The Assessment of Usability of Electronic Shopping:

A Heuristic Evaluation

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Abstract

Today there are thousands of electronic shops accessible via the Web. Some provide user-friendly features whilst others seem not to consider usability factors at all. Yet, it is critical that the electronic shopping interface is user-friendly so as to help users to obtain their desired results. This study applied heuristic evaluation to examine the usability of current electronic shopping. In particular, it focused on four UK-based supermarkets offering electronic services: including ASDA, Iceland, Sainsbury, and Tesco. The evaluation consists of two stages: a free-flow inspection and a task-based inspection. The results indicate that the most significant and common usability problems have been found to lie within the areas of 'User Control and Freedom' and 'Help and Documentation'. The findings of this study are applied to develop a set of usability guidelines to support the future design of effective interfaces for electronic shopping.

Keywords:

1. Electronic Commerce, 2. Usability Evaluation; 3. Interface Evaluation

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1. Introduction

With the widespread use of the World Wide Web (Web), users are increasingly interfacing to, and interacting with, web-based applications. Among a variety of Web-based applications, electronic shopping is a fairly recent phenomenon. Although there are thousands of electronic shops on the Web today, the majority of these are only a few years old (Helander and Khalid, 2000). In traditional shopping, the interaction between users and the physical shop determines the impression that the users have of the shop. However, in electronic shopping the Web site may be thought of as a 'window' through which users have their initial interaction with the shop (Zhang and von Dran, 2002) and the design of which presents the users with a comprehensive image of the shop (Tung, 2001). In other words, the Web site formulates the working environment of electronic shops, so it is critical that the working environment is user-friendly in order to help users to achieve the desired results (Despotopoulos, et al., 1999). As such, usability evaluation of web-based electronic shopping becomes paramount because it can provide concrete prescriptions for developing user-centred electronic shops that might be expected to increase user uptake and the volume of sales achieved by aligning to users' needs.

However, existing research has not paid much attention to evaluating the usability of electronic shopping (Benbunan-Fich, 2001). In this vein, the study reported in this paper aims to assess key elements of the interface design of electronic shopping. In particular, this study will focus on a specific genre of electronic shops, electronic supermarkets,

which are more challenging in current electronic shopping because many interface elements need to be considered (See Section 3.4 for details). Among the various usability inspection techniques, the primary technique used in this study is heuristic evaluation, which involves each interface being scrutinised against a set of recognised usability principles, or the 'heuristics' (Nielsen and Molich, 1990). A number of studies have proven the easy adaptability of this approach to the evaluation of the design of Web sites (Nielsen and Norman, 2000). This study belongs to this category. In addition, this technique allows a detailed evaluation of the whole interface and ensures that the entire problem space is covered. Research has shown that problems overlooked in user testing can be in fact identified through heuristic evaluation. Yet, there is a clear lack of empirical studies that apply such criteria to evaluate electronic shops, and this is where this study seeks to make a contribution.

The paper begins by building a theoretical background to present the importance of usability inspection in the development of electronic shopping. It then progresses to discuss an empirical study, assessing the interface design of electronic shopping using Nielsen's heuristics (1994). Subsequently, the findings of this empirical study are used to develop a set of usability guidelines, which can work as a checklist to help designers to judge the values of different interface features with respect to electronic shopping, and can provide guidance for future usability improvements in this and other web-based applications.

2. Theoretical Background

2.1 Electronic shopping

The rapid proliferation of the Internet and the Web has created a fast growing channel for electronic shopping. Electronic shopping is a major component of the business-to-consumer (b-2-c) category of electronic commerce (Elliot and Fowell, 2000), which is associated with the buying and selling of information, products, and services via the Web (Kalakota and Whinston, 1996). The benefits of electronic shopping are well known. Grewal *et al.* (1999) claim that electronic shopping can provide an extremely high level of convenience for those whose time costs are perceived to be too high to invest in conventional shopping. Other incentives for consumers to use electronic shopping include broader selections (Jarvenpaa and Todd, 1997), competitive pricing, and greater access to information (Peterson *et al.*, 1997). A study by Kehoe *et al.* (1998) indicated that for about 40% of the respondents, electronic shopping was their primary use of the web. This suggests that electronic shopping has gained considerable appeal during the past few years.

However, the success rates of using electronic shopping are only 56% (Nielsen, 2001). Service quality has been found to be one of the most important factors for the success of electronic shopping (Kim and Lee, 2002). One of the challenges of service quality in electronic shopping is Web design and a growing number of studies are examining customer expectations in relation to Web design (Romano, 2001). Jarvenaa and Todd (1997) found ‘shopping experience’ and ‘product perception' to be especially important and there is a proportionate dissatisfaction with navigation when seeking to locate specific items. Kirakowski *et al.* (1998) found that the important factors influencing a

customer's perception include 'attractiveness', 'control', 'efficiency' and 'helpfulness'. A similar study by Wolfinbarger and Gilly (2000) found that the majority of on-line buyers are motivated by design features that increase their sense of 'control' and 'freedom', including order tracking, purchase histories, savings information, optional e-mail notification and special deals. These studies suggest that the usability of Web design has significant effects on users' satisfaction in relation to service quality (Bouch *et al*., 2000).

Failure to provide effective design may also have a serious economic impact. For example, Nielsen (2001) found that electronic shops lose half of their potential sales because of poor usability. Liang and Lai (2000), who studied the quality of web design and analysed consumer choices, found that design quality significantly affected consumer choice of electronic stores. In addition, Hurst (2000) showed that 39% of shoppers failed in their buying attempts because the sites were too difficult to use. Similarly, Tilson *et al.* (1998a) asked users to rate 40 listed items in terms of their effects on the decision to purchase. In the list of the top seven concerns, four items were pertinent to the usability of the interface design: feedback to confirm that the order has been received; the ability to go back and edit the purchase order list; having order buttons that are clear and easy to find; and knowing which category or section of the site to look in to find the product wanted. Another study by Tilson et al. (1998b) indicates that the usability problems of electronic shops become serious, and these problems resulted in users failing to find what they were looking for, or even abandoning the purchase though they had found the relevant product. Scott (2000) concluded that 'Cyber shopping' would not become widespread until screen design and content structure had been improved.

The aforementioned evidence suggests that the usability of Web design is a key factor in determining the success of electronic shopping. Electronic shopping will not be fully accepted by users until usability issues have been addressed in sufficient detail to inform interface design. It seems clear that designing electronic shops with an effective user interface has an important impact on users' attitudes to their use. Ultimately, ease of use and the presence of user-friendly features can determine whether a user frequently returns and uses particular electronic shop. Hence, there is a need to conduct usability inspection of current electronic shopping in order to increase user satisfaction and the purchase of the products as well.

2.2 Usability inspection

Usability is a very broad concept in system design (Lee, 1999). Basically, it is concerned with designing software applications which people find convenient and practicable for use (Nielsen, 1993) and is often defined as a measure related to how usable or user-friendly the product, service, or system is (Flowers, 2000). In formative evaluation, usability is mostly concerned with evaluating the software interface using approaches known as usability inspections or expert reviews (Nielsen and Mack, 1994). Major techniques of usability inspections include:

- Heuristic Evaluation – examination of a user interface based on specific rules (Wild and Macredie, 2001);
- Cognitive Walkthrough - an usability evaluation method based on cognitive theory (Rieman, *et al.,* 1995);
- User Testing - evaluation that involves users to assess usability issues (Conyer, 1995).

Among these techniques, heuristic evaluation is the most rapid, cheap, and effective way for identifying usability problems (Greenberg, *et al*., 2000), and involves an expert evaluating the interface against a set of recognised usability principles – the 'heuristics' (Nielsen, 1994). Heuristic evaluation was first formally described in presentations in the Human-Computer Interaction conference through papers published by Nielson and Molich (1990). Since then, they have refined the heuristics based on a factor analysis of 249 usability problems (Nielsen, 1994a) to derive a revised set of heuristics with maximum explanatory power. Table 1 presents the detail of the revised set of 10 Heuristics (H).

[Insert table 1 about here]

The advantages of heuristic evaluation are reflected by its commercial and industrial applications. Referred to as a 'discount usability engineering method', it is certainly cheap but also fast, easy to learn, flexible, and most importantly effective (Nielsen, 1997). Although heuristic evaluation falls into the category of 'expert review', it can be used effectively by both novices and experts. Ideally, an evaluator should have a broad background in usability evaluation and interface design as well as specific knowledge of the subject domain. However, it is also true that heuristic evaluation techniques provide little difficulty to those who want to use them, regardless of their prior knowledge in usability evaluation and subject domain. In fact, it is possible to use heuristic evaluation after only a few hours of training (Nielsen, 1995). The prescription of structured techniques can also facilitate effective evaluation by novices, more so than for other usability methods available (Levi and Conrad, 1996).

The other advantage of heuristic evaluation is that it can be used to address some of the gaps in past research into interface design, which either focused on a particular aspect of interface design in detail or considered the entire interface without enough depth (Baker *et al.*, 2001). The use of heuristics ensures both that the interface can be evaluated in depth and that the overarching and specific problems can be discovered. Fu *et al.* (2002) applied heuristic evaluation and user testing to assess the user interface of an Internet-based multimedia information application. There were 39 usability problems identified. The heuristic evaluation found a larger number of problems (n=34) than user testing. This practical value of heuristic evaluation is also reflected in the study by Jefferies *et al.* (1991) who compared four different techniques used to evaluate a user interface for a software product prior to its release. The four techniques were heuristic evaluation, software guidelines, cognitive walkthroughs, and user testing. Overall, heuristic evaluations identified the most usability problems, reporting one-third of the most severe problems and two-thirds of the least severe. These serious problems found by heuristic evaluation required the least amount of effort to uncover; leading Jefferies *et al.* (1991) to claim that heuristic evaluation had a distinct cost advantage.

3. Methodology Design

3.1 Conceptual framework

Having demonstrated the potential of heuristic evaluation, this study applies it to assess the interface design of current electronic shopping sites. A conceptual framework of this study is provided in Figure 1. The sections below describe each of the stages outlined in the framework. In the first stage, an existing set of heuristics (Nielsen, 1994) was extended to include three new heuristics (Section 3.2). Subsequently, a set of evaluation

criteria was developed for each heuristic to be used as a checklist for the evaluation sessions (Section 3.3). For the research instruments, electronic supermarkets were selected for the category of electronic shops to be evaluated (Section 3.4). The evaluation sessions comprised two stages: a free-flow inspection and a task-based inspection (Section 3.5). Once the evaluations had been completed, severity ratings were assigned to each of the criteria to indicate the seriousness of each interface's usability problems. Finally, the data collated from the evaluations were analysed (Section 4), and the findings were used to develop a set of new usability guidelines for the future design of effective and usable electronic shopping interfaces (Section 5).

[Insert figure 1 about here]

3.2 Extension of heuristics

Nielsen's (1994b) set of heuristics was used as a benchmark in this study, as their usefulness has already been studied and validated (e.g. Kahn and Prail, 1994). The most widely used and regarded set of heuristics adopted for usability inspections are those proposed in 1990 and last revised in 1994. Since the revision was done 10 years ago, it is necessary to extend Nielsen's existing heuristics to address current needs. In addition, Nielsen's heuristics are notably 'product-oriented' (Floyd, 1997). In terms of assessment/evaluation, they treat systems as self-contained objects, which largely marginalizes the humanistic aspects of systems. To make up for this shortcoming, this study also considered three additional heuristics selected from Muller et al.'s (1995; 1998) *Participatory Heuristic Evaluation*, which take a 'process-oriented' perspective and place emphasis on the fit of the system to users and their work needs. The main difference between the product-oriented and the process-oriented paradigm is that the

former focuses on the system itself whereas the latter emphasises on the human work process that the system is intended to support. Finding from recent studies in software engineering (e.g., Floyd, 1997), usability inspection (e.g., Catani and Biers, 1998) and web user experience (e.g., Hoffman and Novak, 1996) suggest that both paradigms are important and that there is a need to find a balance between them. This is also the reason why the additional heuristics were adapted for use in this study. The details of the additional heuristics are presented in Table 2.

[Insert table 2 about here]

3.3 Development of evaluation criteria

The set of heuristics, although very useful, was only suitable as general usability guidelines that could be used as a broad framework for evaluation. They did not prescribe a step-by-step or pragmatic approach that could be closely followed in usability inspections. If used in isolation, only general usability problems could be identified. To facilitate a detailed, structured and thorough evaluation of each interface, it was necessary to develop associated criteria for each heuristic. The criteria were developed by an analysis of past and present usability studies (e.g. Pierotti, 1995, Nielsen and Mack, 1994). The findings of these studies were applied to identify which interface elements might affect users' performance or cause difficulties in interacting with the system, and such interface elements were extracted to develop the criteria, which were then classified into suitable heuristics based on their characteristics.

In the set of criteria, each criterion developed referred to a requirement for a specific interface feature or element that should be adhered to and was mapped onto a detailed checklist which was used for the usability inspections to examine the interface design of

the electronic supermarkets. The advantage of using the detailed checklist was that the maximum number of usability problems could be identified for each interface. Furthermore, the provision of the detailed checklist helped ensure that during the heuristic evaluation sessions, the usability problems identified could be abstracted down to the lowest levels of detail. The checklist approach facilitated a more comprehensive analysis of an interface's usability problems. Finally, this approach also afforded the added advantage of allowing the structured comparison of results after the evaluation was complete, allowing additional points to be uncovered.

3.4 Selection of electronic shops

Heuristic evaluation was applied to evaluate the user interfaces of four UK-based electronic supermarkets: Iceland, Tesco, Asda, and Sainsbury (Figure 2), which are all popular supermarkets in the UK.

[Insert Figure 2 about here]

The decision to focus on category-specific electronic shops was taken so that they could be comparatively evaluated. The rationale behind choosing electronic supermarkets as the focus for evaluation was that supermarket design requires careful consideration of many aspects, such as visual layouts, navigation routes, visual breaks, and attractive overviews of product groups (Mast and Berg, 1997), but past research has found supermarket interfaces to be problematic. In fact, research conducted into the usability of different genres of electronic shops has highlighted supermarket interfaces to be some of the worst examples. For example, a study conducted by the Royal National Institute for the Blind (RNIB, 2000) found that supermarket interfaces were considered as the least user-friendly of the genres evaluated (bank, fast food and clothing retail stores). Another

study, conducted by Scott (2000), which examined the design of four supermarket web sites, criticised Sainsbury's, Asda and Iceland raising major problems within their interface design and content structure. The only site that was praised was Tesco.

3.5 Evaluation procedures

The user interface for each electronic shop was considered in an alphabetical order. The evaluation for each supermarket interface was completed before moving on to the next one. The evaluations were split up into small sessions lasting up to two hours, each concentrating on a particular part of the interface. Two types of evaluation technique were employed: free-flow and task-based inspections.

3.5.1 Free-flow inspection

The first part of the evaluation was a free-flow inspection. During each session, each interface was inspected several times. The first pass allowed a general perception to be developed for the flow of interaction and the general scope of the system. The second pass focused on the specific interface elements, whilst keeping in mind how they fitted into the overall interface design. As each interface was examined, consideration was given to whether the specific interface elements adhered to or violated the extended set of heuristics and their specified criteria. Problems outside the scope of the heuristics were documented, as were successful interface features that worked well and those features that should not be changed. Each usability problem encountered, however small, was listed separately and exemplified if needed, with the associated reasons and references to the specific criteria and heuristic violated.

3.5.2 Task-based inspection

The second stage of evaluation was also split up into small sessions. The evaluation technique followed a use scenario, which comprised of the steps a user would usually take to perform a set of real tasks. These tasks were representative of the activities that a user would be expected to perform at an electronic supermarket. Examples of such tasks include the selection of products, booking delivery times, finding contact and help information, and finally the checking out and payment processes.

In the same way as before, usability problems were documented as encountered whilst completing the above tasks, and again with reference to the specific criteria and heuristic violated. Good design features and problems outside of the scope were documented as well.

3.5.3 Severity rating

Once the preceding stages had been completed, severity ratings were assigned to the complete set of evaluation criteria for each heuristic. This was done to indicate the relative seriousness of each problem in order to facilitate decision-making and to help establish priorities. This method also served the purpose of gaining additional insight into the usability problems and helped to direct the development of the guidelines for the future design of effective interfaces.

Three factors of severity were considered for each usability problem and combined into a single rating as an overall assessment of each problem. These are outlined below:

- The Frequency with which the problem occurred: Was it common or rare?
- The Impact of the problem: Was it difficult or easy for users to overcome?

- The Persistence of the problem: Was it a one-time problem that users could overcome or would users repeatedly be bothered by it each time it occurred?

The purpose of considering the above factors when allocating severity ratings was to increase the accuracy of the ratings given. Taking into account the frequency, impact and persistence of each problem could help to establish the correct priorities and to reduce the likelihood of making subjective judgements about the seriousness of the usability problems instead. The following scale was used for the severity ratings.

- **0**: Not a usability problem at all
- **1:** Superficial problem – fix if enough time available
- **2:** Minor problem – low priority
- **3:** Major problem – high priority
- **4:** Usability disaster – imperative to fix

The severity ratings were assigned after the evaluations had been completed, and not during the heuristic evaluation sessions. This was because the additional task of allocating severity ratings may have reduced the accuracy of the estimates given by detracting from the main focus during evaluation, which was to find new usability problems. By allocating severity ratings after the sessions, there was a better understanding of the interface's problems as a whole, and the ratings given were more likely to be applied consistently.

4. Discussion of Results

To conduct a comprehensive evaluation, both quantitative measurement and qualitative assessment were applied to analyse the results. The former used the final numeric results of the severity rating to identify the overall effectiveness of each interface (see Section 4.1). The latter presented the documented successful features and problems from the free-flow and task-based inspections to illustrate in detail the strengths and weaknesses of each interface (see Section 4.2). These results were brought together to develop a more rounded understanding of current electronic supermarkets and were applied to develop usability guidelines to support future improvements in the area (Section 4.3).

4.1 Quantitative measurement

The detailed quantitative results from the heuristic evaluations are presented in Tables 3 to 6. For each heuristic listed, the number of criteria violated per severity rating has been shown. To be able to comparatively evaluate the results from the heuristic evaluations, a weighting has been assigned to each heuristic. This has been calculated by multiplying the number of criteria violated under each severity rating, by the severity rating itself. The sum of these calculations was then added together for each heuristic to obtain the score in the 'T' column in the tables. Higher scores indicate the most serious usability problems. By allocating scores in this way, it was easier to determine the specific categories of usability problems that caused the most concern for each interface, and to highlight recurring usability problems for all of the interfaces evaluated.

By adding the scores in the 'T' column together for each of the interfaces, an overall assessment could be made of the usability problem of each interface. Tesco was the worst example with a total score of 242. Iceland and Asda came next with scores of 179 and 177 respectively. The interface with the fewest usability problems was found to be Sainsbury's with a score of 128.

[Insert Tables 3-6 about here]

4.2 Qualitative assessment

As described in Section 3, each heuristic had specified criteria that were used for conducting the free-flow and task-based inspections. During the inspections, the problems and successful interface features were documented; the most frequently recorded successful interface features were regarded as strengths and the most frequently encountered problems were considered as weaknesses. Tables 7 to 10 present the key strengths and weaknesses of the interfaces of each electronic supermarket arising from of the qualitative assessment.

[Insert tables 7-10 about here]

To summarise the qualitative results, the common strengths and weaknesses for the entire electronic supermarket interfaces evaluated are outlined below.

4.2.1 Common strengths:

- *Aesthetic and minimalist design*

  For most of the interfaces evaluated, only essential decision-making information was displayed on each screen. Icons were usually distinct and each screen had a clear title. White space had been used effectively for justification, and field and menu titles were mostly brief, yet long enough to communicate the key issues.

- *Pleasurable and respectful interaction with the user*

  Colours had been used effectively in most of the interfaces. Colour schemes were generally simple and had been consistently applied throughout the sites. Colours

had been used effectively to draw attention, communicate organisation, indicate status changes and establish relationships. The most frequently used function keys were mostly located in the easily accessible positions.

4.2.2 Common Weaknesses:

- *User control and freedom*

  Users were often not free to select and sequence tasks according to their own personal preferences. There was a lack of clearly marked emergency exits to leave an unwanted state without having to go through an extended dialogue. Undo and Redo functions were hardly ever supported.

- *Help and documentation*

  It was not easy for users to switch between help and their work and to carry on from where they left off. There was also a lack of context-sensitive help. The help interfaces were often inconsistent with the rest of the system.

5. Development of Guidelines

Based on the findings from the inspections, a framework of usability guidelines was developed for the future improvement of the usability of electronic supermarkets. Guidelines were generated for each heuristic and they reflected both the common usability problems encountered by users in the study and good design features identified. Each guideline contains two parts. The first part is the specific ‘interface considerations’ that should be followed when developing an electronic shopping interface and the second part outlines the ‘purpose’ of incorporating each interface consideration into the design. In effect, the former indicate ‘what’ interface features should be considered in electronic

supermarket Web sites and the latter explain 'why' these features are critical. The full list of guidelines is presented in Table 11.

[Insert Table 11 about here]

To implement the guidelines successfully, senior managers responsible for the electronic supermarkets need to develop a strategic plan, in which user-centred design of the Web site is an essential issue. In other words, there is a need to involve users in the implementation process, which may include the following activities.

- Designers of the Web site of the electronic supermarkets need to explain the guidelines to the users and ask them to check whether these guidelines match with their requirements. The value of the guidelines rests in their utility as points of reference rather than as inflexible standards. Therefore, the designers should carefully consider the users' feedback to revise the guidelines and reflect on their instantiation in the design of specific Web sites.
- The revised guidelines can be used for the evaluation of the existing electronic supermarkets. After the evaluation, two alternative design options can be considered. One is to produce a 'new' interface for the electronic supermarket and the other one is to produce a 'redesigned' interface based on the existing design. The final decision of which option to follow may well depend on how many problems are discovered.
- Designers could develop a prototype first to address any problems found with an existing Web site and conduct user testing of the prototype, the results of which can be used to improve the prototype and (after subsequent cycles of iterative improvement if finances allow) to implement the final interface.

- It can take some time for users to accept changes, so both the old and new interface might be provided in the first three months alongside a brief description to explain the differences between the two to inform users and help them to choose freely which interface they want to use. The users' choices and their buying behaviour can be recorded in a log file, which will be used to analyse whether the new interface can increase the users' purchase and to better understand any resistance to change. In addition, surveying might help to identify whether user satisfaction can also be improved by providing the new interface. These results can be used to evaluate whether the new interface is effective and to highlight improvements that might need to be considered at the next stage.

6. Concluding Remarks

This study has applied Nielsen's heuristics (1994) to examine the interface design of electronic shopping, especially for electronic supermarkets. The evaluation results suggest that the interface design of current electronic supermarkets needs to be improved. The most significant and common usability problems were found to lie within the boundaries of the heuristics 'User Control and Freedom' and 'Help and Documentation'. For example, with regard to user control and freedom, users were not free to sequence their own tasks, and undo and redo functions were not supported. There was also a lack of clearly marked emergency exits for users to leave an unwanted state. For help and documentation, a recurring problem was that users were not able to switch between help and their work and carry on from where they left off. There was also a clear lack of context sensitive help, and the help system presented in the interfaces was inconsistent. These results suggest that the designers do not pay enough attention to

usability issues associated with electronic supermarkets and/or that they lack the expertise to develop consistently usable interfaces. There is a need to provide guidance for them to integrate the usability considerations into the development of electronic shopping sites. Thus, this study developed a support mechanism for the design of electronic shopping in the form of usability guidelines. This mechanism can be used to support designers in evaluating whether or not an interface is desirable based on whether it meets these guidelines, with the final goal being to create effective electronic shops that can meet with users' needs and increase their shopping enjoyment and the value of their purchase.

However, this study is only a small step. Nielsen (1993) suggested that heuristic evaluation does not allow a way to assess the quality of redesigns; the best results can often be found by alternating both heuristic evaluation and user testing. Future research could conduct user testing to assess the robustness and reliability of the usability guidelines suggested by this paper, which could ensure in turn the development of 'user-centred' interfaces to electronic shops. Therefore, it would be valuable for future research to see whether electronic shopping applying the proposed usability guidelines can increase the satisfaction of the customers or whether their satisfaction would be same. In addition, previous research has indicated that individual differences have significant effects on users' perceptions of the interface features (Chen and Macredie, 2002; Chen, Magoulas and Macredie, 2004). This suggests that there is also a need to conduct further research to examine how individual differences influence the ranking of interface considerations proposed by the guidelines in this paper. The findings of such studies could be applied to build a robust user model for the development of personalised electronic shopping sites that could accommodate users' individual differences.

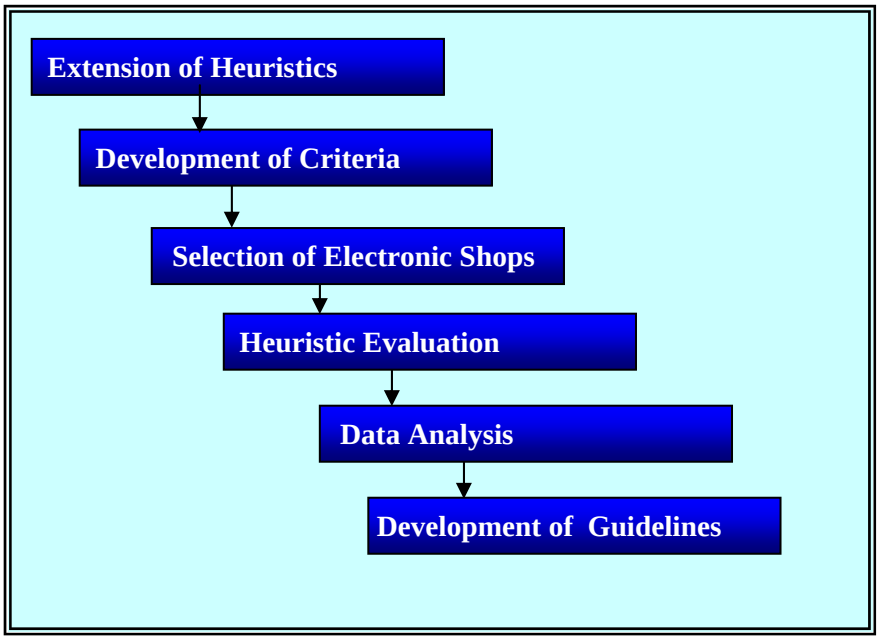

Figure 1: Conceptual Framework

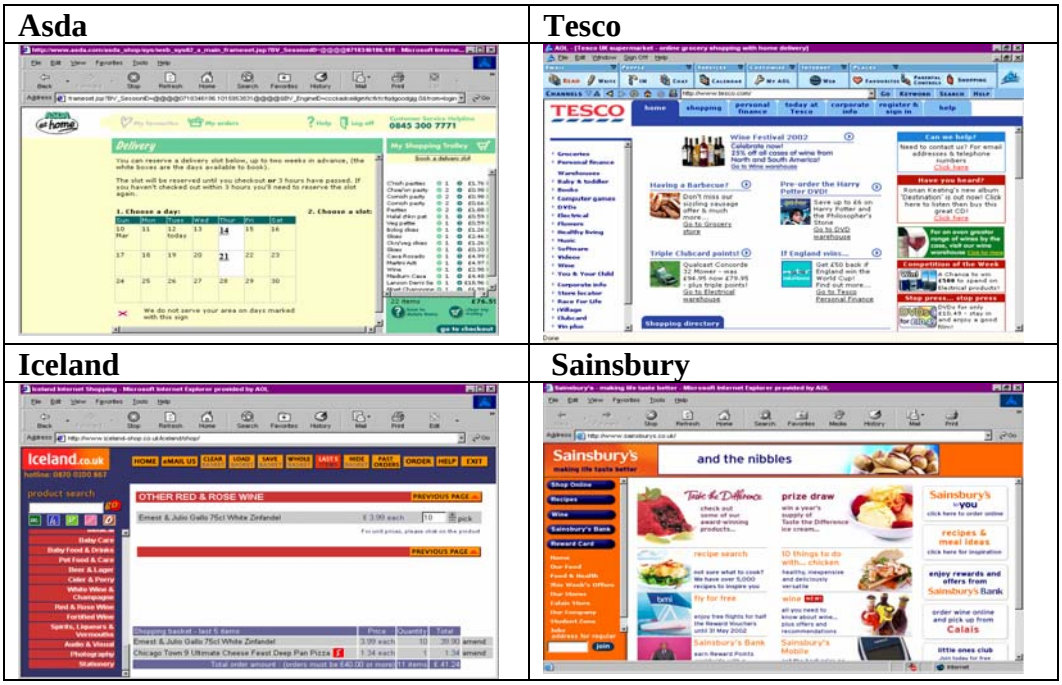

Figure 2: The Sample Page of each of the selected electronic supermarkets

Heuristics	Explanations
H1: Visibility of system status	The system should always keep user informed about what is going on by providing appropriate feedback within reasonable time.
H2: Match between system and the real world	The system should speak the user's language, with words, phrases and concepts familiar to the user, rather than system-oriented terms. Follow real-world conventions, making information appear in a natural and logical order.
H3: User control and freedom	Users should be free to develop their own strategies, select and sequence tasks, and undo and redo activities that they have done, rather than having the system do these for them.
H4: Consistency and standards	Users should not have to wonder whether different words, situations, or actions mean the same thing and the system should follow platform conventions.
H5: Error prevention	Even better than good error messages is a careful design, which prevents a problem from occurring in the first place.
H6: Recognition rather than recall	Make objects, actions, and options visible. The users should not have to remember information from one part of the dialogue to another. Instructions for use of the system should be visible or easily retrievable whenever appropriate.
H7: Flexibility and efficiency of use	Allow users to tailor frequent actions. Provide alternative means of access and operation for users who differ from the "average" user (e.g., physical or cognitive ability, culture, language, etc.)
H8: Aesthetic and minimalist design	Dialogues should not contain information that is irrelevant or rarely needed. Every extra unit of information in a dialogue competes with the relevant units of information and diminishes their relative visibility.
H9: Help users recognise, diagnose and recover from errors	Error messages should precisely indicate the problem and constructively suggest a solution. They should be expressed in plain language.
H10: Help and Documentation	Even though it is better if the system can be used without documentation, it may be necessary to provide help and documentation. Any such information should be easy to search, focused on the user's task, list concrete steps to be carried out, and not be too large.

Table 1: Nielsen's Ten Heuristics (1994b)

Heuristics	Explanations
H11: Support and extend the user's current skills	The system should support, extend, supplement, or enhance the user's skills, background knowledge, and expertise and not replace them.
H12: Pleasurable and respectful interaction with the user	The user's interactions with the system should enhance the quality of her or his work-life. The user should be treated with respect. The design should be aesthetically pleasing - with artistic as well as functional value.
H13: Protect the personal information	The system should help the user to protect personal or private information - belonging to the user or the his/her clients.

Table 2: Additional Heuristics (Adapted from Muller, et al., 1998)

Heuristics	***Asda***					
	0	**1**	**2**	**3**	**4**	**T**
Visibility of system status	9	0	0	2	1	**10**
Match between the system and the real world	8	0	3	1	2	**17**
User control and freedom	7	0	1	1	5	**25**
Consistency and standards	13	0	0	1	1	**7**
Help users recognise, diagnose, recover from errors	4	2	3	2	2	**22**
Error prevention	5	1	1	1	2	**14**
Recognition rather than recall	10	1	2	2	1	**15**
Flexibility and efficiency of use	0	0	1	3	1	**15**
Aesthetic and minimalist design	3	2	1	0	0	**4**
Help and documentation	11	0	3	4	2	**26**
Skills	5	1	2	3	0	**14**
Pleasurable and respectful interaction with the user	6	0	0	1	1	**7**
Privacy	2	0	0	1	0	**3**
Total	94	7	19	25	18	177

Table 3: The Quantitative Results for Asda

Heuristics	***Iceland***					
	0	**1**	**2**	**3**	**4**	**T**
Visibility of system status	8	0	0	4	0	**12**
Match between the system and the real world	10	0	1	2	1	**12**
User control and freedom	9	1	1	3	1	**16**
Consistency and standards	9	2	1	2	1	**14**
Help users recognise, diagnose, recover from errors	9	0	4	0	1	**12**
Error prevention	4	1	1	2	1	**13**
Recognition rather than recall	13	0	2	1	1	**11**
Flexibility and efficiency of use	2	0	3	0	0	**18**
Aesthetic and minimalist design	4	0	2	0	0	**4**
Help and documentation	11	0	2	7	0	**25**
Skills	6	0	4	0	0	**8**
Pleasurable and respectful interaction with the user	4	5	0	2	0	**11**
Privacy	3	0	0	0	0	**0**
Total	**99**	**10**	**24**	**27**	**7**	**179**

Table 4: The Quantitative Results for Iceland

Heuristics	***Sainsbury***					
	0	**1**	**2**	**3**	**4**	**T**
Visibility of system status	6	1	2	2	1	**15**
Match between the system and the real world	13	0	1	0	1	**6**
User control and freedom	7	0	2	1	3	**19**
Consistency and standards	13	1	2	0	0	**5**
Help users recognise, diagnose, recover from errors	4	1	4	4	0	**21**
Error prevention	7	1	1	0	1	**7**
Recognition rather than recall	16	0	0	0	0	**0**
Flexibility and efficiency of use	3	1	1	0	0	**3**
Aesthetic and minimalist design	6	0	0	0	0	**0**
Help and documentation	11	2	4	1	3	**25**
Skills	8	0	2	1	0	**7**
Pleasurable and respectful interaction with the user	8	0	0	0	0	**0**
Privacy	1	0	0	0	2	**8**
Total	**113**	**7**	**25**	**9**	**11**	**128**

Table 5: The Quantitative Results for Sainsbury

Heuristics	***Tesco***					
	0	**1**	**2**	**3**	**4**	**T**
Visibility of system status	3	0	1	2	5	**28**
Match between the system and the real world	10	0	0	1	3	**15**
User control and freedom	4	0	1	4	5	**34**
Consistency and standards	6	1	5	2	1	**21**
Help users recognise, diagnose, recover from errors	1	1	5	4	2	**31**
Error prevention	3	1	2	2	1	**15**
Recognition rather than recall	8	0	2	4	2	**24**
Flexibility and efficiency of use	3	0	1	1	0	**5**
Aesthetic and minimalist design	5	0	0	0	1	**4**
Help and documentation	14	0	6	0	0	**12**
Skills	6	1	2	1	1	**12**
Pleasurable and respectful interaction with the user	3	0	4	0	1	**12**
Privacy	0	0	0	0	3	**12**
Total	**74**	**4**	**32**	**24**	**25**	**242**

Table 6: The Quantitative Results for Tesco

Heuristics	***Asda***	
	Strengths	**Weaknesses**
1. Visibility of system status	During tasks, users can always tell how much more/longer there is to go.	The system does not tell the user the state of the system and the alternatives for action.
2. Match between the system and the real world	Icons are easy to identify and needed.	The system does not anticipate the user's expectations at each step.
3. User control and freedom	Users can easily reverse actions.	No undo function for action/group of actions. Users cannot set up their own defaults.
4. Consistency and standards	Consistent formatting standards have been applied throughout the site.	Vertical and horizontal scrolling can work in all windows.
5. Help users recognise, diagnose, recover from errors	Prompts are brief and constructive.	Error messages do not provide appropriate semantic information.
6. Error prevention	Fields in data entry screens and dialogue boxes contain default information when appropriate.	Users are stuck if a sensor 'breaks'.
7. Recognition rather than recall	The same colour is used to group related elements.	Prompts, cues and messages are not obvious.
8. Flexibility and efficiency of use	None.	Users cannot be interrupted at any time.
9. Aesthetic and minimalist design	Each screen has a short, clear, distinctive title.	Some irrelevant information is displayed on screen.
10. Help and documentation	It is easy to access and return from the help system.	The help system interface is inconsistent with the rest of the site
11. Skills	The system performs data translations for users.	The help system interface is inconsistent with the rest of the site.
12. Pleasurable and respectful interaction with the user	Colour is used with discretion.	Excessive window housekeeping required.
13. Privacy	None.	Password functions are ineffective.

Table 7: The Qualitative Results for Asda

Heuristics	***Iceland***	
	Strengths	**Weaknesses**
1. Visibility of system status	The user can easily determine where they are and what options are available.	During tasks, users cannot tell how much longer there is to go.
2. Match between the system and the real world	Required inputs are meaningful.	Task/menu choices are not ordered in the most logical way.
3. User control and freedom	For multiple menu levels, a mechanism allows users to go back to previous menus.	No undo function for action/group of actions. Users cannot easily reverse their actions.
4. Consistency and standards	Standards have been applied to interaction design.	The pages layouts are not consistent.
5. Help users recognise, diagnose, recover from errors	If an error is detected in a data entry field the system highlights the field in error.	Error messages do not provide appropriate semantic information.
6. Error prevention	Fields in data entry screens and dialogue boxes contain default information when appropriate.	Menu choices are not logical and distinctive.
7. Recognition rather than recall	All the data a user needs is on display at each step in a transaction sequence.	Mapping between controls and actions is not apparent to users.
8. Flexibility and efficiency of use	Partially filled screens can be saved.	Multiple levels of detail are not available to support novice and expert users.
9. Aesthetic and minimalist design	Only information essential to decision making is displayed on screen.	Not every screen has a title.
10. Help and documentation	The information in the help section is complete, accurate and understandable.	Users cannot easily switch between help and their work.
11. Skills	Important keys are larger than other keys.	Multiple levels of detail are not available for novice and expert users.
12. Pleasurable and respectful interaction with the user	Colour has been used with discretion.	Excessive window housekeeping required.
13. Privacy	Protected areas are completely inaccessible.	None.

Table 8: The Qualitative Results for Iceland

Heuristics	***Sainsbury***	
	Strengths	**Weaknesses**
1. Visibility of system status	The user can easily determine where they are and what options are available.	When the system response is delayed, users are not kept informed of the system's progress.
2. Match between the system and the real world	Task/menu choices are ordered in the most logical way.	System does not anticipate user's expectations at each step.
3. User control and freedom	For multiple menu levels, a mechanism allows users to go back to previous menus.	No undo function for action/group of actions.
4. Consistency and standards	Online instructions appear in a consistent location across screens.	Optional data entry fields are incorrectly marked.
5. Help users recognise, diagnose, recover from errors	Prompts are brief and constructive.	Error messages do not provide appropriate semantic information.
6. Error prevention	Data entry fields contain default information when appropriate.	Menu choices are not logical and distinctive.
7. Recognition rather than recall	Different colours are applied to identify emphasised data and de-emphasised data.	None.
8. Flexibility and efficiency of use	The system provides options for high-frequency commands.	None.
9. Aesthetic and minimalist design	Only information essential to decision making is displayed on screen.	None.
10. Help and documentation	Additional explanatory information is provided when ambiguous menu choices are selected.	Users cannot easily switch between help and their work.
11. Skills	The different options were provided.	None.
12. Pleasurable and respectful interaction with the user	Very effective use of colours.	None.
13. Privacy	Protected areas can be accessed with certain passwords.	None.

Table 9: The Qualitative Results for Sainsbury

Heuristics	***Tesco***	
	Strengths	**Weaknesses**
1. Visibility of system status	Colour coding issued to depict the selected options.	Users cannot easily identify where they are in the interaction process.
2. Match between the system and the real world	Questions are always stated in clear, simple language.	Users would be taken through a mandatory registration step.
3. User control and freedom	There is a mechanism that allows users to go back to previous menus.	Some commands have severe, destructive consequences.
4. Consistency and standards	Standards have been applied to interaction design.	Different formats are applied in different sections of the site.
5. Help users recognise, diagnose, recover from errors	None.	Error messages do not provide appropriate semantic information.
6. Error prevention	Data Inputs are case-blind where possible.	Less important options are not located in the least convenient positions.
7. Recognition rather than recall	The same colour is used to group related elements.	Prompts, cues and messages are not placed in the obvious position.
8. Flexibility and efficiency of use	System provides options for high-frequency commands.	There are no multiple levels of detail to support novice and expert users.
9. Aesthetic and minimalist design	Each screen has a short, clear, distinctive title.	Extraneous information is displayed on screen.
10. Help and documentation	The help section is complete, accurate and understandable.	Users cannot easily switch between help and their work.
11. Skills	The system performs data translations for users.	Users are responders rather than initiators of actions.
12. Pleasurable and respectful interaction with the user	Minimal window housekeeping required.	Abundant use of colour and excessive icon design.
13. Privacy	None.	Password functions are ineffective.

Table 10: The Qualitative Results for Tesco

BURA

Heuristics	Interface Considerations	Purposes
H1: ***Visibility of system Status***	To highlight current option selected	To identify current location in interaction process
	To breakdown steps required to complete tasks, and highlight current step reached in interaction process.	During all tasks, to indicate to users how much more/longer there is to go
	To display all options pertinent to the users tasks during interactions	At every time during the interaction, to indicate to users what options are available and the alternatives for action
	To display messages if observable delays are longer than 10 seconds.	To keep users informed of the systems progress
H2: ***Match between the system and the real world***	To provide easily identifiable icons when needed	To make information easy to remember and identify
	To use clear, simple language for question and answer	To make information easily understandable for users
	To arrange task/menu choices in a logical order according to natural sequences	To decrease cognitive load on users.
	To provide meaningful menu choices	To allow menu choices to be readily understood
H3: ***User control and freedom***	To provide mechanism for multiple menu levels	To allow users to go back to previous menus
	To provide undo functions for every action/group of actions	To allow users to reverse their actions and change earlier choices
	To provide back options on every page where a user is completing tasks.	To give users the freedom to select and sequence their own tasks where possible.
	To provide users with customisation of system, session and screen defaults	To allow users to set their own preferences
H4: ***consistency & standards***	To follow company formatting standards	To maintain consistency throughout the site
	To match menu structure to task structure	To reduces cognitive load on user
	To provide vertical/horizontal scrollbars in all windows	To allow all information in every window to be viewed.
	To follow consistent standards for interaction design	To facilitate easy interactions with the system
	To use consistent location for online instructions	To help users easily find instructions
H5: ***Help users recognise, diagnose & recover from errors***	To show meaningful error messages	To suggest the causes of the problems
	To provide suggestion actions when users make errors.	To allow users to recover from the error
	To show constructive, brief, unambiguous messages	To imply that the user is in control
	To highlight the field in error in data-entry fields	To attract attention on the particular field in error

Heuristics	Interface Considerations	Purposes
H6: ***Error prevention***	To provide default values when users fill out the forms	To reduce the likelihood of errors occurring
	To put less frequently used options in least convenient positions	To use the screen effectively
	To show way out for users to exit the system	To ensure users cannot get stuck
	To put function keys causing serious consequences far way from low consequence and high-use keys	To prevent errors
	To show warning message if users are about to make serious error	To make sure user has not selected an option in error
H7 ***Recognition rather than recall***	To group items in logical zones with headings	To distinguish between different groups of items/zones
	To place prompts where eye is likely to be looking	To make prompts clearly visible to users
	To use colours to group related elements	To distinguish between groups of elements
	To distinguish emphasise data and de-emphasise data with different colours	To draw attention to important data. To make less important information not distractive.
H8: ***Flexibility and efficiency of use***	To allow user to save partially filled forms	To allow flexibility for users to return to their work at a later time.
	To provide multiple levels of detail	To cater for the different needs of novice and expert users
	To allow tasks to be resumed after a short period of time	To allow users to go back to their tasks when they are interrupted
	To provide shortcuts for high-frequency actions	To speed up interaction for users
H9: ***Aesthetic and minimalist design***	To display only essential decision-making information on screen	To increase visibility of essential information
	To show brief and clear title for each screen	To make immediately apparent the nature of content within each screen
	To separate meaningful groups of items by using white space	To increase visibility of different groups of items
H10: **Help and documentation**	To maintain consistent help system interface	To ensure consistent standards applied throughout the site.
	To provide option to switch between help and work	To allow users to easily switch between help and their work
	To provide additional explanatory information for ambiguous options	To provide further help where it is most likely to be needed without having to search through the help system.
	To allow work to be resumed from where left off after accessing help	To anticipate the users' expectations
H11: **Skills**	To make important keys larger than other keys	To make important options highly visible
	To anticipate users' next activity correctly	To anticipate users' expectations
	To allow users to initiate actions	To ensure users can actively take actions rather than respond to them

Heuristics	Interface Considerations	Purposes
H12: Pleasurable & Respectful Interaction with the User	To make discretionary use of colour	To enhance quality of users interactions with the interface
	To require minimal window housekeeping	To reduce the level of extra work for users
	To use colour us to draw attention, communicate organisation and status changes	To enhance quality of interactions with the systems
H13: Privacy	To make protected areas inaccessible	To protect users' personal and confidential information
	To make protected areas accessible through passwords	To give each user access to their own personal information
	To make use of effective password features	To ensure user confidence and trust

Table 11: Usability Guidelines

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