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Usability and Accessibility in E-commerce Web Sites

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Abstract

This paper argues that the accessibility and usability of an e-commerce web site are the primary determinants of customer experience. They are also top factors for improving conversion rate and hence the return on investment. Accessibility of web sites to people with disabilities is a legal requirement in many countries. Section 805 in the US and the Disability Discrimination Act in the UK both require providers to make their web sites accessible to people with disabilities. Organizations are now realizing the social and financial benefits of making web sites accessible to people who are older or who have disabilities. The paper reviews usability and accessibility international Standards, guidelines and practice and the current state of e-commerce usability and accessibility. Case studies of e-commerce web sites accessibility and usability and an approach to their evaluation are presented. These include a major telecommunication company, a travel agency and a bank. These case studies describe examples of current practice in the United Arab Emirates; a country with a rapidly growing economy and the highest rate of Internet use in the Middle East [3]. Despite the wealth of information and guidelines available on accessibility, the web site tested neglected some basic accessibility features.

Keywords: Usability, accessibility, e-commerce sites, evaluation case studies

1. Introduction

The usability of an e-business platform can have an appreciable impact on the ability of customers to achieve their goals and do business. The benefits of usability extend beyond improving the user interface and end user productivity. Its beneficiaries include developers and their companies [36]. Good usability leads to customer satisfaction, higher conversion rates and returning customers [26] [36]. Conversely, bad usability leads to angry customers and loss of business. Good usability also contributes to reduced maintenance costs as most of these relate to unmet or unforeseen user requirements or usability problems [24].

There are many example cases illustrating the benefits of good usability. One of the most impressive is a redesign of the IBM web site undertaken to improve usability and navigation which led to a 400% increase in sales and an 84% decrease in the use of the help button in the first week after the redesign [36]. Creative Good, a leading consultancy on customer experience design, have reported 40% to 150% improvements in key metrics over a six year period as a result of applying their "Joining usability with strategy" methodology [4]. These metrics include revenue, cost savings, conversion rate, customer acquisition rate and retention costs.

ISO 9241-11 defines usability as 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. A definition of usability, relevant to web services, according to Reddish [25] is that users can:

- Find what they need
- Understand what they find
- Act appropriately on that understanding
- Do all of that in the time and effort that they think the task is worth

Designing for accessibility has moral and ethical underpinnings. These relate to the principles of equity in use and removing barriers to exclusion. Accessibility of software to people with disabilities and special needs is also a legal requirement in many countries. In addition, there are sound business reasons for organizations to make their web sites accessible. With accessible web sites, companies can reach more customers; increase their market share and ultimately their revenues and profits. By using appropriate assistive technologies, accessible sites represent an unprecedented opportunity to reach customers who find it difficult to overcome barriers to access that are present in traditional media such as print and TV, for those with visual impairment, and radio for those with hearing impairment. Accessibility also benefits users who are older, have a temporary disability, have low literacy or language fluency, or with low bandwidth connections.

2. Usability and Accessibility International Standards, Legislation and Practice

2.1 Web usability guidelines and Standards

The most well established usability Standard is ISO 9241, Ergonomics of Human-System Interaction [12]. This contains 17 parts including guidelines for the software aspects of the user interface - menus, forms, information presentation, etc. Part 11, Usability, provides usability metrics based on the operational definition that can be employed in user evaluations. Following the completion of the Standard, work is underway on a major revision and restructuring to incorporate other relevant Standards and make the ISO 9241 series more usable.

A new Standard for web usability, ISO 23973 [15] has been under development (supplementing the ISO 16071 Standard on general software accessibility [14]). The new Standard relates to the design and commissioning of web sites and is particularly valuable for those involved in making design decisions and need some authoritative guidance. This Standard will become Part 151 of the revised ISO 9241 and will be entitled: 'Software ergonomics for World Wide Web user interfaces' [32]. The Standard contains detailed guidance in four main areas: purpose and strategy, content and functionality, navigation and interaction, and presentation and media design.

2.2 The current state of e-commerce web usability and its evolution over the last 10 years

The acceptance of e-commerce, enabling ordinary people and business to conduct transactions online has been growing steadily since around the year 2000. Initial resistance to widespread uptake at the start of the millennium was due to a number of factors; the slowness of Internet connections in people's homes, lack of trust in online transactions, and poor usability of Internet sites. Jared Spool, for instance, conducted a user study where it was found that users visiting the best sites (some e-commerce) could only accomplish their goals 42% of the time. 58% percent of the time they failed [31]. Web design became a key area within the HCI and Human Factors community and the growth of usability consultancy services started to address these problems. To some extent they have succeeded with many companies such as airlines and supermarkets successfully transferring a high proportion of their business online. Yet e-commerce services are far from uniformly usable today. Travis, [35] in his book on e-commerce usability commented in 2002 that "independent reports are issued on a regular basis that highlight how much business is lost by websites that are difficult to use.... People who want to buy products are unable to because of navigation difficulties; customers are unable to find the correct page to choose the product, or are unable to find the payment option". For a recent example, see Webcredible [40].

Despite the importance of usability, there are no specific legislative requirements requiring that websites must be usable. It is in general the fear of poor publicity, loss of confidence in the site by the consumer and the danger of them not returning, that encourages organizations to produce more usable websites.

2.3 Accessibility guidelines and Standards

There are several accessibility guidelines and Standards including:

ISO 9241-171: Ergonomics of human-system interaction – Guidance on software accessibility: a comprehensive and technical Standard, drawn up by independent international Standards experts, with 150 individual statements, classified as either 'Required' or 'Recommended' [13].

IBM software accessibility checklist: IBM has taken a very proactive attitude to accessibility for a long time, and their checklist is one of the best tools on the Net [11].

Irish IT Accessibility Guidelines: The National Disability Authority (NDA) is an independent agency under the Department of Justice, Equality and Law Reform in Ireland. The NDA commissioned guidelines to provide direction on making electronically delivered services accessible to people with disabilities. The guidelines for application software have seventeen statements and two levels of priority. The website also contains some helpful information about a general process by which accessible IT can be developed successfully [18].

Tiresias checklist for software applications: The Tiresias website contains lists of guidelines for the design of many types of ICT systems, including software. A checklist of around 75 statements is available, which also identifies which disability types are likely to be impacted by each statement [34].

The World Wide Web Consortium (W3C) develops interoperable technologies (specifications, guidelines, software, and tools) to lead the Web to its full potential. W3C is a forum for information, commerce, communication, and

collective understanding. The W3C's WAI (Web Accessibility Initiative) established guidelines for web sites to achieve, based upon 3 levels or priorities of achievement [39].

2.4 Accessibility legislation in US, UK and elsewhere

Section 508 - amended in 1998 [30] - is the United States legislation that requires Federal agencies to make their electronic and information technology accessible to people with disabilities. The law applies to all Federal agencies when they develop, procure, maintain, or use electronic and information technology. The section about software applications and operating systems contained twelve key statements. Most of these related to usability for people with sight impairments. Other types of disability are addressed less well.

The UK Disability Discrimination Act 1995 (the DDA) [5], was introduced with the intention of comprehensively tackling the discrimination which many disabled people face. The DDA makes it unlawful to discriminate against disabled people in terms of recruitment and employment, provision of services, or education. Software (including web sites) is covered under the employment and the education provisions, as there will be IT systems that employees, staff and students need to use to carry out their jobs (RNIB [28]). Software will also be covered when it forms part of the provision of a service, such as in a system that needs to generate letters in appropriate formats.

The public sector Disability Equality Duty also expects consideration of accessibility in the procurement of software. The following paragraph is taken from the Statutory Code of Practice for England and Wales, on the duty to promote disability equality (section 3.46). A similar example is quoted in the Code of Practice for Scotland. "A Government department that is planning to procure a new IT system should ensure that its action plan includes the work it will do to ensure that the new system is suitable for use by disabled employees. The action plan should also indicate the way it will develop the specification so that the system delivers the right products for disabled customers".

2.5 The current state of e-commerce web accessibility and its evolution over the last 10 years

If an ecommerce website is to be successful in increasing sales and customer loyalty it must be carefully designed. Giving careful consideration to issues relating to website design and accessibility is essential if an ecommerce website is to be inclusive of people with disabilities. In 2004, the Disability Rights Commission issued a report into the accessibility of websites [6]. The report summarizes the status of web accessibility based on a series of surveys conducted by different organizations:

The Royal National Institute of the Blind (RNIB) published a report in August 2000 on 17 websites, in which it concluded that the performance of high street stores and banks was "extremely disappointing" [27]. A separate report in September 2002 from the University of Bath described the level of compliance by United Kingdom universities with website industry guidance as "disappointing"; and in November 2002, a report into 20 key "flagship" government websites found that 75% were "in need of immediate attention in one area or another" [10]. Recent audits of the UK's most popular airline and newspaper websites conducted by AbilityNet reported that none reached Priority 1 level conformance and only one had responded positively to a request to make a public commitment to accessibility [1].

The report made recommendations that:

- 1 Disabled people need better advice about the assistive technology available;
- 2 A business case should be established to ensure that higher quality assistive technology products are available at lower cost;
- 3 Vendors of operating systems and browsers should help disabled users identify, select and employ the accessibility features in those products;
- 4 Website developers are relatively well informed about the existence of accessibility guidelines, but require training in the use of accessibility features in the development environment they are using;
- 5 Website owners and commissioners must better understand the accessibility needs of disabled people, and recognize that it is in their commercial interest to meet the needs of these users;
- 6 Automated testing of websites is an important resource for website developers and owners that should be used more widely along with human evaluations.

3. Evaluating Usability and Accessibility

Different methods can be used in evaluating the usability and accessibility of e-commerce sites. What follows is a discussion of the ones which are most commonly used.

3.1 Usability

3.1.1 Heuristic evaluation

Heuristic evaluation is a method for finding usability problems in a user interface. A small set of evaluators undertake a systematic inspection of the interface and judge its compliance with recognized usability principles (heuristics). Heuristic evaluation falls into the general category of usability inspection methods [19] [21]. Some of the most widely used heuristics are those developed by Nielsen [22]. Heuristic evaluation is considered as a discount usability engineering method. The focus is on achieving "the good" with respect to having usability engineering work performed even though the methods may not be the absolute "best" methods. He recommends an evaluation method based on user and task observation, scenarios as prototypes of the system, and heuristic evaluation [20]. A review of problem types found using Heuristic evaluation is available from Nielsen [23].

Heuristic evaluation is an effective and a cost efficient method that is particularly valuable in circumstances where cost and schedule are constrained. Despite its simplicity and cost effectiveness, the reliability of heuristic evaluation as a usability evaluation method has been questioned. One problem is that it is based on the opinions (the expert judgment) of the evaluators. When designers are given the results of the heuristic evaluation and requested to make changes to their design, they may seek to question the validity of the findings. Although the heuristics are based on established design principles, different sets of heuristics can be used in evaluations leading to different findings. For example, Rosenfeld [29] has developed heuristics that are specifically aimed at information architecture. Another common criticism of HE's is that they are capable of generating a large number of relatively minor usability problems that are likely to go unobserved in an empirical usability study, but are identified by evaluators whose awareness is heightened by the guidelines.

3.1.2 Usability testing

The goal of usability testing is to determine whether the product being developed is usable by the intended user population to achieve the tasks for which it was designed [7]. As with heuristic evaluation, user testing aims to find design problems, but from the basis of users attempting to use the system. Some key issues in usability testing are the identification of a representative user sample and development of scenarios and tasks to be used in the tests. The tasks must be realistic, doable with the application and explore the system thoroughly. Tasks of varying degree of complexity are typically used in the tests.

Different types of data can be collected in usability tests. Data concerning task completion rates, number of errors made, and the time it takes to complete a task forms quantitative performance measures. User satisfaction data can also be gathered by using questionnaires and interviews. Observation data can be collected by having an observer watching the users or by recording the session and watching it back.

It is generally accepted that between 10 – 15 users are needed in a usability test. However it is possible to use a smaller number when the budget and the schedule are constrained or when the process is iterative. In a series of experiments, Virzi [37] found that about 80% of the usability problems were uncovered by 5 test subjects.

3.2 Accessibility

Methods similar to the ones discussed above can also be used to evaluate accessibility. This requires experts in accessibility issues or representative users with disabilities. An inspection method using accessibility guidelines (e.g. Web Content Accessibility Guidelines WCAG [38]) or checking for country specific recommendations such as the USA's Section 508 requirements can be employed [30]. In addition, the application can be tested with users who are disabled or who have special needs. Issues of concern when evaluating accessibility include the use of alternative text for images, sufficient color contrast, variable text size and page width and alternatives to any scripts or image maps. Also important is compatibility with AT (assistive technology) such as screen readers and speech

input devices. Another key aspect is access to the website via different browsers on different platforms. Ensuring compatibility can be a time consuming task.

3.3 Proposed framework

Several studies have suggested that it is not adequate to use a single method in order to achieve comprehensive usability evaluation [2] [17]. They recommend that both user testing and heuristic inspection should be used as evaluation tools and as methods for guiding design improvements. Another factor is that heuristic evaluation does not produce data of the same precision and reliability as usability testing. Most practitioners therefore advocate using heuristic evaluation as a supplement to usability testing. This is similar to the use of multiple data gathering or data analysis techniques. This can provide different perspectives and corroboration of findings across techniques thus leading to more defensible findings.

The approach to evaluating e-commerce web site usability and accessibility presented in this work combines heuristic evaluation and user testing where participants are asked to work through a set of tasks that are representative of what customers perform on the web site. A set of 10 – 15 tasks is developed for each e-commerce web site. Participants were asked to complete the tasks using the think aloud protocol. Interaction data was recorded using the Morae [33] usability evaluation software which enabled a video log of the interaction to be generated. It also supported qualitative analysis through observation and quantitative analysis through performance charts and histograms. Evaluating accessibility involved a preliminary review of a representative page sample from the web site, the use of graphical and specialized browsers and the use of an automated web accessibility evaluation tool [8].

4. Case Studies Illustrating Usability and Accessibility Practice in the UAE

4.1 Telecommunication

Etisalat is a major telecommunications provider in the UAE. It provides a variety of services for mobile and fixed line telephony, Internet and TV. The usability and accessibility of the web site (See Figure. 1) were evaluated according to the methods described above. The heuristic evaluation used the ten heuristics developed by Nielsen [22] and adapted for the web by Instone [9]. Both positive and negative findings for each of the categories were noted. Table 1 summarizes some of findings. Some findings relate to more than one heuristic as shown. The main issues found relate to improving the navigation to service information pages and achieving this through an information architecture that provides consistency of presentation.

Usability tests were carried out on the Etisalat web site utilizing a setup with 3 computers running the Morae usability evaluation software. These are recorder, observer and manager. The recorder software is used on the participant's workstation and provides a sophisticated video recording of the test. The observer software enables an evaluator to see the test in real time and place markers to indicate the start and end of each task and to indicate significant events or observations (for example points where the user gets stuck or requests help). The evaluator can also add comment and observation to the video. The manager software facilitates the subsequent analysis of the data and generates summary statistics and charts. It also enables maintenance of the data created by 'observer'. Test participants were asked to 'think-aloud' during the tests. Participants completed 13 tasks selected to reflect the range of services provided by Etisalat. A total of five participants completed the tests.

A wealth of performance data is generated from the recordings including the average time to complete a task, the number of mouse clicks per task, task difficulty score and the time spent on the homepage, navigation pages and destination pages per task. As shown in Figure 2, participants were most successful with tasks 2, 4, 7, 9 and 13 and least successful with task 5 (the lower the score the easier the task and the more successful participants were).

Bringing together the information about the times spent on the different types of pages into one chart enables the display of the average time spent on each type of page for each task. This is shown in Figure 3 and is an informative summary of the navigational aspect of task performance. Given the findings of the heuristic evaluation regarding navigation and information architecture, the chart shows clearly which tasks required a great deal of time spent on navigation. With task 5, we find that the time spent on the destination page is 0 indicating that users were unable to find the information.



Figure 1. The home page of Etisalat.

Table 1. Findings from the heuristic evaluation – a selective summary list

Heuristics	Positive Findings	Negative Findings
H1 Visibility H5 Error Prevention	Navigation bar that shows the path from the home page to the current page through routing pages and provides opportunity to backtrack	Banners and headline links can mislead users who click on them in the belief that they will lead to service information pages
H3 User control and freedom	The drop down lists provide fast access to service information – suitable for experienced users.	Too many service options are available from the drop down lists in the upper right corner of the page.
H2 Match with Real World H6 Recognition rather than recall	The site uses English and Arabic the 2 main languages spoken in the UAE	Users have to remember or understand the names of certain services (e.g. Tarjim - the translation service)
H4 Consistency and Standards	The same fonts, colors and look and feel are used throughout the pages	Too many and different categorizations are provided to access the services
H5 Error prevention H8 Aesthetic and minimalist design	User input is generally by selections instead of free text	Unhelpful search facility message when no results are found

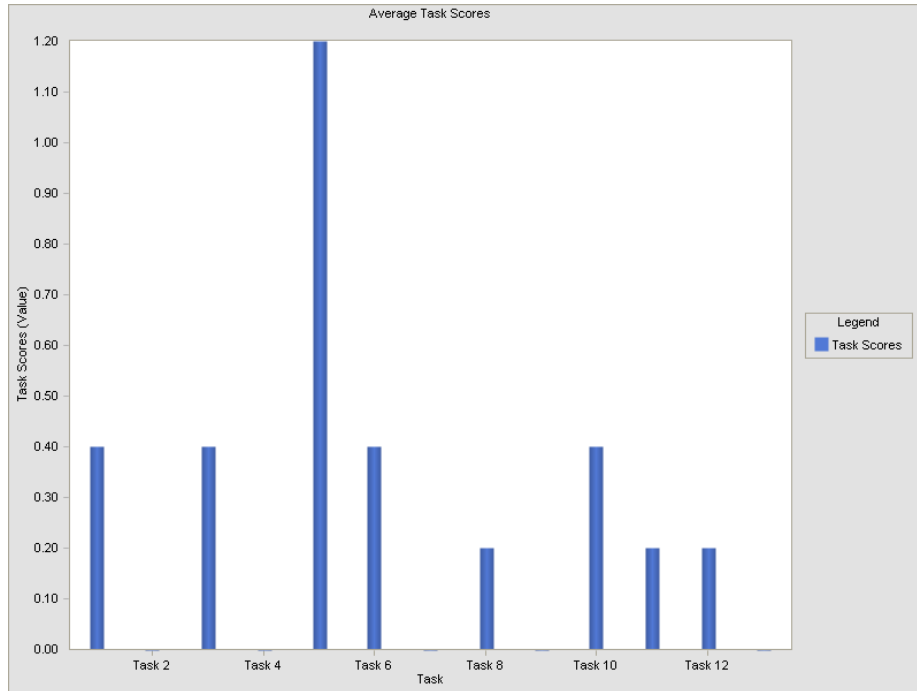


Figure 2. Average task success scores

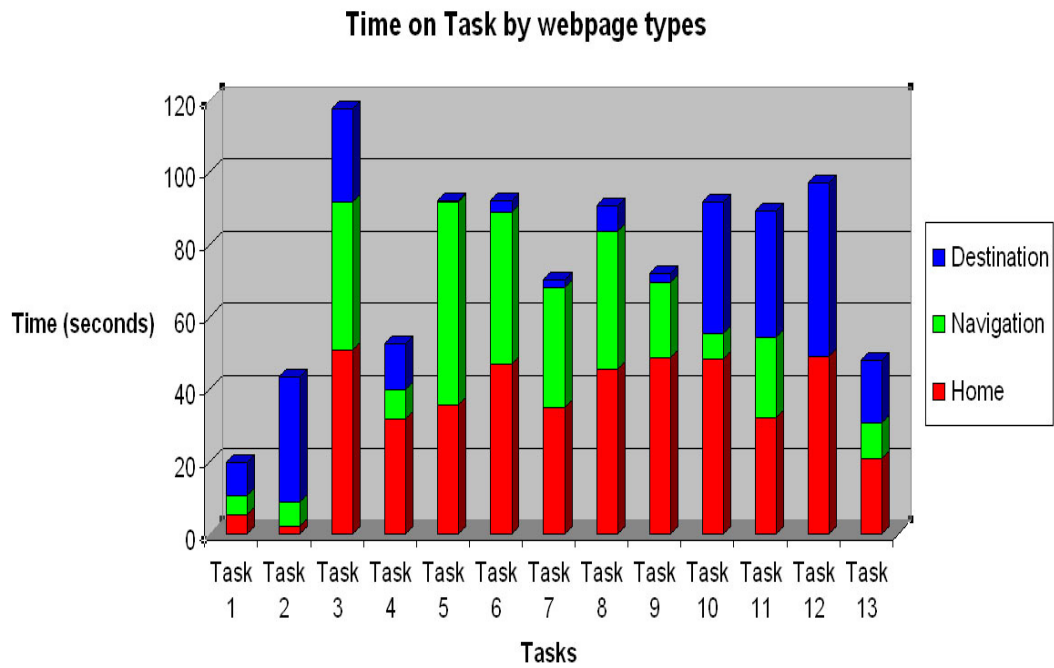


Figure 3. Average time per task by web page types

An evaluation of the Etisalat web site for accessibility revealed several issues. The site had clickable images without alternative text as well as form controls without labels. These 2 problems make the site non compliant with Section 508 requirements [30] and the WCAG [38]. Also in some places, low contrast text was used and other minor issues were noted.

Overall and despite the problems noted above, the site had a good design for usability. An improved and redesigned site will deal with the usability and accessibility issues that the evaluation has uncovered.

4.2 Travel and tourism

Salem Travel Agency is one of the main travel agencies in Abu Dhabi, UAE and provides holidays and travel services. The web site provides information about the services offered, holiday packages, promotions and flight bookings. An evaluation of the usability and accessibility of the web site has been carried out. Both a heuristic evaluation and user tests have been undertaken in a manner similar to that described for the Etisalat case study.

It was found that the site had an attractive, visually appealing design and color scheme. However, the multiplicity of usability and accessibility problems calls for a redesign of the web site; in particular its functionality and information architecture. The heuristic evaluation uncovered both major and minor problems. For example, the online booking facility for flights, cars and hotels was not functional; in many places navigation was counter-intuitive or outright confusing (a number of options appear when 'flight booking' is selected – travel guides, weather, currency converter – this is not what would be expected from flight booking; when one of these latter options are selected they lead to a non-functional booking screen). There was no support for a local language version of the site. The site also had outdated content, dead links and missing images. This can cause the user to distrust the information provided. There is also a lack of consistency in the application of the color scheme, in opening new windows when certain selections are made, and in the use of drop down and pull down menus. User testing confirmed the navigation problems reported with users having difficulty completing tasks such as 'check Singapore's weather for the next 5 days' and 'find the conversion rate between the UAE Dirham and the Singapore Dollar'.

Similar to the telecommunication's company's web site, the site had images without alternative text as well as form controls without labels. These problems make the web site non compliant with Section 508 requirements [30] and the WCAG [38].

4.3 E-banking

As part of an ongoing study into e-banking in the UAE, an evaluation framework specifically aimed at e-banking services has been developed. This combines usability and accessibility with functionality, security and customer service. Initially, questionnaires and heuristic evaluation have been used as the evaluation methods. These will set the stage for subsequent user testing. The e-banking services of 4 regional banks have been selected for this study. In the completed questionnaires, customers expressed commitment to e-banking, and the majority of respondents trusted the security of their e-banking service. Several respondents, however, expressed frustration with their e-banking service citing login problems and ineffective offline support. A heuristic evaluation of the e-banking service identified from the questionnaires confirmed these problems with the evaluator being asked to repeatedly and endlessly change the login password during the evaluation session. The lesson to be learnt here is that security initiatives and improvements should not compromise the usability of the service.

5. Discussion

The findings from the evaluation case studies show that whilst companies in the UAE have managed to develop visually attractive designs for their e-commerce sites, usability and accessibility problems of varying degrees of severity exist. The most important finding concerns accessibility as all of the web sites tested had problems relating to accessibility. For example the web sites tested did not include alternative descriptive text for images or explicit labels for form controls. People who are using screen readers will not be able to make sense of the image content. These issues make the sites non-compliant with the most basic of levels of the WCAG [38]. This is surprising given the wealth of freely available information on accessibility which companies and web design agencies can refer to. It is worth noting that UAE has not yet legislated on accessibility for information spaces. There were, however, many positive findings and examples of good practice relating to usability. These included the feedback given to the user of the web site, the use of familiar jargon free language, the use of consistent style and presentation and good error

prevention. The most important negative findings related to the information architecture and navigation support i.e. the navigation from the home page to destination pages through linking pages. It was possible to combine the qualitative findings from the heuristic evaluation with the quantitative analysis that shows, for each task, the time spent by participants on the different types of web page (classified as home, navigation, and destination pages). This has lent support to the overall conclusions reached.

For companies developing e-commerce platforms, what are the practical steps that can be undertaken to ensure an accessible and a usable system? The following steps are recommended:

- Include users with special needs and accessibility experts in requirements analysis and testing
- Develop accessibility and usability awareness amongst the development team
- Employ design agencies who demonstrate experience in accessibility and usability
- Employ a user centered design process which is driven by user needs
- Take account of established guidelines and include evaluation against guidelines

6. Conclusion

It is concluded that the usability and accessibility of interactive systems are well represented in international guidelines and Standards. Web usability is currently the subject of a new international Standard (ISO 23973) [15]. As noted above, accessibility is also a legal requirement in many countries. An evaluation framework using a combination of methods for usability and accessibility evaluation has been advocated and applied to e-commerce web sites in the UAE.

Given the findings of the evaluation case studies with respect to accessibility, possible reasons for ignoring accessibility requirements include lack of awareness of accessibility issues, lack of commitment on the part of developers and their companies, and the absence of local legislation. A program to raise awareness of accessibility and an appreciation of the business case for accessible web sites is likely to improve the situation. This is likely to be enhanced further by the passing of local legislation in the UAE. In the future, usability and accessibility will be seen as equally important which will be to the benefit of all users.

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