The performance data and observation methods identified another usability problem regarding accessibility and customer service on site 3. This problem concerned inappropriate information and was identified on the FAQ page. The problem related to the lack of information displayed on the FAQ page (Appendix 27).

5.8.2 Open-Ended questions (satisfaction questionnaire)

The users indicated that sites 1 and 2 did not support Arabic. Most users considered the unavailability of an Arabic interface as a usability problem in these sites (Appendix 33).

5.8.3 Heuristic evaluation

The heuristic evaluators identified two problems that were also identified by the user testing. These related to the inappropriate information on the FAQ page of site 3 and the fact that sites 1 and 2 did not support more than one language (Appendix 34). However, the evaluators missed identifying the problem of not being easy to find customer support information on the three sites that was identified by the performance data and observation (which was related to finding the shipping information).

The heuristic evaluators identified other usability problems using their comprehensive guidelines:

- The three sites had the problem of not supporting more than one currency.
- Sites 2 and 3 had a problem regarding not supporting the sending of comments from customers since they did not have a feedback form.
- Site 3 did not have a help/customer support-section.
- Inappropriate information on the FAQ page of site 1.
- It was not easy to find help/customer support information on site 2. This was due to the navigation and content problems identified on this site (Appendix 34).

The heuristic guidelines included a subcategory regarding the ease of finding and accessing the site from search engines. The heuristic evaluators only used a

Google search to check this subcategory due to time limitations. They found it was not easy to find sites 2 and 3 from this search engine.

5.8.4 Heuristic checklist rating

The negative rating of all the accessibility and customer service statements identified significant problems regarding the accessibility and customer service of the three sites (Appendix 35):

- Site 3 had three significant problems: the accessibility of this site from search engines was not good; it did not have appropriate content for the FAQ section; and it did not support comments from customers (i.e. have a feedback form).
- Site 2 had three significant problems: it did not support comments from customers (i.e. have a feedback form); it did not support an appropriate foreign language; and there were problems regarding its help/customer support section (i.e. it was not easy to find this section; the layout of the section was unclear and indistinct; it was not easy to search this section; and it was difficult to navigate).
- Site 1 had two significant problems: it did not have appropriate content in the FAQ section and it did not support appropriate foreign languages.
- A common problem identified on the three sites related to the fact that these sites did not support appropriate foreign currencies.

5.8.5 Google Analytics

Prior to the analysis, the customer support pages were identified by the owner of each site (12 pages for site 1, 18 for site 2 and 20 for site 3) (Appendix 13, Tables 10-12). The low *information find conversion rate* metric provided evidence that visitors could not easily find and visit the customer support pages (Appendix 13, metric 22 and Tables 10-12). This suggests that either the architecture of the sites are at fault or the search facilities are poor.

These findings agreed with the findings from the performance data and observations, and the heuristic evaluation methods. The performance data and observations showed that users did not know where to find the shipping information

on all the sites while the heuristic evaluation method identified navigation problems on the three sites particularly with respect to customer support links being misleading. On site 2, the heuristic evaluation also indicated that it was not easy to find or navigate in the help/customer support pages (as indicated in Section 5.8.3). However, the rating of this metric might also suggest that visitors were not interested in visiting these pages.

The relatively high value of the *feedback form conversion rate* metric (Appendix 13, metric 23) indicated that visitors to site 1 were interested enough to send feedback to the web master. Site 2 and site 3 did not have feedback forms.

5.8.6 Summary of customer service problems

Neither the user testing methods nor the heuristic evaluation methods were best in identifying all the problems related to accessibility and customer service. The user testing methods together identified only some of the problems related to this area. The performance data and observation was the best in identifying problems related to it being difficult to find help/customer support information. The performance data and observation was also good in identifying a problem related to the inappropriate information provided within a help section/customer service. The qualitative data from the satisfaction questionnaire was good in identifying other problem related to sites not supporting more than one language.

The heuristic evaluation method was the only method that identified four problems related to: it not being easy to find sites from search engines, not supporting more than one currency, the lack of a customer feedback form and not having a help/customer support section. This method was also good in identifying problems related to inappropriate information provided within a help section/customer service and the ability/inability to support more than one language. However, this method missed identifying problems related to the difficulty in finding customer support information. The heuristic checklist also identified accessibility and customer service problems. This method identified one problem related to it not being easy to find and access the sites from a search engine only on the site that had the most serious problem.

The analytics method was good in indicating usability problems related to the ability to find customer support pages.

5.9 Inconsistency problems

Only three of the six methods identified usability problems related to the consistency of the sites. This area could not be identified from the interaction of users with the sites. Therefore neither the performance and observation data nor the analytics identified this problem. The satisfaction questionnaire did not include statement regarding this area.

5.9.1 Open-Ended questions (satisfaction questionnaire)

Users identified only one inconsistency problem on one site; the Arabic and English interfaces on site 3 were inconsistent.

5.9.2 Heuristic evaluation

The heuristic evaluators identified a large number of inconsistency problems on all sites. These problems included inconsistent position of the navigation menu on site 1, inconsistent colours and page layout alignment on site 2, and inconsistent page layout, font colours and style, links colours, terminology, content, menu items, design, page heading and sentence format on site 3. Appendix 34 lists the description, as well as the location, of the problem on each site. The heuristic evaluators found that site 3 had many inconsistency problems throughout the site.

5.9.3 Heuristic checklist rating

The negative rating of all the consistency statements identified significant problems with inconsistency on sites 2 and 3 (Appendix 35):

- Site 3 had significant inconsistency problems with its page layout; the justification of text; fonts; colours; terminology/terms; and the content on the different language interfaces.
- Site 2 had significant inconsistency problems in its page layout.
- The heuristic evaluators rated sites 2 and 3 negatively for one statement related to using different link colours rather than standard link colours. However, the heuristic evaluators indicated that, if a site did not use a standard link colour, this did not necessarily mean there was a usability problem.

5.9.4 Summary of inconsistency problems

All the heuristic evaluation methods (the heuristic evaluation and the heuristic checklist) were the best methods for identifying large and detailed inconsistency problems. Only one of the user testing methods (the qualitative data from the satisfaction questionnaire) was good in identifying one of the inconsistency problems. This was related to inconsistent content between Arabic and English interfaces.

5.10 Missing capabilities problems

Only three of the six methods identified usability problems related to the missing capabilities of the sites. The satisfaction questionnaire did not include any statement that asked users about these issues. The performance data and observation and the analytics could not indicate these issues as they are not related to users' interaction with the sites.

5.10.1 Open-Ended questions (satisfaction questionnaire)

Users identified only one problem related to missing capabilities of the sites; site 3 did not have an internal search facility.

5.10.2 Heuristic evaluation

The heuristic evaluators identified a large number of problems regarding missing capabilities on the three sites. They indicated that sites 1 and 2 did not have links to useful external resources and did not have a site map. Furthermore, they stated that site 1 did not display the content of its shopping cart on its top menu, did not support delivery to another address, did not display information about delivery and how to order, did not have alternative methods of delivery and its navigation menu did not give a clear indication of the current page on display, while site 2 did not display information regarding problems with delivery. The evaluators indicated that site 3 did not have an internal search facility or a customer service section, did not have alternative methods of delivery and also this site did not display information regarding either payment options, how to order, problems with delivery or cancelling an order. Appendix 34 listed the missing capabilities on the three sites.

5.10.3 Heuristic checklist rating

The negative rating of seven statement identified significant problems related to missing capabilities on the three sites (Appendix 35). These problems related to the problems listed by the heuristic evaluators and displayed in Appendix 34.

5.10.4 Summary of missing capabilities

The heuristic evaluation and the heuristic checklist methods were the best in identifying problems regarding large and detailed missing capabilities. One of the user testing methods identified one problem regarding missing capabilities. This was the qualitative data from the satisfaction questionnaire and the problem related to the unavailability of an internal search.

5.11 Conclusion

This chapter has illustrated the effectiveness of the six usability evaluation methods that were employed in this research with regard to their ability to identify specific usability problems. The effectiveness of the methods was discussed in terms of ten main usability problem areas/problem themes and their corresponding sub-themes.

Chapter Six: A Framework to Evaluate the Usability of E-commerce Sites

This chapter illustrates how the aim of this research was achieved by developing a framework to evaluate and identify usability problem areas of e-commerce websites. The chapter explains how the framework was suggested based on the results obtained from an analysis of the three methods employed in this research and presented in the previous chapter (Chapter 5). First of all, the chapter reviews the costs of employing the three methods and then presents the proposed framework. This is followed by an evaluation of its usefulness. The chapter finally suggests an enhancement to the suggested framework.

6.1 Comparative costs

The cost of employing the three methods (heuristic evaluation, user testing and the *Google Analytics* tool) was estimated in terms of the time spent designing and analysing each of these methods. The approximate time specifically related to the time the researcher spent while conducting each method including: time for setting up and designing the research tools, collecting and analysing data. This section reviews the approximate time taken for each method. It is should be noted that the

times for the collection and analysis of data given in Table 6.1, represent the average time taken per site.

Table 6.1. Comparative costs for the three methods.

	Heuristic Evaluation	User Testing	Google Analytics
Setup and Design of Research Tools	128 hours	136 hours	8 hours
Collecting Data	15 hours	20 hours	0 hours
Analysing Data	104 hours	170 hours	352 hours
Total Time	**247 hours**	**326 hours**	**360 hours**

6.1.1 Heuristic evaluation method

The approximate time taken to design and analyse the heuristic evaluation method was 247 hours. This included:

- Setup and design time: A total of 128 hours was spent recruiting web experts (8 hours) and designing the heuristic guidelines (120 hours) that were used by the web experts.
- Time spent collecting data: A total of 15 hours was spent taking detailed notes from the five web experts who participated in the study over five sessions; each session took approximately 3 hours.
- Time spent analysing data: A total of 104 hours was spent transcribing the web experts' comments, writing out the usability problems (80 hours), and statistically analysing the heuristics checklist (24 hours).

6.1.2 User testing method

The approximate time taken to design and analyse the user testing method was 326 hours. This included:

- Setup and design time: A total of 136 hours was spent recruiting typical users (16 hours) and designing users' tasks and questionnaires (pre-test and post-test questionnaires) (120 hours).
- Time spent collecting data: A total of 20 hours was spent in users' sessions observing users, taking notes, and in distributing and collecting the questionnaires; each session took approximately one hour.

- Time spent analysing data: A total of 170 hours was spent transcribing the observation data and users' comments, and in writing up the usability problems (90 hours). A further 80 hours were spent statistically analysing the performance data and questionnaires.

6.1.3 Google Analytics method

The approximate time taken to design and analyse the *Google Analytics* method was 360 hours. This included:

- Setup and design time: A total of 8 hours was spent installing the required script and configuring the key business processes.
- Time spent collecting data: *Google Analytics* software automatically collected users' interactions for three months. Therefore, the time the researcher spent collecting these data was considered to be zero.
- Time spent analysing data: A total of 352 hours was spent identifying the key metrics (calculated using *Google Analytics* software) that indicate areas with usability problems (232 hours), calculating the web metrics, and interpreting the metrics' values and the *Google Analytics*' reports (120 hours).

See Table 6.1 above.

The total time taken to identify usability problems using the three methods was high (933 hours), with the *Google Analytics* method requiring the highest total time in comparison to the user testing and heuristic evaluation methods.

The results, however, showed that the *Google Analytics* method cost less in comparison to the other methods in terms of the total time required for setup, design and the collection of data. This is because it did not require the involvement of users or web experts, or the design of specific users' tasks, questionnaires or guidelines as was the case with the user testing and heuristic evaluation methods. Furthermore, the long time that was spent on the analysis of this method was related to the fact that there was no specific matrix of web metrics that could be used in indicating areas of usability problems. Therefore, much of the time was taken up finding out and determining an appropriate matrix of web metrics and discovering how the combination of metrics indicated areas of usability problems after examining each

metric (as explained in Chapter 4). However, if this factor is taken out (because it is an entry requirement), then the time taken by the *Google Analytics* method was considerably less (120 hours). These 120 hours constitute the ongoing cost that is required to calculate and interpret the specific matrix of web metrics.

These results, in addition to the results regarding the types of problem that can be identified using each of these methods (explained in Chapter 5), suggested a framework that could be used to evaluate the usability of e-commerce sites according to specific areas. This could reduce the time needed to employ the three methods: i.e. the user testing, heuristic evaluation and the *Google Analytics* tool.

6.2 An Evaluation framework for the usability of e-commerce websites

An evaluation framework consisting of four steps was suggested. This is aimed at the managers of e-commerce companies who might be interested in identifying usability problems on their sites and improving their design to meet users' needs.

Before reviewing the steps of the framework, the importance of this framework is worth mentioning. This relates mainly to two issues. The first is related to the reduction of the cost of employing two usability methods (user testing and heuristic evaluation) by using the framework. The second is related to the illustration provided by this framework regarding the specific types of problem that could be identified by the two usability evaluation methods.

6.2.1 Reduction of the cost of employing usability evaluation methods

The suggested framework will provide optimum results regarding the identification of comprehensive usability problem areas on an e-commerce website with minimum input regarding the cost of and time spent employing usability evaluation methods. Specifically, this framework involves *Google Analytics* software as a pre-evaluation tool before employing user testing and/or heuristic evaluation methods in the usability evaluation of an e-commerce website. This tool, by employing the specific matrix of web metrics presented in Chapter 4, will highlight usability problem areas in the e-commerce site in a short time and therefore at a low cost (i.e. only 120 hours, as reviewed in Section 6.1.3). This will therefore help in guiding the evaluation process, as well as reducing the time that would be taken by user testing and/or heuristic evaluation in identifying these usability issues. For example, this

could reduce the number of users required to deploy user testing or reduce the extent of the heuristics given to evaluators, offering an opportunity to focus more on identifying specific problem areas on the site. Also, the involvement of this tool will provide useful information regarding the current users of a site and the site's performance which could not be collected by using either a user testing or heuristic evaluation method.

6.2.2 Specific types of problem identified by usability methods

The suggested framework describes the specific types of usability problem that could be identified by the user testing and heuristic evaluation methods. This facilitates decision making regarding which of these methods to employ: i.e. user testing, heuristic evaluation or these two methods together in order to identify usability problems on an e-commerce website. The selection of the methods will depend on the types of problem identified by them.

The suggested framework is shown in Figure 6.1 and involves the following steps:

Step 1:

This is a preparatory step in order to use *Google Analytics* software to track the traffic flows of a website. It includes inserting *Google Analytics* code in the pages to be tracked and configuring *Google Analytics* software. Before configuring this tool, it is necessary to identify the key business processes and the most logical path (the required pages) users are expected to go through to complete these processes. This identification can be undertaken by the manager of the site. Then, *Google Analytics* software can be configured by adding these processes and their expected paths. After this, *Google Analytics* can be used to start tracking users' interactions with the site for a specific time, depending on the time the manager of a site has set aside to redesign the site.

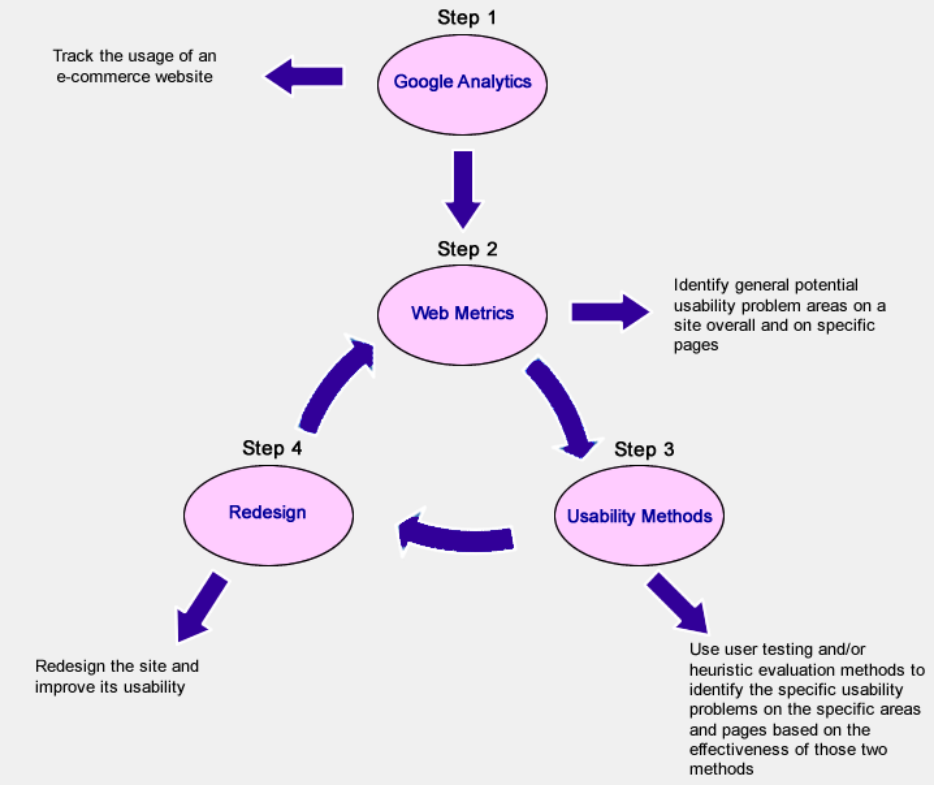

Figure 6.1: A framework to evaluate the usability of an e-commerce website

Step 2:

This step involves the use of the suggested matrix of web metrics (summarised in Chapter 4, p.124) to measure the site's usage in order to obtain a clear picture of the general usability problems on the site overall and on specific important pages.

When using the matrix of metrics the idea is that the evaluator identifies metrics with values that may indicate problems (i.e. low value for *percentage of high or medium click depth visits* or high value of *bounce rate*). Then by noting which metrics are problematic, Figure 4.1 can be used to identify if the likely problem is navigational, architectural, search related, etc. For instance, if a site has low values for *average number of page views per visits* and *percentage of high or medium click depth visits* metrics together with high values for *bounce rate*, *average searches per visits* and *percent of visits using search* metrics, then this indicates a navigational problem. However, if a site has low values for *average searches per visit* and *percent of visits using search* metrics together with high values of *average number of page views per visits*, *percentage of high or medium click depth visits* and *search results to site exit ratio* metrics, then this indicate a problem with the internal search of the site

The matrix will help to investigate:

- The general usability problem areas on a site (i.e. navigation, architecture, content or design).
- The usability of the internal search of the site.
- The usability of the top landing pages of the site.
- The usability of the top content pages of the site.
- The usability of the top exit pages of the site.
- The ability to find customer support information.
- The usability of the purchasing process of a site overall and the usability of specific pages in the purchasing process.

Furthermore, using the matrix will help to obtain a description regarding:

- The site's visitors in terms of: their return behaviour, the characteristics of the computers and Internet browsers used by those visitors, and the connection speed of their network. The browser characteristics include: language, operating systems, browsers, screen colours, screen resolutions, flash versions and Java support.
- The financial performance of the site in terms of the site's ability to generate revenue and to cross-sell.

These two categories will add supplementary information to the understanding of the overall usability of a site.

This step will result in:

- The identification of potential usability problem areas on a site overall.
- The identification of specific pages on the site that appear to have potential usability problems. These pages will include pages encountered by visitors while completing the identified key business processes (i.e. those identified in Step 1). Entry pages, mostly viewed pages and exit pages that have potential usability problems will also be identified.
- The description of the site's visitors and its financial performance.

Step 3:

This step involves employing user testing and/or the heuristic evaluation method in order to identify specific usability problems in particular areas and pages (resulting from Step 2). The decision regarding which method(s) to employ (i.e. user testing, heuristic evaluation or these two methods together) is based on understanding the effectiveness of these methods in identifying specific usability problem areas on a site by using Table 6.2.

Table 6.2 shows ten main usability problem areas, their corresponding sub-areas and the method(s) that can identify such problem sub-areas, that might fail to identify some problems in the area, or that cannot identify these problems. The description of each problem sub-area was discussed in Chapter 5.

The table helps companies choose appropriate methods and tasks for the evaluators. For instance, if Step 2 suggests a navigational problem, then the evaluator should make a judgment on whether this may be related to misleading links or broken links and if misleading links then the table indicates that this should be investigated by user testing, but if broken links then the table indicates that this should be investigated by heuristic evaluation, and if misleading links and broken links then the table indicates that these should be investigated using both methods.

This step will result in identifying specific usability problems on the site overall and on the specific pages that are important for the site's manager and for the visitors.

Table 6.2. Summary of the specific problem areas and sub-areas identified by the user testing and heuristic evaluation methods

Usability Problem Area	Usability Problem Sub-Area	User Testing	Heuristic Evaluation
Navigation Problems	Misleading links	√√	√
	Links were not obvious	√√	√
	Broken links	√	√√
	Weak navigation support	√	√√
	Orphan pages	√	√√
Internal Search Problems	Inaccurate results	√√	√√
	Limited options	√√	√√
	Poor visibility of search position		√√
Architecture Problems	Poor structure	√√	√√
	Illogical order of menu items		√√
	Illogical categorisation of menu items		√√
Content Problems	Irrelevant content	√	√√
	Inaccurate information	√√	√√
	Grammatical accuracy problems		√√
	Missing information about the company		√√
	Missing information about the products	√	√√
Design Problems	Misleading images	√√	√√
	Inappropriate page design	√√	√
	Unaesthetic design	√	√√
	Inappropriate quality of images		√√
	Missing alternative texts		√√
	Broken images		√√
	Inappropriate choice of fonts and colours	√	√√
	Inappropriate page titles		√√
Purchasing Process Problems	Difficulty in knowing what was required for some fields	√√	√
	Difficulty in distinguishing between required and non-required fields	√√	
	Difficulty in knowing what links were needed to be clicked	√√	
	Long ordering process	√√	√√
	Session problem	√√	√√
	Not easy to log on to the site		√√
	Lack of confirmation if users deleted an item from their shopping cart		√√
	Long registration page		√√
	Compulsory registration	√√	√√
	Illogical required fields	√√	√√
	Expected information not displayed after adding products to cart	√√	

Usability Problem Area	Usability Problem Sub-Area	User Testing	Heuristic Evaluation
Security and Privacy Problems	Lack of confidence in security and privacy		√√
Accessibility and Customer Service Problems	Not easy to find help/customer support information	√√	√
	Not supporting more than one language	√√	√√
	Not supporting more than one currency		√√
	Inappropriate information provided within a help section/customer service	√	√√
	Not supporting the sending of comments from customers		√√
	Not easy to find and access the site from search engines		√√
Inconsistency Problems	Inconsistent page layout or style/colours/ terminology/content	√	√√
Missing capabilities Problems	Missing functions/information	√	√√

√√: Good identification of the specific problem area
√: Missed identification of some of the specific problem areas
Blank: Could not identify the specific problem area

Step 4:

This step involves redesigning the site and improving the usability problems identified by Step 3. The description of the site's visitors obtained in Step 2 regarding the characteristics of the computers and Internet browsers and the connection speed of the current visitors, are also taken into consideration. Then, the usage of the site is tracked, moving to Step 2 in order to investigate improvements in the financial performance of the site and/or to identify new usability problems.

6.3 Evaluating the usefulness of the suggested framework

In order to evaluate the usefulness of the suggested framework, two approaches were considered. The first related to asking the three companies that were involved in this research to redesign their sites based on the outcomes of the methods. The intention was to test the suggested framework by repeating the data collection process. Specifically, it was intended to ascertain whether the framework would reduce the time required for employing the three methods (user testing, heuristic evaluation and the *Google Analytics* methods) and to test whether the component parts of the framework would identify the expected specific usability problems areas. The second approach related to obtaining qualitative feedback on the usefulness and effectiveness of the suggested framework from a company perspective.

The second approach was taken because none of the companies agreed to redesign their websites in the time required for this research. These companies are privately owned and they indicated that redesigning their sites would be very costly and did not suit their short-term plans. The results related to each website were presented in reports (Appendix 41 is an example of one report that was sent to company 1). These results were organised according to usability problem areas and a recommendation was made for each specific problem. The report also included an overview regarding the methods that were employed in this research and the time taken in designing and analysing these methods. These reports were sent to each company, together with the suggested framework. This was followed by an interview conducted with each site's manager. During the interviews, and after discussing the results, the usefulness of the framework was tested using the questions shown in Appendix 42. The results obtained from the interviews with the managers concerning testing the usefulness of the framework are presented below.

The usefulness of usability evaluation

All the companies agreed that the usability evaluation of their websites was useful and was an important technique. All the companies were interested in gaining the knowledge regarding the usability methods that were employed in this research, and in their ability to identify the large number of problems on their sites. They indicated that they did not have any knowledge regarding usability evaluation methods before taking part in this research. Two of the companies (companies one and two) indicated that they were using other methods to collect feedback from their customers regarding what they liked or disliked on their websites. They used survey-by email which was sent to their customers more than once. The companies were interested in receiving useful information about the weaknesses of their websites by taking part in this research and by trying these new methods. After receiving the results, they said that there was no comparison between the results gained from employing the usability evaluation methods and the survey that they generally use. The usability evaluation methods provided them with rich, useful and detailed information which was above their expectations. These companies were glad they had decided to take part in this research.

The usefulness and expectations of the results

All the companies indicated that the results were very useful, interesting and unexpected. None of them expected the number and types of problem that were identified on their sites.

Two of the companies (companies one and two) indicated that once they received the results, they fixed certain problems on their websites which were easily implemented. The recommendations that were presented with each problem in the report that was sent to them encouraged them to correct these problems. The companies provided examples regarding the problems that were dealt with. For example, company one reported that they fixed eight problems: two relating to the navigation area and six related to the content area (see Appendix 41, Report 1, 1.1.2, 1.1.5, 2.1.3, 2.2.1, 2.31, 2.3.2, 2.3.3 and 2.3.4). Company two reported that they fixed four problems: two related to the navigation area and two related to the content area. Furthermore, these companies indicated that they are in the process of fixing the different types of problem included in the report with priority being given to all the purchasing process problems. They stated that addressing the problems is now within their short-term plans.

Company three, however, did not indicate that they had fixed any problems on their website based on the outcomes of this research, in spite of having stated that they did not expect their site to have such a large number of problems. However, they did say that it was their intention to make major changes to the design of their site shortly. The large number of problems and the recommendations encouraged this company to take this decision.

The companies' feedback regarding the problems that were fixed, and the decision these companies made regarding fixing the other types of problem, represent further evidence of the usefulness of the results.

The usefulness and applicability of the suggested framework

All the companies agreed that the suggested framework is useful and applicable. However, the readiness of companies to apply this framework varied among them because of variations in their resources. Companies one and two stated that, despite the fact that employing the framework would require additional cost and effort which was not within their plan, they were willing to employ it within their

capabilities in order to improve the usability of their websites. These two companies had an e-commerce department which included a team of developers and designers who were headed by a manager. These companies stated that they were planning to apply the framework. They also indicated that they would use the usability methods within their capabilities by asking their e-commerce team to employ and analyse the usability methods. The e-commerce site of company 3 was developed and updated by one web specialist who took instructions directly from the manager. Therefore, company 3 indicated that currently they do not have sufficient resources to conduct the usability methods and apply the suggested framework. However, this company indicated that they are planning to recruit a team of web specialists in order to redesign their website, taking into consideration all the usability problems and recommendations that resulted from this research. After redesigning their site, and with the help of a new team to be recruited, they said they would consider applying the suggested framework.

The three companies indicated that the illustration of the specific types of problem that can be identified by the two evaluation methods (user testing and heuristic evaluation) which are part of the suggested framework, was one of the main reasons that would encourage them to apply the framework. This was related to the fact that these companies did not have prior knowledge regarding the usability methods and type of problems these methods are able to identify. Therefore, the summary of the problem areas and sub-areas that were identified by these methods encouraged the companies to consider applying the suggested framework in the near future.

The usefulness of Google Analytics and the suggested matrix of web metrics

All the companies believed that using the suggested matrix of web metrics with *Google Analytics* software would be a good approach to indicate quickly potential usability problems on their sites; this would facilitate them in employing the usability methods to validate these potential indications.

Interestingly, company 3, which indicated that they currently did not have enough resources to employ the suggested usability evaluation methods, indicated that they are planning to keep *Google Analytics* software for tracking the usage of their site; they also intended to continue monitoring the usage of their site using the

suggested matrix of web metrics. According to company 3, using the suggested web metrics would not require additional human resources, in spite of the fact that interpreting the web metrics will require some effort. The other two companies are also interested in continuing to monitor their sites' activities all the time using the suggested matrix of web metrics and specifically after redesigning their sites. This will help them to monitor any improvements and to keep them informed regarding indications of potential usability problems.

It is worth mentioning that company 1 indicated that they were using *Google Analytics* before participating in this research. Company one had installed the basic code of *Google Analytics* on their pages and were using this software to obtain statistics and information regarding the usage of their site. Specifically, they used *Google Analytics* to monitor the number of visitors and their geographical location. However, they had not installed the e-commerce code of *Google Analytics* software which helps to collect statistics regarding the e-commerce transactions of their site. Also, they did not use the goal and funnel options of *Google Analytics* which help to monitor whether or not their site achieves their goals. This company was grateful for the idea of the suggested web metrics as this facilitated the monitoring of the activities on their site. It also provided them with useful information which they were otherwise unable to obtain.

Types of problem the companies were interested to identify

The companies, by referring to their results which were categorised in terms of the specific problems themes and sub-themes, reported the specific types of problem they were interested or not interested in identifying on their websites. They also indicated the methods which they would employ to identify these problems:

- Company one reported that they were interested in all the navigation, internal search, content and purchasing process problems that were identified by the user testing method. This company also was interested in one design problem that related to inappropriate page design; this was identified by user testing. Regarding the problems that were identified by heuristic evaluation, this company reported only one design problem that related to missing alternative text. However, company one was not interested in identifying three problems which the heuristic evaluation method was

more effective in identifying. These related to the position of the internal search facility of their site which was not obvious, and two design problems related to misleading images and unaesthetic design.

- Company two reported that they were interested in all the navigation, internal search, content, design and purchasing process problems that were identified by the user testing. This company was also interested in one accessibility and customer service problem which related to it not being easy to find help/customer support information; this problem was identified by the user testing. Regarding the problems identified by heuristic evaluation, this company reported that they were interested in identifying all the purchasing process problems identified by this method. They stated that they aimed to improve the overall purchasing process of their website and therefore they were interested in fixing all these problems. Company two was not interested in identifying four problems. They related to one structural problem which concerned the illogical order of menu items, one design problem regarding unaesthetic design, and two accessibility and customer service problems that related to the failure of the site to support the sending of comments from customers and the fact that it did not support more than one currency. The heuristic evaluation method was more effective in identifying these four problems.

- Company three reported that they were interested in all the problems that were identified on their website by both the user testing and the heuristic evaluation. They explained the reason for this by indicating that they were planning to make major changes in their website. Therefore they were interested in fixing all the problems which, from their perspective, were important and should be fixed. They will employ first heuristic evaluation followed by user testing.

Comprehensiveness of specific problem areas and/or sub-areas

All the companies indicated that the problem areas and sub-areas that were identified by this research and presented in the suggested framework were comprehensive and detailed. They covered all the areas on their websites and provided details regarding the weaknesses of their sites.

6.4 Enhancement of the suggested framework

An enhancement of the suggested framework was undertaken. It was noted that the illustration of the specific types of problem that were identified by the user testing and heuristic evaluation methods, which is part of the framework, was useful and would facilitate the selection of one or two methods to be employed by the companies, as revealed by the results of testing the framework. However, it was inferred from the qualitative feedback from the companies that there is a need to provide more explanation of the 44 specific problems with regard to their importance. This would help the companies prioritise the fixing of the problems on their sites. This was inferred when the companies were asked about the types of specific problem on their sites they were interested or not interested in identifying and the method that they would employ as a result. Therefore, it was suggested that the number of problems identified by the user testing and heuristic evaluation methods should be illustrated according to their severity level (major and minor).

To make the suggested enhancement to the framework, the usability problems that were identified by the user testing and heuristic evaluation methods were examined and classified by their severity: i.e. either major or minor. Major problems included problems where a user made a mistake/error and was unable to recover and complete the task on time. Minor problems included those where a user made a mistake/error but was able to recover and complete the task in the allotted time. Difficulties faced by the user while performing the required tasks, and which were noted by the observer, were also considered minor problems. Major and minor problems, generated by user testing, were identified by referring to the performance data, the observation notes, the notes generated from reviewing the sixty Camtasia files and users' comments, and the post-test satisfaction questionnaire. Minor and major problems generated by the heuristic evaluation were identified by matching each identified problem with the severity rating obtained from the web experts.

It is worth mentioning that two methods were excluded in this stage of analysis. These were the quantitative data obtained from the satisfaction questionnaire and the quantitative data obtained from the heuristic checklist. In this stage of analysis the aim was to count the number of specific problems identified and the severity level of the problem. The quantitative data obtained from these two methods only provided information regarding the existence or non- existence of a

specific problem. However, with regard to a specific problem, these data did not identify the specific location of the problem and how many problems a site had. For example, the quantitative data could indicate if a site had a broken link problem, but it was not possible to know how many broken links the site had. Therefore, to ensure accuracy regarding the number and severity level of the specific problems that were identified by the user testing and heuristic evaluation methods, the quantitative data were excluded.

The following section involves three sub-sections which present the results of the analysis regarding the number and severity level of the specific types of problem identified by the user testing and heuristic evaluation methods. The first subsection presents the number of usability problems that were identified by these methods. The second subsection presents the number of usability problems with regard to usability problem areas and finally, the third subsection presents how the framework was enhanced.

6.4.1 Number of usability problems

A total of 246 usability problems were identified by the user testing and heuristic evaluation methods on the three websites. Figure 6.2 shows the distribution of these problems by each method and shows also the proportion of problems identified commonly by both methods. This figure shows that the heuristic evaluation was more effective than user testing in terms of identifying a larger proportion of problems.

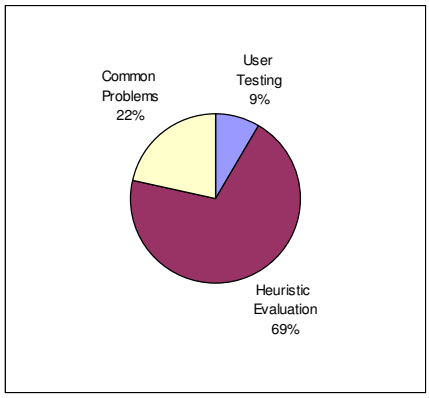

Figure 6.2: Distribution of usability problems identified by the two methods

An analysis of usability problems by level of severity showed that heuristic evaluation was effective in uniquely identifying a large number of minor usability

problems while the user testing was effective in uniquely identifying major problems. Table 6.3 shows the number of problems, by severity level, that were identified by these methods. Interestingly, the common problems identified by these methods were divided into two categories: the first includes common problems where there was an agreement regarding their severity level between the user testing and heuristic evaluation methods, while the second includes problems where there was no agreement between the two methods concerning the problems' severity level. Table 6.3 shows that there was agreement between these two methods regarding the severity level of 39 problems, while there was no agreement for 14 problems. The 14 problems included problems which were identified as major by user testing while they were identified by minor by heuristic evaluators and vice versa. This offers evidence regarding how the web experts could not predict the role of users; they claimed that some problems might cause a task failure while they did not actually influence the completion of tasks and users' ability to recover from these problems. On the other hand, the web experts identified some problems as minor ones while these problems were major for users and caused task failure.

Table 6.3: Distribution of usability problems identified by the two methods by severity

Usability Method		Minor Problems	Major Problems	Total
User Testing		2 (10%)	19 (90%)	21
Heuristic Evaluation		159 (92%)	13 (8%)	172
Common Problems	Agreed Severity	29 (74%)	10 (26%)	39
	Not agreed Severity	14		14
Total Number of Problems				**246**

6.4.2 Number of usability problems with regard to usability problem areas

This section reviews the number of minor and major problems identified by the user testing and heuristic evaluation methods employed in this research. It uses the problem themes that were generated from the analysis to explain which methods were able to identify usability problems related to each problem theme. Figure 6.3 shows the distribution of usability problems that were uniquely and commonly identified by the two methods with respect to a number of usability problems relating to the ten problem themes. Figure 6.3 shows that the heuristic evaluation method was more effective in identifying a large number of problems compared to user testing with respect to all the problem themes, with the exception of one: purchasing process problems. In this problem theme, user testing identified a larger

number of problems. This figure also shows that user testing uniquely identified problems related to four problem themes. These included: navigation, design, the purchasing process and accessibility and customer service.

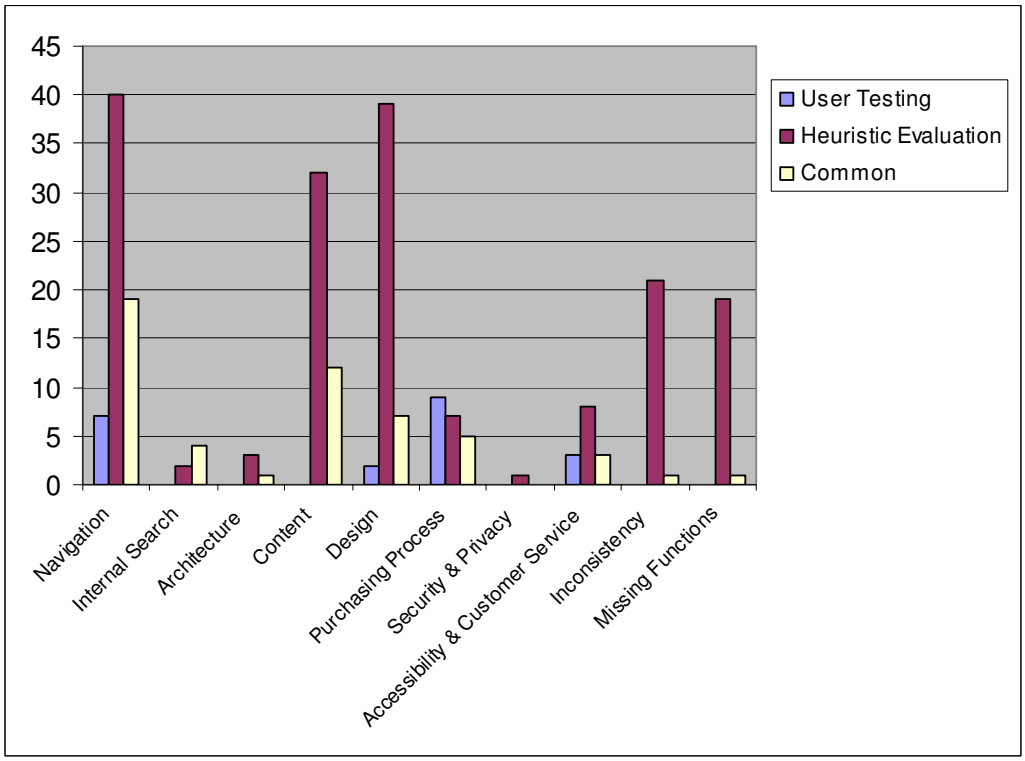

Figure 6.3: Distribution of usability problems identified by the two methods by number and types of problem

The following subsections review, with regard to each problem theme, the effectiveness of each usability method in identifying each problem sub-theme in terms of the number of problems identified and their severity level. Problems common to these methods, and problems missed by these methods, are also highlighted. The description of the types of problem identified will not be discussed here since they have already been discussed in Chapter 5.

6.4.2.1 Navigation problems

The results showed that the sites had major navigational problems relating to three out of the five navigational problem areas. These related to misleading links, links that were not obvious, and weak navigation support. The user testing method was more effective compared to the heuristic evaluation in uniquely identifying major problems related to the first two areas. However, the results showed that the heuristic evaluation was more effective, compared to user testing, in uniquely

identifying major problems related to the third area and minor problems related to four areas. Table 6.4 shows the distribution of the number of specific navigation problems identified on the three sites and their severity level. Regarding the problems that were commonly identified by the two methods, there was an agreement between the two methods regarding the severity rating of 8 out of 19 problems.

Table 6.4: Distribution of specific navigation problems identified by the two methods by the number of problems and severity level

Navigation Problems	User Testing		Heuristic Evaluation		Common Problems		
					Agreed Severity		Not Agreed Severity
	Minor Problems	Major Problems	Minor Problems	Major Problems	Minor Problems	Major Problems	
Misleading links	0	5	14	0	1	0	2
Links were not obvious	0	2	13	1	0	2	6
Weak navigation support	0	0	0	2	0	1	3
Broken links	0	0	3	0	3	0	0
Orphan pages	0	0	7	0	1	0	0

6.4.2.2 Internal search problems

The results showed that only one of the three internal search problems that were identified on the sites was major (inaccurate results) and both the user testing and heuristic evaluation methods identified this problem, as shown in Table 6.5. The limited option problem, which was commonly identified by the two methods, was minor. However, the other two problems that were uniquely identified by the heuristic evaluators were also minor. These related to the not obvious position of the search facilities and the inaccurate results of the search facility of site 3.

Table 6.5: Distribution of specific internal search problems identified by the two methods by the number of problems and severity level

Internal Search Problems	User Testing		Heuristic Evaluation		Common Problems		
					Agreed Severity		Not Agreed Severity
	Minor Problems	Major Problems	Minor Problems	Major Problems	Minor Problems	Major Problems	
Inaccurate results	0	0	1	0	0	2	0
Limited options	0	0	0	0	2	0	0
Poor visibility of search position	0	0	1	0	0	0	0

6.4.2.3 Architecture problems

The results showed that among the three architecture problems that were identified on the sites, only one problem was major (poor structure) and was commonly identified by both the user testing and the heuristic evaluation (see Table 6.6). The other problems that were uniquely identified by the heuristic evaluators and that related to menu items were minor.

Table 6.6: Distribution of specific architecture problems identified by the two methods by the number of problems and severity level

Architecture Problems	User Testing		Heuristic Evaluation		Common Problems		
					Agreed Severity		Not Agreed Severity
	Minor Problems	Major Problems	Minor Problems	Major Problems	Minor Problems	Major Problems	
Poor structure	0	0	0	0	0	1	0
Illogical order of menu items	0	0	2	0	0	0	0
Illogical categorisation of menu items	0	0	1	0	0	0	0

6.4.2.4 Content problemsl

The results showed that the user testing method did not uniquely identify problems relating to this area while the heuristic evaluators uniquely identified a total of 32 problems. Twelve problems were commonly identified by these evaluation methods and were related to three specific content problems: some content was irrelevant, there was some inaccurate information, and some product information was missing. The two methods agreed on the severity of most of these common problems; two major problems and nine minor problems (see Table 6.7). Furthermore, despite the fact that the heuristic evaluators uniquely identified additional problems (28) related to these three specific sub-themes, only two of them were major. It is worth noting also that the other problems that were uniquely identified by the heuristic evaluators which related to inaccurate grammar and missing information about the companies were all minor.

Table 6.7: Distribution of specific content problems identified by the two methods by the number of problems and severity level

Content Problems	User Testing		Heuristic Evaluation		Common Problems		
					Agreed Severity		Not Agreed Severity
	Minor Problems	Major Problems	Minor Problems	Major Problems	Minor Problems	Major Problems	
Irrelevant content	0	0	16	1	4	2	1
Inaccurate information	0	0	0	1	2	0	0
Grammatical accuracy problems	0	0	2	0	0	0	0
Missing information about the products	0	0	10	0	3	0	0
Missing information about the company	0	0	2	0	0	0	0

6.4.2.5 Design problems

In total 48 usability problems were identified by the user testing and heuristic evaluation methods relating to this area; two were uniquely identified by user testing, 39 were uniquely identified by heuristic evaluators and seven problems were commonly identified by both methods (Table 6.8). The two problems that were uniquely identified by user testing and that related to inappropriate page design were major. The seven problems that were commonly identified by the two methods related to three areas (as shown in Table 6.8); the two methods agreed on the severity level of five of them. The additional problems that were uniquely identified by the heuristic evaluators were all minor; 18 problems related to the three sub-themes that included the commonly identified problems and 21 problems related to five areas where only the evaluators identified problems (broken images, missing alternative text, inappropriate page titles, inappropriate quality of images, and unaesthetic design).

Table 6.8: Distribution of specific design problems identified by the two methods by the number of problems and severity level

Design Problems	User Testing		Heuristic Evaluation		Common Problems		
					Agreed Severity		Not Agreed Severity
	Minor Problems	Major Problems	Minor Problems	Major Problems	Minor Problems	Major Problems	
Misleading images	0	0	5	0	1	0	1
Inappropriate page design	0	2	9	0	2	1	1
Unaesthetic design	0	0	3	0	0	0	0
Inappropriate quality of images	0	0	1	0	0	0	0
Missing alternative texts	0	0	4	0	0	0	0
Broken images	0	0	10	0	0	0	0
Inappropriate choice of fonts and colours	0	0	4	0	1	0	0
Inappropriate page titles	0	0	3	0	0	0	0

6.4.2.6 Purchasing process problems

This was the only area where user testing identified a larger number of usability problems compared to the heuristic evaluators (Table 6.9). The user testing uniquely identified nine purchasing process problems while the heuristic evaluators identified only seven. A total of five problems were commonly identified by both methods. Seven of the problems identified by user testing were major while the other two were minor (see Table 6.9). The heuristic evaluators claimed that all the seven problems that were uniquely identified by them and related to the purchasing process were major.

Regarding the problems that were commonly identified by the two methods, the two methods agreed on the severity level of them. Only one of these common problems was a major problem that related to the session problem, while the other four problems were minor.

Table 6.9: Distribution of specific purchasing process problems identified by the two methods by the number of problems and severity level

Purchasing Process Problems	User Testing		Heuristic Evaluation		Common Problems		
					Agreed Severity		Not Agreed Severity
	Minor Problems	Major Problems	Minor Problems	Major Problems	Minor Problems	Major Problems	
Difficulty in knowing what was required for some fields	1	0	0	0	1	0	0
Difficulty in distinguishing between required and non-required fields	0	3	0	0	0	0	0
Difficulty in knowing what links were needed to be clicked	0	3	0	0	0	0	0
Long ordering process	0	0	0	0	1	0	0
Session problem	0	0	0	0	0	1	0
Not easy to log on to the site	0	0	0	1	0	0	0
Lack of confirmation if users deleted an item from their shopping cart	0	0	0	3	0	0	0
Long registration page	0	0	0	1	0	0	0
Compulsory registration	0	0	0	2	0	0	0
Illogical required fields	0	0	0	0	2	0	0
Expected information not displayed after adding products to cart	1	1	0	0	0	0	0

6.4.2.7 Security and privacy problems

In this area, the only problem that was uniquely identified by the heuristic evaluators was a major problem, which was identified on site 3 (Table 6.10).

Table 6.10: Distribution of specific security and privacy problems identified by the two methods by the number of problems and severity level

Security and Privacy Problems	User Testing		Heuristic Evaluation		Common Problems		
					Agreed Severity		Not Agreed Severity
	Minor Problems	Major Problems	Minor Problems	Major Problems	Minor Problems	Major Problems	
Lack of confidence in security and privacy	0	0	0	1	0	0	0

6.4.2.8 Accessibility and customer service problems

The user testing uniquely identified three major problems in this area, the heuristic evaluators uniquely identified eight minor problems, and three minor problems were commonly identified by both methods (Table 6.11). The three major problems uniquely identified by the user testing related to it being difficult to find help/customer support information; this was identified on all three sites (one problem per site).

The eight minor problems that were identified by the heuristic evaluators related to: not supporting more than one currency, the lack of a customer feedback form, it not being easy to find sites from search engines, the difficulty in finding customer support information and lack of information displayed with help/customer service section.

The common minor problems that were identified by the two methods related to: the lack of information displayed on the FAQ page of site 3 and the fact that sites 1 and 2 did not support Arabic.

Table 6.11: Distribution of specific accessibility and customer service problems identified by the two methods by the number of problems and severity level

Accessibility and Customer Service Problems	User Testing		Heuristic Evaluation		Common Problems		
					Agreed Severity		Not Agreed Severity
	Minor Problems	Major Problems	Minor Problems	Major Problems	Minor Problems	Major Problems	
Not easy to find help/customer support information	0	3	1	0	0	0	0
Not supporting more than one language	0	0	0	0	2	0	0
Not supporting more than one currency	0	0	2	0	0	0	0
Inappropriate information provided within a help section/customer service	0	0	1	0	1	0	0
Not supporting the sending of comments from customers	0	0	2	0	0	0	0
Not easy to find and access the site from search engines	0	0	2	0	0	0	0

6.4.2.9 Inconsistency problems

All the problems (22) that were identified on the three sites in this area were minor (Table 6.12). There was only one inconsistency problem that was commonly identified by the two methods (the Arabic and English interfaces on site 3 were inconsistent). Conversely, the heuristic evaluators identified a total of 21 inconsistency problems on all sites, which were explained in Chapter 5.

Table 6.12: Distribution of specific inconsistency problems identified by the two methods by the number of problems and severity level

Inconsistency Problems	User Testing		Heuristic Evaluation		Common Problems		
					Agreed Severity		Not Agreed Severity
	Minor Problems	Major Problems	Minor Problems	Major Problems	Minor Problems	Major Problems	
Inconsistent page layout or style/colours/ terminology/content	0	0	21	0	1	0	0

6.4.2.10 Missing capabilities

The user testing method did not uniquely identify any problem related to missing capabilities on the three sites. However, it identified only one minor problem which was also identified by the heuristic evaluators related to missing capabilities of the sites (Table 6.13).

There were 19 other problems that were uniquely identified by the heuristic evaluators regarding missing capabilities; all of these were minor problems and were discussed in Chapter 5.

Table 6.13: Distribution of specific missing capabilities problems identified by the two methods by the number of problems and severity level

Missing Capabilities Problems	User Testing		Heuristic Evaluation		Common Problems		
					Agreed Severity		Not Agreed Severity
	Minor Problems	Major Problems	Minor Problems	Major Problems	Minor Problems	Major Problems	
Missing functions/information	0	0	19	0	1	0	0

6.4.3 The Enhanced framework

Based on the previous results that related to the number and severity level of each specific problem area identified by the user testing and heuristic evaluation methods, a minor change to the framework was suggested. This related to Step 3. The site manager is advised to use Table 6.14 instead of Table 6.2 to decide the

most appropriate method to employ (i.e. user testing and/or the heuristic evaluation method) to identify the specific usability problem areas (resulting from Step 2). This decision will therefore be based on understanding the effectiveness of these methods in identifying specific minor and major usability problem areas, as illustrated in Table 6.14.

Table 6.14: Summary of the Specific Problem Areas and Sub-areas Identified by the User Testing and Heuristic Evaluation Methods and their Severity Level

Usability Problem Area	Usability Problem Sub-Area	User Testing		Heuristic Evaluation	
		Minor Problems	Major Problems	Minor Problems	Major Problems
Navigation Problems	Misleading links	√	√√	√√	
	Links were not obvious		√√	√√	√
	Broken links	√		√√	
	Weak navigation support		√		√√
	Orphan pages	√		√√	
Internal Search Problems	Inaccurate results		√√	√√	√√
	Limited options	√√		√√	
	Poor visibility of search position			√√	
Architecture Problems	Poor structure		√√		√√
	Illogical order of menu items			√√	
	Illogical categorisation of menu items			√√	
Content Problems	Irrelevant content	√	√	√√	√√
	Inaccurate information	√		√	√√
	Grammatical accuracy problems			√√	
	Missing information about the company			√√	
	Missing information about the products	√		√√	
Design Problems	Misleading images	√		√√	
	Inappropriate page design	√	√√	√√	√
	Unaesthetic design			√√	
	Inappropriate quality of images			√√	
	Missing alternative texts			√√	
	Broken images			√√	
	Inappropriate choice of fonts and colours	√		√√	
	Inappropriate page titles			√√	

Usability Problem Area	Usability Problem Sub-Area	User Testing		Heuristic Evaluation	
		Minor Problems	Major Problems	Minor Problems	Major Problems
Purchasing Process Problems	Difficulty in knowing what was required for some fields	√√		√	
	Difficulty in distinguishing between required and non-required fields		√√		
	Difficulty in knowing what links were needed to be clicked		√√		
	Long ordering process	√√		√√	
	Session problem		√√		√√
	Not easy to log on to the site				√√
	Lack of confirmation if users deleted an item from their shopping cart				√√
	Long registration page				√√
	Compulsory registration				√√
	Illogical required fields	√√		√√	
	Expected information not displayed after adding products to cart	√√	√√		
Security and Privacy Problems	Lack of confidence in security and privacy				√√
Accessibility and Customer Service Problems	Not easy to find help/customer support information		√√	√√	
	Not supporting more than one language	√√		√√	
	Not supporting more than one currency			√√	
	Inappropriate information provided within a help section/customer service	√		√√	
	Not supporting the sending of comments from customers			√√	
	Not easy to find and access the site from search engines			√√	
Inconsistency Problems	Inconsistent page layout or style/colours/ terminology/content	√		√√	
Missing capabilities	Missing functions/information	√		√√	

√√: **Good identification of the specific problem area**
√: **Missed identification of some of the specific problem areas**
Blank: **Could not identify the specific problem area**

It is worth mentioning that it could be worthwhile to test the usefulness of the enhanced framework by obtaining qualitative feedback from the companies for a second time regarding these changes. An examination is needed to check whether

the companies will change their answers regarding what types of problem they are interested or not interested in identifying on their site in the future and therefore what would be the best method to apply. However, this testing was not undertaken because of time limitation.

6.5 Conclusion

This chapter discussed a framework that was developed for use in the evaluation of the usability of e-commerce websites according to specific areas. The chapter illustrates the importance of the framework then this is followed by an explanation of the steps of the framework. An examination of the usefulness of the framework is presented and finally, an enhancement to the framework is explained.

Chapter Seven: Discussion

This chapter discusses the results of this research, presented in Chapters Four, Five and Six, by referring to the aims and objectives of this study (Chapter One), the literature review (Chapter Two), and the context of the research. This research has achieved its aim by developing a comprehensive framework for evaluating the usability of e-commerce websites, as presented in Chapter 6, to address a specific gap in the literature regarding the lack of such a framework in general, and specifically in developing countries. However, in the process of developing the framework and through achieving the objectives of this research, various lessons have been learned from the literature: new gaps were identified and some of these gaps have been addressed. These were categorised into four areas. These were examining the effectiveness of user testing and heuristic evaluation methods, evaluating the usefulness of *Google Analytics* in evaluating the usability of e-commerce websites, suggesting a framework for a comprehensive evaluation of e-commerce websites, and finally highlighting some issues regarding e-commerce implementation in the context of developing countries. This chapter is divided into four sections covering each of these categories. Specifically, each section includes a summarised background of the literature related to the category, then the results of this research are discussed in the light of the existing literature related to the category.

7.1 The effectiveness of user testing and heuristic evaluation methods

User testing and heuristic evaluation methods have been frequently employed to evaluate the usability of websites, including e-commerce websites (Kantner and Rosenbaum 1997; Freeman and Hyland 2003; Chen and Macredie 2005; Barnard and Wesson 2003; 2004). The effectiveness of these two methods in evaluating different types of interface was investigated by previous research, as reviewed in the literature review in Chapter Two. These studies have provided useful findings regarding which of these methods was more effective in identifying the largest number of usability problems, the largest number of major (severe) problems, the largest number of minor problems (improvements) and which of these methods incurred the least cost to employ. Furthermore, some studies provided some examples of the usability problems identified by these methods. However, previous research did not provide details with respect to specific types of problem that could be identified by each method. Despite the fact that part of this research was concerned with addressing this gap, this research presented other results that could be compared to the findings of previous studies. The results of this research highlighted the total number of usability problems that were identified by these two methods in general and the cost of employing these methods. The following sections compare the findings obtained from previous research, which compared the effectiveness of the user testing and heuristic evaluation methods, with the results of this research (presented in Chapters 4, 5 and 6). The comparison is presented under four headings: the number of usability problems, the number of minor and major usability problems, the cost of employing each method, and finally, the content of the usability problems that were identified.

7.1.1 Number of usability problems

The results of this research (as presented in Chapter 4, 5 and 6) are comparable with other research which compared the user testing and heuristic evaluation methods from the point of view that the heuristic evaluation method identified the largest number of problems compared to the user testing (Doubleday *et al*. 1997; Fu *et al*. 2002; Desurvire *et al*. 1992a, 1992b; Law and Hvannberg 2002). This agreement is not surprising due to the processes used by the user testing and heuristic evaluation methods in identifying usability problems, as mentioned by Tan *et al*. (2009). For

example, the user testing focused on identifying usability problems that users faced while performing only specific tasks while interacting with an interface, while the heuristic evaluators explored most parts of the interfaces under inspection without being limited to specific tasks, it is therefore unsurprising that heuristic evaluation identified more problems.

The consistency of the results of this research with the earlier research suggests the usefulness of employing the heuristic evaluation methods using web experts. The experts who conducted the heuristic evaluation were not usability specialists (as indicated in Chapter 3), unlike most of the earlier research which employed such specialists (Doubleday *et al*. 1997; Fu *et al*. 2002; Desurvire *et al*. 1992a, 1992b; Law and Hvannberg 2002; Molich and Dumas 2008). Therefore, the results of this research suggest employing the heuristic evaluation method using web experts if usability specialists are unavailable.

7.1.2 Number of minor and major usability problems

The results of this research revealed that heuristic evaluation was more effective than the user testing in uniquely identifying minor problems, whereas user testing was more effective than the heuristic evaluation in uniquely identifying major problems[5] (as presented in Chapter 6). This is in agreement with the results obtained by earlier research (Law and Hvannberg 2002). These results stress the value of these two evaluation methods as they are complementary; in other words, each of these methods is capable of identifying usability problems which the other method would be unlikely to identify. This issue had already been discussed in the literature and for this reason, researchers advised employing these two methods together (Law and Hvannberg 2002; Fu *et al*. 2002; Jeffries and Desurvire 1992; Desurvire *et al*. 1991, Nielsen and Mack 1994; Kantner and Rosenbaum 1997).

Earlier research also showed the percentages of usability problems that were commonly identified by user testing and heuristic evaluation methods (Law and Hvannberg 2002; Fu *et al*. 2002; Tan *et al*. 2009). However, these studies did not illustrate if these two evaluation methods were in agreement regarding the severity of the problems that were commonly identified by them. Interestingly, this research

[5] The definition of major and minor problems is given in Section 6.4.

differentiates between the usability problems commonly identified by user testing and by the heuristic evaluation method in terms of their severity (i.e. major and minor) and showed that these two methods were in agreement regarding 39 of 53 problems, as discussed in Chapter Six. This provides evidence to support the claim raised in the literature that heuristic evaluators cannot play the role of users and cannot judge the severity of usability problems in an interface for actual users.

7.1.3 Cost of employing usability evaluation methods

There was agreement among the studies which reported the cost of employing user testing and heuristic evaluation methods (in terms of the time spent). These studies reported that the user testing method incurred a higher cost compared to heuristic evaluation methods (Jeffries *et al*. 1991; Law and Hvannberg 2002; Doubleday *et al*. 1997; Molich and Dumas 2008). The results of this research regarding the time spent on employing these two methods are in agreement with the earlier research (see Table 7.1).

However, there was a large difference in the time incurred for performing these methods in this study in comparison with the time spent conducting the methods in the earlier research. This difference related to at least two facts. The first is due to the differences in the experience of the people who conducted these two evaluation methods (user testing and heuristic evaluation) in earlier research compared to this research. The heuristic evaluation and user testing in previous studies was performed by usability specialists who had experience in human computer interaction, whereas in this research no usability specialists were involved while conducting either the heuristic evaluation or the user testing. This experience might reduce the time taken to carry out these methods, and specifically regarding the time required for setting up and designing, and for collecting and analysing data. The second issue regarding the large difference in the time incurred in employing the two evaluation methods in this research compared to the previous research, related to the fact that the previous research did not use a standard categorisation to illustrate how the time was spent while conducting these methods. For example, these studies did not specifically indicate the time spent on setup and design, and on data collection and analysis. Table 7.1 summarises the time reported from earlier research together with illustration of where the time was spent. Therefore, the

unreported time (i.e. the time spent on designing and setting up the research methods) might reduce the total time that was reported by these studies.

Presumably, the time that is shown in Table 7.1 depends on the number of users and evaluators who participated in the user testing and heuristic evaluation methods. However, there is a limitation in this table which previous studies did not explicitly report: the fixed and variable cost of employing the user testing and heuristic evaluation methods. Fixed cost relates to the time spent designing and setting up the methods, regardless of the number of users or evaluators involved in the testing, while variable cost relates to the cost of conducting or collecting and analysing these methods; this depends mainly on the number of users and evaluators involved in the testing.

Table 7.1: Cost of employing usability evaluation methods

Study	Time Spent on User Testing	Time Spent on Heuristic Evaluation
Jeffries *et al*. (1999)	**199 hours** This time was spent on analysis. Six subjects participated in this study	**35 hours** This time was spent on learning the method and on becoming familiar with the interface under investigation (15 hours) and on analysis (20 hours). Four usability specialists conducted this method.
Law and Hvannberg (2002)	**200 hours** This time was spent on the design and application of this method. Ten subjects participated in this study.	**9 hours** The time was spent on the design and conduction of this method by two evaluators
Doubleday *et al*. (1997)	**125 hours** This time included 25 hours conducting 20 users' sessions, 25 hours of evaluator time supporting during users' sessions and 75 hours of statistical analysis	**33.5 hours** This time included 6.25 hours of five experts' time in the evaluation, 6.25 hours of evaluators' time taking notes and 21 hours transcription of the experts' comments and analysis
This Research	**326 hours** The time included 136 hours setup and designing, 20 hours collecting data from 20 users' sessions, and 170 hours analysing data	**247 hours** The time included 128 hours setup and designing, 15 hours collecting data from the five web experts, and 104 hours analysing data

7.1.4 Content of usability problems

This research addressed the gaps noted in the literature regarding three issues. The following three subsections discuss how these gaps were addressed by referring to the results of this research that were presented in Chapters 5 and 6. The first subsection summarises the few examples offered by previous research regarding the types of usability problem identified by the user testing and heuristic evaluation methods, and compares these results with the findings of this research. The second subsection shows how this research illustrated the value or effectiveness of both the user testing and heuristic evaluation methods used in this research with regards to their ability to identify specific usability problems on e-commerce websites. These methods used: performance data and observation, the quantitative and qualitative data obtained from satisfaction questionnaires, the qualitative data obtained from the heuristic evaluators, and the quantitative data obtained from the heuristic checklist. The third subsection shows how this research illustrated the effectiveness of the user testing and heuristic evaluation methods in identifying specific types of usability problem in terms of the number of problems identified and their level of severity.

7.1.4.1 Comparisons between the results

This research explained the effectiveness of the user testing and heuristic evaluation methods in identifying 44 specific usability problems that could be found on an e-commerce website. These problems are related to ten usability problem themes which were identified in this research, as explained in Chapter 4.

Despite the fact that the results of this research involved providing more detailed descriptions of usability problems that were uniquely identified by the user testing and heuristic evaluation methods compared to the previous research, it was found that there was an agreement between most of the results of this research and the results of the previous studies. Table 7.2 summarises examples of the usability problems that were identified uniquely by the user testing and heuristic evaluation methods, as reported in earlier research.

Table 7.2: Examples of content of usability problems that were uniquely identified by user testing and heuristic evaluation methods

	Example of Usability Problems	References
Characteristics of usability problems that were Identified by User Testing	• Related to user performance • Related to a lack of clear feedback and poor help facilities • Related to functionality and learnability problems • Related to navigation • Related to excessive use of complex terminology (technical jargon) • Related to inappropriate choice of font size • Related to the use of an inappropriate format for links • Few consistency problems	(Simeral and Branaghan 1997; Jeffries *et al*. 1991); Doubleday *et al*. 1997; Fu *et al*. 2002; Law and Hvannberg 2002; Mariage and Vanderdonckt 2000)
Characteristics of Usability Problems that were Identified by Heuristic Evaluation	• Related to interface features and interface quality • Related to the appearance or layout of an interface • Inconsistency problems with the interface • Related to slow response time of the interface to display results • Related to compatibility • Related to security and privacy issues	(Nielsen and Phillips 1993; Doubleday *et al*. 1997; Nielsen 1992; Law and Hvannberg 2002; Simeral and Branaghan 1997; Fu *et al*. 2002; Tan *et al*. 2009)

A general overview of the problems that were uniquely identified by the user testing and heuristic evaluation methods in this research revealed that user testing identified problems which influenced the performance of the users while attempting to carry out the purchasing tasks on the sites, as indicated by earlier research. Also, a general overview of the problems that were identified by the heuristic evaluators in this research revealed that this method identified problems related to improvements or interface features and quality, as indicated in the earlier research.

Furthermore, the other problems that were identified by user testing in the earlier research related specifically to: a lack of feedback and help facilities, navigation problems, the use of complex terms, inappropriate choice of font size and few consistency problems; these were also confirmed by the results of this research. Specific examples of problems identified in this research were discussed in Chapter 5 under Sections 5.1.1, 5.1.2, 5.1.3, 5.4.1, 5.4.2, 5.4.3, 5.5.2, 5.6.1, 5.6.2, 5.6.3, 5.8.1 and 5.9.1. Also, the problems that were identified by the heuristic

evaluators in the previous research, which included inconsistency, appearance, layout problems, and security and privacy issues, were confirmed by the results of this research, as discussed in Chapter 5.

It is worth mentioning, however, that some results of the earlier research, which are shown in Table 7.2, were not confirmed by the results of this research. For example, Doubleday *et al.*'s study (1997) revealed that the heuristic evaluators uniquely identified a problem related to the slow response time of an interface in displaying results. In this research, a similar problem was identified by both the user testing and heuristic evaluators; this was related to the inappropriate page design of some pages of a site. These pages displayed large number of images which affected the speed of downloading these pages. The apparent difference in the results could relate to the fact that in Doubleday *et al.*'s study the usability problems that were identified by the user testing were based only on the quantitative data obtained from various methods used in their research, including observation and performance data. In this research, however, the inappropriate page design problem, which was identified by user testing, was based on qualitative data obtained from the satisfaction questionnaire and not from the performance data. This suggests the importance of using various methods to identify different types of problem that could be identified by user testing. This issue is explained in more detail in the next subsection.

Another example of the findings of earlier research that were not in agreement with the results of this study related to three problems that were identified uniquely by user testing and missed by heuristic evaluation, as claimed by Mariage and Vanderdonckt (2000). These problems related to the inappropriate choice of font size, the use of an inappropriate format, and consistency problems. In this research, however, it was found that these problems were identified by both the user testing and heuristic evaluation methods. These problems were identified in this research because the issues were included in the heuristic guidelines that were used by the heuristic evaluators. However, in the study that was conducted by Mariage and Vanderdonckt, these elements were not included in the heuristics used by the evaluators. This might explain why such problems were missed by the heuristic evaluators in Mariage and Vanderdonckt's study. This suggests that the heuristic

evaluation method depends on the heuristic guidelines that are used by the evaluators. This issue was already mentioned in the literature (Sharp *et al.*, 2007).

7.1.4.2 The usefulness of usability evaluation methods in identifying problems

This research conducted a comparison of five usability evaluation methods that were used in this study with regards to their ability to identify usability problems relating to ten main problem areas and their corresponding specific areas, as discussed in Chapter 5. These five methods included three user testing methods: use of performance data and observation, quantitative data from the satisfaction questionnaire, and qualitative data from the satisfaction questionnaire; two heuristic evaluation methods, using qualitative data from the heuristic evaluators and the quantitative data of the heuristic checklist, were also utilised. The aim was to obtain a picture regarding the overall effectiveness of the user testing and heuristic evaluation methods in identifying specific usability problems, and to uncover the contribution or the value of each method in the identification of specific usability problems.

The results of the comparison revealed two main issues. The first related to highlighting the usefulness of each method in identifying specific usability problems on an e-commerce website. This provided methodological implications regarding each method. The second issue related to illustrating what kind of problems each method was capable (or not capable) of identifying. These two issues are beneficial to future research which aims to identify specific usability problems. For example, this research suggests that user testing was uniquely effective in identifying problems regarding misleading links. To obtain similar results, it should be explained which specific usability method helped to identify such a problem, which was the performance data and observation in this research.

It is worth mentioning that, despite the fact that each usability evaluation method involved in this research has its benefits regarding uniquely identifying types of usability problem, these methods produced consistent results regarding the overall description of the usability of the sites in terms of which site had better usability.

The following sections summarise the usefulness of the five usability evaluation methods used in this research and their role in identifying specific types of usability problem.

The performance and observation data

The findings of this research stressed the usefulness of the performance data and observation in identifying specific usability problems on an e-commerce website. This is in agreement with the indications provided by earlier research (Benbunan-Fish 2001). This research, however, showed the specific types of problem that were identified and uniquely identified using this method. The areas where this method failed to identify any problem were also explained. Table 7.3 summarises the sixteen specific usability problems, which related to seven problems areas, that were identified by this method. This method, however, could not identify problems related to three areas: security and privacy, inconsistency and missing capabilities.

Table 7.3: Usability problems that were identified by the performance data and observations method

Usability Problem Areas	Corresponding Specific Usability Problems
Navigation	Misleading links; links were not obvious; weak navigation support
Content	Irrelevant content
Design	Misleading images; inappropriate page design
Architecture	Poor structure
Internal Search	Inaccurate results
Purchasing Process	Difficulty in knowing what was required for some fields; difficulty in distinguishing between required and non required fields; difficulty in knowing what links were needed to be clicked; session problem; required fields were not logical; expected information was not displayed after adding products to cart
Accessibility and Customer Service	Not easy to find help/customer support information; Inappropriate information provided within a help section/customer service

The quantitative data from the satisfaction questionnaires

The findings of this research regarding the quantitative data from the satisfaction questionnaires revealed two issues. The first related to the fact that there were apparent differences between the results obtained using this method and the results

of the two other user testing methods (the performance data and observation and the qualitative data of the satisfaction questionnaire) regarding the identification of specific usability problems on the sites. For example, despite the fact that one of the three sites (site 2) had usability problems, and the users reported explicitly the specific problems on this site through their answers to the open-ended questions in the satisfaction questionnaire, the users did not rate the corresponding statements for this site negatively when identifying specific usability problems on this site.

Also, while the performance data and observation showed that most users performed one tasks (Task 3) more successfully on one site (site 3) than on the other sites (sites 1 and 2) and the same number of users successfully performed another task in all three sites (Task 5), site 3 was the only site that rated negatively for the corresponding statements that were related to these two tasks.

These findings suggest that the quantitative data from the satisfaction questionnaire reflected the users' overall satisfaction with a site without taking into consideration the identification of specific problems. Therefore, this method was not effective or useful in pointing out specific types of usability problem on an e-commerce website. In fact, these findings are not surprising when compared to the literature. Research has found that users' satisfaction with a site cannot be used to investigate the usability of the site (Spool *et al*. 1999). This is related to the fact that users tend to be polite and give a high rating to a site even if the site if unusable (Nielsen 1998). For example, in a study which investigated the usability of nine commercial websites, it was found that the while the users were successful in one site, this site was one of the sites that ranked the least in terms of users preference (Spool *et al*. 1999). Conversely, the site which users preferred the most was only ranked fifth in terms of user success.

The second issue that was revealed by the quantitative data from the satisfaction questionnaire related to the inability of this method to identify specific usability problems relating to the inaccuracy of the internal search facility of a site, and security and privacy problems.

Qualitative data from the satisfaction questionnaire

The findings of this research suggest the usefulness of using open-ended questions in the satisfaction questionnaire to identify additional and specific usability

problems on an e-commerce website, problems which could not be identified using the performance data and observation. This is in agreement with the findings of a previous study which also included open-ended questions in the satisfaction questionnaire and found that this method provided greater depth of usability problems on the tested site (William *et al*. 2004).

Furthermore, this research illustrated the types of specific usability problem that users could identify using this method after their interaction with an e-commerce website. Table 7.4 summarises the ten specific usability problems which were identified by this method; these were related to eight main problems areas and were not identified by the performance data and observation.

Table 7.4: Usability problems that were identified by the qualitative data of the post-test questionnaires method

Usability Problem Areas	Corresponding Specific Usability Problems
Navigation	Broken links; orphan pages
Content	Inaccurate information; missing information about the products
Design	Inappropriate choice of fonts and colours
Internal Search	Limited options
Purchasing Process	Long ordering process
Accessibility and Customer Service	Not supporting more than one language
Inconsistency	Inconsistent design/layout/content
Missing Capabilities	Missing information/functions

Qualitative data from the heuristic evaluation

The findings of this research were in agreement with earlier research regarding the usefulness of the qualitative comments obtained from the heuristic evaluators in identifying specific usability problems while inspecting an e-commerce website.

This research also illustrated the effectiveness of this method in identifying specific types of usability problem that could be found on an e-commerce website, as mentioned in Chapter 5. Table 7.5 summarises a total of eighteen specific new problems that were uniquely identified by this method and that were not identified using the user testing methods. This method, however, failed to identify some

specific problems which related to four areas: navigation, design, the purchasing process, and accessibility and customer support.

Table 7.5: Usability problems that were identified by the qualitative data of the heuristic evaluation method

Usability Problem Areas	Corresponding Specific Usability Problems
Content	Grammatical accuracy problems; missing information about the company
Design	Inappropriate quality of images; missing alternative text; broken images; inappropriate page titles; unaesthetic design
Architecture	Illogical order of menu items; illogical categorisation of menu items
Internal Search	Poor visibility of search position
Purchasing Process	Not easy to log on to the site; lack of confirmation if users deleted an item from their shopping cart; long registration page; compulsory registration
Security and Privacy	Lack of confidence in security and privacy
Accessibility and Customer Service	Not easy to find and access the site from search engines; not supporting more than one currency; not supporting the sending of comments from customers

The results from this method also showed that the problems that were identified by the heuristic evaluators were comprehensive and detailed; the evaluators, unlike with the user testing method, provided suggestions regarding how some problems might be solved. This research also discussed three possible reasons behind the results that were obtained from the heuristic evaluators. The first reason related to the fact that the evaluators used comprehensive heuristic guidelines that were designed specifically in this research to evaluate e-commerce websites. The second related to the experience of the heuristic evaluators compared to that of the users who participated in this research as the evaluators were web experts while most of the users had never previously attempted to purchase from an e-commerce website. The third related to the fact that the heuristic evaluators examined the websites extensively and therefore explored more pages compared to users; also, they were not asked to perform specific tasks on the sites as was the case with the users. These results, and the logical justifications that were offered regarding the reasons behind these findings, has already been mentioned in the earlier research (Tan *et al*. 2009).

Quantitative data from the heuristic evaluation

The findings of this research showed that there was a consistency between the specific usability problems that were identified qualitatively by the heuristic evaluators and the ratings of the evaluators to the corresponding statements in the heuristic checklist. This method confirmed the existence or the non-existence of specific usability problems which were identified clearly and in detail by the heuristic evaluators.

In fact, the heuristic checklist, which included statements that were derived from the heuristic subcategories as mentioned in Chapter 3, was used to identify additional usability problems that might have been missed by the evaluators when examining or inspecting an e-commerce website.

The results, therefore, suggest that the heuristic evaluators did not miss any subcategory of the heuristic guidelines. This also suggests that this method is not useful for identifying additional or new specific usability problems if the heuristic evaluators are asked to provide qualitative comments regarding usability problems.

7.1.4.3 Types and severity levels of usability problems

The literature showed that there were few initiatives that described types of usability problem identified by the user testing and heuristic evaluation methods which also considered their number and severity level. The work of Tan *et al*. (2009) is an example of such initiative. Tan *et al*.'s study reported the number of problems that were identified by the two evaluation methods with regards to their severity level and type. Seven types or categories of problems were identified. However, Tan *et al*.'s study did not mention specific examples of possible usability problems related to each of the seven categories to illustrate the effectiveness of the two usability evaluation methods in identifying specific usability problems in terms of their severity level.

This research performed a further step after illustrating the effectiveness of the user testing and heuristic evaluation methods in identifying 44 specific usability problems related to the ten problem areas that were identified in this research. The step involves illustrating the number and severity level of those 44 specific usability problems which were uniquely identified by either user testing or heuristic

evaluation, those that were commonly identified by both methods, or those that were missed by each method.

The results, as discussed in Chapter 6, showed that most of the problems that were uniquely identified by user testing were major ones which prevented real users from interacting with and purchasing products from e-commerce sites. This method identified major problems related to four specific areas and minor problems related to one area. Conversely, most of the problems that were identified uniquely by the heuristic evaluators were minor; these could be used to improve different aspects of an e-commerce site. This method identified minor problems in eight areas and major problems in four.

7.2 Evaluating e-commerce websites using Google Analytics

The literature review showed how earlier research has successfully used web analytics tools which measure web usage to understand users' experience with the sites and to improve various aspects of website design. However, despite the fact that these tools are useful to improve a website, they incur a cost which may not be affordable to companies. Therefore, the appearance of the *Google Analytics* tool had a major impact on the web analytics industry, as stated by Kaushik (2007), because of its useful features and the fact that it is a free tool.

It is worth mentioning, however, a primary issue that was raised by Burby (2005) regarding *Google Analytics* and many other web analytics tools. He stated that despite the fact that these web analytics providers offer good services, they do not suggest to companies which data or metrics generated by the analytics tools are important so that companies can take action based on this information. They also do not suggest what types of action a company should take based on the data of the web analytics. To put it in another way, despite the fact that there is a large number of metrics and advanced metrics in web analytics reports or which can be calculated using the raw data of the analytics, there is no specific matrix of web metrics that are suggested or recommended by either analytics providers or research to be used with analytics software, such a *Google Analytics*, to describe the usability of an e-commerce website.

This research is similar to the small number of studies which recognised the importance of *Google Analytics* software (reviewed in Chapter 3). However, this

research addressed the issues that were raised in the literature by suggesting specific web metrics, to be calculated using *Google Analytics* software, that are useful for quickly indicating general usability problem areas and specific pages in an e-commerce site that have such problems. This research also indicated the limitations of employing the metrics in the evaluation of usability of e-commerce websites.

The suggested web metrics were based on several steps that were performed in this research and mentioned in the previous chapters (Chapters 4 and 5). To summarise these steps, a matrix of 41 advanced web metrics was devised. This was followed by an examination of the potential usability problem indications that were offered by the web metrics. These usability indications were compared with the findings (usability problems) obtained from the employment of the two usability evaluation methods: i.e. the user testing and heuristic evaluation. Based on the findings, some metrics were disregarded as they were not useful in indicating usability problems in the context of *Google Analytics*. Other metrics, which, either individually or in combination, could identify potential usability problems in six potential usability problem areas on e-commerce sites, were determined. The matrix suggested by this research also included specific metrics that could provide information regarding the financial performance of the site in terms of its ability to generate revenue, as well as other metrics that could describe visitors of a site (i.e. the geographical location of visitors). The suggested web metrics can be used to provide a continual overview of a site's usability and are an important tool for indicating when potential problems may occur. However, the research found that the web metrics could not provide in-depth detail about specific problems that might be present on a page.

In order to gain the advantages of using *Google Analytics* with the suggested web metrics and also to overcome the limitations of these metrics, this research suggested the use of other usability methods to identify specific usability problems on specific areas and pages on the website indicated by the web metrics.

7.3 Suggesting a framework to evaluate e-commerce websites

The literature review showed that previous studies have already recognised the importance of evaluating the usability of e-commerce websites, and these studies have already used the two most common usability evaluation methods (user testing

and heuristic evaluation) in the evaluation of such sites. Furthermore, a framework or a set of usability guidelines was suggested by these studies based on their results; the studies recommended these for use in designing or evaluating the usability of e-commerce websites.

However, these studies did not explain the advantages and disadvantages of the user testing and heuristic evaluation methods in terms of the specific types of usability problem they could or could not identify in an e-commerce website. Also, these studies did not use web analytics tools together with the common usability evaluation methods to evaluate the usability of such sites. Therefore, no practical results were found in the literature regarding the advantages that could be obtained by using these tools together with the common usability evaluation methods in the evaluation of the usability of the sites.

This research, however, developed a framework to evaluate the usability of e-commerce websites which involved the user testing and heuristic evaluation methods together with *Google Analytics* software. The framework was developed based on conducting a thorough examination of the advantages and disadvantages of these three methods in terms of the specific areas of usability problems that they could or could not identify on an e-commerce website. The advantages and disadvantages of these methods were summarised in the previous sections.

Chapter 6 discussed the framework, which utilised the advantage of *Google Analytics* software (using the specific web metrics that were suggested in this research), together with its importance. This is related to reducing the cost of employing the user testing and/or heuristic evaluation methods by highlighting the areas on an e-commerce site that appear to have usability problems. Then, and because of the disadvantages of the use of these web metrics, the framework complements the disadvantages of the metrics by suggesting the use of user testing and/or heuristic evaluation to provide details regarding the specific usability problem areas on a site. The decision regarding whether to use user testing and/or heuristic evaluation to identify specific problems on the site depends on understanding the advantages and disadvantages of these methods in terms of their ability to identify specific minor and major problems related to the 44 specific usability problems areas identified in this research. Therefore, the suggested framework enables specific usability problems to be identified quickly and cheaply

by fully understanding the advantages and disadvantages of the three usability evaluation methods.

It is worth mentioning that the idea of the suggested framework, which involves illustrating and utilising the advantages and disadvantages of the three usability evaluation methods to obtain effective evaluation of the usability of e-commerce websites, could have a particular value to the field of e-commerce website usability evaluation. However, the fact that this framework, which was developed based on the results of this research, was conducted in a developing country (i.e. Jordan), could limit the value or importance of this framework. For example, users and/or heuristic evaluators in other more developed countries could identify different types of problem based on their greater experience.

Therefore, the suggested framework has a particular value if applied to Jordan, while the results of testing this framework have proved its usefulness, as discussed in Chapter 6. In fact, by referring to the aims and context of this research, developing the framework and presenting it for use in Jordan, as a developing country, was an attempt to confront the challenging environment of e-commerce in this country. Presenting this framework to e-commerce companies in Jordan revealed that the attempt was successful and useful. The results showed that the suggested framework raised awareness of usability and usability evaluation methods among e-commerce companies in Jordan. This framework will aid e-commerce companies in taking appropriate decisions regarding which usability method to apply and how to apply it in order to improve part or the overall usability of their e-commerce website. Improving the usability of e-commerce websites will help to obtain the advantages of e-commence in this challenging environment.

It is worth noting, however, that the literature included at least two studies (Singh and Kotze 2002; Barnard and Wesson 2003; 2004) which have already proposed specific guidelines or approaches to design and evaluate e-commerce websites in less developed countries (South Africa) with the aim of facing the challenging environment of e-commerce in that country. Also, the guidelines or approaches that were proposed by these studies were based on the results of employing usability evaluation methods: user testing and questionnaires (Singh and Kotze 2002) and user testing and heuristic evaluation (Barnard and Wesson 2003;

2004). These methods were used in order to investigate the interaction of South African users with the e-commerce websites.

However, the nature of the proposed guidelines or approaches that were the results of these studies are different from the framework which was developed in this research. The approach which was suggested by Singh and Kotze (2002) focused on understanding external environmental factors involving customers and the suppliers of the company as a pre-requisite to designing any usable e-commerce website; they did not recognise guidelines for designing usable e-commerce websites. The study conducted by Barnard and Wesson (2003; 2004) addressed the design guidelines, in this case, that should be taken into consideration when designing any e-commerce website in South Africa. However, the design guidelines, in this case, were based only on the common usability problems that were identified by user testing and heuristic evaluation. Problems that were missed or uniquely identified by those methods were not taken into consideration. Furthermore, only post-test questionnaires were used in the identification of the usability problems that were generated by the user testing. Also, the guidelines that were used by the heuristic evaluators to identify usability problems only included design guidelines that were related to the usability of e-commerce transactions; they paid less attention to general usability guidelines.

7.4 E-commerce in the context of developing countries

The fact that this research was conducted in a developing country (Jordan) revealed some challenges that could affect the development and diffusion of e-commerce in developing countries. Most these challenges were common challenges that developing countries are facing while adopting e-commerce. These challenges have already been mentioned in the literature that is specific to Jordan and in the literature related to developing countries in general. The challenges that were raised in this research could be categorised into three categories:

- Technological infrastructure barrier. This is related to the high cost of connecting to the Internet, as shown by the participants' perception of online shopping. This barrier was already mentioned in the literature and was considered one of the major factors that constrained the development of e-commerce in various developing countries such as Jordan, Brazil, Costa

Rica and Nepal (Sahawneh *et al*. 2003; Obeidat 2001; Tigre 2003; Travica 2002; Kshetri 2007).

- Delivery system barrier. This is related to the high cost of delivery, as reported by users regarding their experience of online shopping.
- Social and cultural barriers: four barriers were identified related to this category. The first related to the customers' preference to touch and see the product before purchasing. The second barrier related to the customers' preference to shop from well-known sellers with a good reputation. The third barrier related to the customers' preference to use sites written in their first language (Arabic) rather than English. The fourth barrier related to a lack of trust as the customers indicated that they were worried about the security and privacy of their information when shopping online. These barriers were identified from users' answers to the pre-test questionnaires and the open-ended questions in both the satisfaction questionnaire and the post-evaluation questionnaire. These barriers were also already mentioned in the literature. For example, in Egypt, customers prefer to touch and see the product before purchasing, as noted by Elbeltagi (2007). In Costa Rica, customers prefer to shop from known sellers to reduce the ambiguity of a product's characteristics, as stated by Travica (2002). Also, in Egypt and Nepal, the English interface for websites, instead of using the local language, was considered to be a barrier in these countries (Elbeltagi 2007; Kshetri 2007). Finally, lack of trust was also considered to be one of the barriers in developing countries (Kurnia 2006; Sahawneh *et al*. 2003).

7.5 Conclusion

This chapter discussed the results obtained from this research in the light of the literature review and illustrated how the aims and objectives of this research have been addressed.

Four areas were identified and addressed: the advantages and disadvantages of the user testing and heuristic evaluation methods, the advantages of *Google Analytics* tools, an evaluation framework and barriers to the diffusion of e-commerce in a developing country.

Chapter Eight: Conclusions

This chapter discusses the conclusions that have been drawn from conducting this research. First of all, the chapter illustrates how the aims and objectives of this research have been achieved. The chapter then presents the limitations of this research and finally, it offers recommendations for future work.

8.1 Achieving the objectives

The aim of this research was to develop a methodological framework which would comprehensively and effectively investigate usability problem areas of e-commerce websites in Jordan. The development this framework was an attempt to raise awareness of usability and usability evaluation methods in this developing country in order to gain the benefits of e-commerce. This aim was achieved by meeting the four specific objectives of this research. This section summarises how the objectives of this research have been achieved.

8.1.1 Objective One: To use three different approaches to evaluate a selection of e-commerce websites from three different perspectives: evaluators, users and software tools

This objective was met by selecting appropriate methods, selecting three e-commerce companies, designing the research tools, and collecting data using the methods. First of all, the literature was investigated to find out what would be the most appropriate approaches that could be used to obtain a comprehensive

evaluation of the usability of e-commerce websites from the three desired perspectives (experts, users and software tools). Chapter 3 explains the reasons behind the selection of each of the methods, together with their advantages and disadvantages. An investigation of Jordanian companies which had e-commerce websites was the next step in order to involve three companies in this research and to apply the research methods there. Chapter 3 summarises the procedure that was undertaken regarding this step.

In order to evaluate the usability of the selected three e-commerce sites, the research tools were designed and the evaluators (web experts) and the users were recruited to take part in the evaluation. The specific script that was required to be installed on the sites was also prepared. Chapter 3 explains the heuristic guidelines that were developed to evaluate the usability of the e-commerce websites and the user testing materials that were created to conduct the user testing. The procedure that was undertaken to recruit the experts and appropriate users is also explained in Chapter 3.

The data were then collected using the three methods. The evaluators, using the developed guidelines, examined the three sites and checked the sites' conformance with the usability principles (heuristic guidelines). The users used the websites and tried to purchase from them; in this way, the users' actual interactions with the sites were determined. Finally, *Google Analytics*' script was installed successfully on the three sites and the visitors' interactions with the sites for three months were tracked. Therefore, the first objective of this research was met and the usability of the sites was evaluated from the three intended perspectives.

8.1.2 Objective Two: To identify the main usability problem areas and opportunities for improving the performance of the selected sites

This objective was a follow up to the previous one (Objective 1); the data collected through the usability methods were analysed. Each usability method employed on each e-commerce website was analysed separately and therefore, the main areas of usability problem, obtained from each method on each site, were identified. Chapter 3 summarises how the usability evaluation methods were analysed and Chapters 4 and 5 summarises the usability problem areas identified on the sites. Opportunities or recommendations regarding how to improve the usability problems on the

websites were suggested. These suggestions were based mainly on the heuristic evaluators' comments, which included details regarding how to fix the usability problems. The users' comments while interacting with the sites, and the observation also helped in suggesting the recommendations. These recommendations were gathered in the form of detailed reports (as shown in the Appendix 41) and were sent to the companies involved in this research. These reports helped to obtain feedback from the companies regarding the usefulness of the usability evaluation and the usability evaluation methods, as presented in Chapter 6. Objective Two was therefore met.

8.1.3 Objective Three: To determine which methods were the best in evaluating each usability problem area

To achieve this objective and follow up Objective Two, which resulted in the identification of usability problem areas on the sites, two steps of comparisons were undertaken. The first comparison aimed to generate a list of the common usability problem areas identified by each method. This was obtained by comparing the usability problems across the sites obtained from each method. Six methods were involved in the comparison: three user testing methods (the performance data and observation, the quantitative data from the satisfaction questionnaire and the qualitative data from the satisfaction questionnaire); two heuristic evaluation methods (the qualitative data from the heuristic evaluation and the quantitative data from the heuristic checklist); and the specific metrics which were suggested in this research calculated using the *Google Analytics* software. The results from this comparison were used as input to the second step of comparison. The common usability problems identified by each method were compared and resulted in the generation of a list of standardised usability problem themes and sub-themes to facilitate comparison among the various methods. This comparison resulted in identifying ten themes and 44 sub-themes; these are discussed in Chapter 4. The comparison of the methods revealed, with regard to the main themes and sub-themes, which methods were the best in evaluating each usability problem area, as illustrated in Chapter 5. A further analysis was undertaken which explained the number and severity level of each specific problem relating to the 44 sub-themes that were identified by the methods. The findings showed which methods were the

best in identifying major and minor specific usability problem areas related to the ten main problem themes and their 44 sub-themes, as presented in Chapter 6.

The results from the methodological comparison, with regard to the ten identified problem themes and their corresponding 44 sub-themes, suggests that specific web metrics, calculated using *Google Analytics* software, can provide quick, easy and cheap indications of potential usability problem areas on e-commerce sites in seven out of the ten identified problem themes. These indications could either provide an idea regarding the overall usability of the site in these potential areas or identify specific pages on the site that might have usability problems. The results, however, showed that the metrics could not identify problems related to three areas of the identified problem themes relating to lack of security and privacy, inconsistent design, and a lack of capabilities. The results also showed that the metrics could not identify most of the specific problems related to the 44 specific usability problem sub-themes.

By contrast, the results from the methodological comparison showed that the user testing and heuristic evaluation methods identified specific problems relating to the 44 specific usability problem sub-themes. Two user testing methods (performance data and observation, and the qualitative data from the satisfaction questionnaire) complemented each other in identifying specific usability problems on an e-commerce website relating to 26 out of the 44 problem sub-themes. These two user testing methods together were the best in identifying nineteen major problems related to four areas: navigation, design, the purchasing process, and accessibility and customer service. However, these methods were not able to identify specific minor usability problems related to eight problem areas. The results also showed that the quantitative data from the satisfaction questionnaire method was not effective in evaluating usability problem areas. The small number of problems identified by the user testing methods gives these methods a value because of the low cost that is required to rectify these problems by making a few changes to the design of the sites. However, the results of this research stressed the drawback of the user testing methods with regard to the high cost in terms of the time spent on conducting these methods.

The results from the methodological comparison showed that the qualitative data from the heuristic evaluators was useful in pointing out specific usability

problems, while the quantitative data from the heuristic checklist was not useful in identifying specific usability problems. The results of this research showed that the qualitative data from the heuristic evaluators was the best in identifying a large number of specific minor usability problems (159) related to eight areas including: navigation, internal search, the site architecture, the content, the design, accessibility and customer service, inconsistency and missing capabilities. The results also showed that the heuristic evaluators uniquely identified major security and privacy problems. However, the results emphasised that the heuristic evaluators could not play the role of real users and could not predict actual problems users might face while interacting with the sites. They did not identify major problems related to four specific problem areas. Furthermore, the results show that, despite the fact that the heuristic evaluation method required a long time to be spent in recruiting appropriate web experts, with relevant knowledge and experience, to create heuristic guidelines and to collect and analyse the data, it was less than the time spent conducting the user testing method. However, the inability of heuristic evaluators to predict accurately the severity of problems might lead to high cost in redesigning a site, if this method was used to identity severe problems that needed rectifying. The results above reveal, therefore, that the third objective of this study has been met.

8.1.4 Objective Four: To create a framework to identify how to evaluate e-commerce sites in relation to specific areas

Based on achieving Objective Three of this study, which related to uncovering which methods were the best in evaluating each usability problem area, a framework was developed so that the main aim of this study was achieved. The framework was aimed at the managers of e-commerce companies in Jordan who are willing to evaluate and improve the design of their e-commerce websites in order to reap the advantages of e-commerce while operating in a developing county. The framework, which explicitly clarifies the effectiveness of three usability methods, was aimed to encourage e-commerce companies in Jordan to address usability in the design of their websites by employing one or all of these methods. The framework involved three issues intended to raise awareness of usability and usability evaluation methods: an initial picture of the overall usability of a site and the pages on the site that had potential usability problems, a clear picture of the effectiveness

of two complementary usability evaluation methods (user testing and heuristic evaluation methods) in terms of finding specific usability problems on the site's pages, and a continual overview of the site's usability and its financial performance. The usefulness of the framework was tested by obtaining qualitative feedback from the three companies which were involved in this research, as presented in Chapter 6. The results of testing the framework were positive which therefore indicated that the intended purpose of the framework was achieved. A further enhancement to the framework has also been suggested. This involves explaining the severity level (minor or major) of the specific usability problem areas identified by the user testing and heuristic evaluation methods. However, the usefulness of the framework, after being enhanced, was not tested because of time limitations.

8.2 Limitations of this study

While conducting this research, a number of limitations were found which could influence the findings obtained. These are as follows:

- The use of convenience sampling for selecting the three e-commerce websites could have influenced the results. These websites were selected on the basis of their availability and not on the basis of having the largest number of usability problems. This could have influenced the types of problems covered in the suggested framework and may not be representative of all e-commerce websites.
- The time period for tracking the usage of the sites using *Google Analytics* software, which was three months, was short when compared to one year used by others.
- The suggested framework, before or after the enhancement, was not tested by collecting data from e-commerce websites. Therefore, an assessment of whether the framework would reduce the time/cost of the employing the usability methods was not undertaken. Also, an assessment of whether the three methods involved would identify the same problems identified in this research was not undertaken.

8.3 Recommendations for future work

In order to address the limitations that were identified in this research a number of recommendations are suggested for future work.

- Further research should be undertaken, with regard to the usability problems identified in this research, to investigate the relationship between the sample size of the users and evaluators, and the number of problems identified by them.
- Research should be undertaken to test the framework that was suggested in this research. Specifically:
    - First, to measure whether interpreting the specific metrics, calculated by *Google Analytics*, would require approximately 120 hours.
    - Then, to consider the areas on an e-commerce website that appear to have usability problems, as indicated by these specific web metrics, while both designing the user tasks in the user testing and inspecting the sites by the evaluators.
    - This could be followed by investigating whether the user testing and the heuristic evaluation methods would identify the same type of problems identified in the framework.
    - Finally, to investigate the relationship between the number of users and evaluators, and the number of usability problems identified by them. The results could then be compared to the results mentioned in the first recommendation to test whether the use of *Google Analytics* would reduce the number of users and/or evaluators required to employ the user testing and heuristic evaluation methods while identifying the same number of usability problems on the sites.
- Research should be undertaken after the three companies involved in this research have changed the design of their websites based on the recommendations offered by this research. The research would involve a comparison between the matrix of the specific web metrics before and after the redesign of the sites. This comparison could investigate the impact of the usability improvements of the sites in terms of the sites' traffic and their financial performance.

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List of Publications

Layla Hasan, Anne Morris & Steve G. Probets. Using Google Analytics to Evaluate the Usability of E-Commerce Sites. HCI International 2009 Conference, San Diego, CA, USA, July 19-24, 2009, Proceedings. Lecture Notes in Computer Science 5619 Springer 2009, p. 697-706.

Layla Hasan, Anne Morris & Steve G. Probets. A Comparison of Usability Evaluation Methods for Evaluating E-commerce Web Sites. *Behaviour & Information Technology Journal*, (under review).

Appendix 1: Letter sent to e-commerce companies

Dear Mr/ Ms,

My name is Layla Hasan and I am a PhD research student in the Department of Information Science at Loughborough University in the UK. The aim of my PhD research is investigate the usability of e-commerce websites in Jordan. As one of the major clothing site in Jordan, I would like to offer you the opportunity of being included in my study which will involve acquiring statistical usage data of e-commerce sites using web analytics software from Google Analytics. This procedure will simply require either myself or your web master adding a small item of Javascript code, provided by Google Analytics, to each page of the site being studied. The intention is examine traffic flows, identify usability problems areas and offer advice on how to improve sites.

If you agree to take part then all data collected would be made freely available to you which you could then use to good effect for market research purposes with the potential for increasing the profitability of your site. Further, I would undertake to keep all data confidential to yourselves; be assured that any data referenced in my thesis would be kept anonymous.

This research is a great opportunity for your company to obtain very useful data for free so I do hope that you will accept this offer. I look forward to reply via email.

If you require more information please contact either myself or my supervisors. Thank you.

Yours sincerely,

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Appendix 2: Testing script

Testing Script

Thank you very much for participating in this study. Let us explain why we have asked you to come in today.

We are here to test the usability of three different Jordanian e-commerce websites to identify features that could be improved, and we would like your help. What you do in this study will be kept completely anonymous. Your participation in this study is voluntary, you may choose to skip any of the questions in this study or quit the entire session at any time.

This entire session may take up to four hours. You will be performing some typical tasks on three websites spending about one hour for each website. We have scheduled breaks for you after testing each website, but you may take a break at any other time if you wish. Before you begin testing each website, we would like you to explore the website you are going to test independently for up to ten minutes. During this exploration feel free to explore any pages that are of interest to you. If you complete your independent exploration before the ten minutes are up, please let us know so that you can proceed to performing the tasks.

We would like you to perform these tasks at a pace that is normal and comfortable for you. If any task takes you longer than the specified time that we determine, we may ask you to move on to the next task. However this is valuable information for us and you should not feel that you are being tested.

The tasks will require your registration as a new customer; which requires entering your personal information. The companies have assured us that they will not use your personal information and that they will remove this personal information from their server after the session. Also, the tasks will require you to purchase different items in which you may select Credit Card as a method of payment, however, you will not be required to enter your personal Credit Card details; you can use fictional financial details and you will stop when you reach the confirmation page, so you will not have to purchase any items and it will not cost you money.

If you feel you are unable to complete a task and would like to stop, please say and you can move on to the next task.

You may ask questions at any time, or you may encounter problems or difficulties. In same circumstances, we may choose not to answer you or give you any help, because we are interested in how you would perform the different tasks on your own, those are exactly the difficulties with the websites that any user might face and we are trying to identify and improve.

After testing each website, we will ask you to fill out a post-test questionnaire, and then at the end of testing the three websites, we will ask you to fill out a post-evaluation questionnaire. It is important that you answer truthfully based on your experience of using these websites in this session.

During this session, we will be observing you and taking notes and we will be recording your screen throughout the session. This recording will only be used to ensure that we have accurately understood what went on during the session.

Do you have any questions?

If no, then please begin by signing the consent form and filling out the pre-test questionnaire.

Appendix 3: Consent form

Consent Form

The purpose of this study is to evaluate the usability of three websites. The procedure involves using the three websites to work through specific tasks. The tasks will require my registration as a new customer which requires entering my personal information. The companies have agreed not to use my personal information and have indicated they will remove my personal information from their server after the session. Also, the tasks will require me to purchase different items, but I understand that if I select Credit Card as a method of payment then I will not be required to enter my personal Credit Card details; I can use fictional financial details and I will stop when I reach the confirmation page, so I will not have to purchase any items and it will not cost me money. I understand that I will be asked to fill out questionnaires. All information collected in this study is confidential, and my participation will be anonymous. I understand that I will be observed and that my screen will be recorded throughout the session.

I also understand that I am free to withdraw from participation at any time.

Participant Signature _____

Date _____

Appendix 4: Pre test questionnaire

Please answer the following questions. They will help us understand your background and experience.

Section One: Background and Experience

Personal Information

1 **Age**

- ☐ 18-29
- ☐ 30-39
- ☐ 40-49
- ☐ Over 50

2 **Gender**

- ☐ Male
- ☐ Female

3 **Education**

- ☐ Postgraduate Degree
- ☐ Higher Diploma
- ☐ Bachelors Degree
- ☐ Diploma
- ☐ Tawjehi or lower

Computer Experience

4 **How long have you been using a personal computer?**

- ☐ Under 1 year
- ☐ 1-3 years
- ☐ More than 3 years

5 **How often do you use a personal computer to complete tasks related to your work in a day?**

- ☐ Less than 2 hours
- ☐ 2-4 hours
- ☐ More than 4 hours

Internet Experience

6 **Which browser do you use normally?**

- ☐ Internet Explorer
- ☐ Netscape Navigator
- ☐ Other _____

7 **How long have you been using the Internet?**

- ☐ Less than 1 year
- ☐ 1-3 years
- ☐ More than 3 years

8 **How often do you use the Internet each week?**

- ☐ Less than 2 hours
- ☐ 2-4 hours
- ☐ More than 4 hours

9 **Have you browsed the following websites before?**

www.website1.com	Yes	☐	No	☐
www.website2.com	Yes	☐	No	☐
www.website3.com	Yes	☐	No	☐

10 **Do you use the Internet for purchasing products?**

- ☐ Yes
- ☐ No

If No please go to Q36

Section Two: Online Shopping Experience

11 **How frequently do you use the Internet for purchasing products?**

- ☐ Weekly
- ☐ Monthly
- ☐ Yearly

12 **When was the first time you bought a product from the Internet?**

- ☐ Less than a year ago
- ☐ One or two years ago
- ☐ Over two years ago

13 **What was your last purchase online?**

14 **Which site did you use to make this purchase?**

15 **Which method of payment did you use to pay for it**?

- ☐ Credit Card
- ☐ Cash on Delivery
- ☐ Cheque by Post
- ☐ Bank Transfer
- ☐ Other _____

From your shopping experience, please rate how you feel about shopping online.

How much do you agree or disagree with the following statements:

			7	6	5	4	3	2	1	
16	I shop online because it saves time	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**
17	I prefer to shop online from well known websites with a good reputation	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**
18	I do not find the website's search function useful when shopping online	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**
19	Generally I find it cheaper to shop online than to go to shops	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**
20	In general a detailed description of the product is not important to me	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**
21	I shop online because I can buy products at lower prices	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**
22	I prefer to research products in detail before purchasing	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**
23	I shop online because I can buy products at any time of day	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**
24	I shop online because I can buy products from anywhere	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**
25	I find it difficult to remember my password when shopping online	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**
26	In general products are received within the time period specified by the company	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**
27	In general I am satisfied with what I receive from Internet shopping and that products are accurately represented by websites	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**
28	Delivery costs are unreasonable	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**
29	In general I get good customer service from online companies	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**
30	Prices online are generally lower than elsewhere	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**
31	I find it encouraging to shop online from sites which have a clear return & refund policy	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**
32	It is important for me if a shopping site has the ability to deliver the order to an address other than my own	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**
33	It makes me feel more confident when the site keeps me informed about my order status	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**
34	I prefer to shop online from sites that provide alternative methods of ordering/payment/delivery	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**
35	I find it frustrating that some sites have limited delivery areas	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**

Section Three: Perception of Online Shopping

			7	6	5	4	3	2	1			
36	The cost of using the Internet is generally reasonable	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**	☐	**Don't know**
37	I am not interested in information about companies that is presented on their websites	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**	☐	**Don't know**
38	I like websites to be easy to navigate	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**	☐	**Don't know**
39	I am interested in well organized websites	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**	☐	**Don't know**
40	Compulsory registration when shopping online is frustrating	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**	☐	**Don't know**
41	I am worried about the security of my financial information while shopping online	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**	☐	**Don't know**
42	I am worried about the privacy of personal information when shopping online	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**	☐	**Don't know**
43	I am worried about the absence of legal regulations that govern online transactions	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**	☐	**Don't know**

-- End --

Thank You.

Appendix 5: Tasks scenario for the three websites

Website 1
Tasks Scenario

Your friend has recommended the *website1.com* website to you as a reliable Islamic women clothing online store which offers a wide variety of products. Visit this website in order to find out more about it and to buy gifts from it.
(Please explore the website for 10 minutes before performing the tasks)

Task 1
Find 'Jilbab JS7107' Jilbab, Size: Large, Price = $79.99, Color: Brown.

Task 2
Purchase two quantities of this Jilbab. (**Stop when you reach the order preview page**)

(Purchase will require the user to create new account, enter user information, enter shipping address, select a shipping method, and select payment method)

Task 3
Change the quantity of the purchased Jilbab from two to one and complete the purchasing process. (**Stop when you reach the order preview page**)

Task 4
Find 'Ameera AH7103' Hijab, Price = $7.99, then add it to your shopping cart and complete the purchasing process. (**Stop when you reach the order preview page**)

Task 5
Change your shipping address that you have just entered during the purchasing process and complete the purchasing process. (**Stop when you reach the order preview page**)

Task 6
Get a list of all the pins which can be purchased from this website, then from the list find the price of the 'plastic pins'.

Task 7
Suppose that you bought a product from this website and would like to complain that it took several months to get to you. Find out how you would do this.

Task 8
Find out how long it will take to receive your order after purchasing it from this website?

Task 9
What is the price of 'Skirt SK6103' Skirt?

Task 10
Get a list of all the items which can be purchased from this website with size XXLarge.

Website 2
Tasks Scenario

Your friend has recommended the *website2.com* website to you as a reliable Islamic women clothing online store which offers a wide variety of products. Visit this website in order to find out more about it and to buy gifts from it.
(Please explore the website for 10 minutes before performing the tasks)

Task 1
Find 'Jilbab with Pants 3106511' Jilbab, Product#: 3106511, Price = $98.99, size: 2, Color: Ivory2.

Task 2
Purchase two quantities of this Jilbab. (**Stop when you reach the order page**)

(Purchase will require the user to register as a new user, enter personal information, activate account by logging, enter free shipping coupon, select a shipping method, enter credit card information)

Task 3
Change the quantity of the purchased Jilbab from two to one and complete the purchasing process. (**Stop when you reach the order page**)

Task 4
Find 'Chiffon Hijab 100S152' Hijab, Product#: 100S152, Price = $14.99, Color: LightSteelBlue1, then add it to your shopping cart and complete the purchasing process. (**Stop when you reach the order page**)

Task 5
Change your shipping address that you have just entered during the purchasing process and complete the purchasing process. (**Stop when you reach the order page**)

Task 6
Get a list of all the shirts which can be purchased from this website, then from the list find the price of 'Shirt 9502237' Shirt, Product #: 9502237.

Task 7
Suppose that you bought a product from this website and would like to complain that it took several months to get to you. Find out how you would do this.

Task 8
Find out how long it will take to receive your order after purchasing it from this website?

Task 9
What is the price of 'Bent Al-Noor Dress 5002002' Dress, Product#: 5002002?

Task 10
Get a list of all the items which can be purchased from this website with prices between $150 to $1000.

Website 3
Tasks Scenario

You will shortly visit your uncle who is living abroad soon. He is interested in heritage gifts which remind him of his country. You have heard about the *website3.com* website which can help you buy gifts online and save time. Visit this website in order to find out more about it and to buy gifts from it.
(Please explore the website for 10 minutes before performing the tasks)

Task 1
Find 'Traditional White Cotton Thobe' Dress, ID = edt-ds-001, Price = $475.00 , small size.

Task 2
Purchase two quantities of this dress. (**Stop when you reach billing information page**)

(Purchase will require the user to select a payment method, select a shipping method, enter personal information. There is no registration)

Task 3
Change the quantity of the purchased dress from two to one and complete the purchasing process. (**Stop when you reach billing information page**)

Task 4
Find 'Almond Oil', ID = gf-oil-051, Size = 40 ML, Price = $3.5, then add it to your shopping cart and complete the purchasing process. (**Stop when you reach billing information page**)

Task 5:
Change your delivery address that you have just entered during the purchasing process and complete the purchasing process. (**Stop when you reach billing information page**)

Task 6
Get a list of all ceramic items which are displayed at TurathCom online catalog, then from the list find the price of 'rusticceramic Jar**'**, Code: raf- 1.

Task 7
Suppose that you bought a product from this website and would like to complain that it took several months to get to you. Find out how you would do this.

Task 8
Find out how long it will take to receive your order after purchasing it from this website.

Task 9
What is the price of 'Those Were The Days' Book?

Task 10
Find out the types of services that TurathCom offer.

Appendix 6: Post test questionnaire

This questionnaire is designed to tell us how you feel about the website you have just used to perform the different tasks. Please select the option that most clearly expresses how you feel about each statement.

Website URL: _____

These questions are concerned with finding information, purchasing, and using the internal search facility tasks										
How easy or difficult did you find the following tasks using this website:										
			7	**6**	**5**	**4**	**3**	**2**	**1**	
1	Finding the information related to the tasks	**Very Easy**	☐	☐	☐	☐	☐	☐	☐	**Very Difficult**
2	Finding the products	**Very Easy**	☐	☐	☐	☐	☐	☐	☐	**Very Difficult**
3	Using the internal search facility	**Very Easy**	☐	☐	☐	☐	☐	☐	☐	**Very Difficult**
4	Registering on the site	**Very Easy**	☐	☐	☐	☐	☐	☐	☐	**Very Difficult**
5	Purchasing a product	**Very Easy**	☐	☐	☐	☐	☐	☐	☐	**Very Difficult**
6	Changing customer information	**Very Easy**	☐	☐	☐	☐	☐	☐	☐	**Very Difficult**
7	Changing the contents of the shopping cart	**Very Easy**	☐	☐	☐	☐	☐	☐	☐	**Very Difficult**
How much do you agree or disagree with the following statements:										
			7	**6**	**5**	**4**	**3**	**2**	**1**	
8	The organization of information on the website was clear	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**
9	Moving around the website without getting lost was difficult	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**
10	The table of contents was helpful	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**
11	The site's search function was quick enough	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**
12	Accuracy of internal search results was good	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**
13	Results of internal search were poor	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**
14	The information on the website was effective in helping me complete the purchasing tasks	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**
If you needed to register on the site to purchase the products then please answer Q15 else go to Q16										
			7	**6**	**5**	**4**	**3**	**2**	**1**	
15	Compulsory registration in order to purchase products was convenient Please go to Q18	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**
16	I prefer to register before purchasing products	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**
17	This website had all the functions and capabilities that I expected it to have	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**
If you disagree with statement 17 then please answer question 18, else go to question 19										
18	Which functions and capabilities were missing in this website?									
These questions are concerned with the general appearance & navigation of the website										
How much do you agree or disagree with the following statements:										
			7	**6**	**5**	**4**	**3**	**2**	**1**	
19	I liked the interface of this website	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**
20	The interface of this website was pleasant/ attractive	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**
21	It was difficult to go to the home page from any sub page of the site	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**
22	The choice of colours was appropriate	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**
23	The size of the text made the site easy to read	**Strongly**	☐	☐	☐	☐	☐	☐	☐	**Strongly**

		Agree								**Disagree**
24	There were few broken/not working links	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**
25	It was clear to know the position of any page of the site	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**
26	I felt comfortable using this website	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**
27	The terminology/terms used throughout this website were clear	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**
28	I would recommend this site to a friend	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**
These questions are concerned with security & privacy of the website										
How much do you agree or disagree with the following statements:										
			7	**6**	**5**	**4**	**3**	**2**	**1**	
29	I trust that the company will not misuse my personal information	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**
30	I feel that the security of my financial information is protected while purchasing from this website	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**
31	I have confidence in purchasing from this website	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**
These questions are concerned with your general feelings about the website										
32	What are the five features that you liked most about this website?									
1										
2										
3										
4										
5										
33	What are the five features that you disliked most about this website?									
1										
2										
3										
4										
5										
34	What would encourage you to purchase a product from this website in future?									
1										
2										
3										
4										
5										
35	What would discourage you from purchasing a product from this website in future?									
1										
2										
3										
4										
5										

-- End --

Thank You.

Appendix 7: Post evaluation questionnaire

This questionnaire is designed to reflect your experience while performing the different tasks using the three websites. For each feature please indicate which site you prefer and explain your reasons for the preference.

1.	Which website has the most professional appearance? Which features of this interface attracted you?
2.	Which website enables you to find products in the most obvious and simple way? Why?
3.	Which website has the most obvious method for ordering items? Why?
4.	Which website has the best support for customers to continue shopping and editing the shopping cart?
5.	Which website do you trust the most? Why?
6.	Which website was the easiest for finding the information related to the tasks? Why?
7.	Which website was the easiest for changing customer information?

-- End --

The researcher would like to thank you for your cooperation with this research.

Appendix 8: A matrix of users' profile

Gender		**Female**			**Male**	
	Company 1	99%			1%	
	Company 2	99%			1%	
	Company 3	60%			40%	
	Company 3	50%			50%	
	Average	**77%**			**23%**	
	Approximate No. of Users	**16**			**4**	
Education Level	**Company 1**	Diploma to Post Graduate				
	Company 2	All levels, from house-wives to Post Graduate				
	Company 3	High school education and above				
	Company 3	High school education and above				
	Education Level	**Tawjehi (High school)**	**Diploma**	**Bachelors Degree**	**Higher Diploma**	**Postgraduate Degree**
	Company 1	0%	25%	25%	25%	25%
	Company 2	20%	20%	20%	20%	20%
	Company 3	20%	20%	20%	20%	20%
	Company 3	20%	20%	20%	20%	20%
	Average	**15%**	**21%**	**22%**	**21%**	**21%**
	Approximate No. of Users	**3**	**4**	**5**	**4**	**4**
Age	**Company 1**	20-45				
	Company 2	16-60				
	Company 3	25-60				
	Company 3	25-45				
	Age	**18-29**	**30-39**	**40-49**	**Over 50**	
	Company 1	40%	40%	20%	0%	
	Company 2	25%	25%	25%	25%	
	Company 3	13%	29%	29%	29%	
	Company 3	30%	40%	30%	0%	
	Average	**27%**	**34%**	**26%**	**13%**	
	Approximate No. of Users	**5**	**7**	**5**	**3**	
Experience using Computer	**Company 1**	more than one year				
	Company 2	97% more than one year				
	Company 3	more than three years				
	Company 3	more than three years				
	Computer Experience	**Under 1 year**	**1-3 years**	**More than 3 years**		
	Company 1	0%	50%	50%		
	Company 2	10%	45%	45%		
	Company 3	0%	0%	100%		
	Company 3	0%	0%	100%		
	Average	**3%**	**24%**	**73%**		
	Approximate No. of Users	**0**	**6**	**14**		
Experience using Internet	**Company 1**	more than one year				
	Company 2	97% more than one year				
	Company 3	more than one year				
	Company 3	more than one year				
	Internet Experience	**Under 1 year**	**1-3 years**	**More than 3 years**		
	Company 1	0%	50%	50%		
	Company 2	10%	45%	45%		
	Company 3	0%	50%	50%		
	Company 3	0%	50%	50%		
	Average	**3%**	**49%**	**48%**		
	Approximate No. of Users	**0**	**10**	**10**		

Appendix 9: An Advertisement to recruit users

Participants Needed for a Research Study

We need participants aged at least 18 years old who have experience in using computers and the Internet and able to deal with the web in English to take part in an evaluation of websites to provide us with their feedback about the design.
The evaluation will take place in an academic institution and will take about 4 hours to perform. It will consist of a set of typical tasks and will involve completing questionnaires. In return you will receive 10 JD to help with your expenses and to thank you for your effort and time.
If you are interested in participating, please send an email to (xx@xx.com) before dd/mm/yyyy.

Appendix 10: Categories, subcategories and references of the developed heuristics

Heuristic	References
Architecture and Navigation	
Consistency	(Oppenheim & Ward, 2006), (Nielsen, 1996), (Brinck *et al*., 2001), (Preece *et al*., 2002), (Van der Merwe & Bekker, 2003), (Webb & Webb, 2004), (Basu, 2002), (Sutcliffe, 2002), (Fisher *et al.*, 2002), (Chen & Macredie, 2005), (Shneiderman, 1998)
Navigation support	(Oppenheim & Ward, 2006), (Brinck *et al*., 2001), (Singh & Kotze, 2002), (Gonzalez & Palacios, 2004), (Nielsen, 2000), (Nielsen, 1996), (Preece *et al*., 2002), (Cao *et al.*, 2005), (Van der Merwe & Bekker, 2003), (Gonzalez & Palacios, 2004), (Webb & Webb, 2004), (Zhang & von Dran, 2001), (Barnes & Vidgen, 2002), (Singh & Fisher, 1999), (Srivihok, 2000), (Basu, 2002), (Molla & Licker, 2001), (Sutcliffe, 2002), (Fisher *et al.*, 2002), (De Marsico & Levialdi, 2004), (Hung & McQueen, 2004)
Internal search	(Oppenheim & Ward, 2006), (Cao *et al.*, 2005), (Brinck *et al*., 2001), (Nielsen, 1996), Tilson *et al*., 1998), (Huang *et al*., 2006), (Van der Merwe & Bekker, 2003), (Barnard & Wesson, 2004), (Zhang & von Dran, 2001), (Liu & Arnett, 2000), (Basu, 2002), (Molla & Licker, 2001), (De Marsico & Levialdi, 2004), (Hung & McQueen, 2004)
Working links	(Oppenheim & Ward, 2006), (Van der Merwe & Bekker, 2003), (Singh & Fisher, 1999), (Fisher *et al.*, 2002), (Huang *et al*., 2006), (Gonzalez & Palacios, 2004)
Resourceful links	(Oppenheim & Ward, 2006), (Huang *et al*., 2006), (Gonzalez & Palacios, 2004)
No orphan pages	(Gonzalez & Palacios, 2004), (Nielsen, 1996), (Preece *et al*., 2002), (Van der Merwe & Bekker, 2003), (Chen & Macredie, 2005), (Zhang & von Dran, 2001)
Logical structure of site	(Van der Merwe & Bekker, 2003), (Brinck *et al*., 2001), (Tilson *et al*., 1998), (Oppenheim & Ward, 2006), (Cao *et al.*, 2005), (Barnard & Wesson, 2004), (Webb & Webb, 2004), (Srivihok, 2000), (Liu & Arnett, 2000), (Molla & Licker, 2001), (Chen & Macredie, 2005), (Hung & McQueen, 2004), (Preece *et al*., 2002), (Basu, 2002)
Simple navigation menu	(Tilson *et al*., 1998), (Oppenheim & Ward, 2006), (Cao *et al.*, 2005), (Barnard & Wesson, 2004), (Preece *et al*., 2002), (Basu, 2002)
Content	
Up-to-date information	(Cao *et al.*, 2005), (Nielsen, 2000), (Nielsen, 1996), (Oppenheim & Ward, 2006), (Van der Merwe & Bekker, 2003), (Barnard & Wesson, 2004), (Webb & Webb, 2004), (Gonzalez & Palacios, 2004), (Barnes & Vidgen, 2002), (Singh & Fisher, 1999), (Srivihok, 2000), (Molla & Licker, 2001), (Hung & McQueen, 2004), (Zhang & von Dran, 2001), (Huang *et al*., 2006)
Relevant information	(Oppenheim & Ward, 2006), (Cao *et al.*, 2005), (Brinck *et al*., 2001), (Nielsen, 2000), (Preece *et al*., 2002), (Van der Merwe & Bekker, 2003), (Webb & Webb, 2004), (Gonzalez & Palacios, 2004), (Barnes & Vidgen, 2002), (Singh & Fisher, 1999), (Liu & Arnett, 2000), (Molla & Licker, 2001), (Delone & Mclean, 2003), (Sutcliffe, 2002), (Fisher *et al.*, 2002), (De Marsico & Levialdi, 2004), (Zhang & von Dran, 2001)
Accurate Information	(Oppenheim & Ward, 2006), (Cao *et al.*, 2005), (Van der Merwe & Bekker, 2003), (Barnard & Wesson, 2004), (Webb & Webb, 2004), (Barnes & Vidgen, 2002), (Singh & Fisher, 1999), (Srivihok, 2000), (Liu & Arnett, 2000), (Molla & Licker, 2001), (Zhang & von Dran, 2001)
Grammatical Accuracy	(Oppenheim & Ward, 2006), (Van der Merwe & Bekker, 2003), (Singh & Fisher, 1999)
Information about the company	(Oppenheim & Ward, 2006), (Huang *et al*., 2006), (Van der Merwe & Bekker, 2003), (Gonzalez & Palacios, 2004), (Barnard & Wesson, 2003), (Basu, 2002), (Sutcliffe, 2002), (Hung & McQueen, 2004)
Information about the products	(Oppenheim & Ward, 2006), (Cao *et al.*, 2005), (Tilson *et al*., 1998), (Huang *et al*., 2006), (Van der Merwe & Bekker, 2003), (Gonzalez & Palacios, 2004), (Barnard & Wesson, 2004), (Zhang & von Dran, 2001), (Liu & Arnett, 2000), (Basu, 2002), (Sartzetaki *et al*., 2003), (Hung & McQueen, 2004)
Accessibility and Customer service	
Easy to find and access website	(Oppenheim & Ward, 2006), (Brinck *et al*., 2001), (Sing & Kotze, 2002), (Nielsen, 2000), (Nielsen, 1996), (Preece *et al*., 2002), (Cao *et al.*, 2005), (Van der Merwe & Bekker, 2003), (Gonzalez & Palacios, 2004), (Singh & Fisher, 1999), (Srivihok, 2000), (Liu & Arnett, 2000), (Molla & Licker, 2001), (Delone & Mclean, 2003), (Fisher *et al.*, 2002), (Hung & McQueen, 2004), (Webb & Webb, 2004), (Basu, 2002), (Shneiderman, 1998)
Contact us information	(Oppenheim & Ward, 2006), (Cao *et al.*, 2005), (Huang *et al*., 2006), (Singh & Kotze, 2002), (Van der Merwe & Bekker, 2003), (Gonzalez & Palacios, 2004), (Barnard & Wesson, 2004), (Webb & Webb, 2004), (Barnes & Vidgen, 2002), (Srivihok, 2000), (Liu & Arnett, 2000), (Basu, 2002), (Molla & Licker, 2001), (Delone & Mclean, 2003), (Sartzetaki *et al*., 2003), (Chen & Macredie, 2005), (Hung & McQueen, 2004), (Zhang & von Dran, 2001)
Help/customer service	(Webb & Webb, 2004), (Barnes & Vidgen, 2002), (Srivihok, 2000), (Liu & Arnett, 2000), (Basu, 2002)
Compatibility	(Brinck *et al*., 2001), (Van der Merwe & Bekker, 2003), (Basu, 2002), (Zhang & von Dran, 2001)
Foreign language & currency support	(Oppenheim & Ward, 2006), (Van der Merwe & Bekker, 2003), (Basu, 2002), (De Marsico & Levialdi, 2004)
Design	
Aesthetic design	(Van der Merwe & Bekker, 2003), (Brinck *et al*., 2001), (Singh & Kotze, 2002), (Preece *et al*., 2002), (Barnard & Wesson, 2004), (Webb & Webb, 2004), (Barnes & Vidgen, 2002), (Singh &

	Fisher, 1999), (Liu & Arnett, 2000), (Basu, 2002), (Molla & Licker, 2001), (Sutcliffe, 2002), (Fisher *et al.*, 2002), (Chen & Macredie, 2005), (Zhang & von Dran, 2001)
Appropriate use of images	(Oppenheim & Ward, 2006), (Cao *et al.*, 2005), (Van der Merwe & Bekker, 2003), (Barnard & Wesson, 2004), (Singh & Fisher, 1999), (Basu, 2002), (Fisher *et al.*, 2002)
Appropriate choice of fonts & colours	(Oppenheim & Ward, 2006), (Van der Merwe & Bekker, 2003), (Singh & Fisher, 1999), (Basu, 2002), (Sutcliffe, 2002), (Fisher *et al.*, 2002), (Shneiderman, 1998)
Appropriate page design	(Nielsen, 1996), (Nielsen, 1996), (Preece *et al*., 2002), (Brinck *et al*., 2001), (Oppenheim & Ward, 2006), (Van der Merwe & Bekker, 2003), (Singh & Fisher, 1999), (Basu, 2002), (Molla & Licker, 2001), (Fisher *et al.*, 2002), (Shneiderman, 1998)
Purchasing Proces	
Easy order process	(Van der Merwe & Bekker, 2003), (Oppenheim & Ward, 2006), (Barnard & Wesson, 2004), (Singh & Fisher, 1999), (Liu & Arnett, 2000), (Molla & Licker, 2001), (De Marsico & Levialdi, 2004), (Shneiderman, 1998)
Ordering information	(Oppenheim & Ward, 2006), (Tilson *et al*., 1998), (Singh & Kotze, 2002), (Van der Merwe & Bekker, 2003), (Gonzalez & Palacios, 2004), (Barnard & Wesson, 2004), (Basu, 2002), (Sartzetaki *et al*., 2003), (De Marsico & Levialdi, 2004), (Hung & McQueen, 2004)
Delivery information	(Oppenheim & Ward, 2006), (Tilson *et al*., 1998), (Sing & Kotze, 2002), (Van der Merwe & Bekker, 2003), (Gonzalez & Palacios, 2004), (De Marsico & Levialdi, 2004)
Order/ delivery status provision	(Oppenheim & Ward, 2006), (Huang *et al*., 2006), (Van der Merwe & Bekker, 2003), (Gonzalez & Palacios, 2004), (Barnard & Wesson, 2004), (Webb & Webb, 2004), (Liu & Arnett, 2000), (Basu, 2002), (Molla & Licker, 2001), (De Marsico & Levialdi, 2004), (Hung & McQueen, 2004)
Alternative methods of ordering/ payment/ delivery are available	(Oppenheim & Ward, 2006), (Van der Merwe & Bekker, 2003), (Basu, 2002), (Molla & Licker, 2001), (De Marsico & Levialdi, 2004)
Security & privacy	(Oppenheim & Ward, 2006), (Brinck *et al*., 2001), (Tilson *et al*., 1998), (Huang *et al*., 2006), (Cao *et al.*, 2005), (Van der Merwe & Bekker, 2003), (Barnard & Wesson, 2004), (Webb & Webb, 2004), (Zhang & von Dran, 2001), (Barnes & Vidgen, 2002), (Srivihok, 2000), (Liu & Arnett, 2000), (Basu, 2002), (Molla & Licker, 2001), (Delone & Mclean, 2003), (Sutcliffe, 2002), (Chen & Macredie, 2005), (De Marsico & Levialdi, 2004), (Hung & McQueen, 2004)

Appendix 11: Heuristics guidelines and their explanation

Heuristic	Explanation
Architecture and Navigation	
Consistency	Page layout or style is consistent throughout the website, e.g. justification of text, font types, font sizes, position of the navigation menu in each page. Colours are consistent and provide consistent look & feel for navigation and information design, e.g. font colours, background colours, use of standard link colours (standard blue link colour should be used for unvisited pages and purple or red colours for visited pages). Terminology/terms throughout the website are consistent. Content is consistent among different languages interfaces
Navigation support	Navigational links are obvious in each page so that users can explore and find their way around the site and navigate easily, e.g. index, or site map, or navigation bar or table of contents
Internal search	Internal search is effective, e.g. fast; accurate; provides useful, concise and clear results which are easy for interpreting
Working links	Links are discernible, working properly and not misleading so that the user knows what to expect from the destination page, e.g. links are obvious, no broken links, link names match page names
Resourceful links	The site is informative and resourceful, e.g. it has links to external useful resources
No orphan pages	The site has no dead-end pages, e.g. it is easy and obvious to go to the home page from any sub-page of the site. Pages have a clear indication of their position within the site
Logical structure of site	The structure of the site is simple and straightforward, related information is grouped together, categorisation of products is helpful. Architecture is not too deep so that the number of clicks to reach goals is not too large
Simple navigation menu	Navigation menu is simple and straightforward, the menu choices are ordered logically so it is easy to understand the website
Content	
Up-to-date information	The information is up-to-date, current, often updated, date of last update is displayed and informs the user when new information is added
Relevant information	The information is sufficient and relevant to user needs, e.g. content is concise and non-repetitive, terminology/terms are clear and unambiguous, there are no 'under construction' pages
Accurate Information	The information is precise, e.g. product measurements, total price, services, etc.
Grammatical Accuracy	Content is free from grammatical errors, e.g. no spelling errors, no grammar errors, punctuation is accurate
Information about the company	Basic facts about the company or company overview are displayed, e.g. year founded, type of business, purpose of its website, etc.
Information about the products	Adequate information about the products is displayed, e.g. description, photographs, availability, prices, etc.
Accessibility and Customer Service	
Easy to find and access website	The site is easily identifiable and accessible from search engines, the URL is domain related, not complex, and easy to remember. Download time of the pages is appropriate
Contact us information	Useful information to enable easy communication with the company is displayed, e.g. FAQ, contact us (e.g. name, physical address, telephone number, fax number, email details), customer feedback form to submit customers' comments
Help/customer service	The help/customer service is easy to find, has a clear and distinct layout, searching for help/customer service is easy, navigating in help/customer service is easy, amount of information is sufficient, concise, and designed to answer the specific questions users will have in a specific context.
Compatibility	The site works with different browsers and on different monitor resolutions
Foreign language & currency support	The site's content is displayed in different languages and uses more than one currency
Design	
Aesthetic design	The site is attractive and appealing so that it impresses the potential customer

Appropriate use of images	Quality of images is adequate, no broken images, images make a contribution to the understanding and navigation of the site, alternative text is used for images, image size is relevant so that it has minimal effect on loading time
Appropriate choice of fonts & colours	Font types are appropriate and easy to read. Choice of colours for both fonts and background is appropriate, combination of background and font colours is appropriate
Appropriate page design	Pages are uncluttered, headings are clear, page margins are sufficient, minimum or no long pages with excessive white space that force scrolling; particularly on the home page of the website, page title is appropriate, describing the company name & the contents of each page
Purchasing Process	
Easy order process	Registration on site is easy, changing customer information is easy, logging on to the site is easy, ordering process is easy, changing the contents of the shopping cart (adding, deleting or editing) is easy, obvious and accurate
Ordering information	Complete information about ordering is displayed and can be accessed easily, e.g. how to order, payment options, cancelling an order, return & refund policy, terms & conditions
Delivery information	Information about delivery & dispatch of an order is displayed, e.g. delivery times, delivery costs, delivery areas, delivery address options (the ability to deliver the order to another address), delivery options, problems (e.g. non-delivery, late delivery, incorrect delivery address, etc.)
Order/ delivery status provision	Company informs the customer about order status, e.g. by sending confirmation email to customer after placing an order, by sending dispatch confirmation email to customer when order is sent out, by using online order tracking system
Alternative methods of ordering/ payment/ delivery are available	Alternative methods of ordering (e.g. online, email, phone, fax, etc.), payment (e.g. Credit Card (Visa, Visa Electron, Master Card, American Express, etc.), cash on delivery, cheque by post, bank transfer, etc.), and delivery (standard, express, etc.) are supported so that the user can select the method that suits him/her
Security & privacy	The site uses secure socket layer or recognized secure payment methods, information about security guarantee and privacy policy is clearly displayed

Appendix 12: Heuristics checklist

This questionnaire is designed to indicate your feelings about the website you have just explored. Please select the option that most clearly expresses how a particular statement is applied in the website.

Website URL: _____

How much do you agree or disagree with the following statements:												
Architecture and Navigation												
			7	**6**	**5**	**4**	**3**	**2**	**1**			
1	Page layout is consistent	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**	☐	**Don't know**
2	Justification of text is consistent	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**	☐	**Don't know**
3	Fonts are consistent	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**	☐	**Don't know**
4	Colours are consistent	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**	☐	**Don't know**
5	Site uses standard link colours	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**	☐	**Don't know**
6	Terminology/terms are consistent	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**	☐	**Don't know**
7	Content is consistent among different language interfaces	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**	☐	**Don't know**
8	Site is easy to navigate	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**	☐	**Don't know**
9	Information for typical tasks is easy to find	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**	☐	**Don't know**
10	Index, or site map, or navigation bar or table of contents exist in appropriate places	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**	☐	**Don't know**
11	Response time for internal search is good	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**	☐	**Don't know**
12	Results of internal search are useful	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**	☐	**Don't know**
13	Links are discernible/obvious	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**	☐	**Don't know**
14	There are few broken/not working links	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**	☐	**Don't know**
15	Link names match page names	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**	☐	**Don't know**
16	There are an acceptable number of links to external resources	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**	☐	**Don't know**
17	It is easy & obvious to go to the home page from any sub page of the site	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**	☐	**Don't know**
18	Pages have a clear indication of their position within the site	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**	☐	**Don't know**
19	Site has a simple & straightforward structure	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**	☐	**Don't know**
20	Related information is grouped together	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**	☐	**Don't know**
21	Categorisation of products is helpful	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**	☐	**Don't know**
22	Number of clicks to reach goals is not too large	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**	☐	**Don't know**
23	Navigation menu is simple and straightforward	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**	☐	**Don't know**
24	Menu choices are ordered logically	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**	☐	**Don't know**
Content												
			7	**6**	**5**	**4**	**3**	**2**	**1**			
25	Information is up-to-date & current	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**	☐	**Don't know**
26	Date of last update is obvious	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**	☐	**Don't know**
27	New information is visible & obvious on the site	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**	☐	**Don't know**
28	Terminology/terms are easy to understand	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**	☐	**Don't know**
29	Content is concise	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**	☐	**Don't know**
30	There are few 'under construction' pages	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**	☐	**Don't know**

31	Information is precise	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**	☐	**Don't know**
32	Content is free from grammatical errors	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**	☐	**Don't know**
33	Appropriate overview of the company is displayed	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**	☐	**Don't know**
34	Products are accurately described	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**	☐	**Don't know**
35	Adequate photographs of products are displayed	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**	☐	**Don't know**
36	Adequate status of products is displayed (e.g. availability)	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**	☐	**Don't know**
37	Adequate explanation of product's price is displayed	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**	☐	**Don't know**
Accessibility and Customer Service												
			7	**6**	**5**	**4**	**3**	**2**	**1**			
38	Accessibility of site from search engines is good	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**	☐	**Don't know**
39	URL is domain-related	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**	☐	**Don't know**
40	URL is not complex and easy to remember	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**	☐	**Don't know**
41	Download time of the pages is quick	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**	☐	**Don't know**
42	Appropriate contents of FAQ	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**	☐	**Don't know**
43	Full 'contact us' information is displayed appropriately (e.g. name, physical address, telephone number, fax number and email details)	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**	☐	**Don't know**
44	Site supports sending comments from customers (e.g. feedback form)	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**	☐	**Don't know**
45	Help/customer service is easy to find	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**	☐	**Don't know**
46	Help/customer service has a clear and distinct layout	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**	☐	**Don't know**
47	Searching for help/customer service is easy	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**	☐	**Don't know**
48	Help/customer service is easy to navigate	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**	☐	**Don't know**
49	Appropriate information is provided within help/customer service	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**	☐	**Don't know**
50	Site has appropriate compatibility to work with different browsers	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**	☐	**Don't know**
51	Site has appropriate compatibility to work on different monitor resolutions	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**	☐	**Don't know**
52	Site supports appropriate foreign languages	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**	☐	**Don't know**
53	Site supports appropriate currencies	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**	☐	**Don't know**
Design												
			7	**6**	**5**	**4**	**3**	**2**	**1**			
54	Site is aesthetic, attractive and appealing	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**	☐	**Don't know**
55	Quality of images is adequate	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**	☐	**Don't know**
56	There are few broken images	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**	☐	**Don't know**
57	The images are related to the content of the site and help to understand it	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**	☐	**Don't know**
58	Alternative text is used for most images	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**	☐	**Don't know**
59	Size of images has minimal effect on loading time	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**	☐	**Don't know**
60	Fonts are easy to read	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**	☐	**Don't know**
61	Choice of font colours is appropriate	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**	☐	**Don't know**
62	Choice of background colours is appropriate	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**	☐	**Don't know**
63	Combination of background & font colours is appropriate	**Strongly Agree**	☐	☐	☐	☐	☐	☐	☐	**Strongly Disagree**	☐	**Don't know**
64	Pages are uncluttered	**Strongly**	☐	☐	☐	☐	☐	☐	☐	**Strongly**	☐	**Don't**

		Agree								Disagree		know
65	Headings are clear	Strongly Agree	☐	☐	☐	☐	☐	☐	☐	Strongly Disagree	☐	Don't know
66	Page margins are sufficient	Strongly Agree	☐	☐	☐	☐	☐	☐	☐	Strongly Disagree	☐	Don't know
67	There are a minimum number of long pages which require scrolling	Strongly Agree	☐	☐	☐	☐	☐	☐	☐	Strongly Disagree	☐	Don't know
68	Page titles appropriately describe the company name & the content of the pages	Strongly Agree	☐	☐	☐	☐	☐	☐	☐	Strongly Disagree	☐	Don't know
Purchasing Process												
			7	6	5	4	3	2	1			
69	Registration on the site is easy	Strongly Agree	☐	☐	☐	☐	☐	☐	☐	Strongly Disagree	☐	Don't know
70	Changing customer information is easy	Strongly Agree	☐	☐	☐	☐	☐	☐	☐	Strongly Disagree	☐	Don't know
71	Logging on to the site is easy	Strongly Agree	☐	☐	☐	☐	☐	☐	☐	Strongly Disagree	☐	Don't know
72	Ordering process is easy	Strongly Agree	☐	☐	☐	☐	☐	☐	☐	Strongly Disagree	☐	Don't know
73	Changing the content of the shopping cart is easy	Strongly Agree	☐	☐	☐	☐	☐	☐	☐	Strongly Disagree	☐	Don't know
74	Accuracy of the shopping cart's contents is good	Strongly Agree	☐	☐	☐	☐	☐	☐	☐	Strongly Disagree	☐	Don't know
75	The shopping cart's contents are clearly presented	Strongly Agree	☐	☐	☐	☐	☐	☐	☐	Strongly Disagree	☐	Don't know
76	How to order is explained appropriately	Strongly Agree	☐	☐	☐	☐	☐	☐	☐	Strongly Disagree	☐	Don't know
77	Payment options are clarified appropriately	Strongly Agree	☐	☐	☐	☐	☐	☐	☐	Strongly Disagree	☐	Don't know
78	Cancelling an order procedure is explained appropriately	Strongly Agree	☐	☐	☐	☐	☐	☐	☐	Strongly Disagree	☐	Don't know
79	Return and refund policy is explained appropriately	Strongly Agree	☐	☐	☐	☐	☐	☐	☐	Strongly Disagree	☐	Don't know
80	Terms & conditions are easy to understand	Strongly Agree	☐	☐	☐	☐	☐	☐	☐	Strongly Disagree	☐	Don't know
81	Delivery time is explained appropriately	Strongly Agree	☐	☐	☐	☐	☐	☐	☐	Strongly Disagree	☐	Don't know
82	Delivery costs are explained appropriately	Strongly Agree	☐	☐	☐	☐	☐	☐	☐	Strongly Disagree	☐	Don't know
83	Delivery areas are explained appropriately	Strongly Agree	☐	☐	☐	☐	☐	☐	☐	Strongly Disagree	☐	Don't know
84	Delivery options are clarified appropriately	Strongly Agree	☐	☐	☐	☐	☐	☐	☐	Strongly Disagree	☐	Don't know
85	Delivery address options are supported (the ability to deliver the order to another address)	Strongly Agree	☐	☐	☐	☐	☐	☐	☐	Strongly Disagree	☐	Don't know
86	Problems with delivery are clarified appropriately (e.g. non-delivery, late delivery, incorrect delivery address, etc.)	Strongly Agree	☐	☐	☐	☐	☐	☐	☐	Strongly Disagree	☐	Don't know
87	Site sends confirmation email to customer after placing an order	Strongly Agree	☐	☐	☐	☐	☐	☐	☐	Strongly Disagree	☐	Don't know
88	Site sends dispatch confirmation email to customer when order is sent out	Strongly Agree	☐	☐	☐	☐	☐	☐	☐	Strongly Disagree	☐	Don't know
89	Site uses online order-tracking	Strongly Agree	☐	☐	☐	☐	☐	☐	☐	Strongly Disagree	☐	Don't know
90	Site has acceptable support for a variety of ordering methods	Strongly Agree	☐	☐	☐	☐	☐	☐	☐	Strongly Disagree	☐	Don't know
91	Site has acceptable support for a variety of payment methods	Strongly Agree	☐	☐	☐	☐	☐	☐	☐	Strongly Disagree	☐	Don't know
92	Site has acceptable support for a variety of delivery methods	Strongly Agree	☐	☐	☐	☐	☐	☐	☐	Strongly Disagree	☐	Don't know
93	Site uses secure socket layer	Strongly Agree	☐	☐	☐	☐	☐	☐	☐	Strongly Disagree	☐	Don't know
94	Site uses recognized secure payment methods	Strongly Agree	☐	☐	☐	☐	☐	☐	☐	Strongly Disagree	☐	Don't know
95	Security guarantee is clarified appropriately	Strongly Agree	☐	☐	☐	☐	☐	☐	☐	Strongly Disagree	☐	Don't know
96	Privacy policy is clarified appropriately	Strongly Agree	☐	☐	☐	☐	☐	☐	☐	Strongly Disagree	☐	Don't know

Appendix 13: Metrics, equations, meaning and results

No.	Metric	Equation	Meaning	Results		
				Site 1	Site 2	Site 3
1	Average Time on Site	Total time spent on site for all visits / Visits	High value of this metric might indicate that visitors interact extensively with the site[1].	00:06:52	00:03:01	00:03:29
2	Average Page Views per Visit	Number of Page Views / Visits	High value of this metric might indicate that: visitors were interested in the site, or the content of the site is interesting, or the site is difficult for visitors to navigate, or the internal search of the site is poor[2][3]. Low value of this metric might indicate that the site is difficult to navigate, or the content of the site is poorly written or the internal search of the site is good[2]	17.00	12.56	5.62
3	Percentage of Time Spent Visits (Percentage of visits in terms of average time visitors spent during their visits)	Percentage of Low Time Spent Visits = (Total Number of Visits Spending between 0 Seconds and 3 Minutes on the Site/ All Visits) X 100	If a site has a relatively high percentage of low time spent visits, then this could indicate either: the site is poorly targeting visitors or it could be that the site has problems in its information architecture and usability or the site's content are not relevant[2]	60.16%	76.76%	77.75%
		Percentage of Medium Time Spent Visits = (Total Number of Visits Spending between 3 and 10 Minutes / All Visits) X 100		21.67%	14.48%	13.23%
		Percentage of High Time Spent Visits (also known as committed visitor share) = (Total Number of Visits Spending more than 10 Minutes on the Site / All Visits) X 100	If a site has high percentage of high time spent visits, this might indicate that visitors engage in the activity of the site[3]	18.17%	7.77%	10.01%
4	Percentage of Click Depth (Page View) Visits (Percentage of visits in terms of number of pages visitors viewed during their visits)	Percentage of Low Click Depth Visits = (Total Number of Visits of Two Clicks or Less/ All Visits) X 100	If a site has a high percentage of low click depth visits, this might mean that the site is confusing or uninteresting[2]	31.29%	35.38%	59.20%
		Percentage of Medium Click Depth Visits = (Total Number of Visits of 3 Clicks to X[4]* / All Visits) X 100		42.57%	37.97%	22.99%
		Percentage of High Click Depth Visits (also known as heavy user share) = (Total Number of Visits More than X* Clicks / All Visits) X 100	If a site has a high percentage of high click depth visits, this might mean that the site is engaging and interesting or that the site is targeting visitors properly and the ease of use of the site[2][3]	26.14%	26.66%	17.81%
5	Bounce Rate for all Pages (also known as Reject Rate for All Page)	(Number of One Page Visits to the Site / All Visits) X 100	Percentage of single page visits, i.e. visits in which a visitor left the site from the entrance page[2]. This metric describes the global design flaws in the site's navigation	22.77%	30.50%	47.58%

[1] http://www.google.com/analytics
[2] Peterson (2006)
[3] Eisenberg (2005)
[4] X* = Average page Views Per Visit

			or its page layout[3]			
6	Ratio of New to Returning Visits	Total New Visits / Total Returning Visits (expressed as fraction).	If the value of this metric under 1.00, it means that the site is retaining it's current visits, if this metric above 1.00, it means that the site is acquiring new visits, and if this metric is exactly 1.00, this means that for every new visits, there is one return visit	1.54	1.48	4.75
7	Visitor Engagement Index (also known as Average Visits per Visitor)	Number of Visits / Number of Unique Visitors.	The average sessions or visits per visitor describes the intensity of visitors' repeating behaviour[1]. If the site has repeat visitors, then the index will be much higher than 1.00, if the site has not repeat visitors, then the index will be very close to 1.00, so that every visitor has one session[1]	1.54	1.55	1.2
8	Percentage of Frequency Visits (also known as Visitor Loyalty) (Percentage of visits in terms of how frequently visitors come to the site)	Percentage of Low Frequency Visits = (Total Number of Low Frequency Visitors (1 time Visit) / All Visits) X 100	These metrics describe the frequency of visitor engagement; the higher the percent of frequency visitors, the more engaged they are with the site[2] These metrics were examined on a monthly basis.	Month 1: 53.67% Month 2: 64.86% Month 3: 63.60%	Month 1: 59.87% Month 2: 58.12% Month 3: 61.21%	Month 1: 86.58%, Month 2: 85.75%, Month 3: 76.03%
		Percentage of Medium Frequency Visits = (Total Number of Medium Frequency Visitors (2 to 5 times Visit) / All Visits) X 100		Month 1: 24.21% Month 2: 22.91% Month 3: 21.96%	Month 1: 21.42% Month 2: 21.28% Month 3: 17.66%	Month 1: 7.63% Month 2: 9.59% Month 3: 9.93%
		Percentage of High Frequency Visitors = (Total Number of High Frequency Visitors (6 to 14 times Visit) / All Visits) X 100		Month 1: 10.75% Month 2: 6.76% Month 3: 7.49%	Month 1: 7.94% Month 2: 8.96% Month 3: 7.14%	Month 1: 3.16% Month 2: 0.78% Month 3: 5.57%
		Percentage of Very High Frequency Visits = (Total Number of High Frequency Visitors (More than 15 times Visit) / All Visits) X 100		Month 1: 11.37% Month 2: 5.47% Month 3: 6.96%	Month 1: 10.76% Month 2: 11.64% Month 3: 13.99%	Month 1: 2.63% Month 2: 3.89% Month 3: 8.47%
9	Percentage of Recency Visits (Percentage of visits in terms of the recency of visitors' visits. Recency means the amount of time that passes between	Percentage of Low Recency Visits = (Total Number of Visits where Last Visit was 0 Days Ago / All Visits) X 100	'low' recency is good, in which the shorter the number of days between previous visits, the likelier the visitors will engage in some action of value[2] These metrics were examined on a monthly basis	Month 1: 72.82% Month 2: 82.21% Month 3: 80.22%	Month 1: 74.76% Month 2: 73.63% Month 3: 76.46%	Month 1: 92.37% Month 2: 94.04% Month 3: 91.53%

[1] Eisenberg (2005)
[2] Peterson (2006)

	subsequent visits)	Percentage of Slightly Low Recency Visits = (Total Number of Visits where Last Visit was Between 1 to 7 Days Ago / All Visits) X 100		Month 1: 13.71% Month 2: 12.57% Month 3: 11.48%	Month 1: 14.68% Month 2: 14.47% Month 3: 13.04%	Month 1: 5.00% Month 2: 3.11% Month 3: 5.33%
		Percentage of Medium Recency Visits = (Total Number of Visits where Last Visit was Between 8 to 30 Days Ago / All Visits) X 100		Month 1: 7.64% Month 2: 3.76% Month 3: 7.06%	Month 1: 6.30% Month 2: 7.23% Month 3: 6.29%	Month 1: 1.58% Month 2: 1.30% Month 3: 2.91%
		Percentage of Slightly High Recency Visits = (Total Number of Visits where Last Visit was Between 31 to 120 Days Ago / All Visits) X 100		Month 1: 4.47% Month 2: 1.05% Month 3: 1.21%	Month 1: 3.07%, Month 2: 3.30% Month 3: 3.39%	Month 1: 1.05% Month 2: 1.55% Month 3: 0.24%
		Percentage of High Recency Visits = (Total Number of Visits where Last Visit was Between 121 to 364 Days Ago / All Visits) X 100		Month 1: 1.24% Month 2: 0.39% Month 3: 0.03%	Month 1: 1.14% Month 2: 1.27% Month 3: 0.75%	Month 1: 0.00% Month 2: 0.00% Month 3:0.00%
		Percentage of Very High Recency Visits = (Total Number of Visits where Last Visit was More than 365 Days Ago / All Visits) X 100		Month 1: 0.12% Month 2: 0.03%, Month 3: 0.01%	Month 1: 0.06% Month 2: 0.10% Month 3: 0.06%	Month 1: 0.00% Month 2: 0.00% Month 3: 0.00%
10	Average Order Value (AOV) (also known as Average Order Amount (AOA))	Sum of Revenue Generated / Number of Orders Taken.	The average size of purchase for all visitors. This metric is used to describe the site's ability to generate revenue[1]	$106.20	NA*	NA*
11	Order Conversion Rate (OCR)	(Number of Orders Taken / Total Number of Visits) X 100.	Percentage of visits that results in an order. Most sites have OCR between two to five percent[1]	1.07%	0.37%	0.25%
12	Average Revenue per Visit (also known as Sales per Visit (SPV))	Sum of Revenue Generated / Visits.	This metric describes the financial performance of a site; the higher the average revenue per visit, the better the site is[1]	$1.14	NA*	NA*

[1] Peterson (2006)

* This site did not did not support data to measure this metric

13	Average Visits to Purchase	Average number of visits (sessions) from first website interaction to purchase[1]	How many visits it takes visitors to purchase from a site[2]	Most purchases occurred after one visit See Appendix 13, Figure 1	Most purchases occurred after one visit See Appendix 13, Figure 2	Most purchases occurred after one visit See Appendix 13, Figure 3
14	Average Days to Purchase	Average number of days from first website interaction to purchase[1]	How long it takes before visitors purchase from a site[2]	Most purchases occurred after 0 days See Appendix 13, Figure 4	Most purchases occurred after 0 days See Appendix 13, Figure 5	Most purchases occurred after 0 days See Appendix 13, Figure 6
15	Average Items per Cart Completed (also known as Average Items per Order)	Sum of Products Purchased / Number of Completed Shopping Carts	Average number of items for the successfully completed carts[3]. It used to describe the site's ability to cross-sell. The average items per cart for retail sites are usually very close to 1.0 and very difficult to increase, which means that retail sites' visitors usually purchased only one item[3].	4	NA*	NA*
16	Average Searches per Visit	Total Number of Searches (Page Views) / Total Visits	The frequency of which visitors use the site's internal search[3]. If the value of this metric is more than 1.00, then this may mean that visitors are interested in the site's content and products, or perhaps that navigational structure is poor[3]	0.07 (product search) 0.01 (advanced search)	0.05 (product search) 0.01 (advanced search)	NA*
17	Percent Visits Using Search	(Total Number of Visits during which at Least one 'Search Results' Page was viewed / All Visits) X 100	Percentage of visits during which visitors search the site[3]. This percentage is related directly to the type of audience that the site attracts, the type of information or products that are displayed at the site, and the overall usability of the site[3]	2.14% (product search) 0.20% (advanced search)	3.16% (product search) 0.80% (advanced search)	NA*
18	Search Results to site Exits Ratio	Total Site Exits from Search Results Page / Total Number of Visits to a Search Results Page (expressed as fraction).	The ratio (expressed as fraction) of searches where the search results were the last pages viewed and exit from the site immediately followed. This metric is used to understand whether visitors find the internal search of a site useful, and to understand how the internal search of	0.79 (product search)	0.53 (product search)	NA*

[1] Kaushik (2006)
[2] http://www.Google.com/analytics
[3] Peterson (2006)
* This site did not did not support data to measure this metric

			the site is driving visitor failure and dissatisfaction if they did not find what they are looking for[1]	0.60 (advanced search)	0.51 (advanced search)	
19	**Top landing pages metrics**: Bounce Rate for Specific Page (bounce rate for each top landing page)	(Number of one Page Visits to a Page (which is also known as Bounces) / Number of Visits Beginning with the Same Page (which is also known as Entrances)) X 100	This metric indicates how effectively a landing page of a site entices visitors to click deeper into the site rather than leaving it immediately[2]. Its may describe the degree of confusion for each page which relate to several reasons such as design or usability problems, or inappropriate content that did not match with users' expectations or users' needs[1]	See Appendix 13, Table 1	See Appendix 13, Table 2	See Appendix 13, Table 3
	Entrance Sources		The entrance sources report, provided by Google Analytics, displays the search engines, sites, etc, that visitors use to arrive at each page. It was used to determine the entrance sources of each landing page	The sources for each page of the top ten landing page were one of the followings: search engines, Islamic Blogs, Islamic sites.	The sources for each page of the top ten landing page were one of the followings: search engines, Islamic Blogs, Islamic sites.	The sources for each page of the top ten landing page were: search engines or hand-craft sites.
	Entrance Keywords		The entrance keywords report, Google Analytics, displays keyword searches that visitors use to arrive at each page. It was used to investigate the entrance keywords for each landing page of the three sites	See Appendix 13, Table 1	See Appendix 13, Table 2	See Appendix 13, Table 3
20	**Top content pages metrics**: Bounce Rate for Specific Page (bounce rate for each top content page)	(Number of one Page Visits to a Page/ Number of Visits Beginning with the Same Page X 100	Percentage of single page visits to each content page	See Appendix 13, Table 4	See Appendix 13, Table 5	See Appendix 13, Table 6
	Average time for each top content page	Total time spent on each top content page for all visits / Visit	Average time visitors spent viewing each content page	See Appendix 13, Table 4	See Appendix 13, Table 5	See Appendix 13, Table 6
	Percentage of site exits from each top content page		Percentage of sites exits from each top content page	See Appendix 13, Table 4	See Appendix 13, Table 5	See Appendix 13, Table 6

[1] Peterson (2006)

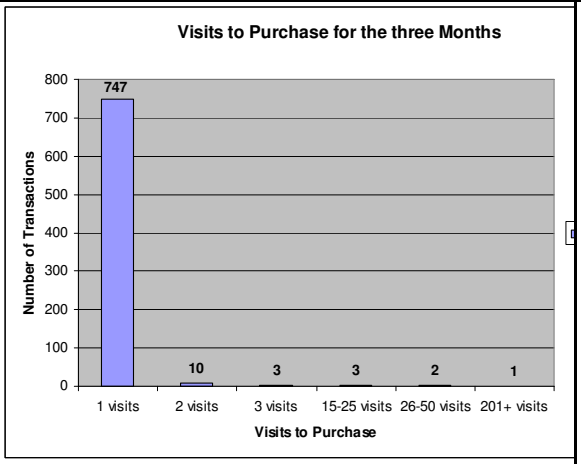
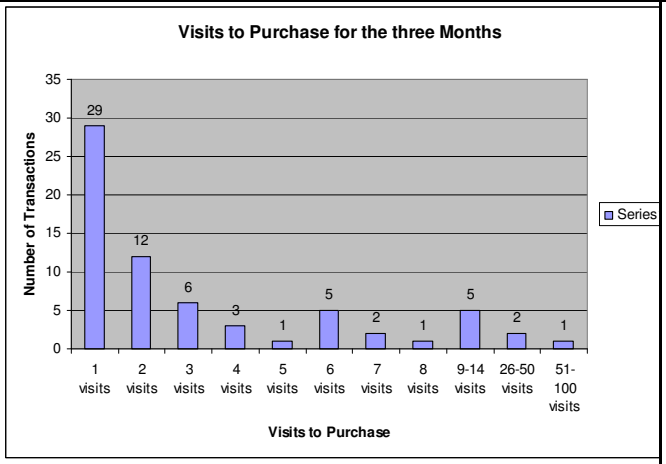
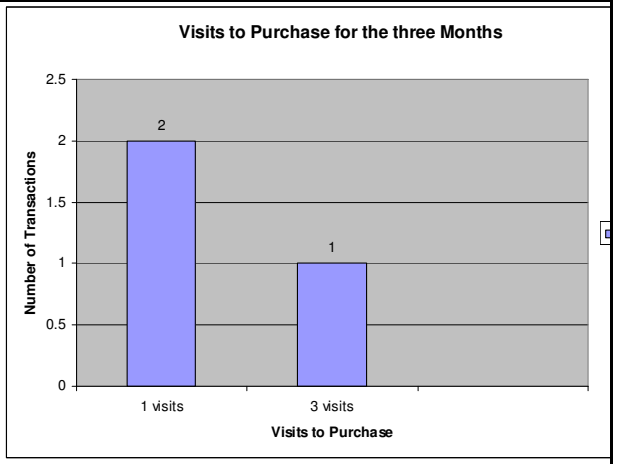
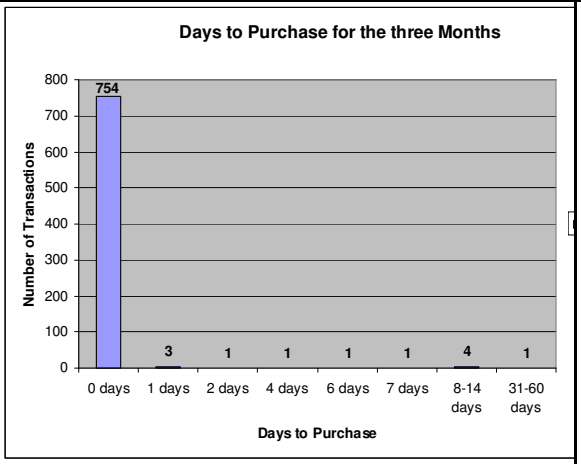
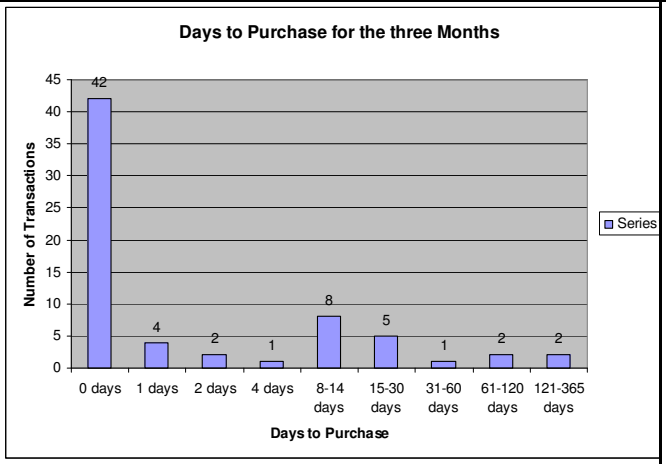
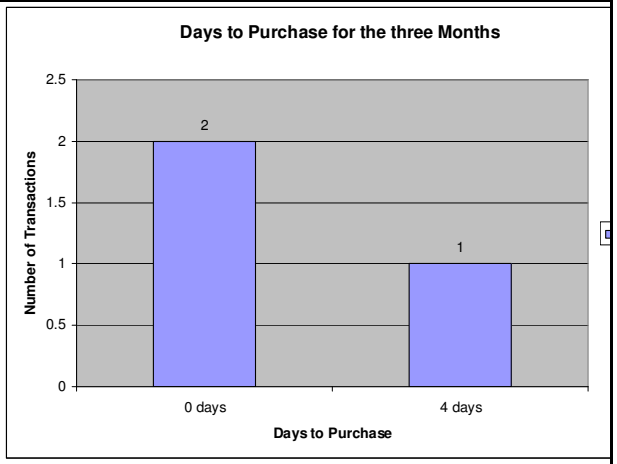
[2] http://www.Google.com/analyticsl

21	**Top exit pages metrics**: Percentage of site exits from each top exit page		Percentage of sites exits from each top exit page	See Appendix 13, Table 7	See Appendix 13, Table 8	See Appendix 13, Table 9
22	Information Find Conversion Rate	(Total Number of Visits to the Customer Support Page / Total Visits) X 100	Percentage of visits in which visitors viewed customer support pages. Low value of this metric might indicate that it was not easy for visitors to find these pages due to usability problems in either the architecture of the site or its search or that visitors were not interested to visit these pages[1]	See Appendix 13, Table 10	See Appendix 13, Table 11	See Appendix 13, Table 12
23	Feedback Form Conversion Rate (also known as *Completion Rate*)	(Number of Visits in which the Form is Submitted / Total Visits in which the Visitor Started Completing the Form) X 100	Percentage of visits that involve visitors who completed the feedback form[1]	11.69%	NA*	NA*
24	Cart Start Rate	(Total Visits where a Shopping Cart is Started / All Visits) X 100	Percentage of visits that involve visitors who added at least one item to their shopping cart[1].	5.94%	2.89%	NA*
25	Cart Completion Rate	(Total Orders / Total Visits where a Shopping Cart is Started) X 100	Percentage of visits where started shopping cart results in a purchase or an order[1]. If the value of this metric is low it might indicate that it was not easy or confusing for visitors to move through the checkout process after adding products to their cart[1]	18.07%	12.98%	NA*
26	Checkout Start Rate	(Total Visits where the Checkout Button is Clicked / All visits) X 100	Percentage of visits that involve visitors who clicked at checkout button[1]. If value of this metric is low it might indicate that the site has a problem in the placement of the checkout button, or a design or usability problem in the page that included the checkout button[1]	3.63%	1.02%	1.7%
27	Checkout Completion Rate	(Total Orders / Total Visits where the Checkout Process is Started) X 100	Percentage of visits where the started checkout process results in a purchase or an order[1].	29.55%	36.61%	15%
28	Ratio of Checkout Starts to Cart Starts	Total Visits where the Checkout Process is Started / Total Visits where a Shopping Cart is Started (expressed as fraction).	This ratio (expressed as fraction) of visits where a shopping cart is started a checkout process is also started. The best value for this ration is 1.0, and the closer this ratio is to 1.0, the better the site is doing to convert started carts into started checkout processes[1].	0.61	0.35	NA*
29	**Visitors' metrics**: Language		The languages report, provided by Google Analytics, displays languages preferred by visitors to a site and number of visits used each language.	See Appendix 13, Table 13	See Appendix 13, Table 14	See Appendix 13, Table 15
	Browsers		The browsers report, provided by Google Analytics, displays browsers used by visitors to a site and number of visits used each browser	See Appendix 13, Table	See Appendix 13, Table	See Appendix 13, Table

[1] Peterson (2006)

* This site did not did not support data to measure this metric

				16	17	18
	Operating systems		The operating systems report, provided by Google Analytics, displays operating systems used by visitors to a site and number of visits used each operating system.	See Appendix 13, Table 19	See Appendix 13, Table 20	See Appendix 13, Table 21
	Screen colours		The screen colours report, provided by Google Analytics, displays screen colours used by visitors to a site and number of visits used each screen colours.	See Appendix 13, Table 22	See Appendix 13, Table 23	See Appendix 13, Table 24
	Screen resolutions		The screen resolutions report, provided by Google Analytics, displays screen resolution used by visitors to a site and number of visits used each screen resolution.	See Appendix 13, Table 25	See Appendix 13, Table 26	See Appendix 13, Table 27
	Flash versions		The Flash version report, provided by Google Analytics, displays Flash version used by visitors to a site and number of visits used each Flash version.	See Appendix 13, Table 28	See Appendix 13, Table 29	See Appendix 13, Table 30
	Java support		The Java support report, provided by Google Analytics, displays number of visits to a site whose platform support Java and whose platform does not support Java.	See Appendix 13, Table 31	See Appendix 13, Table 32	See Appendix 13, Table 33
	Connection speed		The connection speed report, provided by Google Analytics, displays connection speed of the network used by visitors to a site and number of visits used each connection speech.	See Appendix 13, Table 34	See Appendix 13, Table 35	See Appendix 13, Table 36
30	Funnel Report (This is a report that is based on unique page views metric, which is the number of visits during which one or more pages was viewed)		The funnel report, provided by Google Analytics, is used to investigate the sequence of pages that visitors follow to purchase from a site. Funnel reports involve an analysis of the navigational paths followed by visitors based on a number of identified steps (or pages).	See Appendix 14, (funnel report 1) See Appendix 17, (explanation of funnel report)	See Appendix 15, (funnel report 2) See Appendix 18, (explanation of funnel report)	See Appendix, 16 funnel report 3) See Appendix 19, (explanation of funnel report)

Site 1	Site 2	Site 3
		
Appendix 13, Figure 1: Visits to purchase for the three months for site 1.	Appendix 13, Figure 2: Visits to purchase for the three months for site 2.	Appendix 13, Figure 3: Visits to purchase for the three months for site 3.
		
Appendix 13, Figure 4: Days to purchase for the three months for site 1.	Appendix 13, Figure 5: Days to purchase for the three months for site 2.	Appendix 13, Figure 6: Days to purchase for the three months for site 3.

Site 1

Appendix 13, Table 1: Top landing pages

Page Title	Bounce Rate	Entrance Keywords	
		Expected Keywords	Unexpected Keywords
Shawl	47.16%	90%	10%
Khaleji Abaya	36.36%	96%	4%
Kaftan	34.73%	100%	0%
Hijab	28.11%	88%	12%
Al-Amira-Hijab	25.29%	94%	6%
Jilbab	21.24%	82%	18%
Abaya	20.65%	86%	14%
Home Page	18.89%	100%	0%
Ramadan	16.22%	67%	33%
Swim-Suit	17.41%	88%	12%

Appendix 13, Table 4: Top content pages metrics

Page Title	Avg. Time on Page	Bounce Rate	Percentage of Site Exit
Home page	0:01:04	19.90%	28.97%
Abaya	0:00:23	24.64%	25.95%
Jilbab	0:00:25	29.60%	67.18%
Khaleji-Abaya	0:00:17	27.36%	44.17%
newadd	0:00:25	21.89%	37.25%
Swim-Suit	0:00:26	50.28%	14.14%
Tops	0:00:20	27.24%	15.27%
Kaftan	0:00:15	38.50%	45.83%
Hijab	0:00:21	27.24%	48.17%
Dishdash.	0:00:13	37.58%	24.00%

Appendix 13, Table 7: Top exil pages metrics

Page Title	Percentage of Site Exit
Home page	28.97%
Swim-Suit	14.14%
Jilbab	37.18%
Abaya	15.95%
newadd	37.25%
Hijab	48.17%
Khaleji-Abaya	14.17%
Kaftan	55.83%
Tops	25.27%
Accessories	17.57%

Site 2

Appendix 13, Table 2: Top landing pages

Page Title	Bounce Rate	Entrance Keywords	
		Expected Keywords	Unexpected Keywords
Size Chart	92.04%	95%	5%
How to Measure	89.29%	90%	10%
Prayer Clothes	42.98%	93%	7%
Abaya & Dishdash	37.81%	96%	4%
Jilbab	32.72%	100%	0%
Orientals & Caftan	27.05%	100%	0%
Home Page	23.77%	98%	2%
Hijab	23.53%	85%	15%
Al-Ameera Hijab	21.31%	100%	0%
Shawl	17.92%	100%	0%

Appendix 13, Table 5: Top content pages metrics

Page Title	Avg. Time on Page	Bounce Rate	Percentage of Site Exit
Home page	0:00:40	24.17%	27.74%
Abaya & Dishdash	0:00:17	36.20%	38.86%
Hijab	0:00:11	43.56%	30.26%
Jilbab	0:00:06	50.00%	40.55%
Orientals & Caftan	0:00:07	60.00%	51.01%
skirts	0:00:10	33.33%	61.68%
shawl	0:00:07	55.00%	32.18%
Al-Ameera Hijab	0:00:10	47.37%	75.16%
Prayer clothes	0:00:11	35.00%	59.82%
Accessories	0:00:08	64.00%	41.32%

Appendix 13, Table 8: Top exit pages metrics

Page Title	Percentage of Site Exit
Home page	27.74%
jilbab	38.86%
Abaya & Dishdash	40.26%
How to measure	88.79%
Home page	73.98%
Hijab	59.82%
Al-Ameera Hijab	18.68%
Shawl	28.59%
Size chart	93.50%
Wholesale	16.93%

Site 3

Appendix 13, Table 3: Top landing pages

Page Title	Bounce Rate	Entrance Keywords	
		Expected Keywords	Unexpected Keywords
Arab Folk Songs (Arabic)	87.10%	100%	0%
Arab Folk Songs English)	63.16%	90%	10%
Holy River Products (English)	60.00%	86%	14%
Green Fields Products(Arabic)	58.05%	100%	0%
Home Page (Arabic)	54.13%	86%	14%
Showroom Products (Arabic)	53.33%	100%	0%
Home Page (English)	35.19%	94%	6%
Al-Sharqeya Products (Arabic)	30.43%	70%	30%
Mall Home Page (Arabic)	25.00%	100%	0%
Mall Home Page (English)	21.43%	100%	0%

Appendix 13, Table 6: Top content pages metrics

Page Title	Avg. Time on Page	Bounce Rate	Percentage of Site Exit
Home page (Arabic)	0:01:06	46.63%	31.39%
Home page (English)	0:01:16	38.87%	39.50%
Arab Folk Songs (Arabic)	0:00:24	16.67%	44.57%
Guest book (Arabic)	0:02:29	61.78%	50.69%
Mall Home Page (Arabic)	0:00:33	40.00%	66.21%
Home page (English)	0:00:40	50.00%	81.72%
Mall Home Page English)	0:00:27	30.00%	52.63%
Embroidery	0:00:55	40.00%	23.81%
Wood products	0:00:46	50.00%	80.87%
Glass products	0:00:39	58.33%	67.05%

Appendix 13, Table 9: Top exit pages metrics

Page Title	Percentage of Site Exit
Home page (English)	39.50%
Home page (Arabic)	31.39%
Gues book (English)	50.69%
Lina nuqul songs	57.14%
Orders page (Arabic)	34.38%
Home page of Mall	26.21%
Home page (English)	71.72%
Home page (Arabic)	64.57%
Nowl products	77.05%
Llinks page	50.00%

Site 1

Appendix 13, Table 10: Information Find Conversion Rate.

Page Title	Information Find Conversion Rate
Shayma Corner	4.00%
Baby Names	3.82%
Food Recipes	2.87%
Order Status	2.81%
Policy Return	0.61%
Policy Privacy	0.23%
Policy Shipping	0.97%
About Us	0.48%
Contact Us	1.37%
Customer Services	1.67%
FAQ	0.61%
Payment Methods	0.95%

Appendix 13, Table 13: Languages used by visitors to site 1.

Languages of Visitors	Percentage of Visits
en-us	79.55%
fr	6.18%
de	2.20%
en	1.96%
ru	1.48%
ar-sa	1.18%
nl	1.13%
en-gb	0.96%
sv	0.81%

Appendix 13, Table 16: Browsers used by visitors to site 1.

Browsers of Visitors	Percentage of Visits
Internet Explorer	79.39%
Firefox	16.88%
Safari	1.81%
Opera	1.37%
Mozilla	0.29%
Netscape	0.16%
Camino	0.02%
NetFront	0.02%
Konqueror	0.01%
Mozilla Compatible Agent	0.01%

Site 2

Appendix 13, Table 11: Information Find Conversion Rate.

Page Title	Information Find Conversion Rate
Contact Us	2.41%
Contact Us 2	0.40%
Help	0.04%
Privacy Policy	0.10%
Terms and Conditions	0.00%
Order History	2.13%
Gift Certificate	0.12%
Return Request Form	0.09%
Size Chart	1.68%
How to Measure	2.27%
Size Advisor	0.45%
Satisfaction Guarantee	0.30%
Help Center	0.25%
About Us	0.46%
Return Policy	0.39%
Shipping	1.83%
Security	0.13%
Payment Policy	0.45%

Appendix 13, Table 14: Languages used by visitors to site 2.

Languages of Visitors	Percentage of Visits
en-us	86.49%
fr	4.20%
en	1.94%
ar	1.11%
de	0.91%
nl	0.89%
es	0.59%
sv	0.56%
ar-sa	0.53%

Appendix 13, Table 17: Browsers used by visitors to site 2.

Browsers of Visitors	Percentage of Visits
Internet Explorer	76.59%
Firefox	19.33%
Safari	1.74%
Mozilla	1.24%
Opera	0.69%
Netscape	0.33%
Konqueror	0.03%
Camino	0.02%
(not set)	0.01%
AvantGo	0.01%

Site 3

Appendix 13, Table 12: Information Find Conversion Rate.

Page Title	Information Find Conversion Rate for the Arabic Pages	Information Find Conversion Rate for the English Pages
Contact Us	1.10%	0.42%
About Us	2.71%	0.85%
Services	1.02%	0.93%
Site Map	0.42%	0.08%
FAQ	0.25%	0.42%
About Us for the Mall	0.34%	0.08%
Contact Us for the Mall	0.42%	0.08%
Terms & Statements	0.00%	1.36%
Search Mall	0.00%	0.42%
Feedback (or Testimonials)	0.17%	0.00%

Appendix 13, Table 15: Languages used by visitors to site 3.

Languages of Visitors	Percentage of Visits
en-us	63.94%
ar-sa	22.68%
fr	4.30%
zh-cn	2.20%
en	1.10%
de	0.90%
tr	0.80%
he	0.70%
ar	0.60%

Appendix 13, Table 18: Browsers used by visitors to site 3.

Browsers of Visitors	Percentage of Visits
Internet Explorer	85.77%
Firefox	10.56%
Safari	2.30%
Mozilla	1.05%
Opera	0.21%
Netscape	0.10%

Appendix 13, Table 19: Operating systems used by visitors to site 1.

Operating Systems of Visitors	Percentage of Visits
Windows	96.80%
Macintosh	2.58%
Linux	0.42%
(not set)	0.09%
iPhone	0.05%
SymbianOS	0.03%
Danger Hiptop	0.01%
Nintendo Wii	0.01%
PalmOS	0.01%
iPod	0.01%

Appendix 13, Table 20: Operating systems used by visitors to site 2.

Operating Systems of Visitors	Percentage of Visits
Windows	95.88%
Macintosh	2.65%
Linux	1.35%
(not set)	0.08%
iPhone	0.03%
Danger Hiptop	0.01%
Nintendo Wii	0.01%

Appendix 13, Table 21: Operating systems used by visitors to site 3.

Operating Systems of Visitors	Percentage of Visits
Windows	96.13%
Macintosh	2.51%
Linux	1.26%
SymbianOS	0.10%

Appendix 13, Table 22: Screen colours used by visitors to site 1.

Screen Colors	Percentage of Visits
32-bit	90.42%
16-bit	6.21%
24-bit	3.27%
8-bit	0.06%
(not set)	0.04%
12-bit	0.01%
1-bit	> 0.00%
undefined-bit	> 0.00%

Appendix 13, Table 23: Screen colours used by visitors to site 2.

Screen Colors	Percentage of Visits
32-bit	89.99%
16-bit	6.84%
24-bit	3.11%
8-bit	0.04%
1-bit	0.01%
4-bit	0.01%

Appendix 13, Table 24: Screen colours used by visitors to site 3.

Screen Colors	Percentage of Visits
32-bit	87.97%
16-bit	7.01%
24-bit	4.29%
4-bit	0.73%

Appendix 13, Table 25: Screen resolution used by visitors to site 1.

Screen Resolutions	Percentage of Visits
1024x768	47.76%
1280x800	17.67%
1280x1024	10.25%
800x600	8.41%
1440x900	4.31%
1152x864	3.32%
1680x1050	2.18%
1280x768	1.93%
1280x960	0.92%
1400x1050	0.91%

Appendix 13, Table 26: Screen resolution used by visitors to site 2.

Screen Resolutions	Percentage of Visits
1024x768	47.59%
1280x800	17.01%
1280x1024	10.48%
800x600	7.99%
1440x900	3.90%
1152x864	3.63%
1280x768	2.22%
1680x1050	2.14%
1280x960	1.42%
1400x1050	1.18%

Appendix 13, Table 27: Screen resolution used by visitors to site 3.

Screen Resolutions	Percentage of Visits
1024x768	49.79%
800x600	19.25%
1280x800	10.56%
1280x1024	7.53%
1152x864	5.33%
1680x1050	1.67%
1440x900	1.46%
1280x768	1.15%
1300x1300	1.05%
1280x960	0.84%

Appendix 13, Table 28: Flash version used by visitors to site 1.

Flash Versions	Percentage of Visits
9	73.24%
9.0 r47	7.41%
9.0 r115	5.30%
9.0 r28	2.98%
9.0 r45	2.01%
8	1.90%
6	1.86%
(not set)	1.68%
7	1.22%
9.0 r16	0.73%

Appendix 13, Table 29: Flash version used by visitors to site 2.

Flash Versions	Percentage of Visits
9	71.30%
9.0 r47	7.58%
9.0 r115	5.72%
9.0 r45	3.48%
9.0 r28	3.42%
8	1.74%
6	1.53%
(not set)	1.34%
7	1.11%
9.0 r16	0.68%

Appendix 13, Table 30: Flash version used by visitors to site 3.

Flash Versions	Percentage of Visits
9	72.49%
6	5.65%
9.0 r28	4.39%
9.0 r47	3.87%
8	3.66%
9.0 r115	3.24%
(not set)	2.51%
7	1.88%
9.0 r45	0.73%
5	0.42%

Appendix 13, Table 31: Java support used by visitors to site 1.

Java Support	Percentage of Visits
Yes	98.91%
No	1.09%

Appendix 13, Table 32: Java support used by visitors to site 2.

Java Support	Percentage of Visits
Yes	99.25%
No	0.75%

Appendix 13, Table 33: Java support used by visitors to site 3.

Java Support	Percentage of Visits
Yes	99.37%
No	0.63%

Appendix 13, Table 34: Connection speed used by visitors to site 1.

Connection Speed of Visitors	Percentage of Visits
DSL	32.80%
Cable	28.69%
Unknown	27.92%
T1	5.86%
Dialup	3.43%
OC3	1.20%
ISDN	0.11%

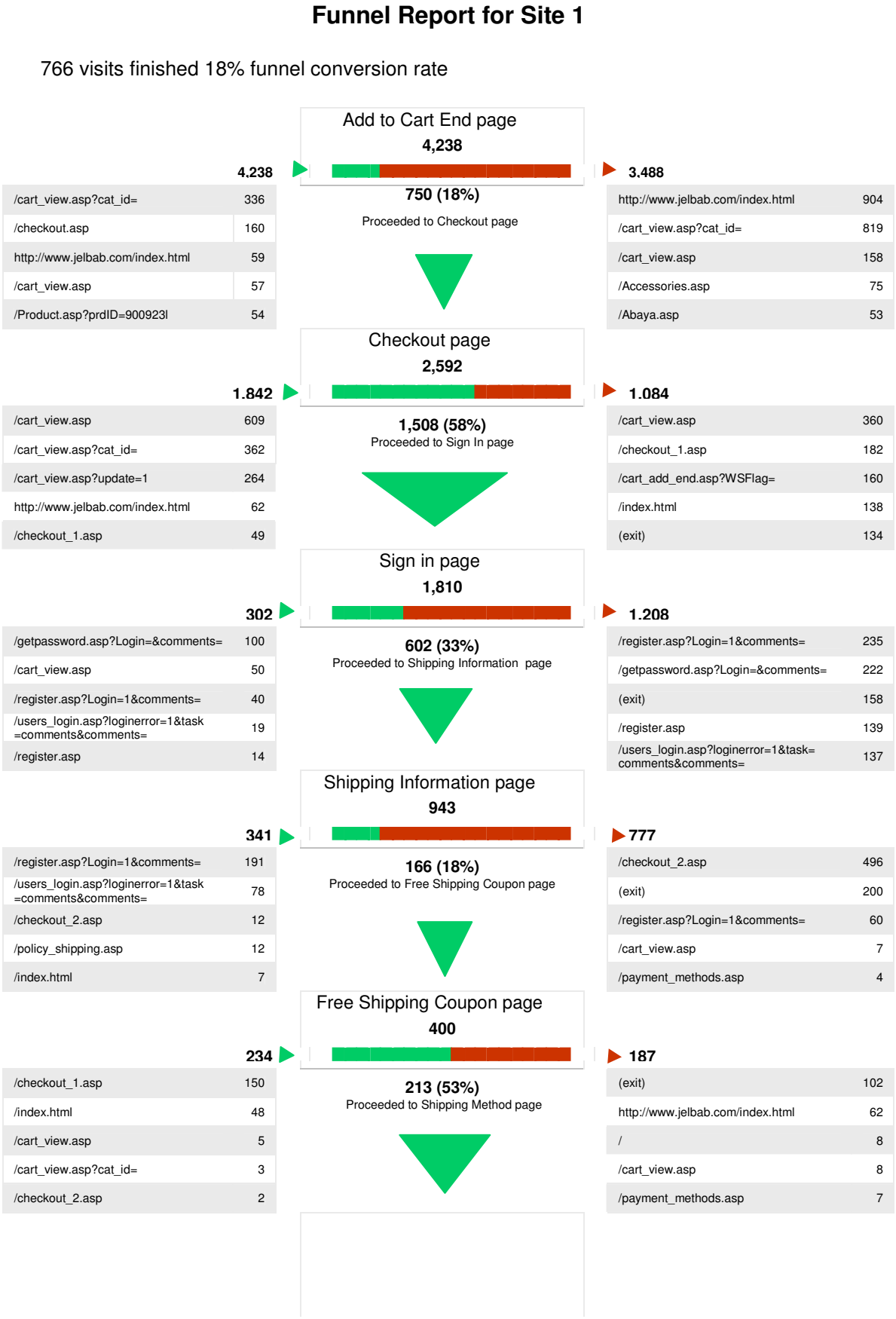
Appendix 13, Table 35: Connection speed used by visitors to site 2.

Connection Speed of Visitors	Percentage of Visits
DSL	32.93%
Cable	31.75%
Unknown	23.80%
T1	6.45%
Dialup	3.55%
OC3	1.46%
ISDN	0.06%

Appendix 13, Table 36: : Connection speed used by visitors to site 3.

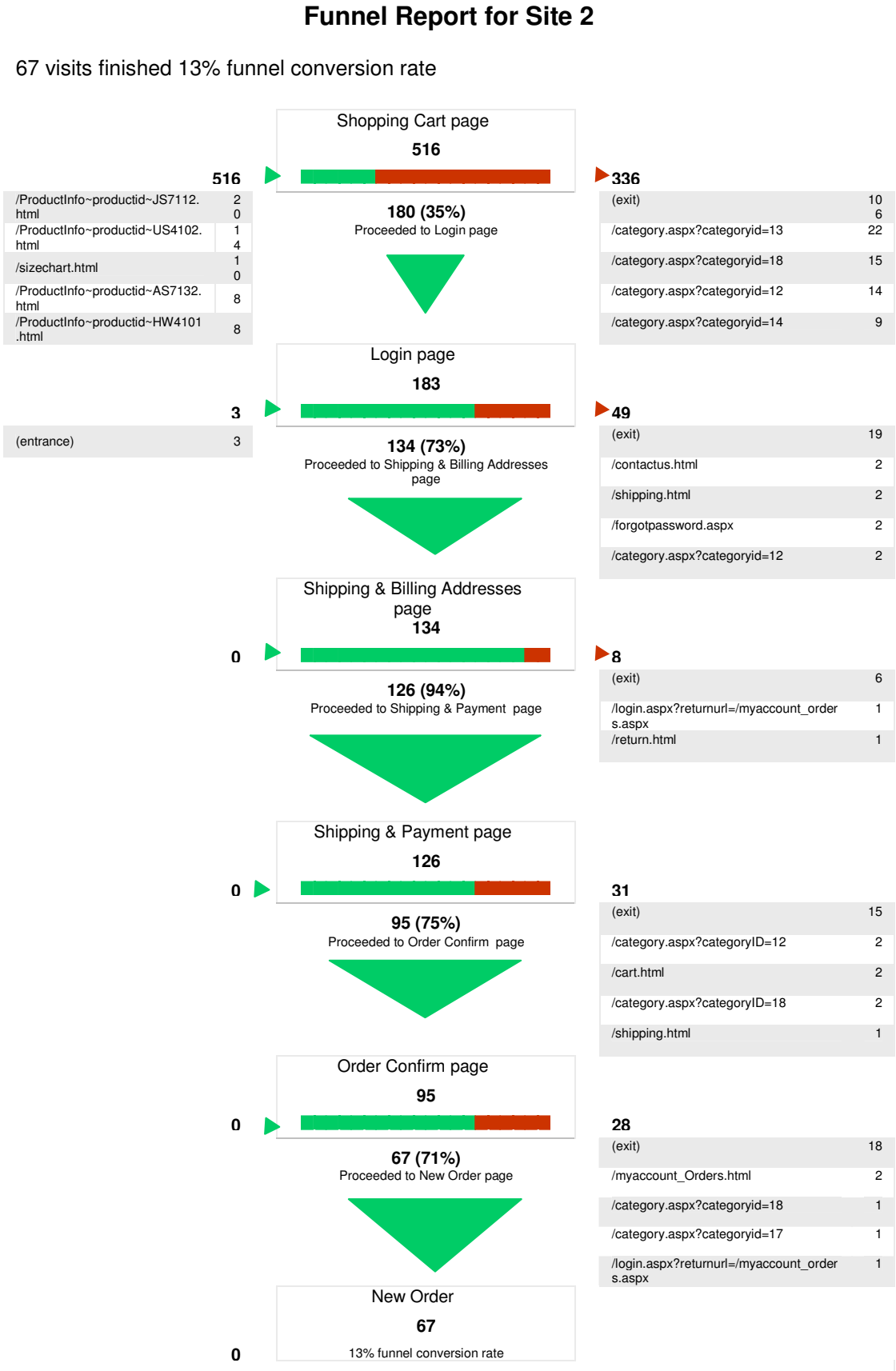
Connection Speed of Visitors	Percentage of Visits
DSL	55.33%
Unknown	26.26%
Cable	8.16%
T1	6.17%
Dialup	3.66%
ISDN	0.21%
OC3	0.21%

Appendix 14: Funnel report for site 1

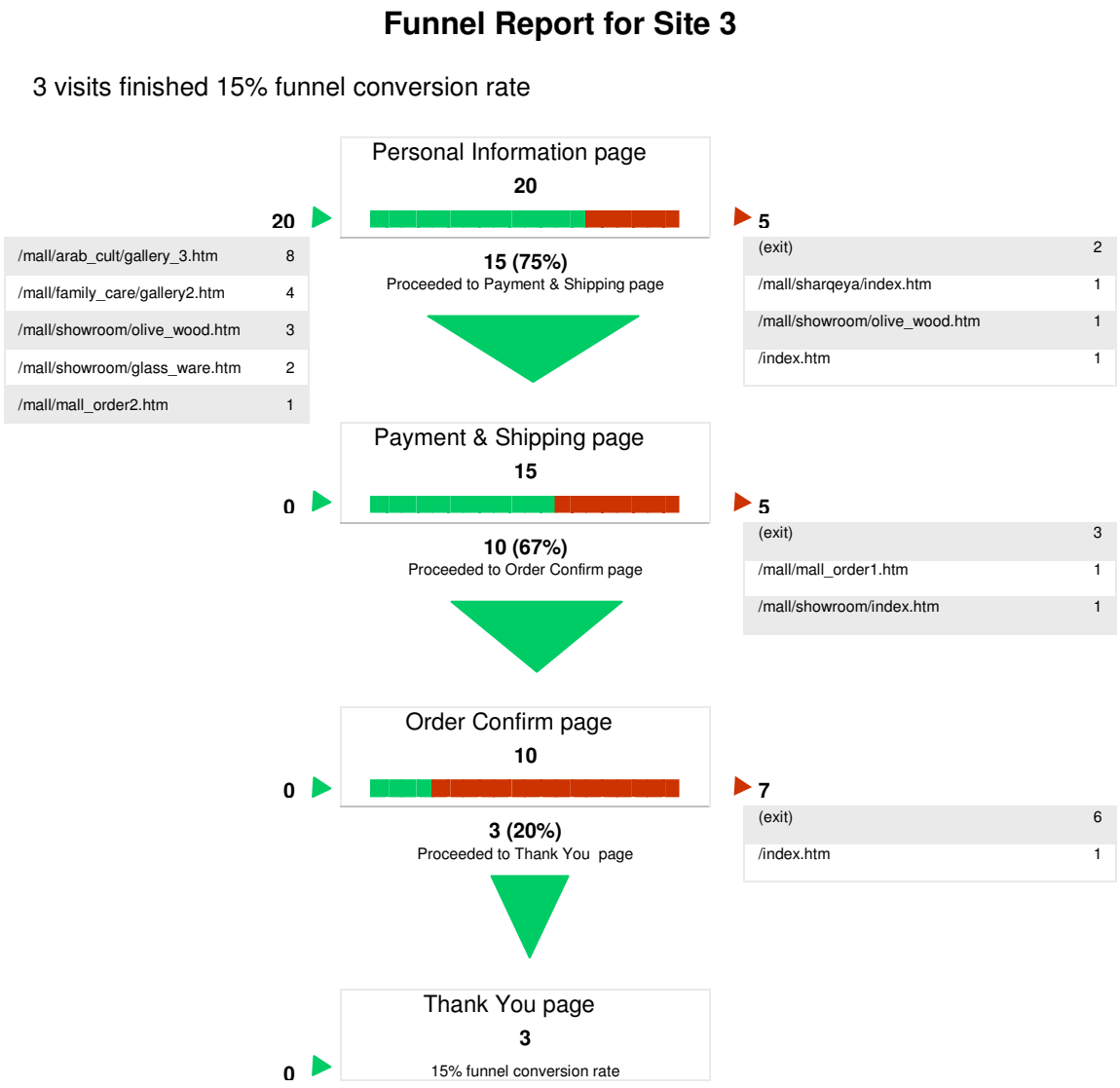



Shipping Method page
1,644
1.431
463
1,181 (72%)
Proceeded to Billing Method page
/checkout_1.asp 784
/checkout_1.asp?task=comments &comments= 496
/http://www.jelbab.com/index.html 42
/ 28
/cart_view.asp 8
(exit) 270
/http://www.jelbab.com/index.html 80
/ 62
/cart_view.asp 16
/index.html 14
Billing Method page
1,265
84
499
766 (61%)
Proceeded to New Order page
/sajedainternational/payment/ checkout_4.asp 76
/http://www.jelbab.com/index.html 5
/guestbook.asp 3
/sajedainternational/payment/ checkout_4.asp 265
(exit) 175
/http://www.jelbab.com/index.html 88
/cart_view.asp 44
/index.html 8
New Order
766
0
18% funnel conversion rate

Appendix 15: Funnel report for site 2



Appendix 16: Funnel report for site 3



Appendix 17: Explanation of the funnel report for site 1

1. Explanation of the funnel report for Site 1

The funnel report described visit movements relating to each step of the defined purchasing. This includes seven pages. For each page of the funnel report one table is displayed on the left and another on the right of it. Rows contain URLs and the number of visits to each URL. This represents the URLs of the top five previous and next pages. The table on the left describes the URLs and the number of visits for each URL, of where visitors came from. The table on the right describes the URLs and the number of visits for each URL that visitors of the current page went to. The number of rows can be between zero and five: zero rows are displayed if the current page did not have other previous pages or next pages in addition to the defined previous page in the funnel. Five rows are displayed if the current page has other previous or next pages in addition to the defined previous and next pages in the funnel. Those five pages represent pages have the highest visits numbers.

The following explains the URLs and the numbers displayed at the funnel report for the seven defined steps of the purchasing process for site 1:

1.1 Step 1: Add to Cart End Page:

Table 1 represented the visit movements to and from the Add to Cart End Page, as it appeared in the funnel report. Table 2 explains the page titles for the URLs that appeared in Table 1 and the meaning of the numbers displayed beside each page.

Table 1: The top previous and next pages for Add to cart End Page

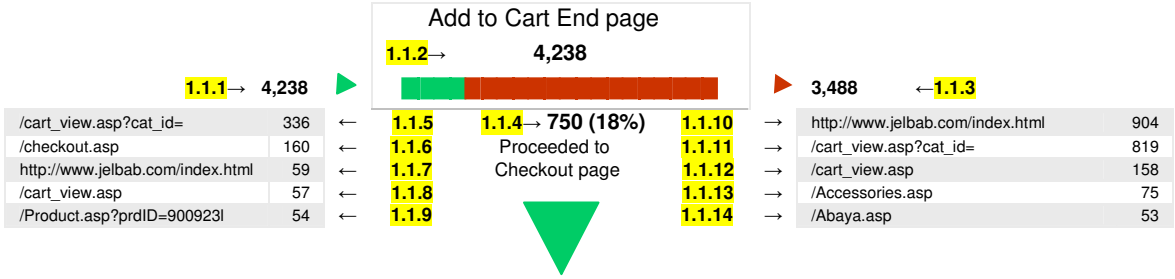


Table 2: Explanation for the top previous and next pages for the Add to cart End page.

	Data of Table 1			Meaning
	Number	**URL**	**Page Title**	
1.1.1	**4,238**	---		The total number of visits to the Add to Cart End page came from different pages (URLs). Only five pages (URLs), which have the highest visits numbers (and the number of visits to those pages) are displayed in the left table under this number.
1.1.2	**4,238**	---		The total number of visits to Add to Cart End page.
1.1.3	**3,488**	---		The total number of visits abandoned at the Add to Cart End page. Five pages (URLs), which have the highest visits numbers (and the number of visits to those pages) are displayed in the right table below this number.
1.1.4	**750 (18%)**	---		The total number of visits and the percentage of visits to the Add to Cart End page that continued on to the next defined page in the funnel, the Checkout page. This number is the result of subtracting the 1.1.3 figure from 1.1.2 figure: (4,238 – 3,488 = 750).
1.1.5	**336**	/cart_view.asp?cat_id=	Shopping cart	336 visits came from the Shopping Cart page. This means that those visits which went directly to the Shopping Cart page from the Add to Cart End page (using view cart link that was located at the middle of add to cart end page), returned back directly to the Add to Cart End page.
1.1.6	**160**	/checkout.asp	Checkout	160 visits came from the Checkout page. This means that those visits which went directly to the Checkout page from the Add to Cart End page, returned back directly to the Add to Cart End page.

1.1.7	**59**	http://www.jelbab.com/index.html	Home page	59 visits came from the home page of the site. This means that those visits which went directly to the home page of the site from the Add to Cart End page, returned back directly to the Add to Cart End page.
1.1.8	**57**	/cart_view.asp	Shopping cart	57 visits came from the Shopping Cart page. This means that those visits which went directly to the Shopping Cart page from the Add to Cart End page (using view cart link that was located at the top menu of the site), returned back directly to the Add to Cart End page.
1.1.9	**54**	/Product.asp?prdID=9009231	Product number 9009231	54 visits came from one of the products pages, product 9009231, a scarf product. This means that this product's page was the most viewed. This product is a supplementary product. It is one of the accessory page products, priced at $3.99.
1.1.10	**904**	http://www.jelbab.com/index.html	Home page	904 visits to the Add to Cart End page went directly to the Home page of the site. Shop more link located at the Add to Cart End page might encourage visitors to do this.
1.1.11	**819**	/cart_view.asp?cat_id=	Shopping cart	819 visits to the Add to Cart End page went directly to the Shopping Cart page. This page was opened using the View Cart link located in the middle of the Add to Cart End page.
1.1.12	**158**	/cart_view.asp	Shopping cart	158 visits to the Add to Cart End page went directly to the Shopping Cart page. This page was opened using the View Cart link located on the top menu of the site.
1.1.13	**75**	/Accessories.asp	Accessories	75 visits to the Add to Cart End page went directly to the Accessories page. This page displayed a rang of supplementary products: under-scarf, hijab pins and hand accessories.
1.1.14	**53**	/Abaya.asp	Abaya	53 visits to the Add to Cart end page went directly to the Abaya page. This page represents one of the site's products.

- **Summary:**

1.1.15 977 visits (977= 819+158) were visitors who added product(s) to their shopping cart and went directly to the shopping cart page. 750 visits were visitors who went directly to the next defined page in the funnel, the Checkout page (see 1.1.11, 1.1.12, and 1.1.4).

1.1.16 Most visits of the Add to Cart End page were visitors who went directly to the Home page of the site after adding product(s) to their shopping cart (see 1.1.10).

1.1.17 The product page that visitors went to after adding product(s) to their shopping cart was the Accessories page. This page displayed a variety of supplementary products with prices less than $12. Statistics show that some visitors added product(s) from this page to their shopping cart. The product page that most visitors visited before adding product(s) to their cart was under scarf products. This product is a supplementary product displayed on the Accessories page (see 1.1.13 and 1.1.9).

1.1.18 The second most product page that visitors went to after adding product(s) to their shopping cart was the Abaya page. Abaya is one of the site's products (see 1.1.14).

1.2 Step 2: Checkout Page:

Table 3 represented the visit movements to and from the Checkout page, as it appeared in the funnel report. Table 4 explained the page titles for the URLs appeared on Table 3 and the meaning of the numbers displayed beside each page.

Table 3: The top previous and next pages for checkout Page

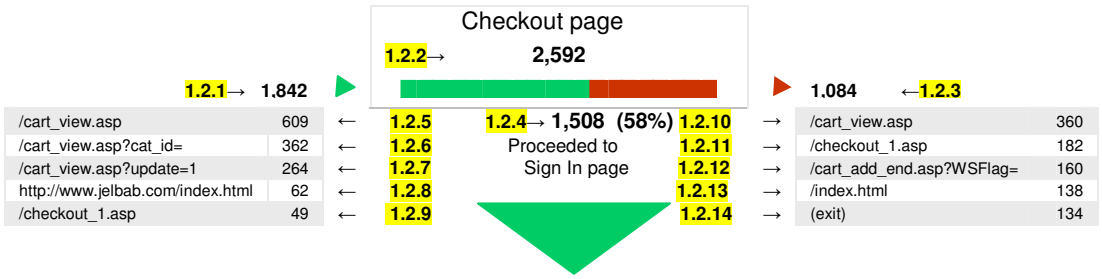


Table 4: Explanation for the top previous and next pages for the checkout page.

	Data of Table 3			Meaning
	Number	**URL**	**Page Title**	
1.2.1	**1,842**	---		The total number of visits to the Checkout page from different pages (URLs) other than the page defined in the funnel report (the Add to Cart End page). Only five pages (URLs), with the highest visit numbers (and the number of visits to those pages) are displayed on the left table under the total number.
1.2.2	**2,592**	---		The total number of visits to the Checkout page. These visits included visits that came from the defined page (funnel) as well as other pages. This number is the result of adding the 1.1.4 figure (see Tables 1 and 2) to the 1.2.1 figure: (750 + 1,842 = 2,592).
1.2.3	**1,084**	---		The total number of visits that abandoned the Checkout page. The five pages (URLs), with the highest visits numbers (and the number of visits to those pages) are displayed on the right table below the total number.
1.2.4	**1,508 (58%)**	---		The total number of visits and percentage of visits of the Checkout page that continued on to the next defined page in the funnel, Sign In page. This number is the result of subtracting the 1.2.3 figure from the 1.2.2 figure: (2,592 – 1,084 = 1,508).
1.2.5	**609**	/cart_view.asp	Shopping cart	609 visits came from the Shopping Cart page. These visits were visitors who checked out from the Shopping Cart page. These visitors could be any number of visitors (between 1 and 158) who went to the Shopping Cart from the Add to Cart End page (see 1.1.12 in Tables 1 and 2).
1.2.6	**362**	/cart_view.asp?cat_id=	Shopping cart	362 visits came from the Shopping Cart page. These visits were visitors who checked out from the Shopping Cart page. These visitors could be any number of visitors (between 1 and 819) who went to the Shopping Cart from the Add to Cart End page (see 1.1.11 in Tables 1 and 2).
1.2.7	**264**	/cart_view.asp?update=1	Shopping cart	264 visits came from the Shopping Cart page. This means that those visits were visitors who checked out from the Shopping Cart page after they had updated their shopping using the update order link. This located on the Shopping Cart page.
1.2.8	**62**	http://www.jelbab.com/index.html	Home page	62 visits came from the home page. This means that those visits who went to the home page from the Checkout page, returned back to the Checkout page. 138 visits went to the home page from the Checkout page (see 1.2.13).
1.2.9	**49**	/checkout_1.asp	Shipping information	49 visits came from the Shipping Information page. This means that those visits who went to the Shipping Information page directly from the Checkout page, returned back to the Checkout page. 182 visits went to the Shipping Information page from the Checkout page (see 1.2.11).
1.2.10	**360**	/cart_view.asp	Shopping cart	360 visits to the Checkout page went to the Shopping Cart page. This means that those visits who came to the Checkout page directly from the Shopping Cart page, returned back directly to the Shopping Cart page. 609 visits came to the Checkout page from the Shopping Cart page (see 1.2.5).
1.2.11	**182**	/checkout_1.asp	Shipping information	182 visits of the Checkout page went directly to the Shipping Information page. This means those visits were visitors who logged into the site from any page before checking out, so they did not have to pass through the Sign In page (as defined in the funnel).
1.2.12	**160**	/cart_add_end.asp?WSFlag=	Add to cart end page	160 visits of the Checkout page went directly to the Add to Cart End page. This means that those visits who came to the Checkout page directly from the Add to Cart End

				page, returned back directly to the Add to Cart End page. 750 visits came to the Checkout page from Add to Cart End page (see 1.1.4).
1.2.13	**138**	/index.html	Home page	138 visits of the Checkout page went directly to the home page of the site. The shop more link located on the checkout page might encourage visitors to do this.
1.2.14	**134**	(exit)		134 visits of the Checkout page exited the site from this page.

- **Summary:**

1.2.15 The total number of visitors (1,235 = 609 + 362 + 264), who checked out from the Shopping Cart page, was more than the number of visitors (750) who checked out from the Add to Cart End page (see 1.1.4, 1.2.5, 1.2.6 and 1.2.7).

1.2.16 The home page was the fourth most visited page by visitors who had checked out (see 1.2.13).

1.2.17 Few visitors logged into the site (182) before checking out, while 1,508 visitors went to the Sign In page during the checkout process, as expected (see 1.2.4 and 1.2.11).

1.3 Step 3: Sign In Page:

Table 5 represented the visit movements to and from the Sign In page, as it appeared in the funnel report. Table 6 explains the page titles for the URLs that appeared in Table 5 and the meaning of the numbers displayed beside each page.

Table 5: The top previous and next pages for sign in page

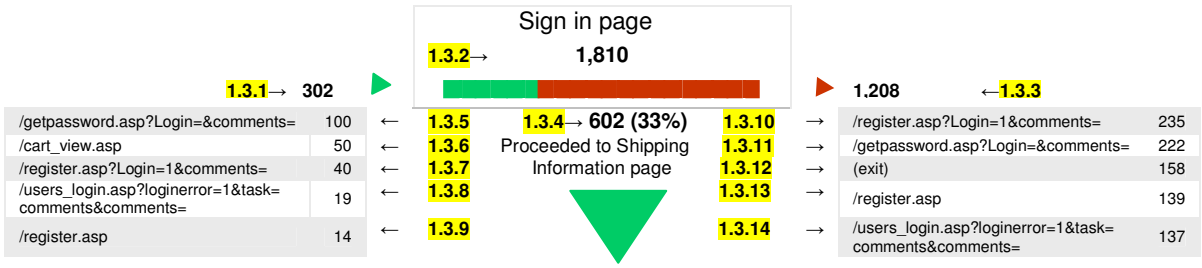


Table 6: Explanation for the top previous and next pages for the sign in page.

	Data of Table 5			Meaning
	Number	**URL**	**Page Title**	
1.3.1	**302**	---		The total number of visits to the Sign In page from different pages (URLs) other than the page defined in the funnel (the Checkout page). Only five pages (URLs), with the highest visit numbers (and the number of visits to those pages) are displayed on the left table under the total number.
1.3.2	**1,810**	---		The total number of visits to the Sign In page. These visits were visits from the defined page in the funnel as well as other pages. This number is the result of adding the 1.2.4 figure (see Tables 3 and 4) to the 1.3.1 figure: (1,508 + 302 = 1,810).
1.3.3	**1,208**	---		The total number of visits that abandoned the Sign In page. Only five pages (URLs), with the highest visit numbers and the number of visits to those pages displayed on the right table below the total number.
1.3.4	**602**	---		The total number of visits and the percentage of visits to the Sign In page that proceeded to the next defined page in the funnel, the Shipping Information page. This number is the result of subtracting the 1.3.3 figure from the 1.3.2 figure: (1,810 – 1,208 = 602).
1.3.5	**100**	/getpassword.asp?Login=&comments=	Forget account number	100 visits came from the Forgot Account Number page. Those visits which went directly to the Forgot Account Number page (using forgot account number link located at the Sign In page), returned back directly to the Sign In page. 222 visits went to the Forgot Account Number page from the Sign In page (see 1.3.11).
1.3.6	**50**	/cart_view.asp	Shopping cart	50 visits came from the Shopping Cart page. Those visits signed into the site from the Shopping Cart page (using the sign in link located at the top menu of the site).

1.3.7	**40**	/register.asp?Login=1&comments=	Registration	40 visits came from the Registration page. Those visits which went directly to the Registration page from the Sign In page, returned back directly to the Sign In page. 235 visits went to the Registration page from the sign in page (see 1.3.10).
1.3.8	**19**	/users_login.asp?loginerror=1&task=comments&comments	Sign in page-login error	19 visits came from the Sign In page-login error. Those visits which went directly to the Sign In page-login error from the Sign In page (by entering the wrong account number or email address), returned back directly to the Sign In page. 137 visits went to the Sign In page-login error from the Sign In page (see 1.3.14).
1.3.9	**14**	/register.asp	Registration	14 visits came from the Registration page. Those visits which went directly to the Registration page from the Sign In page, returned back directly to the Sign In page. 139 visits went to the Registration page from the Sign In page (see 1.3.13).
1.3.10	**235**	/register.asp?Login=1&comments=	Registration	235 visits to the Sign In page went directly to the Registration page, using the register now link located on the middle of the Sign In page. These visitors might be new visitors without an account number, and therefore they went to the Registration page during the checkout process in order to register.
1.3.11	**222**	/getpassword.asp?Login=&comments=	Forget account number	222 visits to the Sign In page went directly to the Forgot Account Number page. These visits include returned visitors who already had an account number, but had forgotten their account number or their email address. Therefore, they clicked at the forgot account number link located on the Sign In page.
1.3.12	**158**	(exit)		158 visits to the Sign In page exited the site from this page.
1.3.13	**139**	/register.asp	Registration	139 visits to the Sign In page went directly to the Registration page, using the register link that was located at the top menu of the site. These visitors might be new visitors who did not have an account number, and therefore they went to the registration page during the checkout process in order to register.
1.3.14	**137**	/users_login.asp?loginerror=1&task=comments&comments=	Sign in page-login error	137 visits to the Sign In page went directly to the Sign In page-login error. These visits include visitors who had an account number but they entered the wrong account number or email address either by mistake or because they had forgotten their login information. Some could be returned visitors.

- **Summary:**

1.3.15 Many visitors went to the Forgot Account Number page to get their account number, or to the Sign In-login error page by entering the wrong login information (see 1.3.11 and 1.3.14).

1.3.16 Some visitors who entered wrong the login information tried to enter their login information a second time (see 1.3.14. and 1.3.8).

1.3.17 Return visitors represented the majority of visitors who signed into the site during the checkout process. Return visitors (961) included visitors who went directly to the next step in the Checkout process (Shipping Information page) by entering their login information (602), and visitors who went to the Forgot Account Number page to remember their login information (222), and visitors who entered wrong login information (137) (see 1.3.4, 1.3.11 and 1.3.14).

1.3.18 New visitors (374 = 235+139) were those visitors who went directly to register into the site from the Sign In page (see 3.10 and 3.13).

1.4 Step 4: Shipping Information Page:

Table 7 represented the visit movements to and from the Shipping Information page, as it appeared in the funnel report. Table 8 explained the page titles for the URLs that appeared in Table 7 and the meaning of the numbers displayed beside each page.

Table 7: The top previous and next pages for shipping information page

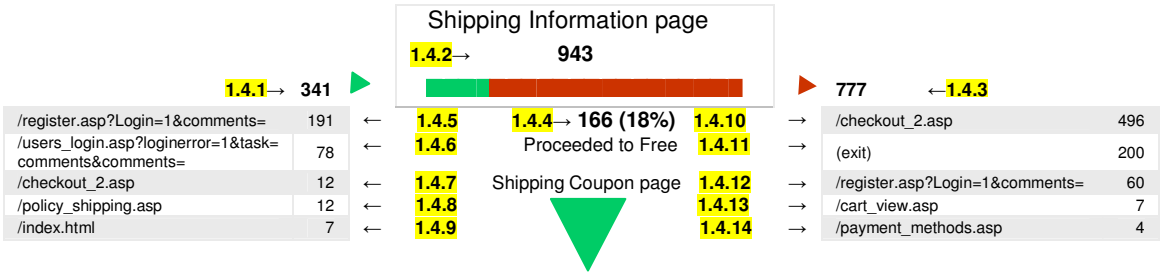


Table 8: Explanation for the top previous and next pages for the shipping information page.

	Data of Table 7			Meaning
	Number	**URL**	**Page Title**	
1.4.1	**341**	---		The total number of visits to the Shipping Information page from different pages (URLs) other than the page defined in the funnel (the Sign In page). Only five pages (URLs), with the highest visit numbers (and the number of visits to those pages) are displayed on the left table under the total number.
1.4.2	**943**	---		The total number of visits to the Shipping Information page. These included visits that came from the defined page in the funnel as well as other pages. This number is the result of adding the 1.3.4 figure (see Tables 5 and 6) to the 1.4.1 figure: (602 + 341 = 943).
1.4.3	**777**	---		The total number of visits that abandoned the Shipping Information page. The five pages (URLs), with the highest visit numbers (and the number of visits to those pages) are displayed on the right table below the total number.
1.4.4	**166 (18%)**	---		The total number of visits and the percentage of visits of the Shipping Information page that proceeded to the next defined page in the funnel, the Free Shipping Coupon page. This number is the result of subtracting the 1.4.3 figure from the 1.4.2 figure: (943 – 777 = 166). (**Note**: the site provides a free shipping coupon for visitors to be used within one month of their registration to site. After the month even if visitors did not use their shipping coupon, it expires. Visitors who went to the Free Shipping Coupon page were visitors who did not use their free shipping coupon provided by the site. These visitors might be new visitors who had just registered on the site, or returned visitors who were new customers, or returned customers who had not used their shipping coupon (and who had registered less than one month ago). The free shipping coupon page disappears for visitors who had used their free shipping coupon, or who registered to the site more than one month ago).
1.4.5	**191**	/register.asp?Login=1&comments=	Registration	191 visits came from the Registration page. These visits visitors were new, completed their registration and then clicked at the Checkout link located on Thank You for Your Registration page. Those visitors accounted for 51% (191 out of 374), where 374 represented visitors who registered as new visitors when they reached the Sign In page (see 1.3.18).
1.4.6	**78**	/users_login.asp?loginerror=1&task=comments&comments=	Sign in page-login error	78 visits came from the Sign In page-login error. This included visitors who entered the correct account information after they had entered the wrong account information. Therefore, they came from the Sign In page-login error. These 78 or 57% of the visitors (see 1.3.14) entered the wrong account number or email address while trying to log into the site (where 57%= 78 out of 137).
1.4.7	**12**	/checkout_2.asp	Shipping method	12 visits came from the Shipping Method page. These visits went directly to the Shipping Method page from the Shipping Information page and then returned back directly to the Shipping Information page. 496 visits went to the Shipping Method page from the Shipping Information page (see 1.4.10).
1.4.8	**12**	/policy_shipping.asp	Shipping	12 visits came from the Shipping Policy page. These visits

			policy	went directly to the Shipping Policy page from the Shipping Information page and then returned back directly to the shipping information page.
1.4.9	**7**	/index.html	Home page	12 visits came from the home page. These visits went directly to the Home page from the Shipping Information page and then returned back directly to the Shipping Information page.
1.4.10	**496**	/checkout_2.asp	Shipping method	496 visits to the Shipping Information page went directly to the Shipping Method page. These visits included returned visitors who had either used their free shipping coupon or were registered to the site more than one month ago (see the note at 1.4.4). These visitors did not have a free shipping coupon and therefore went directly to the Shipping Method page without passing through the Free Shipping Coupon page.
1.4.11	**200**	(exit)		200 visits to the Shipping Information page exited the site from this page.
1.4.12	**60**	/register.asp?Login=1&comments=	Registration	60 visits to the Shipping Information page went directly to the Registration page. These visits came to the Shipping Information page directly from the Registration page and then returned back directly to the Registration page. 191 visits went to the Registration page from the Shipping Information page (see 1.4.5).
1.4.13	**7**	/cart_view.asp	Shopping cart	7 visits to the Shipping Information page went directly to the Shopping Cart page (by clicking on the view cart link located on the top menu).
1.4.14	**4**	/payment_methods.asp	Payment methods	4 visits to the Shipping Information page went directly to the Payment Methods page.

- **Summary:**

1.4.15 Most visitors who went to the Shipping Information page were return visitors. This was indicated by the number of visits to the Shipping Information page directly from the Sign In page. These visits included visitors who had their login information (602). While the number of visits to the Shipping Information page from other pages, which could indicate new and/or return visitors was 341 (see 1.3.4 and 1.4.1).

1.4.16 The majority of visitors went to the Sipping Method page from the Sipping Information page. These were return visitors (who either had used their free shipping coupon or were registered on to the site more than one month ago (see the note at 1.4.4 and 1.4.10).

1.5 Step 5: Free Shipping Coupon Page:

Table 9 represented the visit movements to and from the Free Shipping Coupon page, as it appeared in the funnel report. Table 10 explained the page titles for the URLs that were appeared in Table 9 and the meaning of the numbers that are displayed beside each page.

Table 9: The top previous and next pages for free shipping coupon page

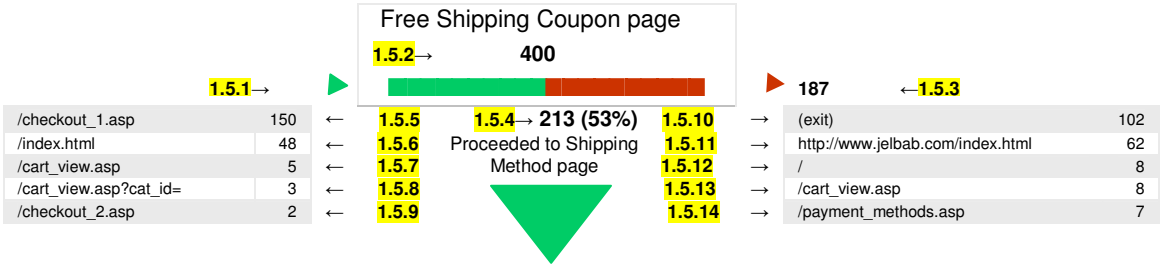


Table 10: Explanation for the top previous and next pages for the free shipping coupon page.

	Data of Table 9			Meaning
	Number	**URL**	**Page Title**	
1.5.1	**234**	---		The total number of visits to the Free Shipping Coupon page from different pages (URLs) other than the page defined in the funnel (the Shipping Information page). Only five pages (URLs) with the highest visits numbers and the number of visit to those pages are displayed on the left table under the

				total number.
1.5.2	**400**	---		The total number of visits to the Free Shipping Coupon page. These visits were from the defined page in the funnel as well as other pages. This number is the result of adding the 1.4.4 figure (see Tables 7 and 8) to the 1.5.1 figure: (166 + 234 = 400).
1.5.3	**187**	---		The total number of visits that abandoned the Free Shipping Coupon page. The five pages (URLs) with the highest visit numbers (and the number of visits to those pages) are displayed on the right table below the total number.
1.5.4	**213 (53%)**	---		The total number of visits and the percentage of visits to the Free Shipping Coupon page that proceeded to the next defined page in the funnel, the Shipping Method page. This number is the result of subtracting the 1.5.3 figure from the 1.5.2 figure: (400 – 187 = 213).
1.5.5	**150**	/checkout_1.asp	Shipping information	150 visits came from the Shipping Information page. Description of these visitors is explained in 1.4.4 the note.
1.5.6	**48**	/index.html	Home page	48 visits came from the Home page. These visits went directly to the Home page from the Free Shipping Coupon page and then returned back directly to the Free Shipping Coupon page. 70 visits went to the Home page from the Free Shipping Coupon page (see 1.5.11 and 1.5.12).
1.5.7	**5**	/cart_view.asp	Shopping cart	5 visits came from the Shopping Cart page. These visits went directly to the Shopping Cart page from the Free Shipping Coupon page and then returned back directly to the Free Shipping Coupon page. 8 visits went to the Shopping Cart page from the Free Shipping Coupon page (see 1.5.13).
1.5.8	**3**	/cart_view.asp?cat_id=	Shopping cart	3 visits came from the Shopping Cart page. These visits which went directly to the Shopping Cart page from the Free Shipping Coupon page and then returned back directly to the Free Shipping Coupon page.
1.5.9	**2**	/checkout_2.asp	Shipping method	2 visits came from the Shipping Method page. These visits went directly to the expected Shipping Method page from the Free Shipping Coupon page and then returned back directly to the Free Shipping Coupon page. 213 visits went to the Shipping Method page from the Free Shipping Coupon page (see 1.5.4).
1.5.10	**102**	(exit)		102 visits to the Free Shipping Coupon page exited the site from this page.
1.5.11	**62**	http://www.jelbab.com/index.html	Home page	62 visits to the Free Shipping Coupon page went directly to the Home page.
1.5.12	**8**	/	Home page	8 visits to the Free Shipping Coupon page went directly to the Home page.
1.5.13	**8**	/cart_view.asp	Shopping cart	8 visits to the Free Shipping Coupon page went directly to the Shopping Cart page.
1.5.14	**7**	/payment_methods.asp	Payment methods	7 visits to the Free Shipping Coupon page went directly to the Payment Methods page.

- **Summary:**

1.5.15 316 visitors (166 +150) who were visitors who had registered to the site less than one month. Those visitors might be new, or returned visitors had not used their shipping coupon (see 1.4.4 and 1.5.5).

1.6 Step 6: Shipping Method Page:

Table 11 represented the visit movements to and from the Shipping Method page, as it appeared in the funnel report. Table 12 explained the page titles for the URLs that appeared in Table 11 and the meaning of the numbers displayed.

Table 11: The top previous and next pages for shipping method page

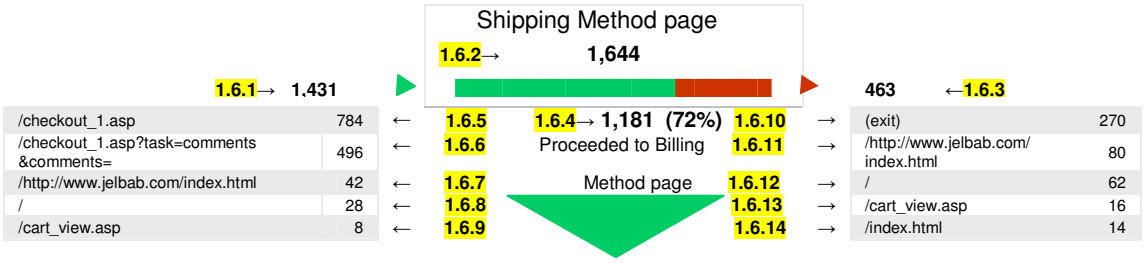


Table 12: Explanation for the top previous and next pages for shipping method page.

	Data of Table 11			Meaning
	Number	**URL**	**Page Title**	
1.6.1	**1,431**	---		The total number of visits to the Shipping Method page from different pages (URLs) other than the page defined in the funnel (the free shipping coupon page). Only five pages (URLs) with the highest visit numbers (and the number of visits to those pages) are displayed on the left table under the total number.
1.6.2	**1,644**	---		The total number of visits to the Shipping Method page. These visits came from the defined page in the funnel in addition to other pages. This number is the result of adding the 1.5.4 figure (see Tables 9 and 10) to the 1.6.1 figure: (213 + 1,431 = 1,644).
1.6.3	**463**	---		The total number of visits abandoned from the Shipping Method page. Five pages (URLs) with the highest visits numbers (and the number of visits to those pages) are displayed on the right table below the total number.
1.6.4	**1,181**	---		The total number of visits and the percentage of visits to the Shipping Method page that proceeded to the next defined page in the funnel, the Billing Method page. This number is the result of subtracting the 1.6.3 figure from the 1.6.2 figure: (1,644 – 463 = 1,181).
1.6.5	**784**	/checkout_1.asp	Shipping information	784 visits came from the Shipping Information page. These visits included return visitors who registered to the site over one month ago (see the note at 1.4.4). Therefore, they went directly to the Shipping Method page without passing through the Free Shipping Coupon page.
1.6.6	**496**	/checkout_1.asp?task=comments&comments=	Shipping information	496 visits came from the Shipping Information page (description of those visitors at 1.6.5).
1.6.7	**42**	/http://www.jelbab.com/index.html	Home page	42 visits came from the Home page of the site. These visits went directly to the Home page from the Shipping Method page and then returned back directly to the Shipping Method page. 156 visits went to the Home page from the Shipping Method page (see 1.6.11, 1.6.12 and 1.6.14).
1.6.8	**28**	/	Home page	28 visits came from the Home page of the site. These visits went directly to the Home page from the Shipping Method page and then returned back directly to the Shipping Method page. 156 visits went to the Home page from the Shipping Method page (see 1.6.11, 1.6.12 and 1.6.14).
1.6.9	**8**	/cart_view.asp	Shopping cart	8 visits came from the Shopping Cart page. These visits which went directly to the Shopping Cart page from the Shipping Method page and then returned back directly to the Shipping Method page. 16 visits went to the Shopping Cart page from the Shipping Method page (see 1.6.13).
1.6.10	**270**	(exit)		270 visits to the Shipping Method page exited the site from this page.
1.6.11	**80**	/http://www.jelbab.com/index.html	Home page	80 visits to the Shipping Method page went directly to the Home page.

1.6.12	62	/	Home page	62 visits to the Shipping Method page went directly to the Home page.
1.6.13	16	/cart_view.asp	Shopping cart	16 visits to the Shipping Method page went directly to the Shopping Cart page.
1.6.14	14	/index.html	Home page	14 visits to the Shipping Method page went directly to the Home page.

- **Summary:**

1.6.15 The majority of visitors who went through the Shipping Method page were return visitors. 1,280 (784 + 496) visitors who went to the Shipping Method page were visitors who had been registered to the site for more than one month (see 1.6.5 and 1.6.6).

1.6.16 213 visitors to the Shipping Method page were visitors who had been registered to the site for less than one month. These could be either new visitors or return visitors (see 1.5.4).

1.7 Step 7: Billing Method Page:

Table 13 represented the visit movements to and from the Billing Method page, as it appeared in the funnel report. Table 14 explained the page titles for the URLs on Table 13 and the meaning of the numbers displayed.

Table 13: The top previous and next pages for billing method page

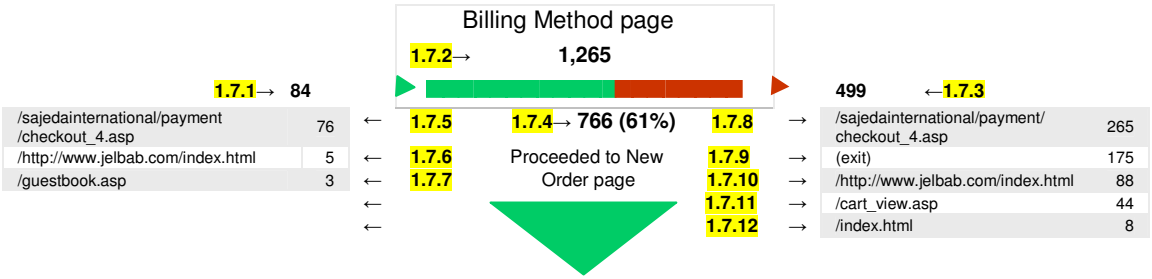


Table 14: Explanation for the top previous and next pages for the billing method page.

	Data of Table 13			Meaning
	Number	URL	Page Title	
1.7.1	84	---		The total number of visits to the Billing Method page from different pages (URLs) other than the page defined in the funnel, the Shipping Method page. Only five pages (URLs) with the highest visit numbers (and the number of visits to those pages) are displayed on the left table under the total number.
1.7.2	1,265	---		The total number of visits to the Billing Method page. These visits came from the defined page in the funnel in addition to other pages. This number is the result of adding the 1.6.4 figure (see Tables 11 and 12) to the 1.7.1 figure: (1,181 + 84 = 1,265).
1.7.3	499	---		The total number of visits that abandoned the Billing Method page. Five pages (URLs) with the highest visit numbers (and the number of visits to those pages) are displayed on the right table below the total number.
1,7.4	766 (61%)	---		The total number of visits and the percentage of visits to the Billing Method page that purchased from the site and went to the Thank you for your order page. This number is the result of subtracting the 1.7.3 figure from the 1.7.2 figure: (1,265 – 499 = 766).
1.7.5	76	/sajedainternational/payment/checkout_4.asp	Error billing page	76 visits came from the Error Billing page. These visits which went directly to the Error Billing page by entering incorrect information and then returned back directly to the Billing Method page. 265 visits went to the Error Billing page from the Billing Method page (see 1.7.8).
1.7.6	5	/http://www.jelbab.com/index.html	Home page	5 visits came from the Home page. These visits went directly to the Home page from the Billing Method page and then

				returned back directly to the Billing Method page. 96 visits went to the Home page from the Billing Method page (see 1.7.10 and 1.7.12).
1.7.7	**3**	/guestbook.asp	Guest book	3 visits came from the Guest Book page. These visits which went directly to the Guest Book page from the Billing Method page and then returned back directly to the Billing Method page.
1.7.8	**265**	/sajedainternational/payment/checkout_4.asp	Error billing page	265 visits to the Billing Method page went directly to the Error Billing page. These visits entered incorrect information in one or more of the billing fields on the Billing Method page.
1.7.9	**175**	(exit)		175 visits to the Billing Method page exited the site from this page.
1.7.10	**88**	/http://www.jelbab.com/index.html	Home page	88 visits to the Billing Method page went directly to the Home page of the site.
1.7.11	**44**	/cart_view.asp	Shopping cart	819 visits to the Billing Method page went directly to the Shopping Cart page.
1.7.12	**8**	/index.html	Home page	8 visits to the Billing Method page went directly to the Home page of the site.

- **Summary:**

1.7.13 The majority of visitors entered incorrect information in one or more field(s) on the Billing Method page (see 1.7.8).

1.7.14 A large number of visitors exited the site from the Billing Method page (see 1.7.9).

Appendix 18: Explanation of the funnel report for site 2

2. Explanation of the Funnel Report for Site 2

The defined purchasing path for site 2 includes five pages. The following explains the URLs and numbers displayed at the funnel report for the seven defined pages or steps of the purchasing process for site 2.

2.1 Step 1: Shopping Cart Page:

Table 15 represented the visit movements to and from the Shopping Cart page, as it appeared in the funnel report. Table 16 explained the page titles for the URLs in Table 15 and the meaning of the numbers displayed.

Table 15: The top previous and next pages for shopping cart page

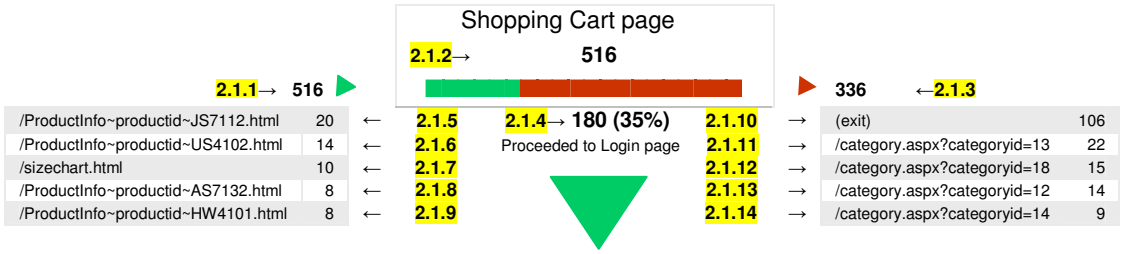


Table 16: Explanation for the top previous and next pages for the shopping cart page.

	Data of Table 15			Meaning
	Number	**URL**	**Page Title**	
2.1.1	**516**	---		The total number of visits to the Shopping Cart page came from different pages (URLs). Only five pages (URLs) with the highest visit numbers (and the number of visits to those pages) are displayed on the left table under the total number.
2.1.2	**516**	---		The total number of visits to the Shopping Cart page
2.1.3	**336**	---		The total number of visits abandoned the Shopping Cart page. Five pages (URLs) with the highest visit numbers (and the number of visits to those pages) are displayed on the right table below the total number.
2.1.4	**180**	---		The total number of visits and the percentage of visits to the Shopping Cart page that proceeded to the next defined page in the funnel, the Login page. This number is the result of subtracting the 2.1.3 figure from the 2.1.2 figure: (516 – 336 = 180).
2.1.5	**20**	/ProductInfo~productid ~JS7112.html	Jilbab JS7112	20 visits came from one of the product pages. This was the jlbab JS7112 product. This means that this product was the most popular product added to the Shopping Cart during the test period.
2.1.6	**14**	/ProductInfo~productid ~US4102.html	Solid Underscarf US4102	14 visits came from another product pages. This was solid the underscarf US4102 product. This means that this product was the second most popular product added to the Shopping Cart during the test period.
2.1.7	**10**	/sizechart.html	Size Chart	10 visits came from the Size Chart page. These visits went to the Shopping Cart page from the Size Chart page using the Shopping Cart link located at the top menu of the site.
2.1.8	**8**	/ProductInfo~productid ~AS7132.html	Abaya AS7132	8 visits came from another product pages. This was the abaya AS7132 product. This means that this product was the third most popular product added to the Shopping Cart during the test period.
2.1.9	**8**	/ProductInfo~productid ~HW4101.html	Embriodered Handwrist HW4101	8 visits came from another product pages. This was the embriodered handwrist HW4101 product. This means that this product was the fourth most popular product added to the Shopping Cart during the test period.

2.1.10	**106**	(exit)		106 visits to the Shopping Cart page exited the site from this page.
2.1.11	**22**	/category.aspx?category id=13	Accessories	22 visits to the Shopping Cart page went directly to the Accessories page (one of the product categories of the site). The Keep Shopping link located o the shopping cart page might encourage the visitors to do this. Note: The destination page of the Keep Shopping link located on the Shopping Cart page varied. It depended on the last product added to the Shopping Cart since it opened the same main category page as the last product purchased. For example, if the last product added to the Shopping Cart was one from the Accessories page, then the Keep Shopping link will open the Accessories page.
2.1.12	**15**	/category.aspx?category id=18	Jilbab	15 visits to the Shopping Cart page went directly to the Jilbab page, which is one of the product categories of the site. The Keep Shopping link located at the Shopping Cart page might encourage visitors to do this (see the note at 2.1.11).
2.1.13	**14**	/category.aspx?category id=12	Abaya	14 visits to the Shopping Cart page went directly to the abaya page, another product categories of the site. The Keep Shopping link located at the Shopping Cart page might encourage visitors to do this. (see the note at 2.1.11).
2.1.14	**9**	/category.aspx?category id=14	Al-Ameera Hijab	9 visits to the Shopping Cart page went directly to the Al-ameera hijab page, another product categories of the site. The Keep Shopping link located at the Shopping Cart page might encourage visitors to do this. (see the note at 2.1.11).

- **Summary:**

2.1.15 Most visits included visitors who exited the site from the Shopping Cart page (see 2.1.10).

2.1.16 Most visits to the Shopping Cart page included visitors who went to different product pages after adding product(s) to their shopping cart (see 2.1.11, 2.1.12, .1.13, and 2.1.14).

2.2 Step 2: Login Page:

Table 17 represented the visit movements to and from the login page, as it appeared in the funnel report. Table 18 explained the page titles for the URLs appeared at Table 17 and the meaning of the numbers displayed.

Table 17: The top previous and next pages for login Page

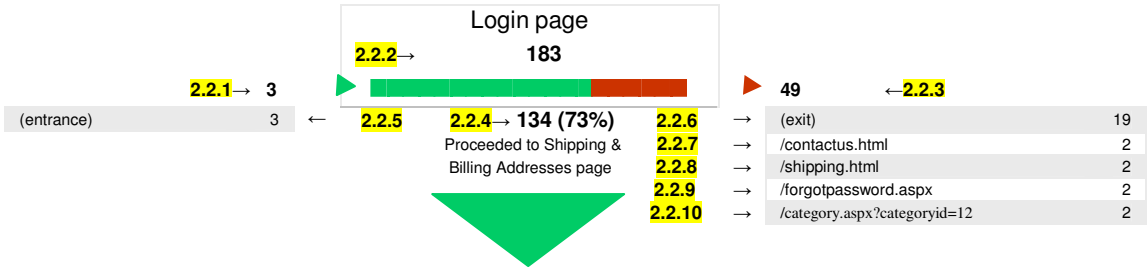


Table 18: Explanation for the top previous and next pages for the login page.

	Data of Table 17			Meaning
	Number	**URL**	**Page Title**	
2.2.1	**3**	---		The total number of visits to the Login page from different pages (URLs) other than the page defined in the funnel (the Shopping Cart page). Only three visits entered the Login page directly as shown on the left table under the total number.
2.2.2	**183**	---		The total number of visits to the Shopping Cart page. These visits came from the defined page as well as other pages. This number is the result of adding the 2.1.4 figure (see Tables 15 and 16) to the 2.2.1 figure: (180 + 3 = 183).

2.2.3	**49**	---		The total number of visits abandoned the Shopping Cart page. Five pages (URLs) with the highest visits numbers (and the number of visits to those pages) are displayed on the right table below the total number.
2.2.4	**134 (73%)**	---		The total number of visits and the percentage of visits to the Shopping Cart page that proceeded to the next defined page in the funnel, the Shipping and Billing Addresses page. This number is the result of subtracting the 2.2.3 figure from the 2.2.2 figure: (183 – 49 = 134).
2.2.5	**3**	(entrance)		3 visits entered the site from the Login page. Therefore, the Login page was the entrance page for some visitors.
2.2.6	**19**	(exit)		19 visits of the Login page exited the site from this page.
2.2.7	**2**	/contactus.html	Contact us	2 visits to the Login page went to the Contact Us page.
2.2.8	**2**	/shipping.html	Shipping	2 visits to the Login page went to the Sipping page.
2.2.9	**2**	/forgotpassword.aspx	Forgot Password	2 visits to the Login page went to the Forgot Password page.
2.2.10	**2**	/category.aspx?categoryid=20	Orientals & Caftan	2 visits to the Login page went to the Orientals & Caftan page, one of the product categories on the site.

2.3 Step 3: Shipping and Billing Address Page:

Table 19 represented the visit movements to and from the Shipping and Billing Address page, as it appeared in the funnel report. Table 20 explained the page titles for the URLs appeared in Table 19 and the meaning of the numbers displayed.

Table 19: The top previous and next pages for shipping and billing address page

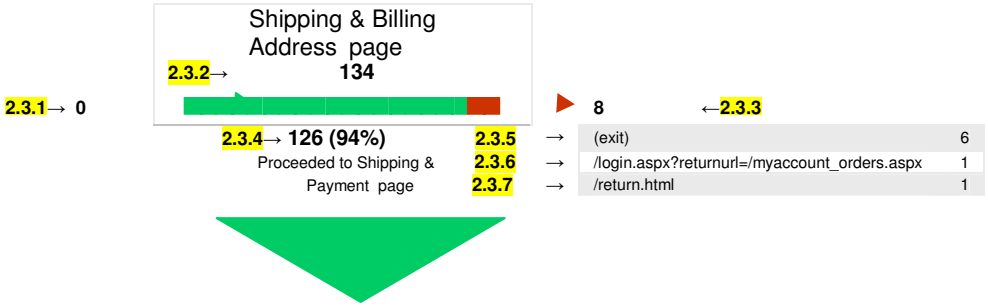


Table 20: Explanation of the top previous and next pages for shipping and billing address page.

	Data of Table 19			Meaning
	Number	**URL**	**Page Title**	
2.3.1	**0**	---		The total number of visits to the Shipping and Billing Address page from different pages (URLs) other than the page defined in the funnel (the Shopping Cart page). All the visits to this page came from the defined page in the funnel.
2.3.2	**134**	---		The total number of visits to the Shipping and Billing Address page. These visits came from the defined page in the funnel in addition to other pages. This number is the result of adding the 2.2.4 figure (see Tables 17 and 18) to the 2.3.1 figure: (134 + 0 = 134).
2.3.3	**8**	---		The total number of visits that abandoned the Shipping and Billing Address page. Eight visits abandoned the Shopping Cart page as shown on right table below the total number.
2.3.4	**126 (94%)**	---		The total number of visits and the percentage of visits to the Shipping and Billing Address page that proceeded to the next defined page in the funnel, the Shipping and Payment page. This number is the result of subtracting the 2.3.3 figure from the 2.3.2 figure: (134 – 8 = 126).

2.3.5	**6**	(exit)		6 visits to the Shipping and Billing Address page exited the site from this page.
2.3.6	**1**	/login.aspx?returnurl=/myaccount_orders.aspx	Login	1 visit to the Shipping and Billing Address page went to the Login page. These visits went to the Shipping and Billing Address page directly from the Login page and then returned back to the Login page. 134 visits went to the Shipping and Billing Address page from the Login page (see 2.2.4).
2.3.7	**1**	/return.html	Return policy	1 visit to the Shipping and Billing Address page went to the Return Policy page.

2.4 Step 4: Shipping and Payment Page:

Table 21 represented the visit movements to and from the shipping and payment page, as it appeared in the funnel report. Table 22 explained the page titles for the URLs appeared on Table 21 and the meaning of the numbers displayed.

Table 21: The top previous and next pages for shipping and payment page

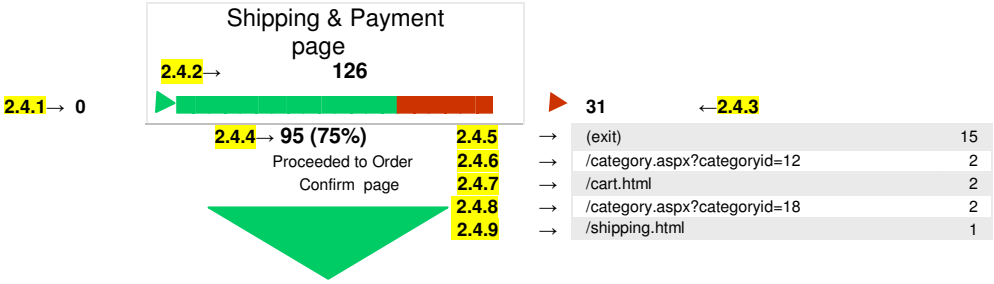


Table 22: Explanation for the top previous and next pages for the shipping and payment page.

	Data of Table 21			Meaning
	Number	**URL**	**Page Title**	
2.4.1	**0**	---		The total number of visits to the Shipping and Payment page from different pages (URLs) to the page defined in the funnel (the Shipping and Billing Address page). All the visits to this page came from the defined page in the funnel.
2.4.2	**126**	---		The total number of visits to the Shipping and Payment page. These visits came from the defined page in the funnel in addition to other pages. This number is the result of adding the 2.3.4 figure (see Tables 19 and 20) to the 2.4.1 figure: (126 + 0 = 126).
2.4.3	**31**	---		The total number of visits that abandoned the Shipping and Payment page. Five pages (URLs) with the highest visit numbers (and the number of visits to those pages) are displayed on the right table below the total number.
2.4.4	**95 (75%)**	---		The total number of visits and the percentage of visits to the Shipping and Payment page that proceeded to the next defined page in the funnel, the Order Confirm page. This number is the result of subtracting the 2.4.3 figure from the 2.4.2 figure: (126 – 31 = 95).
2.4.5	**15**	(exit)		15 visits to the Shipping and Payment page exited the site from this page.
2.4.6	**2**	/category.aspx?categoryID=12	Abaya	2 visits to the Shipping and Payment page went directly to the Abaya page, one of the product categories of the site.
2.4.7	**2**	/cart.html	Shopping cart	2 visits to the Shipping and Payment page went directly to the Shopping Cart page.
2.4.8	**2**	/category.aspx?categoryid=18	Jilbab	2 visits to the Shipping and Payment page went directly to the Jilbab page, one of the product categories of the site.
2.4.9	**1**	/shipping.html	Shipping	1 visit to the Shipping and Payment page went directly to the shipping page.

2.5 Step 5: Order Confirm Page:

Table 23 represented the visit movements to and from the Order Confirm page, as it appeared in the funnel report. Table 24 explained the page titles for the URLs that appeared in Table 23 and the meaning of the numbers displayed.

Table 23: The top previous and next pages for free order confirm page

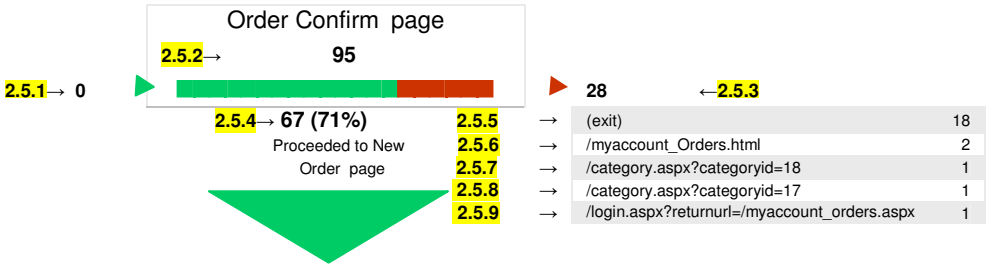


Table 24: Explanation for the top previous and next pages for the order confirm page.

	Data of Table 23			Meaning
	Number	**URL**	**Page Title**	
2.5.1	**0**	---		The total number of visits to the Order Confirm page from different pages (URLs) other than the page defined in the funnel (the Shipping and Payment page). All the visits to this page came from the defined page in the funnel.
2.5.2	**95**	---		The total number of visits to the Order Confirm page. These visits included those from the defined page in the funnel in addition to other pages. This number is the result of adding the 2.4.4 figure (see Tables 21 and 22) to the 2.5.1 figure: (95 + 0 = 95).
2.5.3	**28**	---		The total number of visits that abandoned at the Order Confirm page. Five pages (URLs) with the highest visits numbers (and the number of visits to those pages) are displayed on the right table below the total number.
2.5.4	**67 (71%)**	---		The total number of visits and the percentage of visits to the Order Confirm page who purchased from the site and went to the Thank you for your order page. This number is the result of subtracting the 2.5.3 figure from the 2.5.2 figure: (95 – 28 = 67).
2.5.5	**18**	(exit)		18 visits to the Order Confirm page exited the site from this page.
2.5.6	**2**	/myaccount_Orders.html	Order history	2 visits to the Order Confirm page went directly to the Order History page.
2.5.7	**1**	/category.aspx?categoryid=18	Jilbab	1 visit of the Order Confirm page went directly to the Jilbab page, one of the product categories of the site.
2.5.8	**1**	/category.aspx?categoryid=17	Hijab	1 visit to the Order Confirm page went directly to the Hijab page, one of the product categories of the site.
2.5.9	**1**	/login.aspx?returnurl=/myaccount_orders.aspx	Login	1 visit to the Order Confirm page went directly to the Login page.

Appendix 19: Explanation of the funnel report for site 3

3. Explanation of the Funnel Report for Site 3

The defined purchasing path for site 3 includes three pages. The following explains the URLs and the numbers displayed in the funnel report for the seven defined steps of the purchasing process for site 3:

3.1 Step 1: Personal Information Page:

Table 25 represented the visit movements to and from the Personal Information page, as it appeared in the funnel report. Table 26 explained the page titles for the URLs appeared in Table 25 and the meaning of the numbers displayed.

Table 25: The top previous and next pages for personal information page

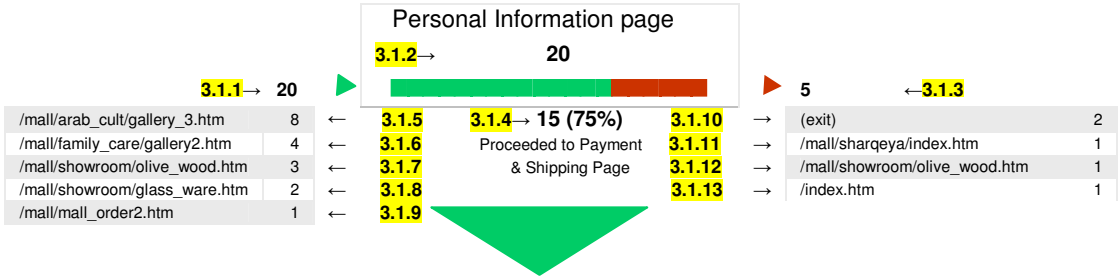


Table 26: Explanation for the top previous and next pages for the personal information page.

	Data of Table 25			Meaning
	Number	URL	Page Title	
3.1.1	20	---		The total number of visits to the Personal Information page from different pages (URLs). Five pages (URLs) with the highest visit numbers (and the number of visits to those page)s are displayed on the left table under the total number.
3.1.2	20	---		The total number of visits to the Personal Information page
3.1.3	5	---		The total number of visits that abandoned at the Personal Information page. Five pages (URLs) with the highest visit numbers (and the number of visits to those pages) are displayed on the right table below the total number.
3.1.4	15 (75%)	---		The total number of visits and the percentage of visits to the Personal Information page that proceeded to the next defined page in the funnel, the Payment and Shipping page. This number is the result of subtracting the 3.1.3 figure from the 3.1.2 figure: (20 – 5 = 15).
3.1.5	8	/mall/arab_cult/gallery_3.htm	Arab cultural society showroom	8 visits came from one of the site's shops. This was the Arab Cultural Society Showroom Shop that displayed a number of products. This means that this shop's page included the most popular product(s) added to the Shopping Cart during the test period.
3.1.6	4	/mall/family_care/gallery2.htm	Dresses-family care	4 visits came from one of the site's shops. This was the Family Care Shop that displayed dresses. This means that this shop's page included the second most popular product(s) added to the Shopping Cart during the test period.
3.1.7	3	/mall/showroom/olive_wood.htm	Turathcom showroom for handcraft and art-holy land statues	3 visits came from one of the site's shops. This was the Turathcom Showroom for Handcraft and Art-holy Land Statues Shop. This means that this shop included the third most popular product(s) added to the Shopping Cart during the test period.
3.1.8	2	/mall/showroom/glass_ware.htm	Turathcom showroom for handcraft and art-hebron glass	2 visits came from one of the site's shops. This was the Turathcom Showroom for Handcraft and Art- Hebron Glass shop. This means that this shop included the fourth most popular product(s) added to the Shopping Cart during the test period.

3.1.9	**1**	/mall/mall_order2.htm	Payment and shipping page	1 visit came from the Payment and Shipping page. This visit went to the Payment and Shipping page directly from the Personal Information page and then returned back to the Personal Information page. 15 visits went to the Payment and Shipping page from the Personal Information page (see 3.1.4).
3.1.10	**2**	(exit)		2 visits to the Personal Information page exited the site from this page.
3.1.11	**1**	/mall/sharqeya/index.htm	Al sharqeya fashion house-home page	1 visit to the Personal Information page went directly to Al Sharqeya Fashion House-Home page.
3.1.12	**1**	/mall/showroom/olive_wood.htm	Turathcom showroom for handcraft and art-holy land statues	1 visit to the Personal Information page went directly to the Turathcom Showroom for Handcraft and Art-Holy Land Statues. This visit came to the Personal Information page directly from the Turathcom showroom for handcraft and art-holy land statues page and then returned back to this page. 3 visits came to the Personal Information page from the Turathcom Showroom for Handcraft and Art-holy Land statues (see 3.1.7).
3.1.13	**1**	/index.htm	Home page	1 visit to the Personal Information page went directly to the Home page of the site.

3.2 Step 2: Payment and Shipping Page:

Table 27 represented the visit movements to and from the Payment and Shipping page, as it appeared in the funnel report. Table 28 explained the page titles for the URLs that appeared in Table 27 and the meaning of the numbers displayed.

Table 27: The top previous and next pages for payment and shipping page

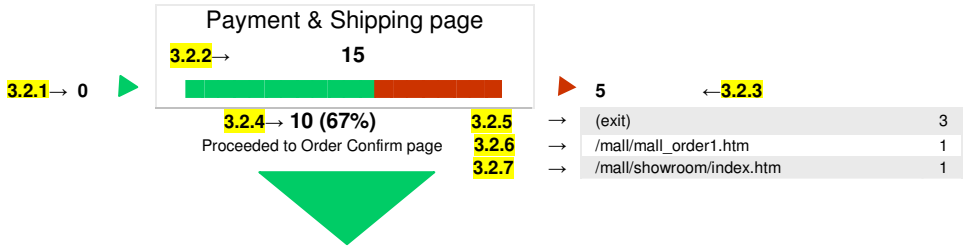


Table 28: Explanation for the top previous and next pages for the payment and shipping page.

	Data of Table 27			**Meaning**
	Number	**URL**	**Page Title**	
3.2.1	**0**	---		The total number of visits to the Payment and Shipping page from different pages (URLs) other than the page that was defined in the funnel (the Personal Information page). All the visits to this page came from the defined page in the funnel.
3.2.2	**15**	---		The total number of visits to the Payment and Shipping page. These visits came from the defined page in the funnel in addition to other pages. This number is the result of adding the 3.1.4 figure (see Tables 25 and 26) to the 3.2.1 figure: (15 + 0 = 15).
3.2.3	**5**	---		The total number of visits that abandoned the Payment and Shipping page. Five pages (URLs) with the highest visits numbers (and the number of visits to those pages) are displayed on the right table below the total number.
3.2.4	**10 (67%)**	---		The total number of visits and the percentage of visits to the Payment and Shipping page that proceeded to the next defined page in the funnel, the Order Confirm page. This number is the result of subtracting the 3.2.3 figure from the 3.2.2 figure: (15 – 5 = 10).
3.2.5	**3**	(exit)		3 visits to the Payment and Shpping page exited the site from

				this page.
3.2.6	1	/mall/mall_order1.htm	Personal information	1 visit to the Payment and Shipping page went directly to Personal Information. This visit came directly to the Payment and Shipping page from the Personal Information page and then returned back directly to the Personal Information page. 15 visits came to the Payment and Shipping from the Personal Information page (see 3.2.4).
3.2.7	1	/mall/showroom/index.htm	Home page-mall	1 visit to the Payment and Shipping page went directly to the Home page of the Mall.

3.3 Step 3: Order Confirm Page:

Table 29 represented the visit movements to and from the Order Confirm page, as it appeared in the funnel report. Table 30 explained the page titles for the URLs that appeared on Table 19 and the meaning of the numbers displayed.

Table 29: The top previous and next pages for order confirm page

Table 30: Explanation for the top previous and next pages for order confirm page.

	Data of Table 29			Meaning
	Number	URL	Page Title	
3.3.1	0	---		The total number of visits to the Order Confirm page from different pages (URLs) other than the page defined in the funnel (the Personal Information page). All the visits to this page came from the defined page in the funnel.
3.3.2	10	---		The total number of visits to the Order Confirm page. These visits included those from the defined page in the funnel in addition to other pages. This number is the result of adding the 3.2.4 figure (see Tables 27 and 28) to the 3.3.1 figure: (10 + 0 = 10).
3.3.3	7	---		The total number of visits that abandoned the Order Confirm page. Five pages (URLs) with the highest visits numbers (and the number of visits to those pages) are displayed on the right table below the total number.
3.3.4	3 (20%)	---		The total number of visits and the percentage of visits to the Order Confirm page that purchased from the site and went to the Thank you for your order page. This number is the result of subtracting the 3.3.3 figure from the 3.3.2 figure: (10 – 7 = 3).
3.3.5	6	(exit)		6 visits to the Order Confirm page exited the site from this page.
3.3.6	1	/index.htm	Home page	1 visit to the Order Confirm page went directly to Home page of the site .

Appendix 20: Users' characteristics and the frequency distribution

No.	Characteristic	Range		Frequency Distribution	
				Novice Group	Expert Group
Personal Information					
1	Age	18-29		60%	70%
		30-39		30%	30%
		40-49		10%	0%
		Over 50		0%	0%
2	Gender	Male		20%	20%
		Female		80%	80%
3	Education	Postgraduate Degree		10%	20%
		Higher Diploma		0%	0%
		Bachelors Degree		40%	60%
		Diploma		40%	20%
		Tawjehi or lower		10%	0%
Computer Experience					
4	Experience using Computer	Under 1 year		0%	0%
		1-3 years		30%	0%
		More than 3 years		70%	100%
5	Daily Use of Computer	Less than 2 hours		20%	0%
		2-4 hours		10%	30%
		More than 4 hours		70%	70%
Internet Experience					
6	Browser	Internet Explorer		90%	90%
		Netscape Navigator		10%	10%
		Other		0%	0%
7	Experience using Internet	Less than 1 year		10%	0%
		1-3 years		90%	0%
		More than 3 years		0%	100%
8	Weekly Use of Internet	Less than 2 hours		0%	0%
		2-4 hours		20%	10%
		More than 4 hours		80%	90%
9	Have you browsed the following websites before?	Website 1	Yes	0%	0%
			No	100%	100%
		Website 2	Yes	0%	0%
			No	100%	100%
		Website 3	Yes	0%	0%
			No	100%	100%
10	Did the User Used the Internet for Purchasing	Yes		0%	40%
		No		100%	60%

Appendix 21: Likert scores of the pre-test questionnaire for novice and expert users and the result of Mann-Whitney test

No.	Question	Likert Score		Mann-Whitney Test
		Novice Group	Expert Group	Was there a statistically significant difference between novice group and expert group
Q36	The cost of using the Internet is generally reasonable	3.40	3.80	**No** (U = 33.500, N1=10, N2=10, p=.218, two-tailed)
Q37	I am not interested in information about companies that is presented on their websites	3.60	5.80	**Yes** (U = 17.000, N1=10, N2=10, p=.011, two-tailed)
Q38	I like websites to be easy to navigate	6.10	7.00	**No** (U = 25.000, N1=10, N2=10, p=.063, two-tailed)
Q39	I am interested in well organized websites	7.00	7.00	**No** (U = 50.000, N1=10, N2=10, p=1.000, two-tailed)
Q40	Compulsory registration when shopping online is frustrating	5.60	5.40	**No** (U = 28.000, N1=10, N2=10, p=.105, two-tailed)
Q41	I am worried about the security of my financial information while shopping online	7.00	7.00	**No** (U = 50.000, N1=10, N2=10, p=1.000, two-tailed)
Q42	I am worried about the privacy of personal information when shopping online	7.00	7.00	**No** (U = 50.000, N1=10, N2=10, p=1.000, two-tailed)
Q43	I am worried about the absence of legal regulations that govern online transactions	7.00	6.56	**No** (U = 25.000, N1=10, N2=10, p=.063, two-tailed)

Appendix 22: Experience of online shopping of expert users

No.	Questions	Range	Frequency Distribution
11	Frequently Use of the Internet for Purchasing Products	Weekly	0%
		Monthly	25%
		Yearly	75%
12	The First Time a User Purchased from the Internet	Less than a year ago	50%
		One or two years ago	50%
		Over two years ago	0%
15	Method of Payment a User Used	Credit Card	75%
		Cash on Delivery	25%
		Cheque by Post	0%
		Bank Transfer	0%
		Other	0%
No.	**Questions**	**Answer**	
13	What was your last purchase online?	- Mobile Phone - Digital Camera - Books - Video Card	
14	Which site did you use to make this purchase?	- www.souq.com - newegg.com - amazon.com - ebay.com	

Appendix 23: Likert scores for online shopping experience of Expert users

No.	Question	Likert Score
		Expert Group
Q16	I shop online because it saves time	7.0
Q17	I prefer to shop online from well known websites with a good reputation	6.8
Q18	I do not find the website's search function useful when shopping online	6.5
Q19	Generally I find it cheaper to shop online than to go to shops	5.8
Q20	In general a detailed description of the product is not important to me	5.5
Q21	I shop online because I can buy products at lower prices	4.3
Q22	I prefer to research products in detail before purchasing	6.8
Q23	I shop online because I can buy products at any time of day	7.0
Q24	I shop online because I can buy products from anywhere	6.8
Q25	I find it difficult to remember my password when shopping online	4.3
Q26	In general products are received within the time period specified by the company	6.0
Q27	In general I am satisfied with what I receive from Internet shopping and that products are accurately represented by websites	6.5
Q28	Delivery costs are unreasonable	6.5
Q29	In general I get good customer service from online companies	5.5
Q30	Prices online are generally lower than elsewhere	4.8
Q31	I find it encouraging to shop online from sites which have a clear return & refund policy	5.5
Q32	It is important for me if a shopping site has the ability to deliver the order to an address other than my own	3.8
Q33	It makes me feel more confident when the site keeps me informed about my order status	7.0
Q34	I prefer to shop online from sites that provide alternative methods of ordering/payment/delivery	6.5
Q35	I find it frustrating that some sites have limited delivery areas	5.8

Appendix 24: Mean time (in Seconds) for each task across the three sites for novice and expert users

Task	Expert and Novice Groups	Site 1		Site 2		Site 3	
		Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation
Task 1	Novice Group	81.0000	36.72117	107.5000	42.28803	117.6000	58.10948
	Expert Group	53.4000	18.79835	83.0000	37.44032	99.4000	55.07409
	Total	**67.2000**	31.72679	**95.2500**	40.85388	**108.5000**	55.88758
Task 2	Novice Group	296.1000	79.11799	406.5000	28.76437	243.7000	111.85511
	Expert Group	247.3000	76.24529	326.9000	68.20793	169.3000	33.47653
	Total	**271.7000**	79.65855	**366.7000**	65.29214	**206.5000**	88.96096
Task 3	Novice Group	116.1000	46.29963	154.5000	44.28004	131.2000	42.12627
	Expert Group	71.3000	24.95796	97.8000	37.15373	72.8000	21.97878
	Total	**93.7000**	42.87939	**126.1500**	49.28144	**102.0000**	44.35028
Task 4	Novice Group	140.3000	32.23887	128.8000	50.74074	170.1000	15.37278
	Expert Group	123.4000	40.74092	127.1000	28.14822	168.3000	12.51710
	Total	**131.8500**	36.79284	**127.9500**	39.94532	**169.2000**	13.67518
Task 5	Novice Group	86.5000	39.39614	105.7000	14.56060	76.5000	35.31839
	Expert Group	80.7000	29.65749	73.5000	32.04944	82.1000	36.25052
	Total	**83.6000**	34.06866	**89.6000**	29.32288	**79.3000**	34.95124
Task 6	Novice Group	155.6000	43.06636	109.8000	54.05923	164.4000	21.59321
	Expert Group	112.8000	49.73664	80.5000	31.86865	159.4000	27.71762
	Total	**134.2000**	50.32275	**95.1500**	45.73065	**161.9000**	24.31785
Task 7	Novice Group	33.2000	21.82659	27.9000	29.08016	20.0000	11.84155
	Expert Group	31.2000	20.82093	17.6000	11.12754	17.2000	12.06280
	Total	**32.2000**	20.78613	**22.7500**	22.07136	**18.6000**	11.72222
Task 8	Novice Group	72.1000	45.01469	97.7000	33.25675	67.0000	45.69464
	Expert Group	62.2000	38.48752	68.8000	41.67013	50.2000	40.07992
	Total	**67.1500**	41.07666	**83.2500**	39.57521	**58.6000**	42.71127
Task 9	Novice Group	63.8000	40.26247	57.4000	23.33429	116.8000	8.50882
	Expert Group	33.2000	21.92310	35.9000	18.50195	99.9000	31.30655
	Total	**48.5000**	35.24127	**46.6500**	23.27473	**108.3500**	23.95231
Task 10	Novice Group	111.7000	70.16021	50.0000	62.85256	43.9000	36.80112
	Expert Group	74.6000	57.64296	34.1000	42.44591	18.0000	12.24745
	Total	**93.1500**	65.32854	**42.0500**	52.83188	**30.9500**	29.81782

Appendix 25: Tasks accuracy

Task	Expert and Novice Groups	Site 1	Site 2	Site 3
		Accuracy Score		
Task 1	Novice Group	100%	100%	60%
	Expert Group	100%	100%	80%
Task 2	Novice Group	100%	30%	80%
	Expert Group	100%	90%	100%
Task 3	Novice Group	70%	40%	70%
	Expert Group	90%	100%	100%
Task 4	Novice Group	100%	100%	50%
	Expert Group	100%	100%	80%
Task 5	Novice Group	70%	60%	80%
	Expert Group	90%	100%	80%
Task 6	Novice Group	10%	30%	0%
	Expert Group	60%	70%	0%
Task 7	Novice Group	100%	100%	100%
	Expert Group	100%	100%	100%
Task 8	Novice Group	50%	40%	60%
	Expert Group	70%	60%	80%
Task 9	Novice Group	100%	100%	20%
	Expert Group	100%	100%	40%
Task 10	Novice Group	60%	100%	80%
	Expert Group	80%	100%	90%

Appendix 26: A Snapshot of the observation notes, notes from Camtasia files and users' comments

Tasks	Critical Problems/ Obstacles[19]	Non Critical Problems / Obstacles[20]	Observation Notes and Comments[21]	Critical Problems/ Obstacles[1]	Non Critical Problems / Obstacles[2]	Observation Notes and Comments[3]
	Novices			Experts		
Website 1/ Task 2		-**Product page**: Three users made an error at this page since they clicked at 'checkout' link instead of 'add to cart' link in order to add the requested product to their cart. After reading the error message they corrected their mistake.	-**Product page**: One user had a long hesitation between clicking at 'add to cart' or 'checkout' links.		-**Product page**: Two users made an error at this page since they clicked at 'checkout' link instead of 'add to cart' link in order to add the requested product to their cart. After reading the error message they corrected their mistake.	-**Product page**: One user had a long hesitation between clicking at 'add to cart' or 'checkout' links.
		-**Registration page**: 1- Four users made an error at this page since they forgot to enter information at state/province field, which is a field at the registration page. After reading the error message they corrected their mistake. 2- One user made an error at this page since he/she misprinted his/her email address at e-mail address field, which is a field at the registration page. After reading the error message he/she corrected his/her mistake.	- **Add to Cart End page**: - Seven users viewed the content of their shopping cart after adding the requested product to their cart, and checked out from their shopping cart. - Two users checked out after adding the requested product to their cart. However, two of those viewed their cart next and checked out from their shopping cart. - One user checked out from the requested product's page. - One user clicked at 'buy now' link after adding the requested product to his/her shopping cart. After recognizing what happened he/she returned back to this page, viewed his/her cart and checked out from it.		-**Registration page**: 1- Four users made an error at this page since they forgot to enter information at state/province field, which is a field at the registration page. After reading the error message they corrected their mistake. 2- One user made an error at this page since he/she forgot to enter his/her phone number at phone field, which is a field at the registration page. After reading the error message he/she corrected his/her mistake.	- **Add to Cart End page**: - Four users viewed the content of their shopping cart after adding the requested product to their cart, and checked out from their shopping cart. - Five users checked out after adding the requested product to their cart. However, two of those viewed their cart next and checked out from their shopping cart. - One user clicked at 'buy now' link after adding the requested product to his/her shopping cart. After recognizing what happened he/she returned back to this page, viewed his/her cart and checked out from it.
		- **Free Shipping Coupon page**: Four users made an error at this page since they entered	- **Free Shipping Coupon page**: Six users were hesitated regarding what to enter at the			- **Free Shipping Coupon page**: Nine users were hesitated regarding what to enter at the

[19] The user made a mistake/an error and was unable to recover and complete the task on time. The user may or may not realize the mistake/ error.
[20] The user made a mistake/ an error but was able to recover and complete the task in the allotted time.
[21] The test observer comments and notes when user had difficulty, or when an unusual behaviour was obvious, or user's comments while performing the task.

		wrong coupon at the free shipping coupon field. After reading the error message they chose 'I will use my coupon later' link.	free shipping coupon field, and then they chose 'I will use my coupon later' link.			free shipping coupon field, then they chose 'I will use my coupon my later' link.
			- **Shipping Information page**: One user was confused when he/she read the error message at this page; therefore he/she changed his/her shipping address.			- **Shipping Information page**: Three users were confused when they read the error message at this page; therefore they changed their shipping address.
						User 6: "Why checkout link is displayed at three pages?"
Website 2/ Task 8	Six users did not know where to find the shipping information. They kept navigating among different pages at the site (such as: user's account (that involves links to order history, wish list), home page, customer service (that was displayed at the top menu), privacy policy, wholesale program, payment options, login) until the allotted time passed.	-One users entered different keywords at the internal search of the site (such as 'shipping', 'delivery time'). When the search did not find a match, he/she navigated the site.	- Three users went to shipping page directly. - One user went to shipping information using 'help' link that was displayed at the bottom menu.	1- Two users did not know where to find the shipping information. They kept navigating among different pages at the site (such as: user's account (that involves links to order history, wish list), home page, customer service (that was displayed at the top menu), privacy policy, wholesale program, return policy, shopping cart, satisfaction guarantee) until the allotted time passed. 2- Two users went to contact us page. They thought that they successfully finished the task. One of them navigated the site first while the other did not.		- Six users went to shipping page directly.

Appendix 27: Usability problem themes and sub-themes identified by performance data and observation and their locations per task

Problem Theme	Problem Sub-Theme	Site 1		Site 2		Site 3	
		Tasks identified the problem	Location	Tasks identified the problem	Location	Tasks identified the problem	ationLoc
Navigation	Misleading Links	Task 2	Any product's page ('checkout' link).	Task 2	Shipping page ('go' link).	Task 10	Home page of the site ('our services' link).
		Task 2	Add to Cart End page ('buy now' link).				
		Task 5	Entire Site – Top Menu ('sign in' and 'register' links).	Task 5	My account page ('address book' link).		Home page of the Mall ('our services' link).
		Task 10					
		Task 10	Entire Site ('advanced search' link).				
	Link were not obvious	Task 3	Entire Site ('shopping cart link').	Task 3	Entire Site ('shopping cart' link).	Task 2	Any product's page ('complete order' and 'shopping basket' links).
				Task 4	Order Preview page ('home page' link).	Task 3	Entire Site ('shopping basket' link).
						Task 6	Home page of the Mall ('online catalog' link)
	Weak Navigation Support	Task 3	Order Preview page (did not have navigational menus or links to the home page or to other pages).	Not Exist	Not Exist	Task 3	Order page (did not have navigational menus or links to the home page or to other pages)
		Task 4					
		Task 5				Task 2	Shopping Cart page (did not have navigational menus or links to the home page or to other pages)
		Task 6				Task 3	
Content	Irrelevant Content	Task 2	Shipping Information page (confusing Error message was displayed all the time).	Not Exist	Not Exist	Task 1	Online Catalog subsection (displayed products which were not ready for selling).
						Task 4	
		Task 4				Task 6	
						Task 1	Search Mall page (under construction page).
						Task 4	
						Task 9	
Design	Misleading Images	Task 3	Order Preview page (site's logo).	Not Exist	Not Exist	Task 3	Entire Site (site's logo).
	Inappropriate Page Design	Not Exist	Not Exist	Task 1	Any product's page (inappropriate presentation of product's description).	Not Exist	Not Exist
				Task 2			
				Task 4			
				Task 2	Login page ('new and current customer' fields).		
					Address page ('shipping and billing' fields).		
Architecture	Poor Structure	Not Exist	Not Exist	Not Exist	Not Exist	Task 1	Entire Site
						Task 4	
						Task 9	
Internal Search	Inaccurate Results	Task 6	Entire Site (product search).	Task 6	Entire Site (product search).	Not Exist	Not Exist
Purchasing Process	Difficulty in Knowing What was Required for Some Fields	Task 2	Free Shipping Coupon page ('free shipping coupon' field).	Task 2	Shipping page ('gift certificate code' field).	Not Exist	Not Exist
	Difficulty in Distinguishing between Required and Non-Required Fields	Not Exist	Not Exist	Task 2	Login page ('password' field).	Task 2	Personal Information page (some required fields).
					Address page (some required fields).	Task 3	
						Task 5	
	Difficulty in Knowing what links were Required to be Clicked	Task 3	Shopping Cart page ('update order' link).	Not Exist	Not Exist	Task 3	Shopping Cart page ('ok' link).
	Session Problem	Not Exist	Not Exist	Not Exist	Not Exist	Task 4	Personal Information page (did not keep the users information).
						Task 9	
	Required Fields were not Logical	Task 2	Registration page ('state/province' field).	Task 2	Address page ('state/region field).	Not Exist	Not Exist
	Expected Information was not displayed after adding products to cart	Task 2	Add to Cart End page.	Not Exist	Not Exist	Task 2	Product page.
		Task 4					
Accessibility and customer service	Not easy to find help/customer support information	Task 8	Entire Site	Task 8	Entire Site	Task 8	Entire Site
	Inappropriate Information Provided within a Help Section/Customer Service	Not Exist	Not Exist	Not Exist	Not Exist	Task 8	FAQ page.

Appendix 28: Result of One-Way within-Subjects ANOV test for each task among the three sites

Task	ANOVA Test (One-Way within-Subjects)
	Was there a statistically significant difference among site1, site2 and site3
Task 1	**Yes** $F(2,38) = 6.021$, $p=.005$
Task 2	**Yes** $F(2,38) = 33.183$, $p=.000$
Task 3	**Yes** $F(2,38) = 4.471$, $p=.018$
Task 4	**Yes** $F(2,38) = 10.873$, $p=.000$
Task 5	**No** $F(2,38) = .502$, $p=.609$
Task 6	**Yes** $F(2,38) = 16.517$, $p=.000$
Task 7	**Yes** $F(2,38) = 4.369$, $p=.020$
Task 8	**No** $F(2,38) = 2.364$, $p=.108$
Task 9	**Yes** $F(2,38) = 40.407$, $p=.000$
Task 10	**Yes** $F(2,38) = 8.814$, $p=.001$

Appendix 29: SPSS output

Tests of Between-Subjects Effects

Measure: MEASURE_1
Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	6668236.682	1	6668236.682	893.833	.000	.980
Group	101790.375	1	101790.375	13.644	.002	.431
Error	134284.910	18	7460.273			

1. Expert and Novice Groups

Measure: MEASURE_1

Expert and Novice Groups	Mean	Std. Error	95% Confidence Interval	
			Lower BoundUpper Bound Lower Bound	Upper Bound
Novice Group	118.447	4.987	107.970	128.923
Expert Group	92.397	4.987	81.920	102.873

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Sites	Sphericity Assumed	5539.363	2	2769.682	2.010	.149	.100
	Greenhouse-Geisser	5539.363	1.877	2950.661	2.010	.152	.100
	Huynh-Feldt	5539.363	2.000	2769.682	2.010	.149	.100
	Lower-bound	5539.363	1.000	5539.363	2.010	.173	.100
Sites * Group	Sphericity Assumed	1874.230	2	937.115	.680	.513	.036
	Greenhouse-Geisser	1874.230	1.877	998.349	.680	.505	.036
	Huynh-Feldt	1874.230	2.000	937.115	.680	.513	.036
	Lower-bound	1874.230	1.000	1874.230	.680	.420	.036
Error(Sites)	Sphericity Assumed	49618.340	36	1378.287			
	Greenhouse-Geisser	49618.340	33.792	1468.349			
	Huynh-Feldt	49618.340	36.000	1378.287			
	Lower-bound	49618.340	18.000	2756.574			
Tasks	Sphericity Assumed	2730695.468	9	303410.608	185.574	.000	.912
	Greenhouse-Geisser	2730695.468	4.429	616560.239	185.574	.000	.912
	Huynh-Feldt	2730695.468	6.380	428033.966	185.574	.000	.912
	Lower-bound	2730695.468	1.000	2730695.468	185.574	.000	.912
Tasks * Group	Sphericity Assumed	53799.375	9	5977.708	3.656	.000	.169
	Greenhouse-Geisser	53799.375	4.429	12147.292	3.656	.007	.169
	Huynh-Feldt	53799.375	6.380	8433.002	3.656	.002	.169
	Lower-bound	53799.375	1.000	53799.375	3.656	.072	.169
Error(Tasks)	Sphericity Assumed	264868.190	162	1634.989			
	Greenhouse-Geisser	264868.190	79.721	3322.458			
	Huynh-Feldt	264868.190	114.833	2306.547			
	Lower-bound	264868.190	18.000	14714.899			
Sites * Tasks	Sphericity Assumed	451529.937	18	25084.996	16.439	.000	.477
	Greenhouse-Geisser	451529.937	6.657	67825.329	16.439	.000	.477
	Huynh-Feldt	451529.937	11.562	39052.922	16.439	.000	.477
	Lower-bound	451529.937	1.000	451529.937	16.439	.001	.477
Sites * Tasks * Group	Sphericity Assumed	12562.270	18	697.904	.457	.973	.025
	Greenhouse-Geisser	12562.270	6.657	1887.007	.457	.856	.025
	Huynh-Feldt	12562.270	11.562	1086.513	.457	.933	.025
	Lower-bound	12562.270	1.000	12562.270	.457	.507	.025
Error(Sites*Tasks)	Sphericity Assumed	494397.860	324	1525.919			
	Greenhouse-Geisser	494397.860	119.830	4125.812			
	Huynh-Feldt	494397.860	208.116	2375.588			
	Lower-bound	494397.860	18.000	27466.548			

Appendix 30: Usability problem themes and sub-themes identified by the post-test questionnaires

Problem Theme	Problem Sub-Theme	Statement Number in the Post-Test Questionnaire	Likert Score		
			Site 1	Site 2	Site 3
Navigation	Weak Navigation Support	9			2.55
		10			3.70
	Broken links	24			3.85
Content	Irrelevant Content	14			3.50
		27			3.25
Design	Unaesthetic Design	20			3.80
	Inappropriate Page Design	25			2.95
Architecture	Poor Structure	1			2.95
		2			2.60
		8			2.70
Purchasing Process	Compulsory registration	15	3.25	2.75	
		16			2.25

Appendix 31: Likert Scores of the post-test questionnaire for the three sites for novice and expert users and the result of Mann-Whitney test

No.	Site 1			Site 2			Site 3		
	Likert Score		Mann-Whitney Test	Likert Score		Mann-Whitney Test	Likert Score		Mann-Whitney Test
	Novice Group	Expert Group	Was there statistically a significant difference between Novice and Expert Groups	Novice Group	Expert Group	Was there statistically a significant difference between Novice and Expert Groups	Novice Group	Expert Group	Was there statistically a significant difference between Novice and Expert Groups
Q1	**5.1**	**6.6**	**Yes** (U = 18.500, N1=10, N2=10, p=.015, two-tailed)	**4.5**	**5.8**	**Yes** (U = 22.500, N1=10, N2=10, p=.035, two-tailed)	**3.1**	**2.8**	**No** (U = 48.500, N1=10, N2=10, p=.912, two-tailed)
Q2	**5.6**	**6.6**	**No** (U = 24.000, N1=10, N2=10, p=.052, two-tailed)	**5.7**	**6.3**	**No** (U = 34.500, N1=10, N2=10, p=.247, two-tailed)	**2.6**	**2.6**	**No** (U = 44.500, N1=10, N2=10, p=.684, two-tailed)
Q3	**5.7**	**6.5**	**No** (U = 27.000, N1=10, N2=10, p=.089, two-tailed)	**5.0**	**6.2**	**No** (U = 26.500, N1=10, N2=10, p=.075, two-tailed)	**NA**	**NA**	**NA**
Q4	**5.2**	**6.5**	**Yes** (U = 20.500, N1=10, N2=10, p=.023, two-tailed)	**4.9**	**6.1**	**No** (U = 28.500, N1=10, N2=10, p=.105, two-tailed)	**3.7**	**2.0**	**No** (U = 27.500, N1=10, N2=10, p=.089, two-tailed)
Q5	**5.9**	**6.1**	**No** (U = 45.000, N1=10, N2=10, p=.739, two-tailed)	**5.4**	**5.8**	**No** (U = 43.500, N1=10, N2=10, p=.631, two-tailed)	**4.4**	**3.9**	**No** (U = 41.000, N1=10, N2=10, p=.529, two-tailed)
Q6	**4.9**	**5.7**	**No** (U = 39.000, N1=10, N2=10, p=.436, two-tailed)	**4.6**	**5.8**	**No** (U = 33.500, N1=10, N2=10, p=.218, two-tailed)	**3.8**	**2.9**	**No** (U = 37.500, N1=10, N2=10, p=.353, two-tailed)
Q7	**4.3**	**5.6**	**No** (U = 28.000, N1=10, N2=10, p=.105, two-tailed)	**4.4**	**5.5**	**No** (U = 29.500, N1=10, N2=10, p=.123, two-tailed)	**4.2**	**3.4**	**No** (U = 39.500, N1=10, N2=10, p=.436, two-tailed)
Q8	**5.5**	**6.6**	**Yes** (U = 22.000, N1=10, N2=10, p=.035, two-tailed)	**5.1**	**5.9**	**No** (U = 32.500, N1=10, N2=10, p=.190, two-tailed)	**3.4**	**2.0**	**No** (U = 25.500, N1=10, N2=10, p=.063, two-tailed)
Q9	**5.9**	**5.4**	**No** (U = 49.000, N1=10, N2=10, p=.971, two-tailed)	**3.5**	**4.8**	**No** (U = 31.500, N1=10, N2=10, p=.165, two-tailed)	**2.7**	**2.4**	**No** (U = 40.500, N1=10, N2=10, p=.481, two-tailed)
Q10	**4.9**	**6.3**	**Yes** (U = 23.000, N1=10, N2=10, p=.043, two-tailed)	**5.1**	**6.3**	**No** (U = 29.000, N1=10, N2=10, p=.123, two-tailed)	**4.1**	**3.3**	**No** (U = 39.500, N1=10, N2=10, p=.436, two-tailed)
Q11	**5.3**	**6.3**	**No** (U = 27.000, N1=10, N2=10, p=.089, two-tailed)	**5.4**	**6.1**	**No** (U = 35.500, N1=10, N2=10, p=.280, two-tailed)	**NA**	**NA**	**NA**
Q12	**5.6**	**6.5**	**Yes** (U = 22.000, N1=10, N2=10,	**5.4**	**6.1**	**No** (U = 37.500, N1=10, N2=10,	**NA**	**NA**	**NA**

			p=.035, two-tailed)			p=.353, two-tailed)			
Q13	**5.4**	**5.9**	**No** (U = 35.500, N1=10, N2=10, p=.280, two-tailed)	**5.8**	**5.6**	**No** (U = 50.000, N1=10, N2=10, p=1.000, two-tailed)	**NA**	**NA**	**NA**
Q14	**4.5**	**5.8**	**No** (U = 25.000, N1=10, N2=10, p=.063, two-tailed)	**4.5**	**5.6**	**No** (U = 32.000, N1=10, N2=10, p=.190, two-tailed)	**3.9**	**3.1**	**No** (U = 37.500, N1=10, N2=10, p=.353, two-tailed)
Q15	**3.4**	**3.1**	**No** (U = 46.500, N1=10, N2=10, p=.796, two-tailed)	**2.0**	**3.5**	**No** (U = 26.500, N1=10, N2=10, p=.075, two-tailed)			
Q16							**2.0**	**2.5**	**No** (U = 40.500, N1=10, N2=10, p=.481, two-tailed)
Q17	**4.7**	**6.2**	**No** (U = 26.500, N1=10, N2=10, p=.075, two-tailed)	**3.9**	**4.8**	**No** (U = 35.500, N1=10, N2=10, p=.280, two-tailed)	**2.5**	**2.0**	**No** (U = 40.500, N1=10, N2=10, p=.481, two-tailed)
Q19	**5.8**	**6.0**	**No** (U = 49.500, N1=10, N2=10, p=.971, two-tailed)	**5.6**	**5.2**	**No** (U = 35.500, N1=10, N2=10, p=.280, two-tailed)	**4.1**	**4.1**	**No** (U = 49.500, N1=10, N2=10, p=.971, two-tailed)
Q20	**5.9**	**6.0**	**No** (U = 44.500, N1=10, N2=10, p=.684, two-tailed)	**5.8**	**5.2**	**No** (U = 36.000, N1=10, N2=10, p=.315, two-tailed)	**4.1**	**3.5**	**No** (U = 40.500, N1=10, N2=10, p=.481, two-tailed)
Q21	**4.4**	**4.1**	**No** (U = 47.500, N1=10, N2=10, p=.853, two-tailed)	**5.7**	**4.8**	**No** (U = 41.000, N1=10, N2=10, p=.529, two-tailed)	**4.6**	**4.1**	**No** (U = 46.000, N1=10, N2=10, p=.796, two-tailed)
Q22	**5.5**	**6.1**	**No** (U = 47.000, N1=10, N2=10, p=.853, two-tailed)	**4.4**	**5.6**	**No** (U = 27.000, N1=10, N2=10, p=.089, two-tailed)	**4.8**	**4.7**	**No** (U = 43.500, N1=10, N2=10, p=.631, two-tailed)
Q23	**5.8**	**5.0**	**No** (U = 40.000, N1=10, N2=10, p=.481, two-tailed)	**4.7**	**5.5**	**No** (U = 33.000, N1=10, N2=10, p=.218, two-tailed)	**4.7**	**4.5**	**No** (U = 49.500, N1=10, N2=10, p=.971, two-tailed)
Q24	**5.5**	**4.7**	**No** (U = 45.500, N1=10, N2=10, p=.739, two-tailed)	**4.5**	**4.6**	**No** (U = 47.500, N1=10, N2=10, p=.853, two-tailed)	**4.8**	**2.9**	**No** (U = 25.500, N1=10, N2=10, p=.063, two-tailed)
Q25	**5.1**	**5.8**	**No** (U = 34.500, N1=10, N2=10, p=.247, two-tailed)	**4.0**	**4.7**	**No** (U = 36.500, N1=10, N2=10, p=.315, two-tailed)	**3.2**	**2.7**	**No** (U = 41.500, N1=10, N2=10, p=.529, two-tailed)
Q26	**4.3**	**6.2**	**Yes** (U = 18.000, N1=10, N2=10, p=.015, two-tailed)	**4.3**	**5.2**	**No** (U = 36.500, N1=10, N2=10, p=.315, two-tailed)	**2.6**	**2.5**	**No** (U = 50.000, N1=10, N2=10, p=1.000, two-tailed)
Q27	**5.2**	**5.3**	**No** (U = 47.500, N1=10, N2=10, p=.853, two-tailed)	**4.4**	**5.5**	**No** (U = 36.500, N1=10, N2=10, p=.315, two-tailed)	**3.1**	**3.4**	**No** (U = 46.500, N1=10, N2=10, p=.796, two-

									tailed)
Q28	**4.5**	**5.6**	**No** (U = 30.500, N1=10, N2=10, p=.143, two-tailed)	**4.8**	**4.9**	**No** (U = 49.500, N1=10, N2=10, p=.971, two-tailed)	**3.5**	**2.0**	**No** (U = 26.500, N1=10, N2=10, p=.075, two-tailed)
Q29	**5.7**	**5.9**	**No** (U = 46.000, N1=10, N2=10, p=.796, two-tailed)	**5.7**	**5.3**	**No** (U = 43.500, N1=10, N2=10, p=.631, two-tailed)	**5.2**	**5.0**	**No** (U = 48.500, N1=10, N2=10, p=.912, two-tailed)
Q30	**5.5**	**4.9**	**No** (U = 42.500, N1=10, N2=10, p=.579 two-tailed)	**5.0**	**5.2**	**No** (U = 47.500, N1=10, N2=10, p=.853 two-tailed)	**5.0**	**3.7**	**No** (U = 34.000, N1=10, N2=10, p=.247, two-tailed)
Q31	**5.5**	**5.3**	**No** (U = 47.000, N1=10, N2=10, p=.853, two-tailed)	**5.3**	**5.1**	**No** (U = 45.500, N1=10, N2=10, p=.739 two-tailed)	**4.6**	**3.4**	**No** (U = 32.000, N1=10, N2=10, p=.190, two-tailed)

Appendix 32: Likert scores of the post-test questionnaire and the result of Friedman test

No.	Question	Likert Score			Friedman Test
		Site 1	Site 2	Site 3	Was there a statistically significant difference among site1, site2 and site3
Architecture and Navigation					
Q1	Finding the information related to the tasks (was very easy)	**5.85**	**5.15**	**2.95**	**Yes** X^2 (2, *N*=20)= 30.714, *p*=.000
Q2	Finding the products (was very easy)	**6.10**	**6.00**	**2.60**	**Yes** X^2 (2, *N*=20)= 34.125, *p*=.000
Q3	Using the internal search facility (was very easy)	**6.10**	**5.60**	**NA**	**NA**
Q8	The organization of information on the website was clear	**6.05**	**5.50**	**2.70**	**Yes** X^2 (2, *N*=20)= 35.273, *p*=.000
Q9	Moving around the website without getting lost was difficult	**5.65**	**4.15**	**2.55**	**Yes** X^2 (2, *N*=20)= 25.016, *p*=.000
Q10	The table of contents was helpful	**5.60**	**5.70**	**3.70**	**Yes** X^2 (2, *N*=20)= 31.356, *p*=.000
Q11	The site's search function was quick enough	**5.80**	**5.75**	**NA**	**NA**
Q12	Accuracy of internal search results was good	**6.05**	**5.75**	**NA**	**NA**
Q13	Results of internal search were poor	**5.65**	**5.70**	**NA**	**NA**
Q21	It was difficult to go to the home page from any sub page of the site	**4.25**	**5.25**	**4.35**	**Yes** X^2 (2, *N*=20)= 17.644, *p*=.000
Q24	There were few broken/not working links	**5.10**	**4.55**	**3.85**	**Yes** X^2 (2, *N*=20)= 15.796, *p*=.000
Content					
Q14	The information on the website was effective in helping me complete the purchasing tasks	**5.15**	**5.05**	**3.50**	**Yes** X^2 (2, *N*=20)= 22.172, *p*=.000
Q27	The terminology/terms used throughout this website were clear	**5.25**	**5.05**	**3.25**	**Yes** X^2 (2, *N*=20)= 22.116, *p*=.000
Design					
Q19	I liked the interface of this website	**5.90**	**5.40**	**4.10**	**Yes** X^2 (2, *N*=20)= 31.115, *p*=.000
Q20	The interface of this website was pleasant/ attractive	**5.95**	**5.50**	**3.80**	**Yes** X^2 (2, *N*=20)= 33.323, *p*=.000
Q22	The choice of colours was appropriate	**5.80**	**5.00**	**4.75**	**Yes** X^2 (2, *N*=20)= 18.473, *p*=.000
Q23	The size of the text made the site easy to read	**5.40**	**5.10**	**4.60**	**Yes** X^2 (2, *N*=20)= 12.792, *p*=.002
Q25	It was clear to know the position of any page of the site	**5.45**	**5.25**	**2.95**	**Yes** X^2 (2, *N*=20)= 29.284, *p*=.000
Purchasing Process					
Q4	Registering on the site (was very easy)	**5.85**	**5.50**	**NA**	**NA**
Q5	Purchasing a product (was very easy)	**6.00**	**5.60**	**4.15**	**Yes** X^2 (2, *N*=20)= 30.632, *p*=.000
Q6	Changing customer information (was very easy)	**4.95**	**4.95**	**3.35**	**Yes** X^2 (2, *N*=20)= 9.033, *p*=.011
Q7	Changing the contents of the shopping cart (was very easy)	**5.30**	**5.20**	**3.80**	**Yes** X^2 (2, *N*=20)= 24.824, *p*=.000
Q15	Compulsory registration in order to purchase products was convenient	**3.25**	**2.75**	**NA**	**NA**
Q16	I prefer to register before purchasing products	**NA**	**NA**	**2.25**	**NA**
Q29	I trust that the company will not misuse my personal information	**5.80**	**5.50**	**5.10**	**Yes** X^2 (2, *N*=20)= 14.176, *p*=.001
Q30	I feel that the security of my financial information is protected while purchasing from this website	**5.20**	**5.10**	**4.35**	**Yes** X^2 (2, *N*=20)= 14.245, *p*=.001
Q31	I have confidence in purchasing from this website	**5.40**	**5.20**	**4.00**	**Yes** X^2 (2, *N*=20)= 26.655, *p*=.000
The Overall Evaluation of the Sites					
Q17	This website had all the functions and capabilities that I expected it to have	**5.45**	**4.35**	**2.25**	**Yes** X^2 (2, *N*=20)= 37.014, *p*=.000
Q26	I felt comfortable using this website	**5.25**	**4.75**	**2.55**	**Yes** X^2 (2, *N*=20)= 25.400, *p*=.000
Q28	I would recommend this site to a friend	**5.05**	**4.85**	**2.75**	**Yes** X^2 (2, *N*=20)= 28.212, *p*=.000

Appendix 33: Usability problem themes and sub-themes identified by the qualitative data of the post-test questionnaires

Problem Theme	Problem Sub-Theme	Site 1	Site 2	Site 3
		Location	Location	Location
Navigation	Misleading Links	Entire Site – Top Menu ('sign in' and 'register' links).	Not Exist	Not Exist
	Links were not obvious	Not Exist	Login page (home page link).	Not Exist
			Address page (home page link).	
			Shipping and Payment page (home page link).	
			Order Preview page (home page link).	
			Shopping Cart page (home page link).	
	Weak Navigation Support	Order Preview page (did not have navigational menus or links to the home page or to other pages).	Entire Site (left main menu did not appear at some pages, i.e. during the ordering process).	Not Exist
	Broken links	Not Exist	Not Exist	Home page.
				Online Catalog subsection - Search Results page.
				Online Catalog subsection – Banner.
				Related Links page.
	Orphan Pages	Not Exist	Not Exist	Product's Image page (larger view) for any product's page.
Content	Irrelevant Content	Not Exist	Not Exist	Entire Site (most pages had repetitive/ not concise content)
	Inaccurate Information	Any product's page (displayed out of stock products).	Any product's page (displayed out of stock products).	Not Exist
	Missing Information about the Products	Any product's page (availability).	Any product's page (availability).	Any product's page (availability).
Design	Inappropriate Page Design	All product category pages (long pages with large number of images).	Any product's page (inappropriate presentation of product's description).	Not Exist
		Best/ Most Seller page (products were displayed at the bottom).		
	Inappropriate Choice of Fonts and Colours	Not Exist	Entire Site (small font size for menus and text, combination of background and link colours).	Not Exist
Architecture	Poor Structure	Not Exist	Not Exist	Entire Site
Internal Search	Inaccurate Results	Entire Site (product search).	Entire Site (product search).	Not Exist
	Limited Option	Entire Site (product and advanced search).	Entire Site (product and advanced search).	Not Exist
Purchasing (Checkout) Process	Difficulty in Distinguishing between Required and Non-Required Fields	Not Exist	Login page ('password' field).	Personal Information page (some required fields).
			Address page (some required fields).	
	Long Ordering Process	Add to Cart End page.	Not Exist	Not Exist
		Checkout page.		
	Session Problem	Not Exist	Not Exist	Personal Information page (did not keep the users information).
Accessibility and Customer service	Not Supporting More than One Language	Entire Site	Entire Site	Not Exist
Inconsistency	Inconsistent Design/Layout/Content	Not Exist	Not Exist	Entire Site (content between Arabic and English interfaces).
Missing Capabilities	Missing Information/Functions	Not Exist	Not Exist	The site did not have internal search.

Appendix 34: Usability problem themes and sub-themes identified by the heuristic evaluation

Problem Theme	Problem Sub-Theme	Site 1	Site 2	Site 3
		Location	Location	onLocati
Navigation		Any product's page (checkout link).	Entire Site -Top Menu (customer service link).	Entire Site - Left Menu (Quick search).
				Entire Site - Left Menu (Training).
		Add to Cart End page (buy now link).		Entire Site - Left Menu – Arabic (Business support).
				Entire Site - Left Menu-Arabic (Message board).
	Misleading Links	Entire Site – Top Menu ('sign in' and 'register' links).	Customer Service page (help link).	Home page (French link).
		Home Page (Shayma Corner links).	Entire Site - Bottom Menu (help link).	Home page (Arab woman diwan link).
				Home page (Click here for more details of training link).
		Home Page (Guaranteed Submenu links).		Home page Arabic (Shourouq job link).
				Home page Arabic (Consultation services link).
	Links were not Obvious	Entire Site ('shopping cart link').	Login page (home page link).	Any product's page (complete order link).
			Address page (home page link).	Any product's page (shopping basket link).
			Shipping and Payment page (home page link).	
			Order Preview page (home page link).	Entire Site: most of the site's links were not discernible (same colours and font styles were used for both text and links). For example: - Home page: click here link for more details about services - Home page: click here link for more details about consultation services - Home page Arabic: click here link for more details about job finding - Our services page: enter here for membership - Our services page Arabic: click here for event management - Our services page Arabic: click here for business support - Khebrat society home page: enter here click for chatting- - Khebrat society home page Arabic: enter here click for chatting - Information and links page: women studies link - Information and links page: general report link - Our members page Arabic: enter for membership link
			Shopping Cart page (home page link).	
			Home page (live chat link).	Home page of the Mall (online catalog link).
			My account page (address book link).	
	Weak Navigation Support	Order Preview page (did not have navigational menus or links to the home page or to other pages).	Entire Site (left main menu did not appear at some pages, i.e. during the ordering process).	Entire Site (many pages did not have navigational menus or links to the home page or to other pages, such as: - Shopping Cart page - Personal Information page - Payment and Shipping page - Order page. - Guest book Arabic page
	Broken Links	Not Exist	Not Exist	Home page (Tell a friend link)
				Home page (Support women link)
				Home page Mall (contact us)
				Home page Mall Arabic (delivery information)
				Turathcom shop Arabic (New design products link)

				Home page Arabic (Al Montada link)
	Orphan Pages	Not Exist	Not Exist	Any large-size product page
				Any large-size Arabic product large
				Favorite links page
				Favorite links Arabic page
				Turathcom subsection/ wood products page
				Turathcom subsection / glass products
				Green fields subsection Arabic/ products page
				Family care subsection Arabic/ products page
Content	**Irrelevant Content**	Shipping Information page (confusing error message was displayed all the time).	Help page (under construction page).	Home page – Site (did not display relevant information regarding the main purpose).
				Home page – Mall (did not display relevant information regarding each shop of the mall and their products).
				The site's interface in French language (under construction page).
				Search Mall page (under construction page).
				Best Seller page (under construction page).
				Testimonial page (displayed only customer's feedback and did not allow users to add their feedback).
				Related Links page (free dictionary link).
				Related Links page (art directory link).
				Related Links page (web directory link).
				Related Links page (Add URL-free.com).
				Related Links page (web hosting reviews).
				Related Links page (businesslinkslist.com).
				Related Links page (ls blog).
				Entire Site (most pages had repetitive/ not concise content), such as: - Home page - Our services page - Home page Arabic - Home page Mall Arabic
				Online Catalog subsection (displayed products which were not ready for selling).
	Inaccurate Information	Any product's page (displayed out of stock products).	Any product's page (displayed out of stock products).	Turathcom Showroom, Nowl Design, Family Care, Arab Culture, In'ash El Usra, Green Fields, Amoun Corner, Holy River subsections (inaccurate description of products).
	Grammatical Accuracy Problems	Home Page - Guaranteed Submenu.	Entire Site - Left Menu.	Not Exist
	Missing Information about the Company	Not Exist	About us page.	About us page.
	Missing Information about the Products	Any product's page: availability, fabric, length of products that had only one size, large images of products.	Any product's page: availability, fabric, length and width of some products, representative images.	Any product's page : availability, fabric, length and width of some products, representative images, size guide.
Design	**Misleading Images**	Order Preview page (site's logo).	Entire Site - Bottom Menu (credit card images).	Entire Site (logo).
		Entire Site - Guaranteed Submenu (credit card images).		Turathcom Network Program page (all images).
		Entire Site - Live Support subsection (live support image).		Turathcom Network News page (all images).
	Inappropriate Page Design	All product category pages (long pages with large number of images).	Any product's page (inappropriate presentation of product's description)	Entire Site (the top banner and the left navigation menu disappeared if the user scrolled any page down).
		Shipping Information page (inappropriate heading).		Home page (cluttered content).
		Order Preview page (inappropriate heading).	Privacy Policy page (long pages).	Our Services page (cluttered content, very long page).
		Shipping Method page (inappropriate heading).		Terms & Conditions page (very long page).
		Best/ Most Seller page (products were displayed at the bottom).		Turathcom Showroom shop subsection - all products pages (inappropriate heading).
		Privacy Policy page (long pages).		

	Unaesthetic Design	Entire Site	Entire Site	Entire Site
	Inappropriate Quality of Images	Not Exist	Not Exist	Entire Site (logo image, all images of the products).
	Missing Alternative Text	New Arrival page. Most Selling page.	Al-Ameera Hijab page.	Entire Site
	Broken Images	Not Exist	Not Exist	- Arab Woman Diwan subsection – Banner, - Online Catalog subsection (view products link-banner) -Turathcom Showroom shop subsection (wood products page- some images). - Ensha Ulusra subsection (accessories products page- some products) - Our services Arabic page -Green fields subsection (products page-come images) - Holy river subsection (products page- some images). - Turathcom blog- banner. - Shouroq women employment page. - News/updates page.
	Inappropriate Choice of Fonts and Colours	Entire Site - Guaranteed Submenu (combination of background and link colours).	Entire Site (small font size for menus and text, very dull colours). Entire Site - Bottom Menu (combination of background and link colours). All products category pages (link colours very dull).	Entire Site (inappropriate font style – the use of bold style for many paragraphs on many pages).
	Inappropriate Page Titles	Entire Site	Entire Site	Entire Site
Architecture	**Poor Structure**	Not Exist	Not Exist	Entire Site
	Illogical Order of Menu Items	Not Exist	Entire Site - Bottom Menu.	Entire Site - Main Left Menu.
	Illogical Categorization of Menu Items	Not Exist	Not Exist	Entire Site - Main Left Menu.
Internal Search	**Inaccurate Results**	Entire Site (product search).	Entire Site (product search).	Entire Site (Online Catalog subsection Search).
	Limited Options	Entire Site (product and advanced search).	Entire Site (product and advanced search).	Not Exist
	Poor visibility of Search Position	Entire Site (product and advanced search).	Not Exist	Not Exist
Purchasing Process	**Difficulty in Knowing What was Required for Some Fields**	Not Exist	Shipping page ('gift certificate code' field).	Not Exist
	Long Ordering Process	Add to Cart End page. Checkout page.	Not Exist	Not Exist
	Session Problem	Not Exist	Not Exist	Personal Information page (did not keep the users information).
	Not Easy to Log on to the Site	Entire Site	Not Exist	Not Exist
	Lack of Confirmation was if Users Deleted an Item from their Shopping Cart	Shopping Cart page.	Shopping Cart page.	Shopping Cart page.
	Long Registration Page	Registration page	Not Exist	Not Exist
	Not Logical Required Fields	Registration page ('state/province' field).	Address page ('state/region field).	Not Exist
Accessibility and Customer Service	**Not Easy to Find and Access the Site from Search Engines**	Not Exist	Entire Site	Entire Site
	Not supporting more than one language	Entire Site	Entire Site	Not Exist
	Not supporting more than one currency	Entire Site	Entire Site	Entire Site
	Inappropriate Information Provided within a Help Section/Customer Service	FAQ page.	Not Exist	FAQ page.
	Not Supporting Sending Comments from Customers	Not Exist	Entire Site	Entire Site
	Not Easy to Find or Navigate in Help / Customer Support Information	Not Exist	Entire Site	Not Exist
Security and Privacy	**Lack of Confidence in Security and Privacy**	Not Exist	Not Exist	No security guarantee policy was displayed and no privacy statement policy was displayed.
Inconsistency	**Inconsistent Design/Layout/Content**	Entire Site (position of the navigation menu).	Entire Site (position of the navigation menu). Entire Site - Main Left Menu (colours to indicate visited	Entire Site (page layout, font colours and font styles, link colours, terminology/terms to indicate product pages, content between Arabic and English interfaces,

			links). Orientals page, Tops page, Address Book page, Wish List page, Order History page (page layout (alignment). Plus Size page, Tops page, Bottom page, Customer Service pages (items of the main left menu throughout the site).	navigation menu, page headings (colours, existence, and position), sentence format, size of products images).
Missing Functions	**Missing Functions/Capabilities**	- The site did not have site map. - The site did not have links to external useful resources. - The site did not have informative shopping cart during navigation. - The site did not have informative navigation menu (i.e. it did not give a clear indication of the current page on display). - Delivery time was not displayed (order preview page). - Delivery information was not displayed. - How to order information was not displayed. - The site did not have flexible delivery (delivery to another address). - The site did not have alternative methods of delivery. - The site did not have alternative methods of ordering.	- The site did not have site map. - The site did not have links to external useful resources. - Delivery time was not displayed (order page). - The site did not display information regarding problems with delivery	- The site did not have internal search. - The site did not have help/customer service section. -The site did not display information about ordering (no information regarding payment options, how to order, cancelling an order). - The site had limited methods of payment. - The site did not have alternative methods of delivery. - The site did not display information regarding problems with delivery

Appendix 35: Usability problem themes and sub-themes identified by the heuristic checklist

Problem Theme	Problem Sub-Theme	Statement Number in the Post-Test Questionnaire	Likert Score		
			Site 1	Site 2	Site 3
Navigation	Weak Navigation Support	8			2.60
		10		3.00	3.00
Internal Search	Inaccurate Results	12	3.00	3.60	
Content	Irrelevant Content	25			1.60
		27		3.00	1.00
		29			3.20
	Inaccurate Information	31	3.20	3.40	3.40
	Missing Information about the Company	33		3.60	3.20
	Missing Information about the Products	35			3.00
		36	2.40	2.00	1.20
Design	Inappropriate Page Design	18			1.80
		59	3.00		
		67	3.20		
	Inappropriate Page Titles	68	3.60	3.40	3.40
	Unaesthetic Design	54			1.40
	Inappropriate Quality of Images	55			3.60
	Missing Alternative Text	58			3.80
Architecture	Poor Structure	9			3.00
		19			2.80
		20			3.00
		21			1.80
		22			2.60
	Illogical Order of Menu Items	23			3.40
	Illogical Categorization of Menu Items	24			2.00
Security and Privacy	Lack of Confidence in Security and Privacy	95			3.20
		96			3.40
Accessibility and Customer Service	Not Easy to Find and Access the Site from Search Engines	38			2.20
	Inappropriate Information Provided within a Help Section/Customer Service	42	2.60		3.20
	Not Supporting Sending Comments from Customers	44		3.00	2.20
	Not Easy to Find or Navigate in Help / Customer Support Information	45		3.40	
		46		3.40	
		47		3.80	
		48		3.00	
	Not supporting more than one language	52	1.00	1.00	
	Not supporting more than one currency	53	2.40	2.0	2.20
Inconsistency	Inconsistent Design/Layout/Content	1		3.60	2.80
		2			3.60
		3			3.40
		4			2.60
		6			3.20
		7			2.40
Missed Capabilities	Missing Information/Functions	16	1.60	1.40	
		76	3.60		3.20
		78			3.80
		85	2.40		
		86		3.60	3.60
		90	3.00		
		92	2.80		3.20

Appendix 36: Likert scores of the of heuristic checklist and the result of Friedman test

No.	Question	Likert Scores			Friedman Test
		Site 1	Site 2	Site 3	Was there a statistically significant difference among site1, site2 and site3
Architecture and Navigation					
1	Page layout is consistent	6.40	3.60	2.80	**Yes** X^2 (2, *N*=5)= 9.333, *p*=.009
2	Justification of text is consistent	6.40	5.40	3.60	**Yes** X^2 (2, *N*=5)= 9.500, *p*=.009
3	Fonts are consistent	6.80	6.00	3.40	**Yes** X^2 (2, *N*=5)= 9.294, *p*=.010
4	Colours are consistent	6.60	6.40	2.60	**Yes** X^2 (2, *N*=5)= 9.500, *p*=.009
5	Site uses standard link colours	6.00	3.60	2.80	**Yes** X^2 (2, *N*=5)= 7.600, *p*=.022
6	Terminology/terms are consistent	5.20	5.20	3.20	**No** X^2 (2, *N*=5)= 4.625, *p*=.099
7	Content is consistent among different language interfaces	NA	NA	2.40	NA
8	Site is easy to navigate	6.20	6.00	2.60	**Yes** X^2 (2, *N*=5)= 9.500, *p*=.009
9	Information for typical tasks is easy to find	5.80	5.80	3.00	**Yes** X^2 (2, *N*=5)= 8.824, *p*=.012
10	Index, or site map, or navigation bar or table of contents exist in appropriate places	5.40	3.00	3.00	**Yes** X^2 (2, *N*=5)= 6.421, *p*=.040
11	Response time for internal search is good	6.40	6.40	NA	NA
12	Results of internal search are useful	3.00	3.60	NA	NA
13	Links are discernible/obvious	6.20	6.00	4.20	**Yes** X^2 (2, *N*=5)= 7.538, *p*=.023
14	There are few broken/not working links	5.60	5.40	4.20	**No** X^2 (2, *N*=5)= 3.000, *p*=.223
15	Link names match page names	5.80	4.40	4.40	**Yes** X^2 (2, *N*=5)= 10.000, *p*=.007
16	There are an acceptable number of links to external resources	1.60	1.40	4.00	**Yes** X^2 (2, *N*=5)= 6.857, *p*=.032
17	It is easy & obvious to go to the home page from any sub page of the site	4.00	6.40	4.60	**Yes** X^2 (2, *N*=5)= 6.615, *p*=.037
18	Pages have a clear indication of their position within the site	4.80	5.20	1.80	**Yes** X^2 (2, *N*=5)= 9.294, *p*=.010
19	Site has a simple & straightforward structure	6.00	6.20	2.80	**Yes** X^2 (2, *N*=5)= 7.538, *p*=.023
20	Related information is grouped together	5.60	5.40	3.00	**Yes** X^2 (2, *N*=5)= 6.632, *p*=.036
21	Categorisation of products is helpful	6.00	6.00	1.80	**Yes** X^2 (2, *N*=5)= 7.895, *p*=.019
22	Number of clicks to reach goals is not too large	5.60	5.40	2.60	**Yes** X^2 (2, *N*=5)= 7.176, *p*=.028
23	Navigation menu is simple and straightforward	6.20	6.20	3.40	**Yes** X^2 (2, *N*=5)= 10.000, *p*=.007
24	Menu choices are ordered logically	6.00	6.00	2.00	**Yes** X^2 (2, *N*=5)= 9.294, *p*=.010
Content					
25	Information is up-to-date & current	5.60	4.20	1.60	**Yes** X^2 (2, *N*=5)= 9.579 *p*=.008
26	Date of last update is obvious	2.20	2.40	1.00	**No** X^2 (2, *N*=5)= 3.714, *p*=.156
27	New information is visible & obvious on the site	6.00	3.00	1.00	**Yes** X^2 (2, *N*=5)= 9.333 *p*=.009
28	Terminology/terms are easy to understand	6.40	6.40	4.80	**Yes** X^2 (2, *N*=5)= 6.857 *p*=.032
29	Content is concise	6.20	6.00	3.20	**Yes** X^2 (2, *N*=5)= 9.500 *p*=.009
30	There are few 'under construction' pages	4.40	4.60	4.40	**No** X^2 (2, *N*=5)= .143, *p*=.931
31	Information is precise	3.20	3.40	3.40	**No** X^2 (2, *N*=5)= .154, *p*=.926
32	Content is free from grammatical errors	4.20	4.0	4.20	**No** X^2 (2, *N*=5)= .118, *p*=.943
33	Appropriate overview of the company is displayed	6.20	3.60	3.20	**Yes** X^2 (2, *N*=5)= 8.316 *p*=.016
34	Products are accurately described	6.40	6.20	4.00	**Yes** X^2 (2, *N*=5)= 9.500 *p*=.009
35	Adequate photographs of products are displayed	6.20	6.40	3.00	**Yes** X^2 (2, *N*=5)= 8.824 *p*=.012
36	Adequate status of products is displayed (e.g. availability)	2.40	2.00	1.20	**No** X^2 (2, *N*=5)= 3.714, *p*=.156

37	Adequate explanation of product's price is displayed	5.40	6.60	5.20	**No** X^2 (2, *N*=5)= 4.769, *p*=.092
Accessibility and Customer Service					
38	Accessibility of site from search engines is good	6.00	4.40	2.20	**Yes** X^2 (2, *N*=5)= 10.000 *p*=.007
39	URL is domain-related	6.20	7.00	6.40	**No** X^2 (2, *N*=5)= 4.667, *p*=.097
40	URL is not complex and easy to remember	6.80	6.60	6.60	**No** X^2 (2, *N*=5)= 1.000, *p*=.607
41	Download time of the pages is quick	5.40	6.60	5.40	**Yes** X^2 (2, *N*=5)= 7.412, *p*=.025
42	Appropriate contents of FAQ	2.60	5.20	3.20	**Yes** X^2 (2, *N*=5)= 8.316, *p*=.016
43	Full 'contact us' information is displayed appropriately (e.g. name, physical address, telephone number, fax number and email details)	6.40	6.40	6.20	**No** X^2 (2, *N*=5)= 2.000, *p*=.368
44	Site supports sending comments from customers (e.g. feedback form)	7.00	3.00	2.20	**Yes** X^2 (2, *N*=5)= 9.500, *p*=.009
45	Help/customer service is easy to find	6.60	3.40	NA	NA
46	Help/customer service has a clear and distinct layout	6.00	3.40	NA	NA
47	Searching for help/customer service is easy	6.00	3.80	NA	NA
48	Help/customer service is easy to navigate	6.20	3.00	NA	NA
49	Appropriate information is provided within help/customer service	5.40	5.20	NA	NA
50	Site has appropriate compatibility to work with different browsers	6.60	6.20	5.20	**Yes** X^2 (2, *N*=5)= 6.615, *p*=.037
51	Site has appropriate compatibility to work on different monitor resolutions	6.40	6.20	5.00	**Yes** X^2 (2, *N*=5)= 6.533, *p*=.038
52	Site supports appropriate foreign languages	1.00	1.00	6.20	**Yes** X^2 (2, *N*=5)= 10.000, *p*=.007
53	Site supports appropriate currencies	2.40	2.0	2.20	**No** X^2 (2, *N*=5)= 3.714, *p*=.156
Design					
54	Site is aesthetic, attractive and appealing	4.20	4.00	1.40	**Yes** X^2 (2, *N*=5)= 7.176, *p*=.028
55	Quality of images is adequate	6.00	6.40	3.60	**Yes** X^2 (2, *N*=5)= 9.294, *p*=.010
56	There are few broken images	4.60	4.60	4.40	**No** X^2 (2, *N*=5)= .125, *p*=.939
57	The images are related to the content of the site and help to understand it	6.60	5.20	5.20	**No** X^2 (2, *N*=5)= 4.667, *p*=.097
58	Alternative text is used for most images	4.40	5.80	3.80	**Yes** X^2 (2, *N*=5)= 7.000, *p*=.030
59	Size of images has minimal effect on loading time	3.00	6.80	6.00	**Yes** X^2 (2, *N*=5)= 9.333, *p*=.009
60	Fonts are easy to read	6.60	6.00	5.00	**Yes** X^2 (2, *N*=5)= 7.600, *p*=.022
61	Choice of font colours is appropriate	6.40	5.40	4.00	**Yes** X^2 (2, *N*=5)= 7.429, *p*=.024
62	Choice of background colours is appropriate	6.20	5.80	5.20	**No** X^2 (2, *N*=5)= 5.000, *p*=.082
63	Combination of background & font colours is appropriate	6.20	4.20	4.40	**Yes** X^2 (2, *N*=5)= 6.632, *p*=.036
64	Pages are uncluttered	6.40	6.20	4.80	**Yes** X^2 (2, *N*=5)= 9.500, *p*=.009
65	Headings are clear	5.80	5.40	4.00	**No** X^2 (2, *N*=5)= 5.778, *p*=.056
66	Page margins are sufficient	6.40	6.40	4.20	**Yes** X^2 (2, *N*=5)= 6.857, *p*=.032
67	There are a minimum number of long pages which require scrolling	3.20	5.80	4.40	**Yes** X^2 (2, *N*=5)= 7.053, *p*=.029
68	Page titles appropriately describe the company name & the content of the pages	3.60	3.40	3.40	**No** X^2 (2, *N*=5)= 1.000, *p*=.607
Purchasing Process					
69	Registration on the site is easy	4.40	6.40	NA	NA
70	Changing customer information is easy	4.60	6.60	1.60	**Yes** X^2 (2, *N*=5)= 9.579, *p*=.008
71	Logging on to the site is easy	4.40	6.80	NA	NA
72	Ordering process is easy	2.80	6.60	2.00	**Yes** X^2 (2, *N*=5)= 9.294, *p*=.010
73	Changing the content of the shopping cart is easy	5.40	6.60	2.40	**Yes** X^2 (2, *N*=5)= 9.333, *p*=.009
74	Accuracy of the shopping cart's contents is good	6.20	6.20	4.00	**Yes** X^2 (2, *N*=5)= 6.533, *p*=.038
75	The shopping cart's contents are clearly presented	6.60	6.80	4.40	**Yes** X^2 (2, *N*=5)= 7.538, *p*=.023
76	How to order is explained appropriately	3.60	5.00	3.20	**Yes** X^2 (2, *N*=5)= 7.176, *p*=.028
77	Payment options are clarified appropriately	6.00	5.80	5.00	**No** X^2 (2, *N*=5)= 3.800, *p*=.150
78	Cancelling an order procedure is explained appropriately	4.80	4.00	3.80	**No**

					χ^2 (2, *N*=5)= 2.667, *p*=.264
79	Return and refund policy is explained appropriately	6.40	5.80	4.00	**No** χ^2 (2, *N*=5)= 6.000, *p*=.050
80	Terms & conditions are easy to understand	5.60	5.20	4.20	**No** χ^2 (2, *N*=5)= 2.286, *p*=.319
81	Delivery time is explained appropriately	6.60	5.0	4.00	**Yes** χ^2 (2, *N*=5)= 7.429, *p*=.024
82	Delivery costs are explained appropriately	6.20	5.20	4.40	**No** χ^2 (2, *N*=5)= 5.636, *p*=.060
83	Delivery areas are explained appropriately	5.60	4.60	4.60	**No** χ^2 (2, *N*=5)= 4.667, *p*=.097
84	Delivery options are clarified appropriately	4.00	4.8	4.60	**No** χ^2 (2, *N*=5)= .875, *p*=.646
85	Delivery address options are supported (the ability to deliver the order to another address)	2.40	4.60	5.00	**No** χ^2 (2, *N*=5)= 4.667, *p*=.097
86	Problems with delivery are clarified appropriately (e.g. non-delivery, late delivery, incorrect delivery address, etc.)	5.00	3.60	3.60	**Yes** χ^2 (2, *N*=5)= 7.625, *p*=.022
87	Site sends confirmation email to customer after placing an order	0.0	0.0	0.0	NA
88	Site sends dispatch confirmation email to customer when order is sent out	0.0	0.0	0.0	NA
89	Site sends dispatch confirmation email to customer when order is sent out	0.0	0.0	0.0	NA
90	Site has acceptable support for a variety of ordering methods	3.00	4.60	4.60	**No** χ^2 (2, *N*=5)= 6.000, *p*=.050
91	Site has acceptable support for a variety of payment methods	5.40	5.80	4.80	**No** χ^2 (2, *N*=5)= 3.714, *p*=.156
92	Site has acceptable support for a variety of delivery methods	2.80	4.20	3.20	**Yes** χ^2 (2, *N*=5)= 6.615, *p*=.037
93	Site uses secure socket layer	5.60	5.60	NA	NA
94	Site uses recognized secure payment methods	5.20	5.40	4.60	**No** χ^2 (2, *N*=5)= .800, *p*=.670
95	Security guarantee is clarified appropriately	6.00	6.60	3.20	**Yes** χ^2 (2, *N*=5)= 7.538, *p*=.023
96	Privacy policy is clarified appropriately	6.20	6.00	3.40	**No** χ^2 (2, *N*=5)= 9.500, *p*=.009

Appendix 37: Usability problem themes and sub-themes identified by Google Analytics method and their locations

Problem Theme	Problem Sub-Theme	Metric/Report	Site 1	Site 2	Site 3
			Location	Location	Location
Navigation	?	Average number of page views per visits	Entire Site	Entire Site	Entire Site
		Bounce rate			
		Percentage of click depth visits			
		Average searches per visit			
		Percentage of visits using search			
Content/Design	?	Percentage of click depth visits	Entire Site	Entire Site	Entire Site
		Percentage of time spent visits			
		Bounce rate			
		Top landing pages' metrics	All product category pages	All product category pages	All product category pages
				Home page	Home page (Arabic)
			Home page	Size Chart page	Home page (English)
				How to Measure page	Home page (Mall)
		Top content pages' metrics	All product category pages	All product category pages	All product category pages
					Home page (Arabic)
			Home page	Home page	Guest book page
					Home page (Mall)
		Top exit pages' metrics	All product category pages	All product category pages	All product category pages
					Guest book page
				Size Chart page	Complete order page
			Home page	How to measure page	Home page (Mall)
				Wholesale page	Links page
	Irrelevant Content	Funnel report	Shipping Information page (confusing error message was displayed all the time).	Shopping Cart page	Order Confirm page
	Inappropriate page design		Shipping Method page		
			Billing Method page		
Architecture	?	Percentage of time spent visits	Entire Site	Entire Site	Entire Site
		Average searches per visit			
		Percentage of visits using search			
		Percentage of click depth visits			
		Average number of page views per visits			
Internal Search	?	Average searches per visit	Entire Site (product and advanced search).	Entire Site (product and advanced search).	Not Exist
		Percentage of visits using search			
		Average number of page views per visits			
		Percentage of click depth visits			
		Search results to site exits ratio			
	Inaccurate Results	Search results to site exits ratio			
Purchasing Process	?	Order conversion rate	Entire Site	Entire Site	Entire Site
		Percentage of time spent visits			
		Cart completion rate			
		Checkout completion rate			
	Difficulty in Knowing What was Required for Some Fields	Funnel report	Free Shipping Coupon page	Not Exist	Not Exist
			Shipping Information page		
			Billing Method page		
			Registration page		
	Not Displaying Expected Information After Adding Products to Cart	Funnel report	Entire Site	Not Exist	Not Exist
	Long Ordering Process	Funnel report	Entire Site	Not Exist	Not Exist
	Not Easy to Log on to the Site	Funnel report	Entire Site	Not Exist	Not Exist
	Compulsory Registration	Funnel report	Entire Site	Not Exist	Not Exist
	Illogical Required Fields	Funnel report	Registration page	Entire Site	Entire Site
	Long Registration Page	Funnel report	Registration page	Entire Site	Entire Site
Accessibility and Customer Service	?	Finding customer support information' metrics	Entire Site	Entire Site	Entire Site

Appendix 38: Results of the funnel report for site 1

Results of Funnel Report for Site 1

Page	Information that was provided from the Statistics of the Funnel Report	Does the Statistics indicate Usability Problem(s)	Possible Usability Problem(s) indicated by the Statistics	Possible Information Indicated by the Statistics
Add to Cart End page	The majority of visits were visitors who visited the Shopping Cart page after adding items to their cart although the shopping cart page was not part of the defined purchasing process funnel path (see Appendix 17, explanation of funnel report, 1.1.15). A large number of visits were visitors who returned back directly to the Add to Cart End page after they had been to the Shopping Cart page (see Appendix 17, explanation of funnel report 1, 1.1.5 and 1.1.8).	Yes	**Expected information was not displayed after adding products to he cart:** The site did not display the content of the shopping cart directly at the Add to Cart End page. The Add to Cart End page only displayed a message which was: 'The item has been successfully added to the cart'.	
	Few visits include visitors who proceeded to the next step of the defined funnel, which was the checkout page (see Appendix 17, explanation of funnel report 1, 1.1.4).			
	Many visits were visitors returned to shop on the site after adding product(s) to their shopping cart (see Appendix 17, explanation of funnel report 1, 1.1.16, 1.1.17 and 1.1.18).	No		This behaviour of visitors is expected given that the average items per cart completed for this site was more than one. This figure was 4 on a monthly basis
Checkout page	Approximately half the visits were visitors who continued on the next page of the defined funnel, the Sign In page (see Appendix 17, explanation of funnel report 1, 1.2.4).	Yes	**Long ordering process:** The Checkout link was displayed on two successive pages (the Add to Cart End page and the Checkout page).	
	Almost the fifth of visits were visitors who checked out from the Add to Cart End page and then returned back directly to the Add to Cart End page after visiting the Checkout page (see Appendix 17, explanation of funnel report 1, 1.2.12).	No		The site encouraged visitors to add additional products to their cart by displaying additional suggested product at the Add to Cart End page.

	A large number of visits were visitors who went directly to the Shopping Cart page from the Checkout page (see e Appendix 17, explanation of funnel report 1, 1.2.15).	No		Visitors might go to the shopping cart page to change the quantity of their shopping cart.
Sign in page	Few visits were visitors who continued on to the next step, the Shipping Information page (see Appendix 17, explanation of funnel report 1, 1.3.4).	Yes	**Not easy for visitors with account numbers to log into the site** **Or** **Compulsory registration**: Visitors did not expect the site to have mandatory registering in order to complete the purchasing process.	
	A large number of visitors went to the Forgot Account Number page to retrieve their account number, or to the Sign In- Login Error page due to entering wrong login information (see Appendix 17, explanation of funnel report 1, 1.3.15 and 1.3.16).			
Shipping Information page	Few visits were visitors who proceeded to the next step in the defined funnel, the Free Shipping coupon page (see Appendix 17, explanation of funnel report 1, 1.4.4).	No		The free shipping coupon page is displayed for new visitors who had registered to the site less than a month. After one month this page disappeared (see Appendix 17, explanation of funnel report 1, 1.4.4-note).
	Almost a fifth of the visits were visitors who exited the site from this page (see Appendix 17, explanation of funnel report 1, 1.4.11).	Yes	**Difficulty to know what to enter at the shipping information page fields** **Or** **Irrelevant content of this page** **Or** **Not easy for visitors who had account number to log into the site using their login information.**	Most visitors who went to shipping information page were return visitors (see Appendix 17, explanation of funnel report 1, 1.4.15 and 1.4.16).
	Almost a third of visits were visitors who went to the Shipping Information page from the Registration page and then returned back directly to the Shipping Information page (see Appendix 17, explanation of funnel report 1, 1.4.12).	Yes		
	57% of visitors who tried to enter their login information after they had entered wrong information first, succeeded (see Appendix 17, explanation of funnel report 1, 1.4.6).	Yes		
Registration page	374 visitors were new visitors who went to register with the site. 51% of those new visitors registered and moved through the checkout process and passed through Shipping Information page (see Appendix 17, explanation of funnel report 1, 1.4.5).	Yes	**Difficulty to know what to enter at the registration fields**. **Or**	

			Illogical required fields or Long registration page	
Free Shipping Coupon page	Almost half the visits were visitors who proceeded to the next step, the Shipping Method page (see Appendix 17, explanation of funnel report 1, 1.5. 4). The statistics could explain this since it showed that return visitors were the majority of visitors who went through to the Shipping Information page (see Appendix 17, explanation of funnel report 1, 1.4.15 and 1.4.16).	No		Few visitors were visitors who had registered to the site less than one month ago. (see Appendix 17, explanation of funnel report 1, 1.5.15).
	A quarter of visits were visitors who exited the site at this page (see Appendix 17, explanation of funnel report 1, 1.5.10).	Yes	**Difficulty to know what to enter at the free shipping coupon field**	
Shipping Method page	A large number of visits were visitors who exited the site from this page (see Appendix 17, explanation of funnel report 1, 1.6.10).	Yes	**Irrelevant content or inappropriate page design**	
Billing Method page	A large number of visits were visitors who exited the site from this page (see Appendix 17, explanation of funnel report 1, 1.7.9).	Yes	**Difficulty to know what to enter at the billing information fields Or Irrelevant content Or Inappropriate design**	
	A large number of visits were visitors who entered wrong information at the Billing Method page. Statistics showed that almost a third of visits included visitors who entered wrong information, while entering their billing information and then returned back directly to the Billing Method page to correct the error (see Appendix 17, explanation of funnel report 1, 1.7.13).	Yes		

Appendix 39: Results of the funnel report for site 2

Results of Funnel Report for Site 2

Page	Information that was provided from the Statistics of the Funnel Report	Does the Statistics indicate Usability Problem(s)	Possible Usability Problem(s) indicated by the Statistics	Possible Information Indicated by the Statistics
Shopping Cart page	Most visits were visitors who exited the site from this page (see Appendix 18, explanation of funnel report 2, 2.1.15). Few visits were visitors who proceeded to the next step in the defined funnel, the Login page (see Appendix 18, explanation of funnel report 2, 2.1.4).	Yes	**Irrelevant content Or Inappropriate page design**	None
Login page	Most visits were visitors who proceeded to the next step in the defined funnel, the Shipping and Billing Address page (see Appendix 18, explanation of funnel report 2, 2.2.4). Few visits were visitors who exited the site from this page (see Appendix 18, explanation of funnel report 2, 2.2.6).	No		None
Shipping and Billing Addresses page	Large number of visits were visitors who proceeded to next step in the defined funnel, the Shipping and Payment page (see Appendix 18, explanation of funnel report 2, 2.3.4). Few visits were visitors who exited the site from this page (see Appendix 18, explanation of funnel report 2, 2.3.5).	No		None
Shipping and Payment page	Most visits were visitors who proceeded to next step in the defined funnel, the Order Confirm page (see Appendix 18, explanation of funnel report 2, 2.4.4) . Few visits were visitors who exited the site from this page (see Appendix 18, explanation of funnel report 2, 2.4.5).	No		None
Order Confirm page	More than half the visits were visitors who purchased from the site (see Appendix 18, explanation of funnel report 2, 2.5.4). Few visits were visitors who exited the site from this page (see Appendix 18, explanation of funnel report 2, 2.5.5).	No		None

Appendix 40: Results of the funnel report for site 3

Results of Funnel Report for Site 3

Page	Information that was provided from the Statistics of the Funnel Report	Does the Statistics indicate Usability Problem(s)	Possible Usability Problem(s) indicated by the Statistics	Possible Information Indicated by the Statistics
Personal Information page	The majority of visits were visitors who proceeded to the next step of the defined funnel, the Payment and Shipping page (see Appendix 19, explanation of funnel report 3, 3.1.4). Few visits were visitors who exited the site from this page (see Appendix 19, explanation of funnel report 3, 3.1.10).	No		None
Payment & Shipping page	Most visits were visitors who proceeded to next step, the Order Confirm page (see Appendix 19, explanation of funnel report 3, 3.2.4). Few visits were visitors who exited the site from this page (see Appendix 19, explanation of funnel report 3, 3.2.5).	No		None
Order Confirm page	More than half the visits were visitors who exited the site from this page (see Appendix 19, explanation of funnel report 3, 3.3.5). Few visits were visitors who purchased from this site (see Appendix 19, explanation of funnel report 3, 3.3.4).	Yes	**Irrelevant content or inappropriate page design**	None

Appendix 41: Report on usability problems and recommendations sent to company one

Department of Information Science

Report on Usability Problems and Recommendations for WebSite 1

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February 2009

Supervisors: Professor Anne Morris and Dr Steve Probets

Table of Contents

Introduction

This report presents the usability problems that were identified on website1 using three different methods and suggests how the usability of this site could be improved.

This report has been divided into two parts; Part One presents an overview of the three methods employed together with the time taken for employing each method and Part Two presents the identified usability problems.

The identified usability problems are summarised, categorised and explained. Recommendations and suggestions for each of these problems are also explained and presented together for each problem. Problems are categorised into eight sections according to eight usability problem areas and their corresponding sub-areas. Section One includes navigation problems, Section Two includes content problems, Section Three includes design problems, Section Four includes internal search problems, Section Five includes purchasing process problems, Section Six includes accessibility and customer service problems, Section Seven includes inconsistency problems and, finally, Section Eight includes missing functions/capabilities/information.

Part One

Overview of the Methods Employed in this Study

The following presents an overview regarding the methods employed in this research and the time taken for setting up, designing and analysing these methods:

1. Heuristic Evaluation Method

This method involves expert evaluators who judge whether an interface conforms to a set of usability principles. These principles are called the heuristics. The evaluators, using the heuristics, inspect the interface and identify usability problems that users might encounter while interacting with an interface. Then they suggest recommendations to improve the usability of the interface.

In order to employ the heuristic evaluation method to evaluate this website:

- A set of comprehensive heuristics specific to e-commerce websites was developed. These heuristics were based on earlier heuristics and guidelines for evaluating websites together with guidelines developed to evaluate e-commerce websites. A heuristic checklist was also developed based on heuristics guidelines. The checklist aimed to produce quantitative data on the conformance rating of the website to each heuristic. It included statements that were derived from previously developed explanations of heuristics.
- A total of five web experts were recruited. They had ten years experience or more in developing and designing e-commerce websites in Jordan.
- Each of the five web experts evaluated the website using the heuristic guidelines. The web experts were asked to read each category and sub-category of the heuristic and its explanation, and to give their comments concerning whether or not the website complied with each heuristic principle (additional comments could be provided). After evaluating the website using the heuristics guidelines, a heuristics checklist was given to each web expert to rate the website based on the degree of conformance to each statement in the heuristics guidelines.

Approximate Time for Employing the Heuristic Evaluation Method

The approximate time taken to design and analyse the heuristic evaluation method was 247 hours. This included:

- Setup and design time: A total of 128 hours were spent recruiting web experts (8 hours) and designing the heuristic guidelines (120 hours) that were used by the web experts.
- Time spent collecting data: A total of 15 hours were spent taking detailed notes from the five web experts who participated in the study over five sessions; each session took approximately 3 hours.
- Time spent analysing data: A total of 104 hours were spent transcribing the web experts' comments, writing out the usability problems (80 hours), and statistically analysing the heuristics checklist (24 hours).

2. User Testing Method

This method involves observing a number of users performing a list of tasks in order to identify the usability problems they encounter during their interaction. In order to identify problems that users encounter in their interactions, an observer is needed to watch users' interactions and make comments. Furthermore, questionnaires and/or interviews can be used to collect data regarding users' satisfaction.

In order to employ the user testing method to evaluate this website:

- User testing materials were developed. These included: a testing script in order to welcome the users and to provide an introduction to the research; a consent form acknowledging the users' agreement to participate in the test and to be observed through the testing session; a pre-test questionnaire to gather users' background information; a tasks scenario that included typical tasks for the e-commerce website that was representative of actual use of the site; and a post evaluation questionnaire to gather information about the preferences of users regarding the website after they had interacted with it.
- A total of 20 users were recruited for the usability testing. The characteristics of the usres were based on the profiles of currents users of the site.
- All user testing sessions followed the same procedure. Data were gathered using screen capture software (Camtasia). Two questionnaires were used and observations of the users working through the tasks were made.
- Data obtained from the observation and the questionnaires were analysed.

Approximate Time for Employing the User Testing Method

The approximate time taken to design and analyse the user testing method was 326 hours. This included:

- Setup and design time: A total of 136 hours were spent recruiting typical users (16 hours) and designing users' tasks and questionnaires (pre-test and post-test questionnaires) (120 hours).
- Time spent collecting data: A total of 20 hours were spent in users' sessions observing users, taking notes, and in distributing and collecting the questionnaires; each session took approximately one hour.
- Time spent analysing data: A total of 170 hours were spent transcribing the observation data and users' comments and in writing up the usability problems (90 hours). A further 80 hours were spent statistically analysing the performance data and questionnaires.

3. Google Analytics Method

This method involves having software that automatically collects statistics regarding the detailed use of a system. Analysing and interpreting the statistics helps to obtain an understanding of how users use an interface; it therefore helps to optimise the interface.

In order to employ the Google Analytics method to evaluate this website:

- The required script was installed on the site's pages that were to be tracked and the Google Analytics tool was configured according to the identified key business processes of the website.
- The website usage was monitored for three months.
- A matrix of web metrics was developed in order to measure the site's usage. Then, the metrics' values were interpreted in order to identify potential usability problem areas.

Approximate Time for Employing the Google Analytics Tool

The approximate time taken to design and analyse the Google Analytics method was 360 hours. This included:

- Setup and design time: A total of 8 hours were spent installing the required script and configuring the key business processes.
- Time spent collecting data: Google Analytics software automatically collected users' interactions for three months. Therefore, the time the researcher spent collecting these data was considered to be zero.
- Time spent analysing data: A total of 352 hours were spent identifying the key metrics (calculated using Google Analytics software) that indicate areas for usability problems (232 hours) and calculating the web metrics and interpreting the metrics' values and the Google Analytics' reports (120 hours).

Table 1 summarises the comparative costs of the three methods.

Table 1: Comparative costs for the three methods.

Methods and Time Spent on Each			
	Heuristic Evaluation	**User Testing**	**Google Analytics**
Setup and Designing	128 hours	136 hours	8 hours
Collecting Data	15 hours	20 hours	0 hours
Analysing Data	104 hours	170 hours	352 hours
Total Time	**247 hours**	**326 hours**	**360 hours**

Part Two

1. Navigation Problems

1.1 Misleading Links

1.1.1 Any Product Page:

Any product page, which displayed detailed descriptions of the product, had two links (*Checkout* and *Add to cart*). The *checkout* link was misleading because users expected that this link would add the product to his/her shopping cart, and that the *payment* page would be the next displayed page. However, if the shopping cart was empty, then the site required the user to add the selected item to his/her cart using the *Add to cart* link. If the shopping cart had items then the user could click on the *Checkout* link.

Recommendation for problem 1.1.1:

If the shopping cart was empty, then the *Checkout* link should not appear on product pages. Instead only the *Add to cart* link should appear.

1.1.2 The Top Menu of the Site:

Sign in and *register* links, which were displayed in the top menu of all pages, were misleading. They were displayed on all pages regardless of whether the user had registered and logged on to the site or not. Also, if the user had registered on the site, the *sign in* link did not change into sign out. This confused the user. Users did not realise that they were logged in until they click on the *sign in* link again. At that time the site displayed a page with two options, which were logout & edit profile.

Recommendation for problem 1.1.2:

If the user registered with the site, the *sign in* link should change into *sign out* or *log out* and instead of displaying register link, a welcome message could be displayed with the name of the user who has registered on the site.

1.1.3 The Guaranteed Sub Menu- Problem 1:

Two links were located sequentially in the same menu (the *guaranteed* sub menu) and opened the same page. *Easy return policy* and *Refunds No qustion asked* links opened the *return policy* page.

Recommendation for problem 1.1.3:

Remove one of the two sequential links that opened the *return policy* page. Only one link in each menu should open any page.

1.1.4 The Guaranteed Sub Menu- Problem 2:

The *security guaranteed* link, which was located in the *guaranteed* sub menu, opened the *privacy policy* page. The *privacy policy* page was a long page that displayed at the bottom information

regarding the security of the site. The security information therefore was not obvious to users.

Recommendation for problem 1.1.4:

Display the information regarding the security of the site in a separate page titled for example 'security' or 'security guaranteed' so that uses can find this information easily.

1.1.5 The Home Page- Problem 1:

The *buy now* link which was displayed under some items on the home page was misleading. Users expect that the destination page of this link to be the *payment* page, but the link opened another detailed page related to the selected item.

Recommendation for problem 1.1.5:

Renaming the *buy now* link into *more details* or *view more*.

1.1.6 The Home Page- Problem 2:

The links to *baby names*, *food recipes*, and *how to wear*, which were located on the home page of the site were misleading. Those links open *Shyama corner* page. This page had links to those three pages (*baby names*, *food recipes, how to wear*).

Recommendation for problem 1.1.6:

Each of the following links: *baby names*, *food recipes*, and *how to wear* should directly open its corresponding destination page.

1.2 Non Obvious Links

1.2.1 The Entire Site:

The link to the home page, which was displayed on all the site's pages was not obvious. The text link to the home page was not part of the site's main menu. It was located in a small font above the main header of each page, which was not obvious.

Recommendation for problem 1.2.1:

Make the text link to the home page more obvious. For example, the link to the home page could be added to the site's main left menu.

1.3 Broken Links

1.3.1 The Return Policy Page:

The *Return Policy* page had a broken link which was the *size chart* link.

Recommendation for problem 1.3.1:

Fix the broken link on this page to open the size chart page.

1.4 Weak Navigation Support

1.4.1 The Billing Method Page:

This page had weak navigation support so that the user could not go to the home page from it. This page did not have menu or navigational links.

Recommendation for problem 1.4.1:

Display the navigation, which was displayed on all the other pages on the site, on this page.

2. Content Problems

2.1 Irrelevant Content

2.1.1 Any Product Page:

The site did not explain to users the condition of the purchase. It did not explain to users that orders must total at least $50 before the user can proceed to the checkout. This site displayed a message to inform the user of the site's condition (the order had to be at least $50) only after the user had clicked the checkout link.

Recommendation for problem 2.1.1:

Condition of the site should be explained to users before users add product to their cart.

2.1.2 The Login Page:

If a registered user (current user) signd into the site, or a new user registered with the site from any page other than during the order process, then *edit profile* page was opened immediately after the *login* page. This may confuse the user.

Recommendation for problem 2.1.2:

Enable the user to return automatically to the home page or to the last page he/she was displaying after registration or logging into to the site. Also, display a welcome message on the home page besides the user's name after registering or logging on to the site.

2.1.3 The Shipping Information Page:

In the *shipping information* page, an error was displayed at the top of the page in red with the following message "P.O. Box is not accepted". This message was not clear and confused users, since the form that was displayed on the S*hipping Information* page did not have P. O. Box field.

Recommendation for problem 2.1.3:

Do not display this error message.

2.1.4 The Billing Method Page:

Delivery time was not displayed on this page.

Recommendation for problem 2.1.4:

Display delivery time on this page as most users prefer to see the delivery time of their items at the *order review* page.

2.1.5 The Home Page- Problem 1:

The home page did not indicate that the site sold Islamic women clothing. The banner of the site included the two logos of the site (English and Arabic), and there was a wide white space between them. Non-Arab people may not be familiar with the logo name.

Recommendation for problem 2.1.5:

Improve the content of the home page to indicate that the site specialised in Islamic women clothing. Add description of selling Islamic clothes to the banner, for example the white space area could be utilised to describe the purpose of the site.

2.1.6 The Home Page- Problem 2:

The home page did not reflect that the site's content is new.

Recommendation for problem 2.1.6:

Add a deadline for the site's offers, which are displayed on the home page of the site. The offers could reflect the newness of the site's information if the deadline of the offers is displayed.

2.1.7 The Affiliate Program Page:

The affiliate program page had a FAQ that displayed information regarding the affiliate program. The FAQ did not have a specific title to indicate that it was an affiliate program FAQ and not the main FAQ for the site. This could confuse the user.

Recommendation for problem 2.1.7:

Change the title of the FAQ that related to the affiliate-program to an appropriate name.

2.2 Inaccurate Information

2.2.1 Any Product Page:

The product pages on the site displayed out of stock products. For example, images for certain products were displayed on the product page but when a user added a product to his/her cart, a message was displayed informing the user that the item was not in stock.

Recommendation for problem 2.2.1:

Do not display out of stock products.

2.3 Grammatical Inaccuracy

2.3.1 The Guaranteed Sub Menu:

One of the items that was located in the g*uaranteed* sub menu had a spelling error (*Refunds No **qustion** asked* link).

Recommendation for problem 2.3.1:

Correct this spelling error by changing ***qustion*** into ***questions***.

2.3.2 The Home Page:

On the home page, at the *Shayma Corner* box there was a space before the comma and space before the dot.

Recommendation for problem 2.3.2:

Check and correct the content of the home page and all other pages on the site to assure their grammatical accuracy.

2.3.3 The Guest Book Page:

On the *guest book* page there was no space between the colon (:) and the name of the customer. This occurred for all customers in the heading of each sub-section.

Recommendation for problem 2.3.3:

Insert a space between the colon (:) and the name of each customer in the heading of each subsection on this page.

2.3.4 The Customer Services Page:

On the *customer services* page there was no space between the left parenthesis and the text in the Downloads sub-section.

Recommendation for problem 2.3.4:

Insert a space between the left parenthesis and the text in the downloads subsection on this page.

2.4 Missing Information About the Products

2.4.1 Any Product Page:

- Some information about products was not displayed on the site. For example:
- Availability of products was not displayed. There was no stock indication for the products.
- Fabric of most products was not displayed. For example, the fabric of the following products was not displayed: Jilbab, Abaya, Kheleji Abaya, Kaftans, Top, Dishdash, Sharqyat, and Thoub.

- The length of products that had only one size was not displayed. For example, the length of the following products was not displayed: *Prayer clothes*, *Hijab*, *Shawl*, and *Al-Amira Hijab*.
- Images of each product were small and therefore details of the product were not clear.

Recommendation for problem 2.4.1:

Display clearly the availability, fabric of products and the length and width of products with one size should be displayed clearly. Displays product images using popup windows, then it would provide clearer images of the product.

3. Design Problems

3.1 Misleading Images

3.1.1 The Billing Method Page:

Misleading image on the *billing method* page. This related to the logo image which did not have link to the home page as users expected.

Recommendation for problem 3.1.1:

Add a link to the site's logo on this page that links to the home page. This would make the page similar to other pages on the site.

3.1.2 Entire Site:

The site had images which could mislead the user. Those images did not have a link, but the user could expect that they would have a link to related information. The images were:

- Images of three delivery companies (Aramex, DHL, and TNT) that were displayed on all the site's pages. The site did not display information about them, and they did not have links. By contrast the site displayed an image of credit cards logos which had a link to *payment methods* page that were used on the site.
- An image that was displayed in the *live support* sub-section. The image and text of the *live support* sub-section were displayed on all the site's pages, but neither the image nor the text had a link.

Recommendation for problem 3.1.2:

Add links to the images of the three delivery companies (Aramex, DHL, and TNT) to the page that included information regarding the payment options. Also, add a link to the image displayed in the *live support* sub-section to open a page with informative customer support information content.

3.2 Inappropriate Page Design

3.2.1 Any Product Page:

Pages that displayed their products on more than one page used numbers to navigate among those pages. On these pages, links to all pages were always active regardless of which page was displayed.

For example if page '1' was currently being displayed, a link to number '1' was still active.

Recommendation for problem 3.2.1:

The link related to the page on display should be inactive, while the link related to the previous and next pages of the page-on display should be active.

3.2.2 The Home Page:

The home page had white space at the end and it required scrolling.

Recommendation for problem 3.2.2:

If the home page did not require scrolling it could be better.

3.2.3 The Product Category Page(s)- Problem 1:

The product category pages were long and displayed a large number of images. The default number of products displayed per product category page was 30 and therefore 30 images were displayed. This affects the loading time of those pages. These pages are: *Jilbab, Abayas, Khaleji abayas, Kaftan, Tops, Dishdash, Sharqyat, Prayer clothes pages, Thoub, Hijab, Al-Amira hijab, Shawl, swim suits, and Eid*.

Recommendation for problem 3.2.3:

Display ten products per page to improve download time.

3.2.4 The Product Category Page(s)- Problem 2:

Two of the product category pages displayed a large number of products (i.e. more than 30 images of products per page). Products were displayed in those pages without categorisation. Those pages were the *new arrivals* and *accessories* pages.

Recommendation for problem 3.2.4:

Partition the *new arrivals* and *accessories* pages into more than one page taking into consideration to display less than 30 images of products per page.

3.2.5 The Product Category Page(s)- Problem 3:

The size of the product category pages was not constant as the pages were downloaded (i.e. pages were wider during download time). The width of these pages increased during download then it returned to its original size after the download was completed. This happened since the site did not specify the dimensions (size) of the images that appear in each page. During the download of any of these pages, images appeared at the bottom of the page then they moved to the upper part of the page. The speed of moving images depends on the speed of the Internet, if the Internet was slow, it takes a long time to move images to the upper part of the page, so users with low speed Internet may think that those pages were empty.

Recommendation for problem 3.2.5:

Change the design of the product category pages so that their size will remain constant during their download and their images will not appear at the bottom.

3.2.6 The Shipping Method Page

The *shipping method* page did not have a heading to describe its content.

Recommendation for problem 3.2.6:

Display an appropriate heading on this page.

3.2.7 The Billing Method Page:

This *billing method* page did not have an appropriate heading. The shipping information heading that is displayed at the top of this page could confuse users since this heading is displayed also on the *Shipping information* page.

Recommendation for problem 3.2.7:

Display an appropriate and clear heading on this page.

3.3 Unaesthetic Design

3.3.1 Entire Site:

The site design is very simple. It is not attractive or appealing enough to impress the potential customers.

Recommendation for problem 3.3.1:

- Use beautiful images and graphics on the home page to capture your visitor's attention. These should reflect the purpose of the site.
- Use a professional, interesting and eye catching color scheme.
- Use Flash to enhance the images and text in the website.
- Find a good balance between the use images and Flash since the use of many graphics and/or Flash can distract the visitor.

3.4 Missing Alternative Text

3.4.1 The Product Category Page(s):

Three of the product category pages did not use alternative text for their images. These pages were the *new arrival, petite size* and *most selling* pages.

Recommendation for problem 3.4.1:

Add an alternative text to the images displayed on these pages.

3.5 Inappropriate Choice of Background and Link Colours

3.5.1 The Guaranteed Sub Menu:

The site used an inappropriate combination of background and link colours in the *guaranteed* sub menu that was displayed on all the site's pages. The background colour of this sub menu was blue and the link colour was white, which changed into blue when activated. This was difficult for the user to read.

Recommendation for problem 3.5.1:

Change the blue colour of the activated links within the *guaranteed* sub menu into an appropriate colour.

3.5.2 The Entire Site:

The site's colours were dull.

Recommendation for problem 3.5.2:

Use more colours in order to attract the user. The site could use more colour since the market likes colours.

3.6 Inappropriate Page Titles

3.6.1 Entire Site:

The site had pages with inappropriate titles. Title of some pages was very long. This was inappropriate if the users wanted to add the selected page to their favorites list. Also, titles of the site's pages were not consistent. Some pages had titles which described the content of those pages, but did not describe the company name. Other pages had titles that included only related keywords.

Recommendation for problem 3.6.1:

Use consistent and appropriate page titles throughout the site. Page titles should include the name of the site as well as the name of the page that describe the page's content.

4. Internal Search Problems

4.1 Misleading Link & Limited Options (Advanced Search):

The *Advanced Search* link constitutes a problem as the link name did not match the content of the destination page. Users would expect this page to have search boxes with many options available to search the site. However, this page included only combo boxes that allowed users to only search the site on limited criteria.

Recommendation for problem 4.1:

Change the name of the link from *Advanced Search* into *Search by colour and size* and change the title of the *Advanced Search* page into *Search by colours and size*. Alternatively, change the content

of the *advanced search* page by improving the options provided by the internal search to allow users to search within a specific category or by product type and product name concurrently.

4.2 Inaccurate Results:

The search facilities of this site provided inaccurate results, whether using the basic search or the advanced search. For example, if a specific colour was entered in the search box, of either the basic search or the advanced search, to get a list of available items with the selected colour, then the basic search did not provide results for the specified colour. In addition the advanced search provided inaccurate search results.

Recommendation for problem 4.2:

Improve the accuracy of the internal search facilities to provide accurate results.

4.3 Not Obvious Position:

The position of the internal search facilities (basic and advanced search) was not obvious. Most users expect to see the internal search box at the top of the home page whereas it was actually located under the left-hand navigation menu.

Recommendation for problem 4.3:

Change the position of the internal search box to the top of the home page to make it more obvious to the users.

5. Purchasing Process Problems

5.1 The Difficulty in Knowing what Information was Required for Some Fields

5.1.1 The Free Shipping Coupon Page:

When users when went to the Free Shipping Coupon page they were asked to enter a coupon in the 'free shipping coupon' field. On this page it was not clear to users what to enter in this field. The coupon was displayed on the site when new users register with the site (after thanking the user for registration) in a small font size. Users did not notice this coupon.

Recommendation for problem 5.1.1:

Change the location of the coupon information or to display this information using a larger font size so that users will be able to notice it.

5.1.2 The Registration Page:

If the user missed entering one field on the registration page, the site did not indicate the missed field. The site displayed the message 'please make sure you filled the required fields' without indicating which fields were missed.

Recommendation for problem 5.1.2:

Display a clear message including the missing field.

5.2 The Difficulty in Knowing What was the Required Link to Click

5.2.1 The Shopping Cart Page:

Users did not recognise that they had to click on the 'update order' link located on the *Shopping Cart* page to confirm an update to the shopping cart.

Recommendation for problem 5.2.1:

Display a clear message on this page to notify users that they have to click on the 'update order' link in order to confirm their shopping cart update.

5.3 Long Ordering Process

5.3.1 The Shopping Cart and Checkout Pages:

The ordering process was long since the 'checkout' link was displayed twice on two successive pages (the *Shopping Cart* and *Checkout pages*). This increased the number of pages in the purchasing process.

Recommendation for problem 5.3.1:

Reduce the number of pages included in the ordering process. This could be done by deleting the checkout page and using the *shopping cart* page (that displays the content of the shopping cart) to checkout. The *sign in* page should be the page that will be displayed directly after the shopping cart page.

5.4 Logging on to the Site was not Easy

5.4.1 The Sign In Page

The site used both account number and email for logging on to the site. It could be inconvenient as well as problematic for users to remember their account number.

Recommendation for problem 5.4.1:

Do not use an account number. Use passwords as it is easy to forget account numbers.

5.5 Long Registration Page

5.5.1 The Registration Page

The *registration* page had many fields which had to be filled in by the users.

Recommendation for problem 5.5.1:

Reduce the length of the *registration* page to encourage the user to register and to proceed to the next step.

5.6 Compulsory Registration

5.6.1 The Sign In Page:

The site requires users to register with the site to proceed in the checkout process. Users considered the compulsory registration frustrating and preferred not to register on the site before purchasing.

Recommendation for problem 5.6.1:

Make registration to the site optional.

5.7 Illogical Required Fields

5.7.1 The Registration Page:

The *Registration* page included 'state/province'. This field was required even if the selected country had no states/provinces.

Recommendation for problem 5.7.1:

If the selected country had not states then the 'state/province' fields should not be displayed.

5.8 Not Displaying Expected Information After Adding Products to Cart

5.8.1 The Add to Cart End Page

The site did not display expected information after users had added products to their carts. It did not display the content of the shopping cart directly on the page which was displayed after users had added products to their cart (cart_add_end.asp?WSFlag). Instead, it only displayed a message that confirmed the addition of the items(s) to the cart. It was observed that most users, instead of checking out from the (cart_add_end.asp?WSFlag) page, viewed their shopping cart (by clicking *view cart* link) and check out from that page.

Recommendation for problem 5.8.1:

Display the content o the cart directly on the (cart_add_end.asp?WSFlag) page that displayed directly after users added products to their cart. Also, add a *checkout* link to this page that will open the *Sign in* page.

6. Accessibility and Customer Service

6.1 Not Supporting Foreign Languages

6.1.1 Entire Site:

The site's content was only displayed in English. Its content was not displayed in other languages like Arabic.

Recommendation for problem 6.1.1:

Support Arabic in addition to English.

6.2 Not Supporting More than One Currency

6.2.1 The Entire Site:

The site used only one currency which was Dollars ($).

Recommendation for problem 6.2.1:

Support other currencies in addition to the Dollars ($).

6.3 Inappropriate Information Provided within Help/Customer service

6.3.1 The FAQ Page:

Too few questions were displayed in the FAQ page. The FAQ page did not display important information, for example information about shipping policy was not displayed.

Recommendation for problem 6.3.1:

Add more questions to the FAQ's content. For example, information about shipping policy could be displayed and provide a link (for example it could be titled 'see more about our delivery policy') to the *shipping policy* page. Also information about the privacy policy could be displayed.

6.4 Not Easy to Find and Access the Site

6.4.1 The Entire Site:

Accessibility to this site from the Google search engine was not good enough. It did not appear in the first page of Google results when searching for Islamic clothing.

Recommendation for problem 6.4.1:

Improve the accessibility of the site from search engines by using more important keywords and Meta tags.

7. Inconsistency

7.1 Inconsistent Position of the Navigation Menu

7.1.1 The Main Left Navigation Menu:

The position of the navigation menu was inconsistent throughout the site. The navigation menu was located on the left side of some pages, but it was located at the top of some other pages. Changing the position of the menu among pages confuses many users.

Recommendation for problem 7.1.1:

Make the position of the navigation menu consistent throughout the site so that it appears in the same position on all the site's pages.

8. Missing Functions/Capabilities/Information

8.1 Not Informative Shopping Cart

8.1.1 The Entire Site:

User did not receive an indication regarding the content of their shopping cart during their navigation on the site.

Recommendation for problem 8.1.1:

Display a *shopping cart* image on the top menu of the site. Beside this image, display the content of the shopping cart (number and type of products users added to their cart).

8.2 Not Supporting Delivery to another Address

8.2.1 The Entire Site:

The site did not have the flexibility to deliver the order to another address. The user had the option to enter only one delivery address during registration.

Recommendation for problem 8.2.1:

Support delivering the order to another address.

8.3 Delivery Information Unavailable

8.3.1 The Entire Site:

The site did not have information regarding shipping/delivery methods. The home page displayed logos of three delivery companies (Aramex, DHL, TNT) but no information was displayed on the site about them.

Recommendation for problem 8.3.1:

Display shipping/delivery information on the site. Also, add links to the logos of the three companies (displayed on the home page) to the shipping information page.

8.4 Alternative Methods of Delivery Unavailable

8.4.1 The Entire Site:

The site did not have alternative methods of delivery. It had only one delivery method which was express shipping using the Aramex delivery company.

Recommendation for problem 8.4.1:

Support other methods of delivery.

8.5 Unclear Menu

8.5.1 The Main Left Navigation Menu:

The navigation menu did not give a clear indication of the current page on display. The menu did not

inform the user which item he/she was currently viewing.

Recommendation for problem 8.5.1:

The link on the navigation menu to the page on display should have a different colour to give a clear indication that the page is currently being viewed.

8.6 Resourceful Links Unavailable

8.6.1 The Entire Site:

The site did not have links to useful external resources.

Recommendation for problem 8.6.1:

Add a page to the site including links to related external resources.

8.7 The Site Map is Unavailable

8.7.1 The Entire Site:

The site did not have a site map.

Recommendation for problem 8.7.1:

Add a site map.

Appendix 42: Questions to evaluate the suggested framework

1. Do you think the usability evaluation of your website is useful?

2. Did you find the results (regarding the specific usability problems identified on your website) useful and/or unexpected? Which problems (specific areas or sub-areas) were expected if any?

3. Do you think the suggested framework overall would be useful and applicable in order to identify usability problems on your site? If not, why?

4. Do you think using Google Analytics software as a preliminary tool to indicate potential usability problems quickly (using the suggested web metrics) is useful? If not, why?

5. By considering the types of problem identified by user testing and heuristic evaluation methods (explained in Figure 2) and by referring to your results:
   5.1 What types of specific problem sub-areas are you interested in identifying on your site? And therefore which of these methods would be the most useful?
   5.2 What are the specific problems areas and sub-areas that you are not interested in identifying on your site?

6. Did you find the specific problem areas and/or sub-areas comprehensive? If not, which problems were missed?

7. Would you employ Google Analytics software to track the usage of your site after redesigning it to measure any improvement and/or to identify potential usability problems?