AN INVESTIGATION INTO THE INFLUENCE OF USABILITY ON THE DEVELOPMENT OF
THE BROWSING EXPERIENCE OF ELECTRONIC COMMERCE APPLICATIONS

by

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SUPERVISOR: PROF P KOTZÉ

JANUARY 2008
I declare that ‘An Investigation into the Influence of Usability on the Development of the Browsing Experience of Electronic Commerce Applications’ is my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references.

In the course of this MSc portions of this study have been presented/published nationally and internationally, see note at the end of chapters.

_______________________ ___________________
SIGNATURE DATE
(Mr S SINGH)
Abstract

We investigate whether usability aspects affect the design and development of the browsing experience in electronic commerce applications. The study is limited to the generic electronic commerce activities and does not address the financial perspective. As background we studied the electronic commerce domain, interaction design and information systems development methodologies. Within a quasi-experimental research design we then developed two experimental websites to test our hypotheses that the usability principles of consistency, structured information and navigation affect the users of a website: one adhering and one violating these principles. Respondents were required to record their perceptions of both using a questionnaire. We found that usability issues had a minimal influence on the perceived success of the websites. It is thus only one of many factors that needs to be considered in the design and development of a successful electronic commerce website, and cannot be treated as an isolated add-on.

Key words: usability, electronic commerce, systems development, interaction design, information systems, browsing, consistency, navigation, and structured information.
Preface: A Note on Style

The traditional approach used to author a scientific document dictates that the author of the document write him or herself out of the document. It is believed that by adopting this approach the document is more unbiased and meets the criteria of a rigorous objective scientific document. I have taken the liberty to refer to myself as either ‘we’ or ‘our’. This should not be perceived as a vain attempt at self-importance; it should instead be read that I acknowledge that my ideas have been a maturation process fuelled by the helpful discussions of many interested persons.

The crux of this dissertation hinges on the premise that easy to use products are successful products. In this dissertation we employed many different statistical tools. Many people are awestruck by the fancy display of number. I have tried to explain the statistics in this dissertation in the simplest of terms, without going into the technical nature of the statistical tool. I further acknowledge that a different application of the statistical techniques will yield a different outcome or outcomes.

I must, however, acknowledge that the discipline of Computing is like a mutating virus – ever changing. However, the discipline of Computing is also affected by changes in other disciplines. I acknowledge that from the conception of this study to the end there have been several advancements in Computing and related disciplines. In managing a dissertation it is humanly impossible to factor all changes into the study.

A word on the referencing scheme, in this dissertation the style that I have used is based on the Publication Manual of the APA, 5th ed. In the text I have use [] brackets instead of () brackets. I use the () brackets for numerical values and narrative text. To be compatible with international trends, decimal values are delimited using ‘.’ Instead of the South African trend of using ‘,’. For example, ten rand will be written R10.00 and not as R10,00.
Acknowledgements

This research is the product of the cooperative efforts of a small number of dedicated individuals and my grateful thanks go to each one of them. I have, for convenience, subdivided these kind individuals into three categories as follows: supportive friends, academic champions and family.

- Supportive friends


- Academic champions

I would like to express my gratitude to Prof. Paula Kotzé for all her kind assistance in this endeavour. I would also like to thank my colleagues from the School of Computing at the University of South Africa for their assistance. I also acknowledge the help and assistance of the following people: Stuart Warden (Cape Technikon), Prof. Geoff J. Erwin (Cape Technikon), Kobus Smith (University of the Western Cape), and Prof. Andrew J. Bytheway (University of the Western Cape), for their assistance with the administration of the questionnaires. I also would like to thank Prof. F E Steffens and Dr. R Nieuwoudt for their help with the statistical analysis. Thanks to Prof. Alan Dix (Lancaster University) for assisting in the refinement of the questionnaire.

- Family

I would like to thank my parents for instilling the value of education in me.
Dedication

To my loving parents Krsna-Krpa Das and Radha-Krpa Dasi.
“To err is human. But to make a real mess you need a computer too.”

IFIP 13.5 Working Conference on Human Error. Safety and Systems Development

Toulouse, France, August 22-27, 2004
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Acronyms

ACM – Association for Computer Machinery
AA – Afro-Asian
AE – Afro-European
ADM – Agile Development Methodology
BDP – Business Data Processing
CBIS – Computer Based Information Systems
CMM – Capability Maturity Model
EFT – Electronic Fund Transfer
EDI – Electronic Data Interchange
GOMS – Goals, Operators, Methods, Selection Rules
GUI – Graphical User Interface
HCI – Human-Computer Interaction
HTA – Hierarchical Task Analysis
ISD – Information Systems Design
ISO – International Standards Organisation
IS – Information Systems
ICT – Information and Communication Technology
IA – Indigenous African
JSE – Johannesburg Stock Exchange
MIS – Management Information Systems
N-Gen – Net Generation
OO – Object Orientation
RACE
SDLC – Systems Development Life Cycle
SA – South Africa
SE – Software Engineering
SMME – Small Medium and Micro Enterprises
SME – Subject Matter Expert
SAM – South African of Mixed Descent
TAKD – Task, Analysis, Knowledge, Description
TDA – Task, Description, Hierarchy
List of Trade Mark Names

Apple II
Apple Macintosh
Airborne
ABSA
Corel
Dell
FedEx
Hewlett Packard
IBM
Informix
Internet Explorer
Java
Lotus
Microsoft Dos
Microsoft Windows
Microsoft FrontPage
Microsoft Word
Microsoft Excel
Mosaic
NetStudio
Netscape
Oracle
Pick ’n Pay

SoftQuads Hot Metal
SQL Server
Sony
UPS
Visual Basic
Word Perfect
Xerox Star
Chapter 1

Introduction

In this chapter we provide background to the main fields of study in this dissertation. We place the dissertation in the context of electronic commerce. We explain our research question and then explain the approach that will be used to investigate the proposed problem.

It seems to me that just about any important product or system is worth engineering. Before you start building it, you’d better understand the problem, design a workable solution, implement it in a solid way, and test it thoroughly. You should probably also control changes to it as you work and have some mechanism for ensuring the end result’s quality. Many Web developers don’t argue with this; they just think their world is really different and that conventional software engineering approaches simply don’t apply.

Pressman R.S, IEEE
Software, 1998

1. Introduction

This dissertation is in the broad discipline of information systems and addresses the development of electronic commerce applications. Advances in computer and telecommunication technologies are making it cheaper for people to buy and use computers. More people are now connecting to the Internet and using the services provided on the Internet. An example of such services that people are using is that of electronic commerce. However, poorly designed and developed electronic commerce applications make it difficult for end users to fully harness the electronic commerce application. Users who cannot use the electronic commerce application will find a more user-friendly electronic commerce site or they will abandon the electronic commerce website.

In our research we investigate different elements in the development of an electronic commerce application. We examine different types of electronic commerce. We examine interaction design and software development processes. We seek to investigate whether usability aspects affect the design and development of electronic commerce applications.

In the context of this dissertation we define information systems as an arrangement of people, data, processes, information presentation and information technology that interact to support and improve day-to-day operations in a business, as well as support the problem-solving and decision-making needs of management and users [Whitten et al., 2001]. Electronic commerce is defined as business processes which shift transactions to the Internet or some other non-proprietary, web-based system [US Department of Commerce, 1999]. Usability is defined as interactive software products that
should be easy to learn, effective to use, and enjoyable from the user’s perspective [Preece et al., 2002].

In the next section we discuss the main fields of study in this dissertation, namely, the business environment, the disciplines of information system, software engineering and human-computer interaction. The context of this dissertation is electronic commerce, which is briefly introduced in Section 3. In Section 4 we discuss the aims and objectives of this dissertation, which is followed by a discussion of the delimitations of this dissertation. Section 6 discusses the research design and methodology. Section 7 lays out the structure of this dissertation, which is followed by a summary.

2. Background: Main Fields of Study of this Dissertation

The purpose of this section is to introduce the main fields of study this dissertation has drawn from: the business environment, information systems, software engineering and human-computer interaction. Although the context of our dissertation, electronic commerce, is only discussed in more detail in Section 3, we will also give some references to it in this section.

2.1. The Business Environment and Information Technology

The environment in which modern day business operates is complex and fragile. Figure 1.1 shows a typical environment in which a business operates. The inner sphere represents the heart of the business organisation (including information resources and the manipulation and management thereof). The second sphere represents the organisation and its controllable variables. The third and outside spheres are uncontrollable factors that affect the business organisation. These factors affect the competitiveness of the business organisation. For example, in the South African context for the outermost sphere, the following aspects are beyond the direct control of the business but severely impact on its operation:
Cultural and language forces: This can be illustrated with an example. In South Africa the car manufacturer Volkswagen launched a series of cars under the brand name Polo, aimed at the young to ‘yuppie’ market. The name Polo [Paroz, 1988] sounds inoffensive in English, but in Sotho (a local African language) the word polo refers to the male sexual organ. What compounds the problem in the use of the word is the descriptions added to the word by the car manufacturer, namely, Polo Playa and Polo Classic. If a young African female owned a Polo Playa, it could add a rather negative connotation to her image. The same trap could exist in the interface development of any information system.

Geography: The world has become smaller with the development of the Internet. In the old world, competitors were just in your direct (vicinity) neighbourhood. The whole world can be seen as competitors to a business organisation in the electronic commerce area.

Levels of technology: The average South African still does not have general access to the Internet. It is still the domain of a privileged few, and so is access to the latest and greatest computer technology.

Figure 1.1. The Business Environment (Adapted from Ricks [1993])
All these aspects have some human component or connotation. Business is driven by human customers, human users of systems, humans making decisions on investing in a business venture, etc. We argue that if these human ‘components’ could be put to better use or better service with the development of appropriate information systems, an organisation will have a competitive advantage over other businesses.

![Figure 1.2. Traditional Approach Shelly et al.](2003)

![Figure 1.3. Contemporary Approach (adapted from Shelly et al. [2003])](2003)

The traditional approach to eliciting information in an organisation, as illustrated in Figure 1.2, was that a user of certain information would request the information from the information technology department and the information technology department would deliver the information as per request. This system was rather inflexible and largely closed to the human components of the wider company or world. In this model the information technology people are seen as the ‘knowledgeable elite.’ The user interface was the domain of the information technology department, be it command driven or graphical user interface. The information technology staff were responsible for finding the information and delivering the information to the respective user.
The more contemporary approach is that the system is opened up to the world, and all stakeholders can interact with the system, as illustrated in Figure 1.3. The system and all stakeholders interface with each other. This means that the interface to the system has to be versatile and flexible in order to be used by various stakeholders, not only the information technology department. The domain for the development of the information systems and ultimately the user interface is, however, still that of the information technology department. But this more contemporary approach adds a new level of complexity to the systems development, as various levels of experience must be catered for.

2.2. Computer-based Information Systems

As stated above, this dissertation is in the field currently known as information systems. The field has been known under various names in the past. It was first known as business data processing, and later as management information systems [Hirschheim & Klein, 2003]. The operative word in the term information systems is ‘system’, because it combines technology, people, processes and organisational mechanisms for the purpose of improving organisational performance [McNurlin & Sprague, 1998]. Computer-based information systems (CBIS) are information systems that require information and communication technology (ICT), including hardware, software, databases, communication technology, procedures and people, to accomplish their goals [Stair, 1992].

The use of ICT has been growing, at an increasing rate, ever since the invention of the modern electronic computer in the 1950s. During the earlier years, computer devices were mainly used by business to handle transaction processing [Stair, 1992]. Nowadays, with the widespread development of the Internet and the World Wide Web, change has accelerated dramatically [McNurlin & Sprague, 1998].

As computer technology continues to leapfrog forward, CBISs are changing rapidly. These changes are having an enormous impact on the capabilities of organisational systems [McNurlin & Sprague, 1998; Stair & Reynolds, 2003; Turban et al., 2001]. The major ICT developments affecting CBISs, as reflected in Appendix A, can be categorised into three groupings: hardware related, software related, and hybrid cooperative environments. They are briefly discussed below.

2.2.1. Hardware and Infrastructure Related

Hardware consists of everything in the ‘physical layer’ of the CBISs – for example, servers, workstations, networks, telecommunications equipment, fibre-optic cables, hand-held computers, scanners, digital capture devices and other technology based infrastructure [Shelly et al., 2003].
We briefly list some of the hardware developments and advancements that have an influence on the implementation of information systems, e.g. electronic commerce systems [Shelly et al., 2002; Stair, 1992; Stair & Reynolds, 2003; Turban et al., 1999; Turban et al., 2001]:

- Constantly improving cost-performance ratio: Computer processing speed and memory capacity are improving, while computer costs continue to decrease. As labour costs increase, the ratio of cost to performance of computer versus manual work improves dramatically. The ‘benefits’ are that computers will have increasingly greater comparative advantages over people and that computers will do more and more routine tasks more economically.

- Storage and memory: DVD/CD-ROMs and other computer storage devices have increased storage capacity and portability of data and information. Large memory capacities will support the use of multimedia and other emerging computer technologies.

- Intranets and extranets: Intranets are networks within an organisation that use Internet technologies to link organisational communications. Extranets are secured networks that connect the intranets of several business partners. Intranets improve organisational communication. Extranets create powerful inter-organisational communication and collaboration systems.

- Client/server architecture: This architecture links personal computers (clients) to specialised powerful computers (servers), which they share via local (Intranet) or global (Internet) networks. This allows for interconnection of different types of hardware and software.

- Network computers (‘thin clients’): These are computers that do not have a hard disk or other fixed internal storage devices, but are rather served from a central computer through a network. This provides the benefits of desktop computing without the high cost of regular personal computing hardware.

- Enterprise-wide computing: This is an extension of computing infrastructure that links all of an organisation’s functions and sometimes even those of its business partners. This will improve the relationships with suppliers, other business partners, and customers, and bring products and services to market more quickly.

- Data warehousing: This is a gigantic computer ‘warehouse’ (storage) of large amounts of data. Data warehouses organise data for easy access by end-users of the data. When integrated with the Internet, they can be accessed from any location at any time.

- Ubiquitous computing: This is the use of compact computers in motor vehicles, machinery, and consumer products. These computer devices are portable, and reduce the time between data collection and processing.

2.2.2. Software Related

Software refers to the programs that control the hardware and produce the desired information or results [Shelly et al., 2003]. Software related development refers to the ongoing advancements in the software aspects of computing technology. We will briefly list some software related advancements
and developments that have an influence on the implementation of information systems such as the 
electronic commerce system [Satzinger et al., 2002; Schach, 2005; Shelly et al., 2002; Stair, 1992; 
Stair & Reynolds, 2003; Turban et al., 1999; Turban et al., 2001]:

- Graphical user interface: A set of software features that provide users with direct control of 
  visible objects on the screen. They use icons, pull-down menus, windows, and a mouse or other 
  pointing device to perform operations, rather than complex syntax.
- Data mining: A sophisticated analysis technique used to discover previously undetected 
  relationships among data. This enables managers to see relationships and dynamics in data 
  elements that they had not foreseen (e.g. how the sales of one product might drive the sales of 
  another product).
- Object-oriented development: This is an approach to system development that views an 
  information system as a collection of interacting objects that work together to accomplish a task. 
  It aims to significantly reduce the cost of both building and maintaining CBIS by using an 
  iterative development strategy.
- Intelligent systems and agents: These are automated rules that execute pre-programmed decisions 
  or tasks when encountering specified conditions in data. This can increase productivity and ease 
  the execution of complex tasks. Intelligent agents help users navigate the Internet, access 
  databases and conduct electronic commerce.
- Electronic document management: This is a technique that converts paper-based documents to 
  digital electronic form via scanning, optical character recognition and related technologies. This 
  can greatly reduce storage requirements, and allows paper documents to be organised and 
  manipulated like any other type of electronic data.

2.2.3. Hybrid Cooperative Environments

Hybrid cooperative environments developments are related to the ongoing advancements in the 
hardware and software aspects of computing technology. These technologies create either new 
opportunities on the Web, while others fill up existing needs on the Web. We will briefly list some 
of these hybrid cooperative advancements that have an influence on the implementation of 
information systems such as electronic commerce systems [Shelly et al., 2002; Stair, 1992; Stair & 
Reynolds, 2003; Turban et al., 1999; Turban et al., 2001].

- Multimedia and virtual reality: Multimedia is the integration of various types of media – voice, 
  text, graphics, full motion, video, and animation. Virtual reality uses 3-D graphics to allow users 
  to enter an artificial representation of some environment. These techniques provide interesting 
  graphic images which can be used to improve educational, training, advertising, communication, 
  and decision-making materials.
- Expansion of the Internet and completion of information superhighways: The integration of 
television and computers over a national fibre-optic based networks on Wifi related development
could connect many more users to the Internet. Completion of the information superhighway will allow the Internet to reach every networked home, business, school and other organisations, and will change how we live, learn and work.

- **Electronic commerce**: This is business done electronically, including the exchange of products, services and money, with the support of computers and computer networks. This can provide a business with a competitive edge and could change organisational structure, processes, procedures, culture and management.

- **Integrated home computing**: This is the integration of home computing, television, telephone, and home security systems in one unit. This will also facilitate telecommuting and the use of the Internet.

These ICT developments are important components to be considered in the development of CBISs and specifically electronic commerce applications. Seemingly, new types of technology like hand-held computing devices set the standards for future development. For example, in South Africa, although very few people have access to the Internet via a computer, the cellular phone, in contrast, has entered every possible market imaginable. With the wide network coverage, cellular phone users range from the rural poor to Johannesburg Stock Exchange company directors. Technology proliferation like this will affect the choice of technology that developers, companies and banks will use in future, and invariably this will affect the development strategies of their CBISs.

Chapter 4 of this dissertation will discuss aspects relating to the development of information systems and electronic commerce, in more detail. Our research is based on the belief that a change in the method used for the development of information systems (such as an electronic commerce application) has a ripple effect in the design of usable computer artefacts.

### 2.3. The View of Software Engineering

Despite many software success stories, a considerable amount of software is still being delivered late, over budget, and with residual faults [Schach, 2002]. Boehm [2006] for example provides a historical perspective on some of the important activities that has affected the area of software engineering. Boehm [2006] argues that we should build of the success of passed software engineering success. In order to be considered successful, such software should be produced in a cost-effective way and should be appropriately functional, maintainable, reliable, efficient, and provide a relevant user interface [Pressman, 2000; Shneiderman, 1998; Whitten et al., 2001]. The field of software engineering aims to present a framework that can be used by developers of computer software to reach this goal. The technology encompasses a process, a set of methods and an array of tools [Pressman, 2001].

The field of software engineering is concerned with the development of software systems, using sound engineering principles for both technical and non-technical aspects. In an effort to increase the success rate of successful implementation of information systems, the field of software engineering has advocated many techniques such as the use of specification, design and implementation techniques and software management techniques. Well-engineered software provides the service required by its users.

Despite the concerted efforts to develop a successful process for developing software, Schach [2002] identifies the following pitfalls:

- Traditional engineering techniques cannot be successfully applied to software development.
- The software depression (software crisis): Software development is seen as a craft, rather than an engineering discipline, and the approach to education taken by most higher education institutions encourages that ‘craft’ mentality [Mullet, 1999], leading to the development of unsound software.
- Lack of professionalism within the software engineering world, e.g. not treating an operating systems failure (crash) as seriously as civil engineers would treat the collapse of a bridge.
- The high acceptance of fault tolerance by software engineers: For example, if the operating system crashes (e.g. Windows blue screen), the solution is not to fix the problem but to reboot the system and hope it will work again, with minimal damage.
- The mismatch between hardware and software development: Both hardware and software development are happening at a rapid pace, independent from each other. Both the hardware and software development have a maturation time to be compatible with each other – by that time everything has changed again.
- The final problem for software engineers is the constant shifting of the goalposts. The customer initially wants one thing, but two weeks later wants something different.

Notwithstanding these pitfalls, Pressman [2000] argues that software engineering principles always work. It is never inappropriate to stress the principles of solid problem solving, good design, thorough testing, control of change, and emphasis on quality.

There seem to be two major established software engineering development methodologies that are used to develop CBISs: the traditional structured systems development methodology and the object-oriented (OO) development approach [Singh & Kotze, 2003]. These development methodologies are discussed in more detail in Chapter 4.

The traditional structured development approach includes methodologies such as: Structured Analysis and Design Techniques (SADT) [Ross, 1985], the Yourdon Systems Method (YSM)
As with the traditional structured development approaches, there are various OO methodologies such as: Objectory [Jacobson, 1994], Unified Modelling Language [Bahrami, 1999], Coad and Yourdon Method [1991a], Booch Method [1987], Object Modelling Technique [Rumbaugh et al., 1991], IBM approach [1990a; 1990b; 1990c; 1999] and Object-oriented Business Engineering [Jacobson, 1994]. This is by no means an exhaustive list. We discuss the Object Modelling Technique [Rumbaugh et al., 1991], Coad and Yourdon Method [1991a] and IBM approach [1990a; 1990b; 1990c; 1999] in more detail in Chapter 4.

Pressman [2000] furthers states that the current basic web development philosophy is that:

- Web applications must be developed in days or weeks. The argument is that time frames do not allow for anything but a rush to the finish line.
- Web applications are constantly evolving. The argument is: why spend the time specifying what is needed, and designing how to build it, when everything will change anyway?
- Web applications are inherently different from other application software. The argument is that the content (text, graphics, images, audio, and video, for example) is inextricably integrated with procedural processing.

With regards to the WWW, Pressman [2000] states the following: “What worries me is that this major new technology has become a breeding ground for important web applications that are hacked in much the same way as important application software was hacked a few generations back – in the 1960s and 1970s”. Boehm and Turner [2005], for example, identify several challenges in the implementation of Agile processes in a traditional development organisation. They identify the following challenges

- How does one merge agile process in a non-agile environment?
- The difference between agile and traditional engineering processes is the way everyday business is conducted and
- People issues.

For each of these issues they suggest some guidelines on how to manages these challenges.

The developers of web applications are different. Web ‘hackers’ are freethinkers who certainly would feel unduly constrained by the old ways. In fact, any talk of a disciplined approach – other than...
building it, testing it exhaustively (if time permits) and then putting it online – usually results in grimaces all round. As companies realised that their haphazardly developed electronic commerce ventures were not as successful as they anticipated, and were prone to failure, they began to investigate alternate development strategies to deal with this rapid changing environment. Some followed the established software engineering approaches while others looked for ‘faster’ solutions. One such approach that has won the favour of web application developers is agile development methodologies. Agile development methodologies do not have prescriptive processes and do not define detailed procedures on how to create a given type of model. Instead they provide advice on how to be effective as a modeller. Agile development methodologies are more flexible than the traditional development approaches. Agile development methodologies can also be seen as a craft and not a science [Ambler, 2003], and the users of the system are still very much ignored.

Pressman [2000] is of the opinion that people who use web applications are more tolerant of errors. The argument is that what users really want are ‘cool’ websites that are up and running within days. It therefore seems as if the agile approaches would suit this kind of environment better.

But, although looking promising, the agile approaches suffer from many of the same problems as the traditional structured and object-oriented approaches.

Pressman [2000] argues that it is almost impossible to know what web applications users really want, because the demographics of web visitors are so hard to predict. We believe that as web applications are becoming an integral part of life, users’ fault tolerance is becoming much lower.

The development of applications for the WWW (such as electronic commerce) therefore has its own set of unique problems. No current theory or development methodology adequately addresses how to effectively create websites for online selling. Current electronic commerce websites typically exhibit poor design, characterised by lack of coherence, legibility and order. There is evidence that this may result in a loss of business, as was illustrated when IBM redesigned their website [Tedeschi, 1999]. With the new improved and redesigned website, sales of hardware and software increased by no less than 400%, while the users’ reliance on the help facilities decreased by 84%. The improvements to the website significant improved the revenue generation of the website. However, they do not explain the methodology that was used in the re-design of the website.

2.4. The View of Human-Computer Interaction

Human beings design and develop ‘tools’ to assist them in their daily lives. We build things using tools such as hammers, chisels and saws. A computer is also a tool. We use computers to do things such as:

- Control a microwave oven.
• Receive the electricity bill for the house with that oven.
• Pay our electricity bill.
• Communicate with our business partners, friends and family.
• Make models of the atmosphere, which predict the changes in world climate caused by global warming.

The use of a tool involves cooperation between a person (the user) and the tool. We do not say: “The hammer banged in the nail”. We say: “I banged in the nail, using the hammer”. The user is in charge. The hammer does not tell you which nail to put in, or beep at you when you use a large nail rather than a small one. Similarly, the computer does not decide to perform a task, although it is capable of obeying a complex series of instructions. A person must set and switch on the microwave oven, decide that electricity bills have to be paid, and build the atmospheric model. Because of this requirement for cooperation, the way in which the person has to interact with the tool determines whether or not the tool is usable [Cox & Walker, 1993].

Interaction design is the process of designing interactive products to support people in their everyday social and work lives. In particular, it is about creating user experiences that enhance and extend the way people work, communicate and interact [Preece et al., 2002]. Interaction design can be considered a synonym to human-computer interaction. Interaction design, however, covers a broader spectrum of activities.

Human-computer interaction (HCI) is concerned with the way in which computers and interactive products can be used to support human beings engaged in particular activities. HCI thus involves the specification, design, implementation and evaluation of interactive software systems in the context of the user’s task and work [Baecker & Buxton, 1987; Dix et al., 1998; Preece et al., 2002; Preece et al., 1994; Shneiderman, 1998]. HCI can therefore roughly be seen as a sub-field of interaction design.

The HCI advocates are intent on discovering the key success of user experiences. For this reason, the concept of usability is intensely investigated. The ISO 9241-11 [ISO/IEC FDIS 9126-1, 1999] standard defines usability as the following: “The extent to which a product can be used by a specified set of users, to achieve specified goals (tasks), with effectiveness, efficiency and satisfaction in a specified context of use.”

Several researchers have produced sets of generic usability principles which can be used in improving software (for example, Dix et al. [1998]; Nielsen [1993]; Nielsen [2000b]; Cato [2001]; Mayhew [1999]; Preece et al. [1994]; Shneiderman [1998]; Shneiderman [2000]; Thimbley [1990]). Some of these principles relate to learnability, visibility, consistency and standards, flexibility,
robustness, responsiveness, feedback, constraints, mappings, affordances, stability, simplicity, help and documentation, etc. Unfortunately, the definitions of the design and usability principles are mostly too broad or general, and in some cases too vague, to directly and seamlessly apply in a particular context – as, for example, an electronic commerce application. It has been shown repeatedly that general usability advice is not effective on its own when designing systems for a context specific environment. It is therefore, in general, difficult for the non-usability expert or the novice to apply these principles to a particular domain and situation, taking into account the unique factors that propel problems from that domain.

We argue that usability advice should be linked to a context specific environment. Travis [2003b] gives context specific advice for the development of electronic commerce applications. We, however, used general advice for the development of our experimental website. For example, if you were trying the design a website to entice a prospective surfer to stop browsing and make a purchase, it would be different from someone who is doing Internet banking, which is vastly different from someone using an online library catalogue system. The design of a site for Pick ’n Pay (supermarket chain), ABSA (commercial bank), and the University of South Africa’s (Unisa) library should therefore be approached differently.

Some work has been done on these issues in the context of usability principles for electronic commerce (for example, see Badre [2002] and Travis [2003b]).

The HCI proponents also propose certain development life cycle models. Williges et al. [1987], for example, have produced a model of development to rectify some of the problems in the traditional structured development approach and the OO development approach. In their approach HCI principles and interface design drive the whole process. Other HCI oriented life cycles models include the Star Model of Hartson and Hix [1989], The Usability Engineering life cycle of Mayhew [1999], and the Interaction Design Model of Preece et al. [2002]. These methods also introduce various strategies for the development of effective user interfaces. The argument for putting forward these alternative development models is that by spotting user requirements early on in the development cycle, there will be less of a demand for code generation and modification in the later stages of systems development. These will be discussed in more detail in Chapter 4.

Both the software engineering (SE) proponents and the HCI proponents have a point with regard to their approach. The software engineer tries to produce a workable solution and the HCI proponents try to develop a usable solution. The two approaches are not mutually exclusive. A workable solution may not be a usable solution, or vice versa, and a usable solution may be a workable solution, or vice versa. The problem is that the HCI advocates are disjointed from their software engineering colleagues, who in turn ignore the HCI advocates. The HCI advocates use a ‘blinder approach’ in
their attempt to develop software, by only focusing on the HCI aspects of the design of software, while the SE are concerned with a satisfactory solution.

3. The Context: Electronic Commerce

There are many applications making use of the WWW, including commerce, entertainment, leisure, and information resources. The WWW as a vehicle for the implementation of trade and commerce, has attracted the attention of business, government and researchers alike. In this dissertation we focus on electronic commerce.

In this section we briefly research electronic commerce. The term ‘electronic commerce’ conjures up various interpretations. Figure 1.4 clarifies the context in which electronic commerce is referred to in this dissertation. There are many different types of electronic commerce, for example, according to participants’ involvement. Internet commerce can be classified as: Business-to-Business (B2B); Business-to-Consumer (B2C); Consumer-to-Business (C2B); Consumer-to-Consumer (C2C); People-to-People (P2P); Non-business electronic commerce; Intrabusiness (organisational) electronic commerce; Business-to-Employees (B2E); Government-to-Citizen (G2C); Exchange-to-Exchange (E2E); Collaborative commerce, Ultimate Commerce (U-commerce) and Mobile commerce (M-commerce). In this dissertation we focus on the generic electronic commerce activity only. The different types will be discussed in more detail in Chapter 2.

![Diagram of Types of Commerce](image)

**Figure 1.4.** Types of Commerce (adapted from Chan *et al.* [2001] and Lubbe and Pather [2003])
For any type of electronic commerce to function efficiently, certain basic infrastructure is required. The key components of this infrastructure are computer networks, web servers, web server support and software, electronic catalogues, website design and construction software, transactional software and Internet access components [Stair & Reynolds, 2003; Turban et al., 1999; Turban et al., 2001].

The infrastructure on which the electronic commerce application is built will affect the users’ experience of that application. It is generally accepted that electronic commerce that does not provide an experience to the user will not thrive [Brandt, 1999; Gao, 2005]. The traditional approaches of enticing a purchase in brick-and-mortar commerce, such as atmosphere, placement of goods, lighting, etc., do not transfer to online commerce. Nielsen [1999] contends that a ‘bad’ user interface is one of the reasons for electronic commerce failure. It is interaction and participation that are the emotional hooks for electronic commerce, and the developers of electronic commerce sites should keep this in mind. Ideas on how to accomplish this are beginning to be explored (for example, see Badre [2002] and Carroll [2003]).

In Section 3.1 we briefly discuss electronic commerce infrastructure and some of the associated problems. Section 3.2 is a discussion of the electronic commerce experience, particularly its different phases.

3.1. Electronic Commerce Infrastructure

The web is an intricate and complex combination of technologies (both hardware and software) that are at different levels of maturity. Engineering web-based electronic commerce software therefore has its own unique challenges. In essence, the network becomes a massive computer that provides an almost unlimited software resource that can be accessed by anyone with a modem [Pressman, 2000]. We illustrate these complexities in Figure 1.5. It is a representation of a home computer that is attached to the Internet, depicting the underlying operating system (the base platform), the method of connection to the Internet (dial-up: the technology that supports web activities), the browser, an example of a web communication language (HTML), and additional technology that may be required to be web active.

All the aspects of Figure 1.5 will in some way or other support electronic commerce software. They will influence the HCI advocate’s approach to designing software for the web, as well as that of the software engineer. A software engineering defect in any of these five layers would create problems. For example, if the operating system is poorly engineered, the technology that sits on this platform will give weak functionality at best. The problem is further complicated by piecemeal ‘patch’ solutions. These poor solutions can severely affect the usability of the interactive application, for example, by

- Giving cryptic error messages.
• Installing add-ons that affect some unknown setting that the user does not understand.
• Installing add-ons that require a particular bit of hardware or software to be present.

Figure 1.5. e-Commerce Web Application Platform (adapted from Hurst and Gellady [2000])

3.2. The Basic Electronic Commerce Actions

From an electronic commerce perspective, for every application there is a common entry point (the ‘start’ web page). The first phase of the ‘shopping experience’ is characterised by an iterative interactive experience of trying to find one’s desired product(s). We refer to this as browsing. This process is typically characterised by the ‘shopper’ browsing the catalogue until s/he finds the desired product. This phase (Phase 1 as illustrated in Figure 1.6) typically follows the following generic ‘activities’:

• The prospective customer enters the ‘store’.
• The prospective customer may access company information – the customer may choose to verify that this is a valid, legal and trustworthy company (website).
• The prospective customer browses for goods/services.
• The prospective customer will select items s/he wants to obtain/purchase, and may browse further, or move to Phase 2 (as illustrated in Figure 1.6), or exit the website.

Once the desired product(s) is found, the ‘shopper’ proceeds to the ‘checkout’ phase (Phase 2). During the ‘checkout’ phase the ‘shopper’ is locked into a sequential set of actions to get the transaction completed (see Chapter 2 for more details). The ‘shopper’ cannot go directly to the checkout phase without first finding and placing/selecting an item for the ‘shopping cart’. This phase typically follows the following generic ‘steps’, other researchers allude to these steps [Chan et al., 2001; Li & Chatterjee, 2006; Nielsen, 2000b]:

Add-ons: cookies, plug-ins, Java, Javascript (all of which have their own error messages, liable to appear at any time), the familiar DNS error, ad banners, etc.

HTML: links, graphics, frames, forms, tables, etc.

Browser: bookmarks, history file, Back/Forward/Home/Reload buttons, etc.

TCP/IP: running dial-up network to call the ISP, retrying if necessary, etc.

Operating System: opening and closing of windows, menus, dialog boxes, clicking ‘Start’ to shut down the computer, etc.
• The prospective customer will specify quantities of goods (if not done in Phase 1).
• The prospective customer will provide his/her personal details.
• The prospective customer will specify shipping details and method of payment.
• The prospective customer will submit the order.
• The prospective customer will review the order prior to payment.
• The customer will make the payment.
• The customer will receive confirmation of the order.

In the checkout phase of the shopping experience (Phase 2) the structured sequence is (fairly) standardised, but in Phase 1 this is not true.

The basic actions that are followed in an electronic commerce activity are illustrated in Figure 1.6. The relationships between these two phases are: Phase 1 is uncontrolled, user pre-emptive [Dix et al., 1998] and iterative. Phase 2 is controlled, system pre-emptive [Dix et al., 1998] and sequential.

Figure 1.6. The basic actions that are followed in the e-commerce activity
4. Aims and Objectives of this Dissertation

Some researchers, such as Nielsen [2000b], are of the opinion that the web is the ultimate customer-empowering environment. S/he who clicks the mouse gets to decide everything. It is so easy to go elsewhere: all the competitors in the world are but a mouse click away. The user interface therefore rules the Internet in general, and electronic commerce in particular. Simply stated, if the customer cannot find a product, then s/he will not buy it.

We argue that the web can be a very intimidating and foreign environment for many users (novice to expert). Websites are a jungle of links, buttons, forms, blinking graphics and undecipherable jargon. The ‘cherry on the top’ is the cryptic error messages that leap out at users when something goes ‘wrong’, sometimes unexplainably and unpredictably. The appropriate use of user interface features will thus influence the success or failure of a user in a particular task.

In the context of the development of interactive web applications, such as those for electronic commerce, we therefore argue that it is critical for the software engineer/team to understand the user and, inter alia, the iterative browsing experience.

The impact of various user interface features on the success of an online environment, and their appropriate usage, are currently topics of research in the wider computing and business community. In the case of the WWW and electronic commerce, the effective use of user interface features has, however, not been adequately investigated from a development methodology perspective.

A common phase to both the traditional structured development methodologies and the object-oriented methodologies is requirements gathering. This is the process of eliciting the overall requirements of the product from the prospective users. These requirements encompass information and control needs, product function and behaviour, overall product performance, design and interface constraints, etc. The requirements gathering phase has the following typical process:

- Requirements elicitation.
- Requirements analysis and negotiation.
- Requirements specification.
- System modelling.
- Requirements validation.
- Requirements management [Pressman, 2000].
Our argument in this dissertation is that it is critical to get the users’ full involvement at the requirements gathering stage.

It is with this in mind that we chose to have an in-depth look at Phase 1 of the ‘electronic commerce experience’. This dissertation seeks to make a contribution to the understanding of the usability issues involved in the electronic commerce development process, specifically to this Phase. The information gathered from this research aims to assist software engineers with some usability aspects associated with requirements analysis that should be considered in the development of interactive applications.

In this context we pose the following research question:

*Do usability aspects affect the design and development of the browsing experience in electronic commerce applications?*

As a first step in solving this problem of understanding the effects of selected usability concepts on the development of electronic commerce applications, we conducted an experiment focusing on Phase 1 of the electronic commerce experience, i.e. the iterative browsing phase. The following hypotheses are stated and examined:

- \( H_0: \) Instructions do not affect the activities of a website user.
- \( H_1: \) Instructions affect the activities of a website user.
- \( H_0: \) Response times of websites do not affect the activities of a website user.
- \( H_2: \) Response times of websites affect the activities of a website user.
- \( H_0: \) Visual aids assisting with communication features of the website do not affect the website users’ activities.
- \( H_3: \) Visual aids assisting with communication features of the website affect website users’ activities.
- \( H_0: \) The website users’ reactions to the website do not affect their activities on the website.
- \( H_4: \) The website users’ reaction to the website affects their activities on the website.
- \( H_0: \) The visual appearance of the website did not affect the website users.
- \( H_5: \) The visual appearance of the website affects the website users’ activities.
- \( H_0: \) Navigation of a website does not affect the activities of the website user.
- \( H_6: \) Navigation of a website affects the activities of the website user.
- \( H_0: \) The overall structure of the website does not affect the users.
- \( H_7: \) The overall structure of the website affects the users.

### 5. Delimitations of the Dissertation

This dissertation should be read from the following perspective: we approach the issue of design for electronic commerce from an information systems design and HCI (and specifically usability)
perspective. The information systems development (including traditional structured, object-oriented and agile approaches) advocates propose a variegated approach to designing applications, and the HCI advocates approach application design from the perspective of usability.

As stated earlier, the ISO 9241-11 [ISO/IEC FDIS 9126-1, 1999] standard definition for usability identifies three different aspects: (1) a specified set of users; (2) specified goals (tasks) which have to be measurable in terms of effectiveness, efficiency and satisfaction; and (3) the context in which the activity is carried out.

In this dissertation, as per the ISO 9241-11 usability definition, we limit the dissertation to the following:
- A specified set of users: The dissertation focuses on the Net-generation (N-gen). (See Chapter 5 for a detailed discussion of the N-gen.)
- To achieve specified goals (tasks): To search and find information on a website.
- In a specified context of use: Electronic commerce.

We do not address electronic commerce from a business economics point of view. The following (non-exhaustive) issues related to web applications are also not addressed in the dissertation:
- Due to the difficulty of testing actual electronic commerce websites, our experiment is based on general browsing. This general browsing can be applied to electronic commerce applications.
- We do not investigate Phase 2 of the shopping experience.
- Change in the middleware, i.e. the issue of legacy [Satzinger et al., 2002].
- Moore’s law [Moore, 1997].
- Bad standards becoming the norm [Nielsen, 2000b].
- Economies of scale [Samuelson & Nordhaus, 1989].
- Paradox of the user [Carroll & Rosson, 1987].
- Low/uneducated users [Shneiderman, 2000].
- The South African socio-political issues, i.e. unfulfilled basic needs like water, housing, basic communication, electricity, etc. [Government Communication, 2004].
- Mimicking the technologies of developed countries [Singh & Erwin, 2002].
- Online payments and security [Shaw et al., 2000].
- Privacy [Sockel & Chen, 2005; Turban et al., 2002].
- Trust.
- Cultural diversity [Macfadyen, 2006; Rose, 2006].
6. Research Design and Methodology

When undertaking research, it is important to make use of a structured research methodology to ensure that the research has integrity, i.e. that the research is reliable, valid and can be ‘reproduced’ [Remenyi & Williams, 1995].

According to Leedy [1989], a research methodology is an ‘operational framework’ within which the facts are placed so that their meaning may be seen more clearly. Remenyi and Williams [1995] suggest three approaches which are appropriate for the scientific acquisition of knowledge in the study of IS:

- Passive observation.\(^1\)
- Uncontrolled intervention.
- Deliberate intervention.

According to Remenyi and Williams [1995], the passive observation research process is the most commonly used approach in the study of IS, and is the one adopted in this dissertation. Passive observation draws on conclusions from information collected from any one of the following techniques:

- Interviews.
- Reports.
- Questionnaires.

The research reported upon in this dissertation made use of a questionnaire to elicit data. The questionnaire was designed to identify users’ attitudes to changes in usability aspects of the websites. The questionnaire was piloted and subsequently redesigned before use in the experiment. Interpretation of the data is based on the respondents’ answers to specific questions, as well as their answers to the open-ended comments.

The following summarises the steps followed in the overall research process for this dissertation:

1. Knowledge domain review. In order to investigate the chosen field of study, the following media were consulted: books, Internet-based articles and sites, journals, conference proceedings and personal communication.
2. Assessment of established theoretical frameworks (information systems, interaction design, electronic commerce and software engineering).
3. Setting the theoretical conjecture.
4. Selecting the hypothesis/empirical generalised formulation.
5. Defining the measuring instrument (e.g. Likert-type scale questionnaire).
6. Sampling (e.g. judgment sample technique).
7. Testing/Analysis (e.g. Cronbach’s Alpha, t tests, Anova and Kruskal-Wallis Test).
8. Confirmation of theoretical conjecture and development of fuller/refined theory.

7. Structural Organisation of this Dissertation

This dissertation is organised in the following nine chapters. Figure 1.7 will be placed at the beginning of each chapter as a roadmap, indicating progress through the dissertation. The shopping cart icon is used to indicate the current chapter that we are in. Table 1.1 is a summary of the different chapters in this dissertation.

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<tr>
<th>Chapter</th>
<th>Contents</th>
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<tr>
<td>1. Introduction</td>
<td>In Chapter 1 we provide a background to the main fields of study in this dissertation. We place the dissertation in the context of electronic commerce. We explain our research question and then explain the approach that would be used to understand the proposed problem.</td>
</tr>
<tr>
<td>2. Electronic Commerce</td>
<td>In this chapter we introduce the context of the dissertation. We discuss the contemporary approach to business and then focus on electronic commerce. We consider the various classifications of electronic commerce activities, which are: classification according to participants, classification according to task, and classification according to technology. Next, we look at the state of electronic commerce in South Africa, with some examples.</td>
</tr>
<tr>
<td>3. Interaction Design</td>
<td>Chapter 3 contains an overview of the concept of usability. The chapter reviews various definitions of usability, looks at usability principles and usability principles in general for the web. We then look at various usability methods for the web, and consider examples of web usability and electronic commerce usability.</td>
</tr>
<tr>
<td>4. Systems Development Life Cycles</td>
<td>This chapter provides an overview of some of the major trends in systems development. In the chapter we review standards for systems development; we particularly focus on structured systems development methods, object-oriented methods, and human-computer interaction development methods. This chapter has an overview of agile methodologies. We then compare the different methodologies, namely, structured systems development methods, object-oriented methods, human-computer interaction development methods and interactive systems design for the web and electronic commerce. The chapter ends by discussing usability as a key design component.</td>
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| 5. Research Methodology | Chapter 5 describes the research approach and the research }
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<tr>
<th>Chapter</th>
<th>Contents</th>
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<tbody>
<tr>
<td>1. Introduction</td>
<td>Instrument. We look at general research techniques and research techniques used in IS. We discuss how we went about acquiring the knowledge and our chosen research technique. We also discuss the concept of generational theory in this chapter. We describe the integration of Chapters 2, 3, 4 and 5. The various statistical techniques are briefly discussed, as well as the questionnaire.</td>
</tr>
<tr>
<td>6. Experimental Websites</td>
<td>In Chapter 6 we discuss the design of the experimental website. There were two websites designed. Site B was designed after taking into consideration usability factors, namely consistency, navigation and structured information. In Site A we did not consider the usability factors of consistency, navigation and structured information. Respective web users looked at these two websites and completed a questionnaire based on their perceptions of the websites.</td>
</tr>
<tr>
<td>7. Experiment Results</td>
<td>In Chapter 7 we apply several statistical techniques to the data. We analyse the outcomes of the statistical analysis and provide an explanation for the results. Our overall observation is that usability cannot be the only determinant for making web applications usable.</td>
</tr>
<tr>
<td>8. Discussion of Findings and Contributions</td>
<td>In Chapter 8 we discuss our findings. We demonstrate that we need a much richer understanding of the human, social, cultural and technical world in which we design and develop interactive computer software products, so that the final user finds the interactive product useful, usable, and stimulating. Systems requirements are dynamic and they evolve over time. User needs are constantly changing as well, based on time, place, circumstances and levels of empowerment, so that it is difficult to have a universally accepted standard solution for designing engaging interactive computer software.</td>
</tr>
<tr>
<td>9. Conclusions, Recommendations, and Further Research</td>
<td>In Chapter 9 we summarise the dissertation and outline the contributions of this dissertation. We further reflect on the knowledge acquisition process in this dissertation. We finally outline further research opportunities.</td>
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**Table 1.1. Structural Organisation of this Dissertation**
An Investigation into the Influence of Usability on the Development of the Browsing Experience of E-Commerce Applications

Shawren Singh
8. Summary and Conclusion

In this chapter the various fields that this dissertation draws from were briefly introduced. These fields are: the business environment, the computer based information systems field, the software engineering field and the human-computer interaction field. We introduced our application, namely, electronic commerce. We then discussed the details of how we were going to solve our research problem. The main objective of this dissertation is to investigate: *Do usability aspects affect the design and development of the browsing experience in electronic commerce applications?* Some of our findings are that:

- From a usability perspective: Usability is one of many critical success factors that are required for the development of effective interactive applications such as electronic applications. Usability guidelines and principles tend to be very vague and generalistic. Every time a user goes to a website that has changed (assuming it is done through a systematic development approach or otherwise), the user is relegated to the level of a novice user. The user will have to try and re-figure out the operations and structure of the site.

- From an electronic commerce perspective: Electronic commerce development needs to follow a structured development strategy. There are different classifications of electronic commerce. Electronic commerce is a special activity involving transaction processing and interactivity development [Singh & Kotze, 2002].

- From a systems development perspective: The traditional approach of soliciting sales in a brick-and-mortar commerce, such as atmosphere, placement of goods, lighting, etc., do not transfer to online commerce. It is interaction and participation that are the emotional hooks for electronic commerce, and the developments of electronic commerce sites should bear this in mind [Singh & Kotze, 2002]. There is a dire need for the development of a unified process to the approach of user interface in the development methodologies. There are gaps in communication that exist between the software engineering community and the human computer interaction community. These communities at times seem to communicate the same ideas in very different language.

In the next chapter we will focus on the context of this dissertation, which is electronic commerce.

Notes:

1 The observation techniques used in this dissertation should not be confused with the HCI observation technique. In the HCI observation technique, users can be observed or videotaped while performing tasks of interest [Brinck *et al.*, 2002; Dix *et al.*, 1998; Macaulay, 1995; Preece *et al.*, 2002].
An Investigation into the Influence of Usability on the Development of the Browsing Experience of E-Commerce Applications

Shawren Singh
Chapter 2

Electronic Commerce

In this chapter we introduce the context of the dissertation. We discuss the contemporary approach to business and then focus on electronic commerce. We consider the various classifications of electronic commerce activities, which are: classification according to participants, classification according to task and classification according to technology. Next, we look at the level of electronic commerce in South Africa, with some examples.

Electronic commerce is the smartest way of doing business. You ask your customers to do the work for you such as filling in the order forms, checking the order status and downloading the product themselves so that you can save huge costs and manpower. Furthermore, they do not make any complaints and even think that you have done excellent work for them. Can you think of anything smarter than this?

Chan et al., 2001

1. Introduction

In the previous chapter the various fields that the dissertation draws from were briefly introduced. The research problem and delimitations of the study were set, and the context of the study was briefly discussed. We defined our research question as: Do usability aspects affect the design and development of the browsing experience in electronic commerce applications? In this chapter the key context, i.e. electronic commerce, is investigated.

One of the advantages of living in the 21st century is our unique ability to watch the world develop, from the looming black gold (oil) crisis to the advent of democracy in South African in 1994. With these social changes in the foreground, in the background there have been significant technological developments. One of these technological miracles is the Internet, which has spawned electronic commerce. Just as during the 19th century gold rush, the Internet has attracted many eager people who believe they can make money from nothing. While explorers in the 19th century died in the harsh elements, today’s adventurers only lose their money [Amor, 2001]. The ‘New Economy’ is upon us and everyone is searching for rules, frameworks, guidelines, pointers, anything to assist them in their understanding and dealing of this unfamiliar territory [Gilfillan, 2000]. Although, this ‘technology revolution’ seems to be something very exciting and new - even the hype that surrounds it is actually a very regular feature that has occurred over and over again in the past. If we, for example, compare
the technology revolution of today with the Industrial Revolution of the early 1820s, some very interesting similarities emerge. Although the first steam engine had already been in operation since 1776, it was not until the 1820s that steam engines were used in an industrial environment. The steam engine was to the Industrial Revolution what the computer has been to the technology revolution – merely its trigger, not the change that it provoked in society [Amor, 2001]. The pattern is therefore always very similar when a new technology is introduced.

There are many applications of the WWW such as commerce, entertainment, leisure and information resources. The WWW, as a vehicle for the implementation of trade and commerce, has attracted the attention of both businesses and governments.

Electronic commerce provides unparalleled opportunities for companies to expand their business worldwide, to increase market share, and to potentially reduce costs [Turban et al., 2001]. The impact of electronic commerce on customer service, as well as on industries such as financial services, travel, and retailing, is so dramatic that almost any organisation is affected. Electronic commerce is changing all functional areas and their important tasks, ranging from advertising to paying bills. The nature of competition is also changing drastically, due to many online companies and the diversity of available products and services.

To find the desired product, an electronic commerce customer has to browse an electronic commerce website. As stated in Chapter 1, the primary focus of this dissertation is on the browsing phase of a typical electronic commerce task.

Browsing can be defined from several perspectives. Toms [2000] provides a general description of browsing as “an activity in which one gathers information while scanning an information space without an explicit objective.” Nah and Davis [2002] point out that Toms’ definition implies that the user’s goals may be unclear, or there may be no goals focusing on finding a specific information/product. Specifically in the context of electronic commerce browsing, the browser can be defined as “someone who is shopping with no definite intent to buy” [Browser, 2007]. There are different types of browsing. Cove and Walsh [1988] distinctively identify three different types of browsing:

- Search browsing – directed search, where the goal is known.
- General purpose browsing – consulting sources that have a high likelihood of items of interest.
- Serendipitous browsing – purely random.

Marchionini [1989] further develops this distinction in designating open and closed tasks. Closed tasks have a specific answer and often integrate sub-goals, e.g. go to Amazon.com and buy the
newest Harry Potter book. Open tasks are much more subject-oriented and less specific, e.g. go to Amazon.com and find a gift for your Aunty Girlie. Browsing can be used as a method of fulfilling either open or closed tasks in electronic commerce. Usually in terms of the electronic commerce system, most tasks are goal-oriented and most relevant information is usually located within two clicks [Park & Kim, 2000] – that is, if you know what you want (closed task).

Nah and Davis [2002] point out that there are several challenges facing the users in browsing an electronic commerce website, such as the users’ inability to navigate websites and to search for desired products. For trust and security reasons consumers may wish to remain anonymous, or may even want to hide their browsing pattern and even the identification of the product they may decide to buy [Aiýmeur et al., 2004]. Users may wish to blindly browse [Aiýmeur et al., 2004]. This blind browsing may make it difficult for electronic commerce site designers.

In the remainder of this chapter we discuss electronic commerce and its context in more detail. In the next section of this dissertation we briefly discuss some business principles, and in Section 3 we consider the different definitions of electronic commerce. In Section 4 we classify electronic commerce in terms of participants, nature of task and in terms of technology infrastructure. In Section 5 we provide a brief account of the electronic commerce activities in South Africa. In Section 6 we look at the growth of electronic commerce in South Africa, which is followed by a summary.

2. Principles of Business

In essence, the basic principles of doing business and profit making have remained unchanged over the years, although technology now plays a more important role in the speed and method of communication and transactions. Business principles still remain – it is just the process that has changed [Gilfillan, 2000]. It is important for developers to consider these changes when considering the development of electronic commerce applications.

Several prominent researchers believe that the driving principles of the new economy are:

- **Matter (physical size):** The belief that ‘bigger’ and ‘heavier’ is a sign of a quality product, is not true. The proposed value may lie in the intangibles like: knowledge, information services, and software. For example, processing information is dramatically more powerful and cost-effective than moving physical products. Increasingly, the value of a company is to be found not in its tangible assets, but in intangibles such as people, ideas, and the strategic aggregation of key information-driven assets. The 3 to 10kg computer is easily disposable, while the weightless software raises the value of the hardware [Meyer, 2000].
• Space: Distance has vanished. The world is your customer and your competitor. Geography has always played a key role in determining who competes with whom. Now your business can connect with customers all over the globe. The disadvantage of this is that your business is exposed to worldwide competitors as well [Sawhney, 2000].

• Time: Instant interactivity is critical, and is breeding accelerated change. In a world of instantaneous connection, there is a huge premium on instant response and the ability to learn from and adapt to the marketplace in real time. Winning companies accept a culture of constant change and are willing to constantly break down and reconstruct their products and processes – even the most successful ones [Spulber, 2000].

• People: People are the crown jewels, and they know it. Brainpower cannot be tallied on a ledger sheet, but it is the prime factor driving the new economy. More than ever in history, huge value is being leveraged from smart ideas and the winning technology and business models they create. The people who can deliver them are becoming invaluable, and methods of employing and managing them are being transformed [Tapscott, 2000].

• Growth: Growth is accelerated by the networks (computer networks) of communication. The Internet can dramatically boost the adoption of a product or service by viral marketing. Communication is easy on the web, and product awareness spreads like wildfire. Once a company reaches critical mass, it can experience increasing returns, leading to explosive growth. This principle means that in the new economy, first-mover advantages are greater than ever [Jurvetson, 2000].

• Value: Value rises exponentially with market share. For example, if a product helps establish a platform or a standard, the network effect is even more pronounced. This is illustrated with the examples of the free Adobe pdf. reader software. The more plentiful the software becomes, the more essential each individual unit is – a striking exception to the economic rule that value comes from scarcity. In addition, some companies give away their products to establish market share, then sell linked services later on. Network effects were experienced historically in the adoption of telephones and fax machines. The difference today is that because everyone is linked, far more products and services gain their value from widespread network acceptance [Seybold, 2000].

• The middleman plays a key role: ‘Infomediaries’ replace intermediaries. Traditional distributors and agents are seriously threatened by a network economy in which buyers can deal directly with sellers. However, a new brand of middleman is being created. As the amount of info-clutter grows, these infomediaries are needed to turn dumb data into usable information. They offer aggregated services, or intelligent customer assistance, or powerful technology-based buying aids, or an attractive community-based buying environment [Mougayar, 2000] (also see Section 5 of this chapter).
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- Markets: Buyers are gaining dramatic new power and sellers new opportunity. It is no longer necessary for your customer to walk down the street to compare prices and services. Your competitor may just be a mouse-click away. Intelligent software will help buyers find the best deal. Business that genuinely offers unique services or lower costs will flourish, benefiting from a flood of new buyers. Those that have relied on physical barriers to competition will fail [Singh, 2000].

- Transactions: Transaction processing has become a one-on-one game with customer and supplier. Information is easier to customise than the hard goods. The information portion on any goods or service is becoming a large part of its total value. Thus, suppliers will find it easier and more profitable to customise products, and consumers will demand this sort of tailing [Mott, 2000]. (For a different view see Section 4.2 of this Chapter.)

- Impulse: Every product is available everywhere. The gap between desire and purchase has closed. The shelf space of the WWW is unlike any other, in that it has no bounds. Artificial constraints on choice are replaced by the ability to purchase the precise product you desire. The impulse to buy, and the purchase itself, used to be separated by a combination of physical and mental barriers. When you heard a song on the radio, you had to both remember the song or the artist and actually go to a store to purchase. Online, it is different. Discover a product you desire, and just hit the ‘buy’ button. The consequence of this is that the processes for marketing, sales and fulfilment are merging [Reid, 2000].

These principles introduce a series of opportunities for the development of electronic commerce websites. These principles affect all the key stakeholders (see Chapter 1, Section 2.1) in the understanding and development of an effective and efficient electronic commerce website.

### 3. Electronic Commerce

The first electronic commerce applications were used 20-30 years ago in the early 1970s. The original applications were in the form of electronic fund transfers (EFT). These applications were limited to larger corporations and financial institutions [Tian & Stewart, 2006; Turban et al., 2000]. This type of transaction later included electronic data interchange (EDI). Electronic commerce as we know it today does, however, involve much more than EDI [Greenstein & Feinman, 2000], such as business-to-business electronic commerce, electronic government, electronic learning, mobile commerce, etc.

There is still no standard definition for electronic commerce, but a number of researchers have attempted to define electronic commerce over time. The following represents a sample of these:

- Electronic commerce is any electronic business transaction or exchange of information to conduct business [McLaren & McLaren, 2000].
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- Electronic commerce is the exchange of products and services that require transportation, via some form of telecommunication medium, from one location to another. Electronic business is defined as the exchange of information and customer support. The activities supporting, for example, the exchange of information and provision of customer support, are not strictly speaking ‘commerce’ activities, but can be referred to as ‘business’ activities [Greenstein & Feinman, 2000].

- Ford and Baumm [1997] see electronic commerce as an umbrella term that includes automated business transactions, online purchases, electronic filling in of forms, and industrial inventory control transactions. They conclude that electronic commerce represents a broad range of technologies, is socially accepted, and is expected to be used.

- Turban [2000] and Turban et al. [2001] provide two definitions of electronic commerce. First, electronic commerce is business done online, including the exchange of products, services, and money, with the support of computers and computer networks. The second definition provided is from a managerial perspective, and sees electronic commerce as an emerging concept that describes the process of buying and selling or exchanging of products, services, and information via computer networks, including the Internet.

- Electronic commerce involves conducting both internal and external business over the Internet, intranet, and extranets. Electronic commerce includes the buying and selling of goods and services, the transfer of funds, and the simplification of day-to-day business processes – all through digital communication [Whitten et al., 2001].

- Electronic commerce is business processes that shift transactions to the Internet or some other non-proprietary, web-based system [US Department of Commerce, 1999].

In principle, however, most authors are in agreement that electronic commerce uses some form of transmission medium through which exchange of information takes place in order to conduct business [Barnard & Wesson, 2000]. In this dissertation we adopt the definition of the US Department of Commerce, that is: “electronic commerce is business processes that shift transactions to the Internet or some other non-proprietary, web-based system” [US Department of Commerce, 1999].

4. Different Types of Electronic Commerce

The nature of the relationship between the buyer and seller defines what type of electronic commerce it is [Chan et al., 2001]. In Chapter 1 we introduced Figure 1.4 where electronic commerce was classified according to participants in the process. Electronic commerce can, however, be classified using a variety of attributes. We will focus on only three of these, namely:

- The participants in the process.
• The nature of the task involved.
• The technology involved.

In the remainder of this section we will discuss electronic commerce types using these attributes.

Figure 1.4. Types of Commerce (adapted from Chan et al. [2001] and Lubbe and Pather [2003])

4.1. Classification According to Participants

One approach to classifying the electronic commerce activities is according to the participants in the process. Each type of electronic commerce has been developed to cater for a particular type of participant. Some of these types of electronic commerce have been driven by the needs of the participants, while other types of electronic commerce have become more prominent because of technological developments. Several researchers have provided definitions for these different types of electronic commerce that have developed over time [Chuang et al., 2006; Galanxhi-Janaqi & Nah, 2005; Huang et al., 2005; Kee et al., 2001; Korper & Ellis, 2001; Laudon & Traver, 2002; Lee et al., 2001a; Leung & Antypas, 2001; Lowry et al., 2002; Mockler et al., 2006; Rayport & Jaworski, 2001; Sofokleous et al., 2005; Turban et al., 2002; Turban et al., 2000; Watson, 2000]:

• Business-to-Consumer (B2C): B2C transactions are mostly retailing transactions with individual customers or consumers. An example of B2C is Amazon.com (www.amazon.com).
• Consumer-to-Business (C2B): In this category one will find consumers who sell to organisations. It also includes individuals who seek sellers with whom they may interact in order to conclude a transaction. An example of C2B is Priceline (www.priceline.com).

• Consumer-to-Consumer (C2C): C2C involves consumers selling directly to other consumers. This type of application includes auction sites and advertising personal services on the Internet. It can also include intranets and other organisational networks to advertise items and services. An example of C2C is eBay (www.eBay.com).

• People-to-People (P2P): This type of transaction is a special type of C2C where people exchange CDs, videos, software and other goods (www.napster.com).

• Non-business Electronic commerce: Many institutions or organisations also use Electronic commerce to improve their operation and their customer services.

• Intrabusiness (organisational) Electronic commerce: All internal organisational activities involving exchange of goods, services or information usually performed on intranets, are included in this category.

• Business-to-Employees (B2E): This is a subset of the intrabusiness category where the organisation delivers services, information or products to individual employees.

• Government-to-Citizen (G2C) and to others: In this type of electronic commerce, a government entity buys or sells goods, services, or information to businesses or individual citizens.

• Exchange-to-Exchange (E2E): With the proliferation of exchanges and portals, it is logical for exchanges to connect to one another. E2E is a formal system that connects exchanges.

• Collaborative commerce: (C-commerce) is an application of inter-organisational information system for electronic collaboration between business partners and between organisational employees.

• Ultimate commerce (U-commerce): Is the use of ubiquitous networks to support personalised and uninterrupted communications and transactions between a firm and its various stakeholders, to provide a level of value over, above and beyond traditional commerce.

• Mobile commerce (M-commerce): When electronic commerce takes place in a wireless environment.

4.2. Classification According to Task

Electronic commerce can also be classified by the nature of the task. Electronic commerce can be used to perform various tasks, such as e-shopping, e-banking, e-investments, e-advertising, e-retailing, e-procurement, e-insurance, e-travel, e-consulting, e-training, e-support, e-recruitment – all
the way up to e-cooking [Singh & Kotze, 2002]! We will briefly discuss three of these, namely, e-shopping, e-banking and e-investments.

4.2.1. e-Shopping

An online shopping environment transcends geography. Compared to the traditional shopping environment, it takes the online shoppers virtually no effort to switch to another website. In the traditional shopping environments, when a consumer finds himself in a choice situation that is too stimulating for him, he may end up quickly grabbing the items he needs and leaving the store, because it might be too much of an effort for him to get to another store to make his purchase [Donovan & Rossiter, 1982]. However, in the online shopping environment, the consumer is just a mouse-click away from other websites offering the same merchandise. If he thinks a website is too stimulating, it is much easier for him to just switch to another website that he finds more comfortable. Similarly, it takes more effort for a consumer to explore another brick-and-mortar store than a web store, when he is faced with an electronic shopping environment that he thinks is too mundane.

The online shopping environment also provides the possibility of customising shopping environments at a very low cost [Johnson et al., 1999; Menon & Kahn, 2001]. One way to customise, as suggested by Johnson [1999], is that web retailers can gain access to the information about their customer profiles at a relatively low cost, by allowing for the possibility of customising shopping environments through clickthrough data or purchasing history data. Therefore, web retailers can customise their shopping environments, based on the demographic profiles of their target customers [Luo & Trivedi, 2002].

For e-shopping we can classify the browsing aspects of e-shopping as search browsing, general purpose browsing and serendipitous browsing. An e-shopping task has the following two unique phases: the look, see and decide phase (LSD) and the checkout phase [Renaud et al., 2001], as illustrated in see Figure 2.1.

- Look, See and Decide: This stage is the browsing stage and will typically be used to browse available products, compare them, and then make a decision about whether or not to purchase any products. This may be done iteratively until consumers have found products that satisfy their needs. This phase is intensely user-driven because the user is looking at and assimilating information continuously. It has several user pre-emptive sub-stages that can be traversed iteratively and in varying sequences. These include: welcome, search, browse, and choose. User pre-emptive is defined as when the user is entirely free to initiate any action towards the system, whereas system pre-emptive is where the system can initiate all the dialogue, and the user responds to the request for information [Dix et al., 2004].
• Checkout: The commitment to buy takes place in this stage. When the users trigger this stage they have made their choice of offered products and have decided to make a purchase. They now have to provide certain personal information, such as their address and credit card details. This stage is system-driven and changes the paradigm of the interaction process from user pre-emptive to system pre-emptive [Dix et al., 2004]. Feedback is of critical importance during this stage. Users who feel that they have lost control can simply leave the site without any embarrassment – unlike a user who is standing at a checkout till in a supermarket. This stage is typically composed of at least the following steps, which should be navigated in a serial fashion: identifying the user, where the delivery should take place, how it should take place, payment, confirmation of order and completion (closure).

![LSD Model](image.png)

**Figure 2.1. LSD Model**

In Chapter 1 Section 3.2 we discussed the generic electronic commerce activity. We will now discuss an example of an electronic shopping activity. We look at a specific example of an electronic commerce experience illustrating the electronic commerce activity, using the Amazon.com website [Amazon.com, 2005], as illustrated in Figure 2.2. It shows the movement possibilities of the user’s activities between Phase 1 and 2 during the electronic commerce activity.
Look See Decide Phase

Add to Basket

Proceed to Checkout

Sign in

Shipping and Payment

Gift Wrap Option

Place Order/Confirmation

Exit

Uncontrolled Phase 1

Subject to being logged on to the system for security reasons

Controlled Phase 2

This is a two phase process: add/change address and nominate method of payment

This is an optional phase, users may choose to skip this phase

Key

- iterative action

At this phase the user is locked in and payment made

Users are locked into these phases but can jump out to the LSD at the other phases

Figure 2.2 Case specific scenario of Amazon.com

The users can abandon their shopping activity at any point in time during Phases 1 or 2. With the Amazon experience we have the uncontrolled iterative Phase 1 experience and Phase 2 is a controlled pseudo-sequential experience. We argue that due to the interactive experience, the effective use of usability principles in the design of electronic commerce activities is an important consideration for both Phase 1 and Phase 2. In this dissertation we limit this study to Phase 1 of the shopping experience, and leave Phase 2 as a topic for further research.

4.2.2. e-Services

The Internet provides a variety of value added financial services for its users. For the purpose of illustration we will consider the following two service categories: e-banking and e-investment. For e-banking and e-investments we can classify the browsing aspects as search browsing and general purpose browsing. With these e-services we have a more restricted set of users – users have to be registered users of the service before they can conduct any type of transaction.

The main difference between e-shopping and e-banking is in the time of authentication: the authentication for e-shopping takes place when the transaction starts, and for e-banking the authentication takes place prior to the transaction when the user accesses the website. e-Banking services allow banking clients to obtain account information and balance enquiries, execute account payments and inter-account fund transfers, make queries on account balances, obtain statements and, in some cases, view images of cheques from the comfort of their homes or offices, etc. [Chan et al.,...
Additionally, by linking their accounts to personal finance software (such as Intuit Quicken and Microsoft Money), they will be able to track their spending offline, and later reconcile that with their bank statements online.

E-Banking is, however, controlled by financial regulations pertaining to the country involved. For example, the South African Banks Act restricts a bank's ability to provide certain online services, such as applications for a credit card, as original paper documentation is required [Van Dyk, 1999]. Furthermore, South African legislation in the form of the Financial Intelligence Centre Act restricts certain online services [Financial Intelligence Centre Act, 2001a].

A typical e-banking task would include the following phases:

- Authentic using login account number and password (see Figure 2.3 Page 2).
- Browse available options (LSD).
- Choose type of transaction to conduct: This could be several steps, itself, and the user may choose to conduct more than one transaction. The transaction could be, for example, to obtain a statement for a specified period. This has at least two phases: LSD and do transaction. These steps are sequential (see Figure 2.3 Page 3).
- LSD or logoff from bank’s website (see Figure 2.3 Page 4).
4.2.2.1. e-Investments

e-Investment is a process that allows a user to trade stocks, bonds, mutual funds and other financial equities, on the Internet. e-Investment companies enable users to trade at a very small cost, compared with discount brokers or full-service brokers. This has resulted in online trading companies seizing an increasing market share [Chan et al., 2001].

A typical e-investment task to purchase shares/stocks would be:

- Authenticate: Login using account number and password.
- Browse available options (LSD).
- Compare products (product ‘A’ and product ‘B’). Determine which product has the highest performance in term of key product performance dimension.
• Checkout phase: Choose type of transaction to conduct. This could be several steps in itself. The user may choose to conduct more than one transaction. This has at least two phases: LSD and do transaction).

• Checkout phase: Purchase chosen product.

• Checkout phase: Confirm purchase.

• Browse more available options (LSD).

• Logoff from website.

Both e-banking and e-investment websites provide a service to the users. What these sites sell is economic information. The tasks follow the following generic phases, as illustrated in Figure 2.4:

• Web page entry: Depending on the expertise of the user, the user would either go directly to this chosen task or spend some time comparing the information given.

• Authenticate and logon.

• Browsing.

• Service interpreter: Once the user has chosen what he wants to do, he moves to the next phase where the service interpreter provides the chosen service (this is a sequential action).

• Browse more or logoff.
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Choose Service

Browse/Compare

Welcome/General Browsing

Authentication/Login

Search

Web Page

Exit

LSD

Secure service entry

Service Interpreter

Supply Information

Verify service activities

Sure?

Done

Figure 2.4. Service Delivery

The above examples are but a small spectrum of the e-revolution. There are several other e-activities, as stated earlier, such as e-retailers, e-insurance, e-travel, e-consulting, e-training, e-support, e-recruitment – all the way up to e-cooking!

4.2.3. Synthesis of the Classifications of Electronic Commerce Activities according to Task

The electronic commerce experience for e-shopping and e-service can be synthesised as illustrated in Figure 2.5. The commonality for both these experiences is the underlying commerce activity. Figure 2.5 demonstrates:

- That we have a common entry point (the web page).
- The electronic commerce experience is characterised by an iterative browsing experience to try and find one’s desired product(s).
- Once the desired product(s) is found the client proceeds to ‘checkout’ phase. Then the client is locked into a sequential set of actions to get the transaction completed.

Because of the uncontrolled interactive experience of Phase 1, the effective use of usability principles in the design of electronic commerce activities is an important consideration. The iterative action phase (Phase 1) is the main focus of this dissertation and associated experiment.
4.3. Classification by Technology Infrastructure

For electronic commerce applications to succeed, it is necessary to provide the relevant infrastructure and other building blocks. This is not a simple task, because there are large number of subject matter experts and interest groups involved in this process [Turban et al., 2001]. For electronic commerce to be effective, a suitable infrastructure is required [Chan et al., 2001; Langer, 2002; Lawrence et al., 2000; Lee et al., 2001b; Michael et al., 2000; Norris et al., 2000; Perry & Schneider, 2001; Ravi & Whinston, 1997; Turban et al., 2002; Turban et al., 1999; Turban et al., 2001; Westland & Clark, 2000]:

- Technological infrastructure must be in place. Electronic commerce transactions must be executable worldwide, without any delays or mistakes. Some transactions involve several trading partners, requiring a more complex infrastructure.

- Electronic payments need to be secure, convenient, fast, and inexpensive to process.

- Support services for specific activities must be in place. An example is a clearinghouse for paying royalties on intellectual property.

- Appropriate planning and strategy that consider legal, technological and other requirements, is necessary.

The infrastructure components must be chosen carefully, and integrated to be capable of supporting a large volume of transactions with customers, suppliers and other business partners worldwide [Stair & Reynolds, 2003]. Online consumers complain that poor website performance (e.g. slow response time and ‘lost’ orders) drives them to abandon some electronic commerce sites in favour of those with better, more reliable performance (see Chapter 3 Section 3.4, Case 1 and Case 4).
Turban et al. [2002] suggest a comprehensive infrastructure framework for electronic commerce. We will analyse this infrastructure framework in the context of the classification of the Internet economy of Whinston et al. [2000]. In the framework of Turban et al. [2002], as illustrated in Figure 2.6, there are four distinct levels:

- **Lower level:** The lower level is a strong foundation level based on sound management principles. This relates to Chapter 1 and the stakeholders that are involved in the development process of an interactive application.

- **Middle level:** This level deals with the infrastructure that is required to effectively conduct electronic commerce transactions. Electronic commerce infrastructure requires a variety of hardware and software, as illustrated in Figure 2.6. The key components are networks, web servers, web server supports and software, electronic catalogues, web page design and construction software, transactional software, and Internet access components [Stair & Reynolds, 2003; Turban et al., 1999; Turban et al., 2001]. (We further discuss this in Section 5.1).

- **Support level:** This level deals with ‘stakeholder’ issues and is linked with the stakeholder issues discussed in Chapter 1.

- **Upper level:** The upper level is the electronic commerce applications level. Once the infrastructure is in place, a number of different types of electronic commerce transactions can take place.

We will now briefly discuss each level in more detail.
4.4. Electronic Commerce Infrastructure

There is a hierarchy to the Internet economy that can be used be trace how businesses generate revenue [Whinston et al., 2000]. This hierarchic structure is related to the electronic commerce framework of Turban et al. [2002]. In Figure 2.6 we have linked the framework to the different layers in Figure 2.7. This hierarchical structure can be used to classify the Internet economy into infrastructure and economic activity categories, as illustrated in Figure 2.6.

Figure 2.6. Electronic Commerce Building Blocks

Figure 2.7. Classification of the Internet Economy [Whinston et al., 2000]

The infrastructure categories are further divided into two distinct but complementary ‘layers’ [Whinston et al., 2000]:

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• The Internet infrastructure layer which provides the physical infrastructure for electronic commerce, and

• The Internet application infrastructure, which includes:
  o Software applications.
  o Consulting with subject matter experts.
  o Training and integration services that build on top of the network infrastructure, which makes it feasible for organisations to engage in online commerce.

The economic activity category is also subdivided into two layers:

• Intermediaries: This layer involves the role of a third party in a variety of capacities, such as:
  o Market maker, provider of expertise or certification that makes it easier for buyers to choose sellers and/or products.
  o Search and retrieval services that reduce transaction costs in an electronic market, and other services that facilitate the conduct of online commerce.

• Online transactions: This layer involves direct transactions between buyers and sellers such as manufacturers and e-retailers.

Each of the two layers will now be discussed briefly.

4.4.1. Layer One: Internet Infrastructure - Hardware (Middle Level in Figure 2.6)

The growth of the digital economy depends on several interrelated factors. These are [Whinston et al., 2000]:

• The ubiquitous presence of high-speed and intelligent electronic networks.

• The ability to share any type of content between all agents in the economy.

The Internet infrastructure layer includes companies that manufacture or provide products and services that make up the Internet network infrastructure. This is related to the middle level of Figure 2.6. This layer includes companies that provide telecommunications and fibre backbones, access and end-user networking equipment necessary for the proliferation of electronic commerce, for example [Whinston et al., 2000]:

• National and regional backbone providers (e.g. Qwest, MCI WorldCom, Telkom).

• Internet Service Providers (e.g. AOL, Earthlink, @lantic).

• Network equipment for backbones and service providers (e.g. Cisco, Lucent, 3Com, Siemens).
• Conduit manufacturers (e.g. Corning).

• Server and client hardware (e.g. Dell, Compaq, HP).

4.4.2. Layer Two: Internet Applications Infrastructure  (Middle Level in Figure 2.6)

Products and services in this layer build on the above Internet protocol network infrastructure and make it technologically feasible to perform business activities online. This is related to the middle level of Figure 2.6. In addition to software applications, this layer includes the human capital involved in the deployment of electronic commerce applications. For example, web design, web consulting and web integration are considered as a part of this layer. This layer includes the following categories [Whinston et al., 2000]:

• Internet consultants (e.g. MarchFIRST, Scient).

• Internet commerce applications (e.g. Microsoft, Sun, IBM).

• Multimedia applications (e.g. RealNetworks, Macromedia).

• Web development software (e.g. Adobe, Allaire, Vignette).

• Search engine software (e.g. Inktomi, Verity).

• Online Training (e.g. Sylvan Prometric, SmartPlanet).

• Web-enabled databases (e.g. Oracle, IBM DB2, MS SQL Server - only Internet/Intranet related revenues are counted here).

• Network operating systems.

• Web hosting and support services.

• Transaction processing companies.

4.4.3. Layer Three: Internet Intermediary  (Support Level in Figure 2.6)

Internet intermediaries increase the efficiency of electronic markets by facilitating the meeting and interaction of buyers and sellers over the Internet. This is related to the support level of Figure 2.6. They act as catalysts in the process through which investments in the infrastructure and applications layers are transformed into business transactions.

In the physical world, intermediaries are distributors and dealers whose primary role is to increase the efficiency of distribution and to lower buyer transaction costs by locating close to the customer population. By sharp contrast, physical proximity is not an issue on the Internet. Online searching, evaluation, communication, coordination, and assurance of vendor and product/service quality are the
important aspects in the Internet Economy. Internet intermediaries play a critical role in filling information and knowledge gaps which would otherwise impair the functioning of the Internet as a business channel. This layer includes [Whinston et al., 2000]:

- Market makers in vertical industries (e.g. VerticalNet, PCOrder).
- Online travel agencies (e.g. TravelWeb, Travelocity).
- Online brokerages (e.g. E*trade, Schwab.com, DLJ direct).
- Content aggregators (e.g. Cnet, Cdnet).
- Portals/Content providers (e.g. Yahoo, Excite).
- Internet advertisement brokers (e.g. DoubleClick, 24/7 Media).
- Online advertising (e.g. Yahoo, ESPN Sportszone).
- Web-based virtual malls (e.g. Lycos shopping).

4.4.4. Layer Four: Online Transactions (Upper Level in Figure 2.6)

This layer includes companies that generate product and service sales to consumers or businesses over the Internet. This is related to the upper level of Figure 2.6. This indicator includes online retailing and other B2B and B2C transactions conducted on the Internet [Whinston et al., 2000]:

- E-retailers selling books, music, apparel, flowers, etc. over the web (e.g. Amazon.com, 1-800-flowers.com).
- Manufacturers selling products direct such as computer hardware and software (e.g. Cisco, Dell, IBM).
- Transportation service providers selling tickets over the web (e.g. Delta, United, Southwest).
- Online entertainment and professional services (e.g. ESPN Sportszone, guru.com).
- Shipping services (e.g. UPS, FedEx).

It is important to note that many companies operate at multiple layers. For instance, Microsoft and IBM are important players at the Internet infrastructure, applications, and Internet commerce layers, while AOL/Netscape has businesses that fall into all four layers. Similarly, Cisco and Dell are important players at both the infrastructure and commerce layers. Even though the four-layer Internet Economy framework makes it time-consuming to separate revenues for multi-layer players, the framework presents a more realistic and insightful view of the Internet Economy than a monolithic conceptualisation that does not distinguish between different types of activities [Whinston et al., 2000].
Each layer of the Internet Economy is critically dependent on every other layer. For instance, improvements in layer one can help all other layers in different ways. As the Internet protocol network infrastructure turns to broadband technologies, applications vendors at layer two can create multimedia applications that can benefit from the availability of high bandwidth. Companies at layers three and four can benefit from improvements in both layers one and two – providing media-rich content to consumers, as well as new digital products and service (information and software delivered online). This interdependence also exhibits itself in the form of alliances where conduit and content providers or applications vendors and e-retailers join hands to create bundled offerings that are valuable to consumers [Whinston et al., 2000].

5. Electronic Commerce in South Africa

In this section we will discuss several issues that are pertinent to electronic commerce in the South African contexts. These issues relate to usage for electronic commerce in South Africa, challenges to electronic commerce activities in South Africa, regulatory issues, software piracy, telecommunications, credit cards, and example of electronic commerce in South Africa.

5.1. Usage for Electronic Commerce in South Africa

From a communication perspective, South Africa has 4.729 million landline telephones in use and there are 33.96 million mobile cellular phones in use. The South African telephone system can be described as the best-developed and most modern network in Africa. The South African telecommunication network consists of carrier-equipped open-wire lines, coaxial cables, microwave radio relay links, fibre-optic cable, radiotelephone communication stations, and wireless local loops [Central Intelligence Agency, 2007].

The Internet user base in South Africa is growing year by year at a very slow rate. Figure 2.8 shows the Internet usage and population statistics for South Africa. From the year 2000 to the year 2006 we see, proportionately, that the usage of the Internet by the population of South Africa is very low. From this slow growth in the Internet user base we can conclude that there are several challenges facing the growth of the Internet in South Africa. Some of these challenges are related to infrastructure for the Internet, cost of computer technology, and service provider challenges.
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Figure 2.8. Internet Usage in South Africa [Internetworldstats.com, 2007]

Goldstuck has, over the years, reported on Internet Access in South Africa [Goldstuck, 2002]. He has predicted a very slow-paced growth rate in the usage of the Internet in South Africa. Below is a brief summary of the Goldstuck Report on Internet Access in South Africa for 2002, 2004, 2005 and 2007:

In 2002 the state of Internet access was:

- One out of every 15 South Africans had access to the Internet at the end of 2001. This compares with at least one in two people in countries such as the USA, Canada, South Korea, Singapore and Hong Kong.
- The total number of South Africans with access to the Internet at the end of 2001 was 2,89 million.
- This number was expected to grow by less than 10% to 3,1 million by the end of 2002.
- There is a strong demand by corporate South Africa for broadband Internet access.
- Only a small handful of ISPs are profitable. In the corporate market, Internet Solution is the most profitable ISP, while in the dial-up space World Online is the only major ISP operating profitably. An increasing number of ISPs are profitable on an EBITDA basis (earnings before interest, tax, depreciation and amortisation). In short, it is no longer uncommon for ISPs to be operating profitably, but they still have a legacy of debt.
- The number of ISPs has grown dramatically, largely due to the rollout of a Virtual ISP service by Internet Solution and the continued heavy use of the equivalent service from SAIX.
• Business strategies in the ISP industry are maturing to the extent that it has become possible to create a model that explains not only how ISPs evolve, but also how they meet their clients' needs as those needs evolve.

• A tiny proportion of ISPs in South Africa have gone out of business through bankruptcy.

• Mobile access to the Internet has been minimal, with only a tiny proportion of those people who have appropriate devices actually using the devices to connect to the Internet.

• The arrival of GPRS, the so-called 2.5 generation of mobile network technology, may alter the mobile access picture during 2003, but only if appropriate handsets become available.

• Community centres, resource centres and digital villages in townships will continue to underachieve in their goals of bringing Internet access to a sizeable proportion of residents in disadvantaged areas.

In 2004 the state of Internet access was:

• One in every 13 South Africans will have access to the Internet.

• There was a 6% growth, with 3,28 million South Africans expected to have Internet access by 2003.

• The market remains healthy because companies are reinvesting, improving reliability of the networks, and building backup systems.

• ISPs are now focusing on existing customers.

• Factors expected to boost Internet growth in 2004 were: A competitive Second Network Operator, the launch of high-speed or broadband wireless access by Sentech, and the favourable rand-dollar exchange rate which makes the cost of technology cheaper.

• School connectivity was seen as a priority.

In 2005 the state of Internet access was:

• One in every 12 South Africans will have access to the Internet.

• 3,6 million South Africans were expected to have access to the Internet.

• There has been significant growth in corporate usage of the Internet.

• Growth of Internet access had slowed down, with the dial-up market experiencing no growth in subscribers.

• A competitive Second Network Operator failed to materialise, which impacted on the growth of the Internet.

• ISPs were evolving to provide specialist services.
- School connectivity was experiencing delays of up to three years.

In 2007 the state of Internet access is:

- One in every 12 South Africans will have access to the Internet.
- The study showed that there will be more than 800 000 broadband subscriber accounts active in South Africa.
- The dial-up users base has fallen dramatically, dropping by 122 000 users, and falling below the one million mark for the first time since 2001.

The growth of the Internet in South African is very slow, due to the lack of competition in the telecommunications industry.

To summarise, in 2002 one out of every 15 South Africans had access to the Internet, in 2007 there was a marginal change to one in every 12 South Africans. The growth rate of the adoption of the Internet is very slow. The access to appropriate technology and infrastructure is impedance to the growth of the Internet in South Africa.

Goldstuck [2006] suggests that the following factors will drive the growth of the Internet in South Africa:

- Continued strong economic growth.
- The emergence of the African middle class.
- Improved education levels, including computer literacy.
- Improved affordability of personal computers, both as a result of cheaper products and new financing options.
- Convergence of voice and data.
- Technology improvements.
- Demand for more server/storage capability to meet higher levels of corporate governance requirements.

5.2. Challenges to Electronic Commerce Activities in South Africa

Electronic commerce will only be encouraged if the infrastructure supports the technology. A ‘digital divide’ may arise in the business world, where the larger, well-established companies effectively use the technology, forcing small and medium companies to adapt or die. Small firms are at times intimidated by the technology, are frequently concerned about the ability of outsiders to tap into the workings of a small firm via computers, and often lack the time or resources to develop an
understanding of how information systems can help them. Wang [1999] reports that medium and small business concerns often do not fully understand the concept of information systems and their ability to facilitate electronic commerce.

Guomundsdottir [2005] suggests that there are several factors that challenge the growth of the Internet in South Africa. Before these challenges are tackled, however, he aptly suggests that fulfilling the basic needs of the greater population has to become a prerequisite to bridging the digital divide in South Africa. In Table 2.1 Guomundsdottir [2005] models the South African digital divide as follows:

<table>
<thead>
<tr>
<th>Types of Needs</th>
<th>The Type of Divide</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Basic needs</td>
<td>The real divide</td>
<td>This includes access to clean water, electricity, justice etc.</td>
</tr>
<tr>
<td>2 Hardware – software</td>
<td>Material divide</td>
<td>Poor access or costly technology</td>
</tr>
<tr>
<td>3 Mentality – content</td>
<td>Mental divide</td>
<td>How will the Internet really help me?</td>
</tr>
<tr>
<td>4 Skills – knowledge –</td>
<td>Utilisation divide</td>
<td>Lack of basic computer skills and user support</td>
</tr>
<tr>
<td>5 Culture – language /</td>
<td>Suitability divide</td>
<td>The alienness of the Internet; it is modelled more on a Western cultural background</td>
</tr>
<tr>
<td>social diversity</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2.1. Different Types of Digital Divides

5.3. Regulatory Issues

South Africa has been quite active in the e-revolution. The South African government has developed the following policy documents and regulations, the South African Green Paper [Central Government, 2000] and the Electronic Commerce and Transaction Bill [Electronic Communication and Transaction Bill, 2002].

5.3.1. The South African Green Paper

The South African Green Paper on electronic commerce [Central Government, 2000] is divided into four categories. Each category contains key issues or areas of concern that need serious consideration in electronic commerce policy formulation:

- The need for confidence in the security and privacy of transactions performed electronically.
- The need to enhance the information infrastructure for electronic commerce.
- The need to establish rules that will govern electronic commerce.
• The need to extend the opportunities of electronic commerce to the entire population.

5.3.2. Electronic Communications and Transactions Bill

The Electronic Communications and Transactions Law, effective from 31 July 2002, governs all companies that conduct electronic commerce in South Africa. The law was designed to facilitate electronic commerce, but may instead increase the regulatory burden and introduce an unacceptable level of uncertainty for some businesses. The law requires:

• Accreditation for certain electronic signatures.

• Takes government control of the “.za” domain name.

• A long list of disclosures for websites that sell via the Internet.

The Electronic Communication and Transaction Bill [Electronic Communication and Transaction Bill, 2002] has the following regulatory objects for electronic communications and transactions:

• To provide for the development of a national e-strategy for the Republic.

• To promote universal access to electronic communications and transactions and the use of electronic transactions by Small, Medium and Micro Enterprises (SMMEs).

• To provide for human resource development in electronic transactions.

• To prevent abuse of information systems.

• To encourage the use of e-government services.

• To provide for matters connected therewith.

Some of the objects of the Act are to enable and facilitate electronic communications and transactions in the public interest, and for that purpose to:

• Recognise the importance of the information economy for the economic and social prosperity of the Republic.

• Promote universal access primarily in under-serviced areas.

• Promote the understanding and acceptance of and growth in the number of electronic transactions in the Republic.

• Remove and prevent barriers to electronic communications and transactions in the Republic.

• Promote legal certainty and confidence in respect of electronic communications and transactions.
• Promote technology neutrality in the application of legislation to electronic communications and transactions.

• Promote e-government services and electronic communications and transactions with public and private bodies, institutions and citizens.

• Ensure that electronic transactions in the Republic conform to the highest international standards.

• Encourage investment and innovation in respect of electronic transactions in the Republic.

• Develop a safe, secure and effective environment for the consumer, business and the Government to conduct and use electronic transactions.

• Promote the development of electronic transactions services which are responsive to the needs of users and consumers.

• Ensure that, in relation to the provision of electronic transactions services, the special needs of particular communities and areas, and the disabled, are duly taken into account.

• Ensure compliance with accepted international technical standards in the provision and development of electronic communications and transactions.

• Promote the stability of electronic transactions in the Republic.

• Promote the development of human resources in the electronic transactions environment.

• Promote SMMEs within the electronic transactions environment.

• Ensure efficient use and management of the .za domain name space.

• Ensure that the national interest of the Republic is not compromised through the use of electronic communications.

Though these objectives are utopian, they are the first steps in developing a manageable framework for the sustainable development of the electronic community in South Africa. It is only by actions like this that South Africans can get active role players involved in the development of a strategy for the electronic community in South Africa [Singh, 2002].

The South African Law Reform Commission submitted draft legislation and discussion documents on privacy and data protection for public comment by 28 February 2006. The South African Law Reform Commission held a series of workshops on the legislation in February 2006. Numerous public submissions were received, and the Commission is currently preparing its report, with recommendations on the draft legislation. Legislation may negatively impact on the ability of South African and foreign companies to receive and send trans-border flows of personally identifiable data [Office of the United States Trade Representative, 2007].
5.4. Software piracy

Software piracy is a problem in South Africa. In 2006 the Business Software Alliance estimated that the piracy rate was 35% and that U.S. industry in South Africa lost an estimated $119 million in sales [Office of the United States Trade Representative, 2007].

5.5. Telecommunications

South Africa’s main telecommunication provider, Telkom, continues to maintain a monopoly on telecommunications services, which is presenting difficulties. Many businesses have complained about high telecommunications prices, many of which are a result of control of the underlying network by Telkom. In 2004 Telkom was cited by the South African Competition Commission for anti-competitive conduct with respect to Value Added Network Services (VANS). A new complaint was filed by the South African Internet Service Provider Association alleging further abusive practices by Telkom. In addition to such practices, one U.S. company has pursued extensive legal remedies against Telkom to honour the results of binding arbitration regarding a multimillion dollar contract. Instead of honouring the arbitrator’s findings, Telkom took steps to block the arbitral award and appealed the award to a local trial court. In 2005 the Department of Communications sponsored two colloquiums to discuss measures to lower telecommunications prices. At the conclusion of the second colloquium the Department of Communications promised to release an action plan in early 2006. In November 2006 the South African Supreme Court of Appeal found in favour of the U.S. company.

South Africa has committed to license a second national operator (SNO) to compete in long distance, data, telex, fax and privately leased circuit services, no later than 1 January 2004. The Minister of Communications conditionally approved a license for the SNO in September 2004, but disagreements among SNO shareholders over operational control and allocation of equity stakes delayed the launch until 2006. The result is that Telkom has enjoyed monopoly privileges. The SNO was licensed by ICASA (Independent Communications Authority of South Africa) in December 2005. It began operations on 30 August 2006 under the name ‘Neotel’. Neotel has also entered the business-to-business market and planned to enter the residential market in April 2007.

Some of the problems facing value added network services and Internet service providers may be addressed by new telecommunications policies and regulations. On 1 February 2005 the Minister of Communications implemented sweeping liberalisation in the telecommunications sector. Because of this liberalisation, mobile operators are allowed to use any fixed lines in the provision of their service, value added network services can be offered through infrastructure other than that which is owned by Telkom, and value added network services providers are allowed to employ Voice-Over-Internet Protocols. In addition, private telecommunications network operators are allowed to sell
spare capacity. On 20 May 2005 the Minister approved additional regulations for the licensing of value added network services.

In 2003 the Department of Communications released a draft Convergence Bill with the aim of simplifying the existing legislative framework, empowering the regulator and opening the telecommunications industry to greater competition. Comments received during a public comment period were highly critical of the draft bill and, as a result, the Department of Communications revised the bill. In 2005 the Department of Communications released for comment its modified version, the Electronic Telecommunications Bill. In December 2005 the bill was sent to the South African president for signature. He refused to sign it, citing that the bill gave too much control to the Department of Communications at the expense of ICASA. The president requested a constitutional review of the bill and its companion legislation, the ICASA Amendment.

The Electronic Telecommunications Bill (plus amendment) was passed in June 2006 in a compromise that allows ICASA to maintain some independence. The Department of Communications, however, maintains a strong grip on ICASA, as it approves ICASA funding [Office of the United States Trade Representative, 2007].

5.6. Credit cards

Another inhibiting factor to electronic commerce is the limited number of credit cards on the market and the fact that the rules completely favour the issuing bank. Because merchants are required to have a signed slip from a sale, online retail sales are always at risk, because fraud can take place as long as someone has the user’s credit card details [Goldstuck et al., 2006].

5.7. Examples of Electronic Commerce in South Africa

In this section are some examples of South African electronic commerce activities.

5.7.1. Commercial Applications

Electronic commerce has not only affected government but has also actively moved into the mainstream South African economy. Sectors of the economy that are using this technology are: banking-retail/business, finance, insurance, media, retail, travel, recruitment, mining, automotive, data/telecoms and health. Companies using these technologies are given in Table 2.2:
Table 2.2. SA Electronic Commerce Companies

<table>
<thead>
<tr>
<th>Sector</th>
<th>Company</th>
<th>URL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Banking-retail</td>
<td>ABSA</td>
<td><a href="http://www.absa.co.za">http://www.absa.co.za</a></td>
</tr>
<tr>
<td>Banking-business</td>
<td>ABSA</td>
<td><a href="http://www.absa.co.za">http://www.absa.co.za</a></td>
</tr>
<tr>
<td>Finance</td>
<td>SA Home Loans</td>
<td><a href="http://www.sahomeloans.com/">http://www.sahomeloans.com/</a></td>
</tr>
<tr>
<td>Insurance</td>
<td>Liberty Life</td>
<td>MyLife.com</td>
</tr>
<tr>
<td>Media</td>
<td>Independent Newspapers</td>
<td><a href="http://www.iol.co.za">http://www.iol.co.za</a></td>
</tr>
<tr>
<td>Retail</td>
<td>Pick ’n Pay</td>
<td><a href="http://www.pnp.co.za/">http://www.pnp.co.za/</a></td>
</tr>
<tr>
<td>Travel</td>
<td>SAA</td>
<td>Kulula.com</td>
</tr>
<tr>
<td>Recruitment</td>
<td>Career Junction</td>
<td><a href="http://www.careerjunction.co.za">http://www.careerjunction.co.za</a></td>
</tr>
<tr>
<td>Mining</td>
<td>Mincom</td>
<td><a href="http://www.mincom.com">http://www.mincom.com</a></td>
</tr>
<tr>
<td>Automotive</td>
<td>Motoronline</td>
<td><a href="http://www.motoronline.co.za">http://www.motoronline.co.za</a></td>
</tr>
<tr>
<td>Data/telecoms</td>
<td>M-Web</td>
<td><a href="http://www.mweb.co.za/">http://www.mweb.co.za/</a></td>
</tr>
<tr>
<td>Health</td>
<td>Clickatell</td>
<td><a href="http://www.clickatell.co.za">http://www.clickatell.co.za</a></td>
</tr>
</tbody>
</table>

For example, in the retail sector, Pick ’n Pay, who chose a watch and wait strategy to electronic commerce, is one of South Africa’s success stories. Pick ’n Pay’s online strategy is:

- The groceries are delivered from an actual Pick ’n Pay store in the user’s area.
- When users place their orders, specially trained pickers will shop on users’ behalf from the selected Pick ’n Pay store.
- Users can buy almost everything that they would expect to find in a local Pick ’n Pay Supermarket, online, at the same prices.
- Products are displayed with pictures, but these can be disabled for faster browsing.
- A further feature is their ability to create a shopping history for users, if users so desire, by asking the Pick ’n Pay database for all products purchased by them in-store over the past year using either cheque, debit card or credit card.
- Users can have multiple delivery addresses: User’s home; user’s office; user’s holiday home.
- Goods are delivered in packets, within sealed containers. Pick ’n Pay delivery personnel will open the sealed containers in front of users. They will also talk users through the delivery note.

Another example is the banking sector. ABSA was a market leader when it came to e-banking. ABSA, as part of their e-business strategy, initiated the ABSA Online Payments (AOP) project. The objective of the project was to overcome customers’ concerns about security over the web and to provide a secure, convenient and easy-to-use electronic commerce service.
5.7.2. South African Revenue Services (SARS)

In an effort to streamline the tax collection process, SARS has introduced e-filing. E-Filing is facilitated through service providers which are external companies that have the necessary infrastructure to provide electronic submission services. Below is a brief description of the e-filing systems:

- Taxpayers who wish to file and pay electronically will register with the service provider of their choice, conclude an agreement and receive a private access code and password to access the available services.

- The private access code and password will only be issued once the service provider has authenticated the taxpayer.

- The service provider will forward the necessary details of the taxpayer to SARS in order for the taxpayer to be activated as an e-filer on the SARS systems.

- When returns are to be issued, SARS will issue the electronic return/s to the service provider with whom the taxpayer is registered.

- The service provider will in turn issue a reminder to the taxpayer, either by SMS or e-mail, informing him/her of the return/s that have been received from SARS.

- The taxpayer will utilise his/her private access code and password to access the return.

- The web-based application will automatically display the return information as received from SARS.

- The taxpayer will then complete the return on the web. When the taxpayer electronically completes the return, the details entered onto the return are validated thoroughly and all calculations are performed by the system in order to eliminate any potential of transmitting incorrect information. The taxpayer also has the option to make a payment when submitting a return and can make the payment any time prior to the due date [SARS, 2002].

6. Growth of Electronic Commerce in South Africa

Goldstuck et al. [2006] report that in 2005 electronic commerce activities grew by 20%. This was lower that the 25% growth in 2004. The total amount spent on electronic commerce retail goods in 2005 was R514 million. For example, Kulula.com is the largest single success story of electronic commerce in South Africa and was the first South African consumer website to reach R1 billion in sales in a single year.

The two largest malls are M-Web ShopZone and Digital Mall. The two largest online grocers are Pick ’n Pay Home Shopping and Woolworths. The two largest online book retailers are Kalahari.net
and Exclusive Books, and the largest online florist is NetFlorist. The largest online wine retailer is Cybercellar, which has expanded its business internationally by launching cybercellar.com – a new portal which can accept international payments. The largest online electronics store is Digital Planet, and the largest online health and beauty store is Ascot Direct.

FlySAA.com saw 740% growth in the year (2006) to August, with the number of online transactions growing to 25% of the total number of tickets booked, from 3% the previous year. Kulula.com showed a 58% increase in online bookings, with 77% of their total bookings being made online.

Table 2.3 is a summary of the growth in electronic commerce activities in South Africa.

<table>
<thead>
<tr>
<th>Year</th>
<th>R000 000s</th>
<th>% growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>1996</td>
<td>0.75</td>
<td></td>
</tr>
<tr>
<td>1997</td>
<td>1.55</td>
<td>106%</td>
</tr>
<tr>
<td>1998</td>
<td>3.53</td>
<td>127%</td>
</tr>
<tr>
<td>1999</td>
<td>16.5</td>
<td>367%</td>
</tr>
<tr>
<td>2000</td>
<td>82</td>
<td>396%</td>
</tr>
<tr>
<td>2001</td>
<td>162</td>
<td>97%</td>
</tr>
<tr>
<td>2002</td>
<td>252</td>
<td>55%</td>
</tr>
<tr>
<td>2003</td>
<td>341</td>
<td>35%</td>
</tr>
<tr>
<td>2004</td>
<td>428</td>
<td>25%</td>
</tr>
<tr>
<td>2005</td>
<td>514</td>
<td>20%</td>
</tr>
<tr>
<td>2006</td>
<td>617</td>
<td>20%</td>
</tr>
</tbody>
</table>

Table 2.3. Electronic Commerce Growth in South Africa [Goldstuck et al., 2006]

7. Summary

In this chapter we discussed some of the new business principles that affect the business environment. We then defined electronic commerce and identified three ways in which we could classify electronic commerce. We then discussed electronic commerce activities in South Africa. Our findings are briefly summarised below.

Electronic commerce that does not give the user an experience will not thrive [Brandt, 1999]. Electronic commerce applications that are hard to use or difficult to understand by the users will ultimately fail (see Section 4.2.1). Therefore, the goal of this dissertation was to try to find out some of the issues that might influence this user experience.

We found that electronic commerce development cannot be done haphazardly and needs to follow a systematic development strategy. The systems designers should use an appropriate systems
development methodology that suits the particular system being developed. By understanding the type of electronic commerce that is being conducted, an appropriate development methodology can be used (see Section 4.2.3).

We found that electronic commerce activities can be classified in a variety of ways (see Section 4). These are:

- The participants in the electronic commerce activity: Our research revealed the following participant combinations: Business-to-Business (B2B), Business-to-Consumer (B2C), Consumer-to-Business (C2B) Consumer-to-Consumer (C2C), People-to-People (P2P), Non-business Electronic commerce, Intrabusiness (organisational) Electronic commerce, Business-to-Employees (B2E), Government-to-Citizen (G2C) and to others, Exchange-to-Exchange (E2E), Collaborative commerce (C-commerce), Ultimate commerce (U-commerce), and Mobile commerce (M-commerce). We did not focus on a particular subset of participants in this dissertation, but on generic electronic commerce activities instead.

- The typical electronic commerce task involved: We found that a typical electronic commerce application has the following basic components:
  
  o A common entry point (the web page): This could be an open entry into the electronic commerce application, or as entry point to a secure login before the electronic commerce application is activated. This page should be designed for maximum information representation so that the user knows up front what to expect.

  o An interactive activity called the browsing phase: The application is characterised by an iterative user pre-emptive browsing experience of trying and find the desired product(s). This activity is the primary focus of the research for this dissertation.

  o A transaction processing activity called the checkout steps: Once the desired product(s) is found the client proceeds to ‘checkout phase’. In this phase the client is locked into a sequential (linear) system pre-emptive set of actions to get the transaction complete in a controlled manner. Although we did not focus on this activity, we argue that most of our findings with regard to the browsing experience will also be applicable to this phase.

- Our research further revealed that the majority of electronic commerce tasks can be classified as either e-shopping or e-service. Renaud et al. [2001] proposed the LSD model to characterise the e-shopping task. An original contribution of our research was to identify that e-service also has a generic task format, and we proposed the e-service task model to represent this (see Figure 2.4).

- The technology involved to support the electronic commerce activity: We found that the technology used in electronic commerce activities can be classified as hardware and network...
infrastructure, web server and electronic commerce software, Internet intermediary and support, and the transaction itself. We did not explicitly focus on technology issues or legal issues in this dissertation.

In the context of our research we argue that for electronic commerce to be effective, a ‘formal’ development process should be followed, with the developer constantly applying usability checks and balances to develop an effective online shopping experience for the user, which would translate into money for the company.

In the next chapter of this dissertation we will focus on interaction design, in particular usability.

8. Note

Some of the works represented in this chapter has been published in a modified form, see attached CD for the full paper:


  Summary of paper: Electronic Commerce is creeping into our everyday lives via websites and e-transactions. This digital shift changes the way business is conducted. Previous implementations of business software involved the purchase of software in order to install and use an interface. However, the World Wide Web and its associated standardised technologies provide the interface before transactions are deployed. This paper looks at Human-Computer Interaction for e-Business in the South African context. We conducted an experiment using Amazon.com. Respondents were given a shopping task. All subjects were interrupted during the checkout phase of the task; they were interrupted for five to ten minutes and then asked to proceed with their task. This interruption was geared at identifying how users recover from an interruption using the web features provided, such as the Back Button on the browser or the features provided on a particular website. We found that a well-defined, limited set of web features would enhance the shopping experience in an electronic commerce site.


  Summary of paper: The modern day global village economy of the world has not bypassed South Africa. With the proliferation of the Internet and the constant technological advancements, it is
clear that E-Commerce will reshape the business world. Government organizations, large co-
opérations, medium and small business would now have to organise their information and
information systems in an accountable, well-structured way. How do we document an electronic
businesses activity?

The information content of goods continues to increase. The proliferation of the World Wide
Web provides seemingly instant gratification for information, and has changed the way business
is being conducted. One of the major issues associated with a rapid transition to electronic
commerce methods from traditional methods is the ability of a business to cope with the volume
and changes in electronic commerce technologies. This transition period can result in many
electronic commerce approaches being designed on soon-to-be-obsolete technical platforms,
resulting in electronic commerce legacy systems. This paper describes an initiative to establish
the use of electronic business standard practices to develop electronic commerce applications in
the South African context. It also describes the initial outcomes of a field study.

  (pp. 50-68). Hershey: Idea Group Publishing.

Summary of chapter: This chapter is an extension of Unravelling the Chaos in E-Commerce
Land: A Preliminary Framework for Auditors for Systematically Dealing with Processing of
Electronic Transactions. We introduce the e-CAP ABCD framework to designing effective
electronic commerce sites. The letters ABCD symbolise the grassroots approach: start at the
beginning, and do not assume anything about your audience. A stands for atmosphere: the
organisation should understand the atmosphere in the particular environment that it is operating
in, i.e. socio-political, law, local customs, and amongst the local languages spoken. B stands for
build-up: one may be an electronic entity, but one has to build up a culture of trust between
oneself and the customers, who are in any part of the world. C stands for communication: build
up good communication lines between customers, supplies and yourself. Being at a distance from
the community that one does business with has the effect of dehumanising the relationship. D
stands for discipline: work within the rules and regulations of the community.

The ABCD approach is a simple approach that assists the company to assess the social
environment that it exists in.

  Publishing.
Summary of chapter: This chapter is an overview of the different classifications of electronic commerce.
**FIGURE 1.7. STRUCTURE OF THE DISSERTATION**

<table>
<thead>
<tr>
<th>SETTING THE SCENE</th>
<th>THEORETICAL FRAMEWORK</th>
<th>KNOWLEDGE ACQUISITION PROCESS</th>
<th>DATA ANALYSIS AND FINDINGS</th>
<th>CONCLUSION</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHAPTER 1</td>
<td>CHAPTER 2</td>
<td>CHAPTER 3</td>
<td>CHAPTER 4</td>
<td>CHAPTER 9</td>
</tr>
</tbody>
</table>

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### Conclusion
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- Final Note

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An Investigation into the Influence of Usability on the Development of the Browsing Experience of E-Commerce Applications  
Shawren Singh
Chapter 3

Interaction Design

This chapter contains an overview of the concept of usability in the context of interaction design. The chapter reviews various definitions of usability, looks at usability principles and usability principles in general for the web. We then look at various usability methods for the web, we consider examples of web usability and electronic commerce usability.

The dependability of computing is a problem with which our societies will continue to have to wrestle.

Donald MacKenzie

1. Introduction

In the previous chapter we discussed the context of the study, namely, electronic commerce. Our research question ‘Do usability aspects affect the design and development of the browsing experience in electronic commerce applications?’ also involves the concept of ‘usability’. In this chapter, we are going to look at the issues affecting usability and usability’s application to interactive applications. For a system to be usable, an interface must let users of the system, working in their own physical, social and cultural environments, accomplish their goals and tasks effectively and efficiently [Hackos & Redish, 1998].

Meeting the needs of users who demand power without complication has made the computer industry increasingly sensitive to the design of the user interface. The user interface could be the most important determinant of success for electronic commerce [Singh & Erwin, 2002]. In fact, to many users, the interface is the system [Turban & Aronson, 1998]. The success of any interactive product or system is ultimately dependent on it providing the right facilities for the task at hand in such a way that they can be effectively used, at an appropriate price [Dillon, 1994]. In the past, implementation of business software involved acquiring (purchasing) a piece of software in order to install and use an interface. For example, if you would purchase MS Word for document processing and wanted to share your documents with other prospective users, these users needed to have MS Word as well. This was costly. The WWW and its associated standardised technologies have changed this, and now provide the interface free of charge before transactions are deployed. For example, to use an electronic commerce website your user needs access to a ‘browser’ using standard technology. The question that arises now is how to improve the design on the ‘interface’. So, the ‘interface’ aspect is a subject of study in interaction design.

There are several reasons why we should consider interaction design in any system. MacKenzie [2000], for example, provides a list that documents the cases of possible computer-related accidental
death (to end of 1992). Prominent on the list is what MacKenzie [2000] labels the “human-computer interaction problem”. Examples include problems with medical equipment, mission controls, aeroplanes, robotics and general work equipment that have ‘malfunctioned’ due to problems in the interface and caused the loss of human life. Although electronic commerce users will not die from using poorly designed electronic commerce websites, designers should consider the impact of poorly designed user interfaces. This idea reinforces the arguments of Pressman [2000], as discussed in Chapter 1.

Another reason for considering interaction design is that of dependability. Computer systems’ dependability is intrinsically multifaceted. Dependable hardware is patently of limited value unless accompanied by dependable software - which may not be very helpful if the human interaction with the hardware and software system is fault-prone. The resulting effect is that the dependable socio-technical performance of an inappropriate task may cause wider damage [MacKenzie, 2000]. The usability factor is a critical aspect of the dependability puzzle [Scholtz, 1995].

Yet another reason why one should adopt a human-centred design approach is the increasing legal regulations for designing safe systems which do not harm the health or the well-being of their intended users [Human Factors: Guide, 1993].

Growing computerisation in all fields of human activity, including the rapid growth of electronic commerce, begs the following question: Because ‘money’ is involved, how do we make our computer systems more dependable and usable (improving the browsing experience), for electronic commerce in particular?

From an interaction design perspective there are various terms that are related to interaction design. These are usability and human-computer interaction. All these terms are related.

In Chapter 1, Section 3.2 (Figure 1.6), we introduced the basic steps in the electronic commerce activity. Browsing is a typical iterative activity. This browsing activity is user pre-emptive. We argue that by applying usability aspects to browsing, the browsing experience of the user will improve.

In order to put electronic commerce usability into perspective, we discuss the broader context of interaction design in Section 2. Section 3 addresses usability in general, as well as electronic commerce usability, which is followed by a summary in Section 4.

2. Human-Computer Interaction and Interaction Design

*Human-computer interaction* aims at designing, constructing and evaluating computer-based interactive systems, including hardware, software, input/output devices, displays, training and documentation, so that people can use these computer-based interactive systems efficiently,
effectively, safely and with satisfaction [Baecker & Buxton, 1987; Carroll, 2003; Cox & Walker, 1993; Dix et al., 2004; Downton, 1993; Hartson & Hix, 1989; Hartson, 1998; Kotze & Johnson, 2001; Newman & Lamming, 1995; Preece et al., 2002; Preece et al., 1994; Shneiderman, 1998; Sutcliffe, 1988]. Human-computer interaction is cross disciplinary in its conduct and multidisciplinary in its roots. Human-computer interaction draws on, synthesises and adapts from several fields, including:

- Human factors (e.g. the roots for task analysis and designing for human error in HCI).
- Ergonomics (e.g. the roots for design of devices, workstations and work environments).
- Cognitive psychology (e.g. the roots for user modelling).
- Behavioural psychology and psychometrics (e.g. the roots of user performance metrics).
- Systems engineering (e.g. the roots for much pre-design analysis).
- Information systems (the development of user-centric computer artifacts).
- Computer science (the roots for graphical interfaces, software tools and issues of software architecture) [Hartson, 1998].

The first formal published use of the term human-computer interaction can be traced back to 1982 when the Gaithersburg, Maryland conference on Human Factors in Computer Systems (CHI ’82) took place. This coincided with the commercial introduction of personal computers [Kotze, 2000]. Various researchers have, over the years, defined and redefined human-computer interaction. Some of these definitions are:

- Human-computer interaction is a “set of processes, dialogues, and actions through which a human user employs and interacts with a computer” [Baecker & Buxton, 1987].
- Human-computer interaction is a “discipline concerned with the design, evaluation, and implementation of interactive computer systems for human use, and with the major phenomena surrounding them. From a Computer Science perspective, the focus is on interaction and specifically on interaction between one or more humans and one or more computational machines” [ACM SIGCHI Curricula of Human-Computer Interaction, 1992]. A computational machine is defined to include traditional workstations as well as embedded computational devices, such as spacecraft cockpits or microwave ovens, or specialised boxes such as electronic games. A human is defined to include a range from children to the elderly, computer aficionados to computer despisers, frequent users to hesitant users, and teenagers to people with special needs.
Chapter 3

- Human-computer interaction “involves the design, implementation and evaluation of interactive systems in the context of the user’s task and work” [Dix et al., 2004]. A (human) user is defined as whoever is trying to accomplish something using the technology, and can mean an individual user, a group of users working together, or a sequence of users in an organisation, each dealing with part of the task or process. The computer is defined as any technology ranging from the general desktop computer to large-scale computer systems, a process control system or an embedded system. The system may include non-computerised parts, including other people. Interaction is defined as any communication between a user and the computer, be it direct or indirect. Direct interaction involves a dialogue with feedback and control during performance of the task. Indirect interaction may involve background or batch processing.

- Human-computer interaction “is concerned with studying and improving the many factors that influence the effectiveness and efficiency of computer use. It combines techniques from psychology, sociology, physiology, engineering, computer science, and linguistics” [Johnson, 1997].

- Human-computer interaction “is the process of designing software so that computer systems are efficient, pleasant, easy to use and do what people want them to” [Sutcliffe, 1988].

- Human-computer interaction “is a discipline whose main aim is to change people’s attitudes towards computers and computer systems; from considering them as end products, to considering them as tools to assist (non-computer related) work” [Kirakowski & Corbett, 1999].

- Human-computer interaction “is about designing computer systems that support people so that they can carry out their activities productively and safely” [Preece et al., 1994]. Preece et al. go one step further, however, and prefer to consider human-computer interaction from a wider, all-encompassing perspective, referring to it as interaction design. They define interaction design as “designing interactive products to support people in their everyday work lives” (p.6). By interactive products we mean: computers, cellular phones, personal organisers, remote controls, automated teller machines, ticket machines, the web, etc. [Preece et al., 2002]. In this dissertation we prefer this broader definition and focus on the concept of interaction design.

It is easy to say that the generic aim of interaction design is to design efficient, effective and reliable computer systems that are usable and understandable for the person using that system. This is where the concept of usability comes to the forefront.

3. Usability

Usability means different things to different stakeholders. In this section, we will look at several definitions of usability. Usability is generally regarded as ensuring that interactive products, such as electronic commerce applications, are easy to learn, effective to use, and enjoyable from the user’s
perspective, and involves the optimisation of user interaction with these interactive products [Preece et al., 2002]. Over time, several researchers have produced sets of generic usability principles which can be used in improving electronic commerce websites, as well as showing how to test usability and how to design software products, bearing usability in mind (for example, Dix et al. [2004]; Badre [2002]; Bevan [2006]; Cato [2001]; Falk & Sockel [2005]; Mayhew [1999]; Nielsen [1993]; Nielsen [2000b]; Preece et al. [2002]; Preece et al. [1994]; Shneiderman [1998] and Thimbley [1990]. These principles include aspects such as effectiveness, efficiency, safety, utility, learnability, flexibility, robustness, memorability, etc.

3.1. Usability Definitions

We will now consider a number of definitions of usability, namely, those set out by ISO, RACE, ETSI and Preece et al. [2000].

3.1.1. The ISO Definition

On a broad level, any research should be carried out in an organised systematic manner. The ISO 9241 standard [Abran et al., 2003; ISO 9241, 1998; Travis, 2003a] describes ergonomic requirements for office work with visual display terminals. The ISO 9241 standard defines and points out the following about usability:

- How to specify and measure the usability of products.
- Defines the factors that have an effect on usability.

In order to specify or measure usability it is necessary to identify the goals and to decompose effectiveness, efficiency, satisfaction and the components of the context of use into sub-components with measurable and verifiable attributes. The ISO 9241 standard defines effectiveness, efficiency and satisfaction as:

- Effectiveness: Is the accuracy and completeness with which specified users can achieve specified goals in particular environments.
- Efficiency: The resources expended in relation to the accuracy and completeness of goals achieved.
- Satisfaction: The comfort and acceptability of the work system to its users and other people affected by its use.

The components and the relationships between effectiveness, efficiency and satisfaction are illustrated in Figure 3.1.
The standard sets out the following criteria for specifying/measuring usability:

- A description of the intended goals.

- A description of the components of the context of use, including users, tasks, equipment and environments. This may be a description of an existing context, or a specification of intended contexts. The relevant aspects of the context and the level of detail required will depend on the scope of the issues being addressed. The description of the context needs to be sufficiently detailed so that those aspects of the context, which may have a significant influence on usability could be reproduced.

- Target or actual values of effectiveness, efficiency, and satisfaction for the intended contexts.

The context of use defined by the standard includes the following factors:

- Description of users: Characteristics of the users need to be described. These can include knowledge, skill, experience, education, training, physical attributes, and motor and sensory capabilities. It may be necessary to define the characteristics of different types of users. For example, users having different levels of experience or performing different roles.
• Description of tasks: Tasks are the activities undertaken to achieve a goal. Characteristics of tasks which may influence usability should be described, e.g. the frequency and the duration of the task.

• Detailed description of the activities and processes may be required if the description of the context is to be used as a basis for the design or evaluation of details of interaction with the product. This may include descriptions of the allocation of activities and steps between the human and technological resources. Tasks should not be described solely in terms of the functions or features provided by a product or system. Any description of the activities and steps involved in performing the task should be related to goals that are to be achieved.

• Description of equipment: The description of the hardware, software and materials may be in terms of a set of products, one or more of which may be the focus of usability specifications or evaluation, or it may be in terms of a set of attributes or performance characteristics of the hardware, software and other materials.

• Description of environment: Relevant characteristics of the physical and social environment need to be described. Aspects that may need to be described include attributes of the wider technical environment (e.g. the local area network), the physical environment (e.g. workplace, furniture), the ambient environment (e.g. temperature, humidity) and the social and cultural environment (e.g. work practices, organisational structure and attitudes).

• Usability measures: Usability measures include effectiveness, efficiency and satisfaction. These are measured in user trials of the product. The goal of the user trial may be to help in defining user requirements, to validate that the technology works in real conditions, to measure user attitudes, or to start the marketing of the system.

3.1.2. The RACE Definition

According to RACE [RACE 1065-ISSUE, 1992] usability is defined from the designer’s perspective (i.e. what designers need to do to ensure that usable systems and services are developed). Design guidance is offered to ensure that the appropriate enabling state exists for each of the user’s goal tasks, and reduce or minimise the costs to the users in reaching the appropriate enabling states for their goal tasks. A goal task is what the user wants to achieve, and an “enabling task” is what users must do to create a state that enables the goal task to be performed.

3.1.3. The ETSI (European Telecommunications Standards Institute) Definition

ETSI considers usability as a purely ergonomic concept not depending on costs of providing the system [Human Factors: Guide, 1993]. Usability, together with the balance between the benefit for the user and the financial costs, form the concept of utility. This means that an ergonomical, highly
usable system may have low utility for a particular user who considers the cost to be too high in relation to their need for using the system.

Measures of usability are assumed to be of two kinds [Human Factors: Guide, 1993]:

- Performance measures: Which are objective measures or observations of user behaviour and are focused on task performance, i.e. how well the user can achieve a specific task.
- Attitude measures: Which are subjective measures or observations of the users' opinion of working with the system, i.e. how much they like to use the system.

These two measures of usability are considered to be mutually exclusive. This means that a system or a service can obtain a high score on performance measures and a low score on the attitude measures. The two measures can, however, be dependent through sharing a common set of physical characteristics. The scores on these two usability measures may vary independently for a given system, if either the task or the user category is changed. In conclusion, these two measures are highly dependent on the context, task and type of users concerned.

Performance and attitude measures are also complementary in the sense that both contribute to the complete evaluation of the usability of a human/machine system. An assessment in both dimensions is therefore necessary, unless it can be shown that one attribute remains constant over different implementations of a concept.

It is important to remember that the usability definition given here refers to a specific kind of task, user and environment. Usability in this sense cannot be generalised over different kinds of tasks, users and environmental conditions. Variations in these aspects are expected to give different values of usability for the same system, and require separate evaluations [Human Factors: Guide, 1993].

3.1.4. Preece et al. Definition

Preece et al. [2002] define usability in terms of the following criteria: interactive products should be easy to learn, effective to use, and enjoyable from the user’s perspective. Preece et al. [2002] breaks down usability into the following goals:

- Effective to use: This is a general goal and refers to ‘clarity’ and ‘functionality’ of the system.
- Efficient to use: This refers to the manner in which the system assists users in conducting their tasks.
- Safe to use: This involves protecting the physical well being of the user as well as protecting the user from an undesirable situation.
• Has good utility: This refers to the extent to which the system provides the correct kind of functionality so that the user can achieve his desired goal.

• Easy to learn: This refers to how easy it is to use the system.

• Easy to remember how to use: This refers to how easy it is to remember, once one has learned the system.

There are various overlaps with the different definitions of usability. For this dissertation we adopt the ISO 9241 definition.

3.2. Usability Principles

In order to unravel these definitions, several researchers have over the years produced sets of principles or guidelines aimed at improving the usability of interactive systems. Usability guidelines are lists of rules about when and where to do things, or not to do things, in an interface. These guidelines can take a variety of forms and may be obtained from several sources such as journal articles, general textbooks, company in-house style guides, etc.

Dix et al. [2004], for example, put forward principles to support usability in three categories:

• Learnability: Referring to the ease with which new users can begin effective interaction and then attain a maximal level of performance. Usability principles related to learnability include predictability, synthesisability, familiarity, generalisability, and consistency.

• Flexibility: Referring to the multiplicity of ways in which the user and the system exchange information. A user is engaged with a computer in order to achieve some set of goals in the work or task domain. Usability principles related to flexibility include dialogue initiative, multi-threading, task migratability, substitutivity, and customisability.

• Robustness: Referring to the level of support provided to the user in determining successful achievement and assessment of goals. Usability principles related to robustness include observability, recoverability, responsiveness, and task conformance.

Shneiderman [1998] also focuses on this aspect. He advocates three groups of principles when he discusses user-centred design. Many of these overlap with the principles proposed by Dix et al. [2004]. Shneiderman’s principles include:

• The recognition of diversity.

• The use of the eight golden rules of interface design (see below).

• The prevention of errors.
Shneiderman [1998] further advocates the *eight golden rules for interface design*. These rules present the underlying principles of design that are applicable to most interactive systems. These underlying principles must be interpreted, refined, and extended for each environment, and include:

- Strive for consistency.
- Enable frequent users to use shortcuts.
- Offer informative feedback.
- Design dialogues to yield closure (the completion of a group of actions).
- Offer error prevention and simple error handling.
- Permit easy reversal of actions.
- Support internal locus of control.
- Reduce short-term memory load.

All applications require user interfaces, the design of which is not a trivial matter. The same is true for electronic commerce and any other web-based applications. Shneiderman [1998] states that within the ocean (WWW) of information “there are also lifeboat websites offering design principles, but often the style parallels the early user interface writings of the 1970s.” The problem with early user interfaces, that of ignoring the abilities and preferences of the users, is therefore still present. In the context of this study, we argue that by using the appropriate technology and usability features (which would be done according to the current time, current place, and current circumstances), electronic commerce applications would be designed more effectively.

### 3.3. Web Usability in General

Usability has assumed a much greater importance in the Internet economy than it has in the past [Seilheimer, 2004]. In traditional physical product development, customers did not get to experience the usability of the product until after they had already bought and paid for the software product. Usability is an important consideration for the web.

Nielsen [2000b] identifies the following common errors made in web design:

- Business models: The company sees the web as an electronic brochure instead of considering that there is a fundamental shift in the way we conduct business in the networked economy.
- Project management: Web-based software projects are managed as if they were traditional corporate projects. The consequences of this approach are that it may lead to an internally
focused design with an inconsistent user interface. A website should be managed as a single customer-interface project.

- Information architecture: The websites’ structure reflects that of the companies. Ideally, the website should be structured in such a way that it reflects the users’ tasks and their views of the information space.

- Page design: Pages are not designed to optimise the user experience under realistic circumstances.

- Content authoring: Written content should be optimised for online readers who frequently scan text and who need very short pages, with secondary information relegated to supporting pages.

- Linking strategy: Develop a linking strategy that clearly identifies the company’s content and outside links to other websites. Design well defined entry and exit points to the website.

To bridge the common problems identified by Nielsen [2000b], there are various techniques that can be used to incorporate usability into the design of interactive software. We will focus on some of the techniques that can be used to incorporate usability design and testing in the electronic commerce development process. These techniques are divided into two groups. The first group is usability evaluation. Under the auspices of usability evaluation we will discuss heuristic evaluation, checklists, usability tests, think aloud approaches and user acceptance testing. The second group is designing with usability in mind. Under the auspices of designing with usability in mind, we will discuss user and task analysis, walkthroughs and technology acceptance model [Brinck et al., 2002; Carroll, 2003; Charlton & O'Brien, 2002; Cox & Walker, 1993; Dix et al., 2004; Gould, 1999; Hackos & Redish, 1998; Hartson & Hix, 1989; Hartson, 1998; Karoulis et al., 2006; Mandl, 2006; Nielsen, 1993; Nielsen, 1994b; Nielsen & Molich, 1990; Preece et al., 2002; Preece et al., 1994; Shneiderman, 1998; Thimbleby, 1990]. Each approach has its own set of advantages and disadvantages [Maria et al., 2003].

3.3.1. Usability Evaluation

Usability evaluation is a process of evaluating a website against a group of well defined criteria, such as easy to learn, effective, efficient, safe and satisfying [Preece et al., 2002]. In this section we will discuss heuristic evaluation, checklist, usability testing, think aloud approaches and user acceptance testing. These techniques can be used to improve the usability of an interactive software product.

3.3.1.1. Heuristic Evaluation

Heuristic evaluation is sometimes referred to as “discount usability engineering.” Heuristic evaluation is a form of usability inspection where usability specialists evaluate whether an interface
follows established usability guidelines, or heuristics. Heuristic evaluation is best conducted in the 
early prototype stages of an electronic commerce project, and repeated as significant design changes 
are implemented.

Usability heuristics are general user interface design principles. The most widely used heuristics are 
the ones defined by Jakob Nielsen. He originally developed the heuristics evaluation in collaboration 
can be used in expert evaluation as they provide a guideline and checklist for user interface 
designers. Nielsen [1994a] presents a list of ten usability heuristics based on an analysis of 249 
usability problems. These are:

- Visibility of system status: The system should always keep the users informed about what is 
going on, through appropriate feedback within reasonable time.

- 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.

- User control and freedom: Users often choose system functions by mistake and will need a 
clearly marked ‘emergency exit’ to leave the unwanted state, without having to go through an 
extended dialog. Supports undo and redo.

- Consistency and standards: Users should not have to wonder whether different words, situations, 
or actions mean the same thing. Follow platform conventions.

- Error prevention: Even better than good error messages is a careful design that prevents a 
problem from occurring in the first place.

- Recognition rather than recall: Make objects, actions and options visible. The user 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.

- Flexibility and efficiency of use: Accelerators, unseen by the novice user, may often speed up the 
interaction for the expert user so that the system can cater to both inexperienced and experienced 
users. Allow users to tailor frequent actions.

- Aesthetic and minimalist design: Dialogues should not contain information that is irrelevant or 
rarely needed. Every extra unit of information in a dialog competes with the relevant units of 
information and diminishes their relative visibility.

- Help users recognise, diagnose and recover from errors: Error messages should be expressed in 
plain language (no codes), precisely indicate the problem and constructively suggest a solution.
• 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. Such information should be easy to search, focused on the user's tasks, list concrete steps to be carried out and should not be too large.

The above set of heuristics is very general. Heuristics can also be designed to be more specific. See, for example, Borges [1998] who provides the following set of guidelines for the design of web pages:

• Headers should not take more than 25% of a letter size page.

• Headers and footers should be clearly separated from the body of the page. (One way of achieving this is by placing bold lines or bars between them and the body).

• Names of links should be concise and provide a hint on the content of the page that they link to. (Avoid using technical words such as servers, links, web server, etc.)

• Avoid adding explanatory comments to textual links.

• Avoid ‘linking-mania’ (making a link every time a keyword of a page is mentioned in a text).

• Verify that links connect to existing pages.

• Linking icons should have a distinctive feature of the page they are linking to.

• Maintain consistency when using icons. The same icon should be used for the same intended purpose.

• Colours should be selected so that the pages can be clearly displayed and reproduced on black and white displays and printers.

• It is desirable to include the date the page was last modified, the e-mail address of the person who maintains the page and the URL address of the page in a footer.

For the initial home page of a website:

• Pages should not be overcrowded with links.

• Pages should be short (do not have long scroll downs).

• Links should be to primary aspects or characteristics of the institution. Textual information should be left for secondary pages.

• Organise links as primary and secondary topics.

• Links to resources or other repositories on the Internet should be placed on a secondary page. (This page should be reached with a link on the primary page.)

• A more extensive index of links, properly grouped, can be provided on a secondary page for fast access to a wide range of the institution's repositories.
Heuristics by nature are meant to be general guidelines, unless otherwise stated. It does at times become difficult to apply these guidelines in a specific context for a specific domain. Heuristics can also be used to evaluate a website. A usability expert would evaluate a sample of the website, based on predetermined usability criteria.

3.3.1.2. Checklist

A usability evaluation can also be conducted by going through a checklist of guidelines. Using checklists is a subjective evaluation method, and is closely related to the heuristic evaluation methods as examined in the previous section. It is based on training, field experience and an examination of human factors data [Van Dyk, 1999].

Checklists can be short or long, general purpose or special purpose. For example, Holmes [2002] provides an extensive checklist that covers the following aspects of website design:

- Content.
- Information architecture.
- Navigation design.
- Screen design.

A short checklist takes less time and, with practice, can substitute single, broad principles for a long list of specific guidelines that all follow the same general principle. For example, there are many ways in which a website can be consistent, and if one has learned to check for all the different types of consistency, the checklist only needs to mention ‘consistency,’ rather than a whole list of specific principles such as the following [Brinck et al., 2002]:

- Page layouts are consistent throughout the site.
- Page titles are consistent with link names.
- All headers have consistent syntax, capitalisation, and punctuation.
- Bullets are the same style throughout the site (e.g. open circle, squares or diamonds).
- Images receive the same stylistic treatment throughout the site.
- Logos all conform to strict corporate standards, without variation.
- Link colours do not vary from page to page.
- Link colours are consistent with web conventions: blue for non-visited links, green or purple for visited links.
A checklist specifically related to electronic commerce has also been developed. Perry [2001], for example, suggests the following checklist for an electronic commerce website:

- Design the site around how the users will navigate the site, not around the company’s organisational structure.
- Use small graphics and keep file sizes small so that pages load quickly.
- Place frequently used links at the top of the page.
- Clearly show the company’s name and contact details on the home page.
- Ensure that all pages include a link back to the home page for visitors who do not enter the site through the home page.
- Avoid using business jargon and terms that visitors might not understand.
- Design for legacy systems, i.e. older browsers, older computers, etc.
- Be consistent with the use of design features and colour on all web pages within the site.
- Make sure that the navigation links are clearly indicated to the user.
- Check that text and background colour combinations are visible to colour-blind users.

### 3.3.1.3. Usability Tests

Another approach often used for usability evaluation is usability testing. Usability testing is one of the cornerstones of user-interface design [Cox & Walker, 1993; Nielsen, 1993]. Various researchers suggest different variations to usability testing [Cato, 2001; Hackos & Redish, 1998; Mandel, 1997; Nielsen, 1993; Preece et al., 2002; Redmond-Pyle & Moore, 1995; Shneiderman, 1998; Spool et al., 1999]. Usability tests are conducted with actual end users, ideally in their own environment, while performing real tasks. Only three to five users are needed to obtain a significant amount of valuable data. Research conducted by Nielsen [1993] has shown that as much as 85% of usability problems can be identified in the first usability test with a small group. Nielsen [1993] suggests that when the site is redesigned based on the initial usability test results, it must be tested again to ensure that prior problems have been eliminated and new problems have not been created. Usability evaluators also gather data on problems that arise, such as: errors, confusion, frustrations and complaints. These can be noted and discussed with the user. It is useful to have the users talk aloud about what they are doing. Usability tests identify serious or recurring problems [Galitz, 1997].

Table 3.1 is an overview of some usability testing approaches that can be used, and the particular circumstances in which each test can be used. In Table 3.2 is a summary of some usability considerations [Cox & Walker, 1993], which provide a basis for usability testing.
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An Investigation into the Influence of Usability on the Development of the Browsing Experience of E-Commerce Applications

Shawren Singh

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Testing

Table 3.2. Summary of Some Usability Considerations [Cox & Walker, 1993]

<table>
<thead>
<tr>
<th>Functionality</th>
<th>Can the user do the required task</th>
</tr>
</thead>
<tbody>
<tr>
<td>Understanding</td>
<td>Does the user understand the system</td>
</tr>
<tr>
<td>Timing</td>
<td>Are the user tasks done within a reasonable time</td>
</tr>
<tr>
<td>Environment</td>
<td>Do the tasks fit in with other parts of the user environment</td>
</tr>
<tr>
<td>Safety</td>
<td>Will the system harm the user, either psychologically or physically</td>
</tr>
<tr>
<td>Errors</td>
<td>Does the user make too many errors</td>
</tr>
<tr>
<td>Comparisons</td>
<td>Is the system comparable with other ways the user might have of doing the same task</td>
</tr>
<tr>
<td>Standards</td>
<td>Is the system similar to others the user might use</td>
</tr>
</tbody>
</table>

Table 3.1. An Overview of Usability Testing [Cox & Walker, 1993]

<table>
<thead>
<tr>
<th>Testing</th>
<th>Things to test (see Table 3.2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Users to test (naive, novice, skilled or expert)</td>
<td></td>
</tr>
<tr>
<td>Approaches to take (see test methods)</td>
<td></td>
</tr>
<tr>
<td>Testing methods</td>
<td>Task analysis</td>
</tr>
<tr>
<td>Questionnaires</td>
<td></td>
</tr>
<tr>
<td>Interviews</td>
<td></td>
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To summarise, Cox and Walker [1993] state that:

- Usability testing requires a user.
- Usability testing is done by observing people doing tasks with the products being tested.
- Usability measures are imprecise and there is no prescription that tells us how usable an artifact can be. Interpreting observations always requires judgment and will vary depending on the circumstances.

Nielsen [1993] and Shneiderman [1998] point out that there are several methodological pitfalls in usability testing. For example, one needs to pay attention to the issues of reliability and validity. Reliability is the question of whether one would get the same results if the test were to be repeated, and validity is the question of whether the results actually reflect the usability issues that are tested.

Galitz [1997], for example, provides the following framework to conducting usability tests. The framework is expressed in three phases: before starting the test, during the test and after the test. Each will be briefly explained.

**Before starting the test:**

- Explain that the object is to test the software, not the participants.
- Explain how the test materials and records will be used.
- If a consent agreement is to be signed, explain all information on it.
• If verbal protocols will be collected, let participants practise thinking aloud.

• Ensure that all the participants’ questions are answered and that the participants are comfortable with all procedures.

**During the test:**

• Minimise the number of people who will interact with the participants.

• If observers will be in the room, limit their number to two or three.

• Provide a checklist for recording:
  
  o Times to perform tasks.
  o Errors made in performing tasks.
  o Unexpected user actions.
  o System features used/not used.
  o Difficult/easy to use features.
  o System bugs or failures.

• Record techniques and search patterns participants employ when attempting to work through a difficulty.

• If participants are thinking aloud, record assumptions and inferences being made.

• Record with a tape recorder or video camera.

• Do not interrupt participants unless absolutely necessary.

• If participants need help, provide some response.
  
  o Provide encouragement or hints.
  o Give general hints before specific hints.
  o Record the number of hints given.

• Watch carefully for signs of stress in participants:
  
  o Sitting for long times doing nothing.
  o Blaming themselves for problems.
  o Flipping through documentation without reading it.

• Provide short breaks when needed.

• Maintain a positive attitude, no matter what happens.

**After the test:**
• Hold a final interview with participants, telling them what has been learned in the test.

• Provide a follow-up questionnaire that asks participants to evaluate the product or tasks performed.

• If the test was videotaped, use as follows:
  o Respect participants’ privacy.
  o Get written permission to use tape.

3.3.1.4. Think Aloud Approaches

The think aloud approach requires users of an interactive application to verbally express themselves while performing a computer-related task or solving a computer-related problem [Jaspers, 2006].

Holmes [2002] suggests the following quick and easy usability tests. There are a few important rules and steps to follow when doing the testing:

• Choose a person who fits the user profile for the site. Do not choose someone who has worked extensively on the site.

• Place them before a computer, give them the URL, and give them a small scenario, e.g. “I am testing this CV (curriculum vitae) site. Imagine you are a person looking for a job, and try to enter your CV.” Also, tell them to think aloud, especially when they are wondering about something.

• Then silently observe.

• Watch them use the site. If they ask you something, tell them you are not there. Then silently observe.

• Start noting all the things you are going to have to change.

• Afterwards ask them what they thought.

The National Cancer Institute, on the other hand, presents a variation on the above approach, which they refer to as an informal test. The informal test can be conducted in any space with or without specialised recording equipment. The approach can be summarised as follows [National Cancer Institute, 2002]:

• Sit with the user. The tester may have another person sitting nearby to take notes.

• Let the user do the work. Encourage the user to think aloud. The tester may also ask clarifying questions while the user is working.
• The tester may probe the user on how they interpret a screen or what they would expect to happen if they clicked a particular item.

• Collect primarily qualitative data.

3.3.2. Designing with Usability in Mind

In this section we will discuss user and task analysis and walkthroughs as techniques used for designing with usability principles in mind.

3.3.2.1. User and Task Analysis

User and task analysis is the process of learning about ordinary users by observing them in action [Diaper, 2006]. User task analysis is conducted before design begins. The results of the analysis will be used to create the information architecture, navigation structure and labelling schemes that make sense to users.

A detailed task analysis can be conducted to understand the current system and the information flows within it. These flows are important to the maintenance of the existing system and should be incorporated in any new or replacement system [Maguire, 1997]. Kirwan and Ainsworth [1992] present a similar definition as the previous ones, but they substitute “to achieve a task” with “to achieve a system goal”. Newman [1995] also emphasises the goal-directed nature of tasks when he states succinctly that “a task is a unit of human goal-directed activity”. There is no real consensus among practitioners concerning what constitutes task analysis [Shepherd, 1989].

Formal task analysis yields the following benefits [Maguire, 1997]:

• It provides knowledge of the tasks that the user wishes to perform.

• It is a reference against which the value of the system functions and features can be tested.

• It is a cost-saving exercise because failure to allocate sufficient resources to the task analysis activity increases the potential for costly problems arising in later phases of development.

• Task analysis makes it possible to design and allocate tasks appropriately and efficiently within the new system.

• The functions to be included within the system and the user interface can be more accurately specified.

Formal task analysis has one major limitation in that it can be time-consuming and produce a large volume of data which may require considerable effort (and skill) to analyse [Van Dyk, 1999].
Task decomposition, knowledge-based techniques and entity-relationship-based analysis are three different but overlapping approaches to task analysis [Dix et al., 2004]:

- **Task Decomposition**: This consists of defining the overall task in terms of sub-tasks and their sequence. Hierarchical task analysis (HTA) is such an approach and produces a hierarchy of tasks, subtasks and plans, or a description of task conditions (when a subtask is performed), and a task sequence or order of execution.

- **Knowledge-based techniques**: This builds a conceptual model of the way the user views the system and the task, and what a user needs to know about task objects and actions. One technique (TAKD or task analysis for knowledge description) uses an either/or (AND, OR and XOR) branch based taxonomy (TDH or task descriptive hierarchy) of all objects and actions in the task, which differs from the HTA methods (based on ‘how to’) in that it is based on task and object similarities (i.e. genericity).

- **Entity-relationship-based analysis**: The emphasis is on identifying objects and actors and their relationships and operations, rather than on object similarities. Objects are classified as being either actors (usually human entities), concrete objects (all the other ‘things’), and composite objects (sets or combinations of the previous two groups). Attributes of objects and actors are listed only when it is relevant to a human or computer task.

- **There are a number of techniques used to conduct task analysis. Under the GOMS (Goals, Operators, Methods and Selection rules) approach there is a family of techniques such as [John, 2003]:**
  - Hierarchical task analysis
  - Link analysis
  - Operational sequence diagrams
  - Timeline analysis
  - Cognitive work analysis.

3.3.2.2. *Structured Walkthroughs*

The goal of a structured walkthrough in HCI design is to detect problems very early on, so they can be eliminated [Preece et al., 1994].

Structured walkthroughs involve constructing carefully defined tasks from a system specification or screen mock-ups. A typical example would be to walk through the activities (cognitive and operational) that are required to get from one operational screen to another to complete a specified task. Before doing a walkthrough, experts determine the exact task that will be done, the context in
which it will be done and their assumptions about the user population. They then walk through the
task, review the actions that are necessary to achieve the task, and attempt to predict how the user
population would most likely respond to the problems that they may encounter [Preece et al., 2002;
Preece et al., 1994].

There are various techniques for conducting a walkthrough, for example:

- Cognitive walkthroughs: A cognitive walkthrough involves simulating a user’s problem-solving
  process at each step in the human-computer dialogue, and checking to see if the user’s goals and
  memory for actions can be assumed to lead to the next correct action. The defining feature is that
  they focus on evaluating design for ease of learning – a focus that is motivated by observation
  that users learn by exploration [Brinck et al., 2002; Nielsen, 1993; Preece et al., 2002].

- Pluralistic walkthroughs: A process in which users, developers and usability experts work
  together to step through a (task) scenario, discussing usability issues associated with dialog
  elements involved in the scenario steps. Each group of experts is asked to assume the role of
  typical users [Brinck et al., 2002; Nielsen, 1993; Preece et al., 2002].

- Group walkthroughs: A group walkthrough brings together several people to review the website
  jointly. The group walks through the website for each major task a user would perform, trying to
  touch on every page that will be commonly used. For each task the group steps through every
  page on a website to experience everything that a user would encounter [Preece et al., 1994].

From the various abovementioned walkthroughs, HCI researchers tend to adapt methods that best fit
their particular circumstances [Casaday, 2001].

3.4. Examples illustrating the need for Web Usability

The following cases illustrate the need for usability in the design of web-based systems:

3.4.1. Case 1: Handyman’s Tools

Shopping over the Internet can be both an enjoyable and a timesaving exercise, yet it can also be a
frustrating and time-consuming effort if the underlying technology does not support the task at hand.
The Internet shopping experience is marketed by companies doing business over the web, as being
convenient, hassle-free and the safest shopping experience. By simply filling in an electronic order
form, your order is dispatched by the click of a button. Your order is processed in the background,
your credit card is debited and your order is on its way. Sometimes it is not as simple as that. For
example, Casaday [NUblog, 2001] reports on a frustrating 47-day delay in a mere attempt to
purchase two wrenches online. In the process he had to submit two different orders to buy two
wrenches instead of being able to just update the quantity field on the order form. He had to use two
different credit cards and he had to phone the help line to bypass the electronic system (he had to buy an item requiring installation in order to make the system revert to the manual mode so that a human agent could intervene). The usability problem in this case was that the user was not given the option to easily update his order.

3.4.2. Case 2: The Olympic Games

In Australia, in June 1999, Bruce Maguire lodged a complaint with the Human Rights and Equal Opportunity Commission under a law called the Disability Discrimination Act [Travis, 2003b]. His complaint concerned the poor website design of the Sydney Organising Committee for the Olympic Games, which Maguire alleged was inaccessible to visually impaired persons.

Maguire used a refreshable Braille display, as opposed to a screen reader, to view web pages. Braille displays and screen readers’ lack the sophistication to convert images into a text equivalent. The Sydney Organising Committee for the Olympic Games was fined in a court of law for not having made provision for blind users, and ordered to add alt text to all images on its website.

The above case points out that the design team and other stakeholders did not consider the diversity of their intended users.

3.4.3. Case 3: University Website

The University of South Africa (Unisa), on 8 June 2003, in the Sunday Times: Business Times, advertised various academic and administrative posts at the University. In the advertisement the University’s URL was supplied. The assumption was that prospective candidates could go to the website, obtain further information and download the relevant application forms. Figure 3.2 is a storyboard that relates to my attempts to find the relevant information for the advertised posts.
Chapter 3

An Investigation into the Influence of Usability on the Development of the Browsing Experience of E-Commerce Applications

Shawren Singh
Upon arriving at the Unisa web page (see Page 1), I tried in vain to find the advertised posts and application forms. I tried the drop-down quick (see Page 2) reference menu with no success. The simplest thing to do was to try the search option provided on the Unisa web page (see Page 3). I keyed in as the search string the word ‘vacancies’ (also tried the words ‘job’, ‘jobs’ and ‘vacancy’). The results for vacancies were not shown in the storyboard, but the same results appeared as shown in Page 4). Page 4 had some promising results to explore. With a ranking of 224, there was the option ‘Vacancies/bursaries’ and with a ranking of 40 was the option ‘Employment’ (I am still not sure how and why the ranking was placed next to the found options or how it worked). Both options took me to unrelated pages (see Pages 5 and 6). At this stage it was safe to conclude that the advertised post and related information was not on the Unisa web page.

Purely by chance I saw the drop-down menu (see Page 2) and clicked on the option ‘About Unisa’ (with the intent to read about Unisa’s 130-year history) and saw the option ‘employment’ (see Page 7). Clicking the option took the user to the ‘Vacancies’ page (see Page 8).

It can be concluded that this site was not subjected to a usability test, there was no clearly defined development methodology (see Chapter 4) and there was no logical information structure. The search strategy seems to be a “brute force” strategy.

3.4.4. Case 4: University of South Africa – School of Computing

In contrast, on the same site, the School of Computing had the following ‘well-designed’ web page, as illustrated in Figure 3.3
There is no information hiding on this page. The ‘blue line’ menu runs consistently throughout all the CS/IS related webpages. This is a one-stop shop – prospective students, registered students, certificate students and prospective employees can visit this page and find the information that they are looking for (see Page 1, Figure 3.3). The original quest to find the information regarding the advertised post can be found on these pages under the option ‘vacancies’ (See Page 2, Figure 3.3).

3.4.5. Case 4: I paid you

Electronic Internet payments have apparently made life that bit easier. In this case study we relate the experience of a user (whom we will call John) with the local town council, and his ordeal in paying them. John, like all good money-wise men, waited for the final notice of order to pay his outstanding account, and chose to do an Internet payment. He made the payment, everything went well and he even printed out a receipt for proof of payment. One month later John received a statement claiming that he did not settle his outstanding account, and that interest and delivery charges had been added to the account. John verified that he did make the payment, and sent an e-mail confirming it. This e-mail resulted in a string of communications:

- John’s e-mail in English stated his claims and provided evidence.
- He received a reply in English.
- John sent an e-mail again, in English.
- John received a reply in Afrikaans. It is presumed that the reply was in Afrikaans because John signed his previous e-mail with his full name and surname, and his surname happened to be of Afrikaans descent (see Section 4 of this Chapter).
- John then replied in Afrikaans.

To no avail. John resorted to calling the call centre. After several calls, and speaking to second-language English speakers, John’s problem was solved by speaking to an Afrikaans-speaking person.
who claimed that they were aware that the system did not work as effectively as they originally expected.

Many of the above problems can be attributed to poor design (see Chapter 4), testing and usability. Often these ‘shopping’ sites cater for the mythical ideal customer who enjoys the navigational adventure of securing a product.

3.5. Electronic Commerce Usability

The usability techniques in Section 3.3.1 can easily be adapted to electronic commerce applications. Various researchers have, however, also suggested specific methods to improve electronic commerce usability [Atterer & Schmidt, 2005; bonasource.com, 2004; Nielsen, 1996; Nielsen, 2000b; Schaffer & Sorflaten, 1999]. Travis [2003b], for example, suggests the following for electronic commerce websites:

- Understand the needs of the customer for your project.
- Understand the current website that is in use.
- Get different people on your project team to profile the website that is being developed. Compare these profiles.
- Use representative customers to test the website.
- Contact customers who recently e-mailed the webmaster and ask them questions so that you can understand the customer profile.
- Understand the environment that your system will be operating in.
- Identify the key objectives of the website and try to benchmark these activities.
- Conduct task analysis on one important activity on the website.
- Conduct heuristic evaluation on one screen of the website, and consider the implication on the next cycle of the development process.
- Conduct a walkthrough test on a frequently expected task on the website.

Kuan et al. [2005] argue that there are four main electronic commerce usability dimensions:

- Perceived website usability: Designers should implement features that enhance the customer’s shopping experience. For example, a travel website can allow customers to book flights, accommodation, car rental and purchase travel insurance, all within the website.
- Perceived interface quality: Designers should work upon increasing the ease of navigation and consistency of interface interaction.
• Perceived information quality: Developers should work on content, accuracy, format and
timeliness. For content, developers should provide sufficient relevant information for customers
to make a good decision for purchase. In the area of accuracy and timeliness, effort should be
made to ensure that the website provides information that is correct, reliable and timely.

• Perceived service quality: Designers can work on responsiveness, interactivity, security and
privacy policies, and search and comparison facilities.

Rohn [1998] suggests the following design guidelines (including usability issues) for the design of
electronic commerce applications:

• General navigation: Website navigation should answer three key questions: Where am I in the
website? Where have I been in the website? and, Where can I go in the website?

• Browsing and searching: There are several issues that should be considered for browsing and
searching, such as: use category pages for products; do not over-classify; enable sorting
(Amazon.com allows users to sort products by price value from cheapest to most expensive); and,
compare similar products.

• Product pages: These pages should show product images, display prices, provide details about
the product, show product availability and provide information on guarantees and conditions.

• Effective online content: Web writing is a unique skill. The following should be considered:
people scan web pages rather than read – do not write volumes of text with zero information
value, use simple words, provide full company contact details and remove outdated content.

• Visual design: Designers should consider: limiting different text styles, colour and size; do not
use underlining except for links; do not write large blocks of text on a dark background; use
graphics sparingly; do not make important page elements look like advertisements; and, design
for printability.

• Search engines: Designers should consider: including keywords in the page titles, filling pages
with meaningful content, using meta-tags, and submitting the website to directories and related
websites.

• Checkout and shopping cart guidelines: An effective cart would show items, all costs and
subtotal; allow user to modify quantities and remove items (see Case 1 in this Chapter);
explain/show the steps of the checkout process; show shipping charges earlier; provide field for
shipping instructions; enable separate shipping and billing fields; preserve entered information;
provide order summary before committing the purchase; and, send a confirmation e-mail.

We will now look at a specific cases related to electronic commerce usability.
Rohn [1998] argues that to produce a highly usable and successful electronic commerce site, usability is a key factor. Rohn relies heavily on electronic commerce usability heuristics relating to: site introduction, content, navigation, product selection, shopping cart, international issues, ordering, downloads, feedback and errors, help, and rewarding customer loyalty. Rohn suggests that the following factors should also be considered:

- Utilise usability engineering methods prepared by experienced usability engineers, throughout the design and development of the site.
- Understand what the goals of the site are.
- Decide on the target population.
- Research and profile the target customer population and update the profiles of the target customer population, including attributes, context of use, goals, tasks, and priorities.
- Create a specification based on functionality and design requirements derived from customer research.
- Perform interactive design and usability evaluation to drive functionality and design decisions.

Tilson et al. [2000] point out that researchers and practitioners know little about the habits of virtual shoppers or how to create effective electronic commerce sites. Tilson et al. concentrate on the following aspects that will improve usability: structure and navigation, obviousness and feedback. For the structure and navigation to be effective the following factors have to be accounted for:

- The number of clicks required to view an item.
- Helpful product organisation.
- Scanning and selecting item from a list of products.
- Returning to different levels after adding an item to the shopping cart.

For the obviousness and feedback to be effective, the following factors have to be accounted for:

- Feedback on saved items.
- Obviousness of ‘Order’ links.
- Presentation of additional features (such as wish list).
- Security messages.

Kubilus [2001] reports that slow response time, lack of user-friendliness, poor navigation and poor website design affect the success of electronic commerce websites. The factors that would improve
electronic commerce success are: customer’s previous experience should have been positive, fast response time, and relevant frequently updated content. Kobilus [2001] suggests the following strategy to improve electronic commerce website usability:

- Understand the conceptual model of the user and the system: How does the user perceive the system?
- Develop an information presentation strategy.
- Provide feedback.

Huang [2002] also argues that usability is an important aspect in electronic commerce systems. He brings to our attention the following issues that need to be considered in the electronic commerce usability saga:

- Users of electronic commerce websites are located at remote locations, making it difficult to access hands-on help from technical support personnel.
- If an electronic commerce site is riddled with poor usability, the user will switch to a more usable site.
- Users are heterogeneous – an electronic commerce website should accommodate these users.
- Poor usability presents a bad image for a company.
- Poor usability could increase running costs, e.g. toll free numbers.
- Users are not trained to use electronic commerce websites.
- Users of electronic commerce websites may not know what they are looking for, or not know if the electronic commerce system can solve their particular problem.

Huang [2003] further reinforces the notion that developing a usable electronic commerce website is not an easy task. There are various factors that need to be considered. He points out that there is no well-defined set of usability principles available. Most usability principles are vague. He further points out the concept of usability as subjective as well as scientific. Usability is dependent on the computing environment.

Tzanidou et al. [2005] argue that the majority of the existing electronic commerce website design guidelines have been derived from expert heuristic evaluation, apparently without involving the users themselves. Their research contradicts Nielsen’s [1996] heuristics that “place important information at the top of the page”. Their eye tacking research indicated that users looked at the centre of the screen when information was downloading and not the top of the screen. Tzanidou et al. [2005] point out several defects relating to heuristics. They focus in particular on banner advertisements,
product images and design layout. Their research also reveals that users adapt quickly to unexpected design layouts. This does question the concept of consistency. Bark et al. [2005] indicate that different human-computer interaction practitioners are using different techniques in their projects. The uses of these different usability techniques affect the usability of the final product.

There is thus no formula for the effective application of usability to an electronic commerce websites. Overall, electronic commerce researchers agree that electronic commerce websites should be consistent in the interface design, follow an understandable navigation strategy, and the information should be presented in a structured format. It seems to us that usability is part craft, part art and part science. Usability is only one aspect of the success formula for the development and maintenance of a viable electronic commerce website. Nielsen [2002] poses the question “Did poor usability kill electronic commerce?” His answer is “no”, but he points out various factors such as uncontrollable costs as a possible answer to the problems associated with poor electronic commerce. Nielsen argues that electronic commerce sites lose almost half their potential sales because the user cannot use the sites. He clearly states that “even a site that scores well on usability guideline compliance and enjoys the resulting good sales can go under.” This is probably because other uncontrollable factors affect the economic environment (see Chapter 1, Section 2.1).

4. Summary

In this chapter we mainly considered usability in the context of interaction design, and the various ways in which usability can be employed in the design of interactive products such as electronic commerce. In the context of this research question ‘Do usability aspects affect the design and development of the browsing experience in electronic commerce applications?’ We have noticed the following:

- The traditional approach of soliciting sales in a brick-and-mortar commerce, such as atmosphere, placement of goods, lighting, etc., do not transfer to online commerce. It is interaction and participation that are the emotional hooks for electronic commerce, and the developers of electronic commerce sites should bear this in mind in their development strategies (see Section 3.4).

- Electronic commerce users have evolved to become more sophisticated, and now demand powerful uncomplicated applications. Developing usable user interface is one main facet of developing these successful, powerful applications (see Section 3.3).

However, usability means different things to different role players. While some see usability as an additional expense, some see it as a necessary expense. With regard to usability guidelines, we have found that:
There are general usability guidelines that can be applied to electronic commerce websites. However, usability guidelines and principles tend to be very vague and generalistic. There are few domain-specific usability guidelines and principles for electronic commerce (see Section 3.3).

There are a few methods to apply and evaluate usability in an electronic commerce application, each with its own unique advantages and drawbacks. There are no universally accepted standards for electronic commerce evaluation (See Sections 3.2, 3.3 and 3.5).

In the context of our research, usability is only one piece of the puzzle in the development of a successful electronic commerce website. Our general belief is that by identifying the key stakeholders (we discuss this in Chapter 4) as well as introducing usability very early in the development process, the proposed electronic commerce website will be more successful. In terms of the electronic commerce application, there are two phases (see Chapter 2 Section 4.3.2): the interactive browsing and the sequential checkout phase – each phase requires a special form of interaction design; the same set of usability principles cannot be applied to both phases.

In the next chapter of this dissertation we focus on systems development approaches.

5. Note

Some of the works represented in this chapter has been published in a modified form, see attached CD for the full paper:


Summary: This paper describes cultural and social issues that could affect the success and design of effective electronic commerce websites. The paper focuses on social aspects and the appropriate use of suitable enabling technology.


Summary: This paper investigates the links between the socio-economic culture of users in the design of electronic commerce websites within the context of usability. This paper suggests that designers should look very carefully at the audience they are designing for.

Summary of chapter: This chapter is a summary of electronic commerce, development of electronic commerce applications, issues to be considered in usability, such as cognition, perception and physiology, culture and personality difference, and principles and guidelines to support usability.


Summary of chapter: This chapter is a summary of HCI in South Africa. The chapter covers e-activities in South Africa, the Electronic Commerce and Transaction Bill, and the state of the Internet in South Africa.


Summary of chapter: This chapter is a summary of general usability and web usability. The chapter discuss usability methods for the web.
Chapter 4

Systems Development

This chapter provides an overview of some of the major trends in systems development. In the chapter we review standards for systems development. We particularly focus on structured systems development methods, object-oriented methods, agile methodologies and interaction design methods. We then compare the different methodologies. The chapter ends by providing an example of how systems development went wrong and why usability is an important consideration in the design methodologies.

1. Introduction

In the previous chapter we discussed usability and the consequences of usability on electronic commerce. Our research question is ‘Do usability aspects affect the design and development of the browsing experience in electronic commerce applications?’ In this chapter we discuss software development methodologies. We argue that by introducing/incorporating aspects of usability very early in the development process, the users’ experience of the application will be enhanced.

Today, it is hard to imagine any industry or business that has not been affected by computer information systems and computer applications. Many businesses consider management of their information resources to be equal in importance to managing their other key resources such as property, facilities, employees and capital [Whitten et al., 2001]. The systems development life cycle (SDLC) is the process of understanding how an information system can support business needs, design the system, build it and deliver it to users [Dennis & Wixom, 2000].

The goal of the development of any computerised information system is to make human endeavour easier and safer. Whitten et al. [2001] define an information system as an arrangement of people, data, processes, information presentation and information technology that interact to support and improve day-to-day operations in a business, as well as support the problem-solving and decision-making needs of management and users. Satzinger et al. [2002] have a much narrower definition of information systems: ‘an information system is a collection of interrelated components that collect, process, store, and provide as output the information needed to complete a business task’. From an electronic commerce perspective we could also define electronic commerce as a computerised system with an arrangement of people, data, processes, information presentation and information technology that interact to support and improve online commerce transactions in a business, as well as support the problem-solving and decision-making needs of commerce management and users.
The definitions of both Whitten et al. [2001] and Satzinger et al. [2002] are essentially correct. These definitions provide the fundamental philosophical stance that they have adopted in their understanding of systems development. There is, however, an inherent defect in both definitions (philosophical stance), in that both the traditional structured systems development life cycle and object-oriented approaches tend to ignore the human (people) issues during systems development. A ‘user friendly’ interface is almost always slapped on to the developed system at the end. In fact, the critical flaw in the Satzinger et al. [2002] definition is that it leaves out the human aspect of the entire system altogether.

There are various development methodologies that are used in developing information systems, some more conventional than others. On the conventional side there are two major approaches to systems development methodologies that are used to develop information system applications: the traditional systems development methodology and the object-oriented development approach. More recently, agile development methodologies have started to emerge. The proponents of HCI and interaction design propose life cycle methodologies with a stronger user focus than the conventional approaches.

The user interface component has become a significant aspect of software projects, as 37% to 50% of design efforts throughout the software life cycle are related to the system's user interface [Vanderdonckt & Harning, 2003]. It is for this reason that the interaction design and its sub-fields play an important role in the development of any computerised system. Despite strong motivation amongst organisations and academics to practise and apply both effective software development and interaction design methods, several gaps still exist in understanding suggested practice and how software is actually developed in industry, and between the best practices in each of the fields. There are also several gaps in communication between the interaction design and software engineering fields: the methods and vocabulary being used in each community are often foreign to the other community. As a result, product quality is not as high as it could be, and (avoidable) re-work is often necessary [Vanderdonckt & Harning, 2003].

This chapter focuses on systems development in the context of their different development phases. In Section 2 we discuss the generic software process and in Section 3 we discuss standards for software development. In Section 4 we discuss various systems life cycle methodologies. In particular, we look at structured software life cycle methodology, object-oriented methodologies and agile methodologies. In Section 5 we discuss interaction design methodologies, and in Section 6 we discuss interactive systems design for the web and electronic commerce specifically. In Section 7 we compare the different techniques. In Section 8 we discuss usability as a key design issue, which is followed by a summary.
2. The Generic Software Process

The quality of developed information systems increases considerably when the development process is carefully managed. The system development life cycle is a widely used framework for organising and managing the process. A system development life cycle typically defines software processes that are completed by the project team as they move from the beginning to the end of the development project. The term ‘life cycle’ is used, because every information development project has a beginning and eventually an end. Between these points in time, the project ‘lives’ in one form or another.

Each project phase/process includes specific tasks, or steps, that the development team should follow, and each task or set of tasks usually results in a completed product, or deliverable. A deliverable is something finished or completed – often, a finished document or model describing something about the system, or a completed part of the system itself.

The phases/processes can be completed sequentially, although in practice they often overlap. There has been a move away from a sequential or waterfall approach to a more iterative approach, whereby previous parts of the life cycle can be revisited for further enhancement.

The generic software process is defined as a logical process by which systems analysts, software engineers, programmers, and end-users build information systems and computer applications to solve business problems and needs [Whitten et al., 2001].

Several authors have used the ‘building of a house’ metaphor to explain the software development process [Dennis & Wixom, 2000; Kendall & Kendall, 1999]. In many ways, building an information system is similar to building a house. There are several iterative steps:

- The house (or the information system) starts with a basic idea (or several ideas).
- This idea (chosen idea(s)) is transformed into a simple drawing that is shown to the customer and refined (often through several drawings, each improving on the other) until the customer agrees that the picture depicts what they want.
- A set of plans are designed that present much more detailed information about the house (or ‘information system’).
- The house (or ‘information system’) is built, following the plans – and often with some changes and decisions made by the customer as the house (or ‘information system’) is erected.

The generic software process has a similar set of four fundamental phases: planning, analysis, designs, and implementation (Table 4.1). Different projects may emphasise different parts of the generic software process or approach the generic software process phases in different ways, but all
projects have elements of these four phases. Each phase is itself composed of a series of steps which rely on techniques that produce deliverables [Dennis & Wixom, 2000].

Table 4.1 suggests that the generic software process phases and steps proceed in a logical path from start to finish. The generic software process does not propose a logical path or sequence to be followed. It just states the components and connection between the phases. This might be true, but in many projects the project teams move through the steps consecutively, iteratively, or in other patterns [Dennis & Wixom, 2000].
<table>
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<td>Conversion plan, Training plan</td>
</tr>
</tbody>
</table>

Table 4.1. Generic System Process Framework Elements (Source: Dennis & Wixom[2000])
Each of the phases of the generic software process will be briefly discussed below. It must be noted that these are the generic phases used in the generic software process, and that each particular information systems development methodology may vary in the approach used [Avison & Fitzgerald, 2003; Behan & Holmes, 1990; Brookes et al., 1986; Dennis & Wixom, 2000; Jackson, 1983; Stair & Reynolds, 2003; Turban et al., 1999; Whitten et al., 2001].

2.1. **Planning (Why build a system)**

The *planning phase* is the fundamental process of understanding *why* a computerised system should be built, as well as determining how the project team will go about building it. The planning phase has the following generic steps [Avison & Fitzgerald, 2003; Dennis & Wixom, 2000; Jackson, 1983; Kendall & Kendall, 1999; Pressman, 2001; Satzinger et al., 2002; Stair & Reynolds, 2003; Turban et al., 2001]:

- **Identify business values:** All systems have to address needs or they are likely to fail. Therefore, most organisations have a process for ensuring that business values have been identified before a development project can begin. Every organisation has its own way of initiating a system, but most start with a technique called a systems request. A systems request documents the business reasons for building the system and the value that the system is expected to provide.

- **Analysis feasibility:** A feasibility analysis is performed to ascertain the viability of the proposed system. It includes:

- **Technical feasibilities:** Focuses on whether the system can be built, by examining the risk associated with the users’ and analysts’ familiarity with the application, familiarity with the technology, and project size.
  - Economic feasibilities: Addresses whether the system should be built. It includes a cost-benefit analysis of development costs, tangible benefits, and intangible cost and benefits.
  - Organisational feasibilities: Assesses how well the system will be accepted by its users and incorporated into the ongoing operations of the organisation.

- **Develop a work plan:** A project manager creates a work plan that lists the tasks that need to be completed to meet the project’s objects. After the tasks are identified, using a top-down approach or an exiting methodology, the project manager estimates the amount of time and effort that will be needed to complete the project. Some of the factors that considered are:
  - The size of the project is estimated by relying on past experiences or industry standards or by calculating the function points – a measure of program size based on the number and complexity of inputs, outputs, queries, files, and program interfaces.
The project manager calculates the effort for the project, which is a function of the size and production rates. Algorithms like the COCOMO model can be used to determine the effort value.

The optimal schedule for the project is estimated, along with the number of staff members that should be assigned to the project.

- Staff the project: Staffing involves assigning project roles to team members, developing a reporting structure for the team, and matching people’s skills with the needs of the project. Information from these tasks is placed in the staffing plan. Staffing also includes motivating the team to meet the project’s objectives and minimising conflict among team members.

- Requirements gathering: Requirements gathering involves determining who the actual users are, who the stakeholders are and what the organisational needs are.

- Control and direct project: The final step of project management includes controlling and directing the project, which includes refining original estimates, tracking tasks, coordinating project activities, managing scope and mitigating risk.

### 2.2. Analysis (Who, what, when, where will the system be?)

The *analysis phase* answers several questions, such as: *who* will use the system, *what* the system will do, and *when* it will be used. During this phase, the project team investigates any current system(s), identifies improvement opportunities, and develops a concept for the new system. The analysis phase has the following generic steps [Avison & Fitzgerald, 2003; Dennis & Wixom, 2000; Jackson, 1983; Kendall & Kendall, 1999; Pressman, 2001; Satzinger et al., 2002; Stair & Reynolds, 2003; Turban et al., 2001]:

- **Analysis**: The basic process of systems analysis is divided into three steps: understanding the as-is (current) system, identifying improvements, and developing a concept for the to-be (new) system. There are three different strategies for analysis:
  - Business process automation, which seeks to automate but not to make major changes to the underlying business processes.
  - Business process improvement, which seeks to make moderate changes to the business process.
  - Business process reengineering, which seeks to radically change how the organisation runs its business.

- **Information gathering**: Information gathering is a process of collecting information about system problems, opportunities, solution requirements, and priorities. Some of the information gathering techniques that are used are:
  - Sampling of existing documentation, reports, forms, files, databases, and memos.
  - Research of relevant literature, benchmarking others’ solutions, and site visits.
  - Observation of the current system in action and the work environment.
• Questionnaires and surveys of the management and user community.
• Interviews with appropriate managers, users and technical staff.

• Process modelling: Process modeling is a formal way of representing how a business system operates. It illustrates the processes or activities that are performed and how data moves among them.

• Data modelling: A data model describes the data that support the business processes in the organisation. During the analysis phase, that data model presents the logical organisation of data without indicating how the data are stored, created, or manipulated so that analysis can focus on the business without being distracted by technical details. During the design phase, the data model is changed to reflect exactly how the data will be stored in databases and files.

2.3. Design (How will the system work?)

The design phase describes how the system will operate, in terms of the hardware, software, and network infrastructure; the user interface, forms and reports that will be used and the specific programs, databases and files that will be needed. The interface design specifies how the users will move through the system (i.e. navigation methods such menus and on-screen buttons) and the forms and reports that the system will use. The design phase has the following generic steps [Avison & Fitzgerald, 2003; Dennis & Wixom, 2000; Jackson, 1983; Kendall & Kendall, 1999; Pressman, 2001; Satzinger et al., 2002; Stair & Reynolds, 2003; Turban et al., 2001]:

• Physical design: The physical design phase includes most of the work required to fit the logical design into the target hardware/software environment. Although program specifications are not produced until later in the project, processing sequences are determined, as are all aspects of codes, input-output media, database design, communications network specifications, and implementation plans.

• Architecture design: The architecture design describes the proposed technical environment for the new system. This technical environment contains the hardware, software and communications infrastructure on which the new system will be created, and the methods for supporting the system’s security needs and global requirements. The deliverable from architecture design contains the network model, the hardware and software specifications, and the plan for security and global support.

• Interface design: Meeting the needs of users who demand power without complication has made the computer industry increasingly sensitive to the design of the user interface. This could be the most important determinant of success for electronic commerce. In fact, to many users, the interface is the system [Turban & Aronson, 1998]. The user interface design defines the way in which the users will interact with the system and the inputs and outputs that the system accepts and produces. The user interface includes three fundamental parts:
• The first is the navigation mechanism: the way in which the user gives instructions to the system and tells it what to do (e.g. buttons, menus).

• The second is the input mechanism: The way in which the system captures information (e.g. forms for adding new customers).

• The third is the output mechanism: The way in which the system provides information to the user or to other systems (e.g. reports, web pages).

• Each of these is conceptually different, but all are closely intertwined: All computer displays contain navigation mechanisms, and most contain input and output mechanisms.

Whitten et al. [2001] provide taxonomies for classifying computer-generated outputs (see Appendix B), input taxonomy (see Appendix C) and screen output design principles (see Appendix D).

2.4. Implementation

The final phase in the generic software process is the implementation phase, during which the system is actually built (or purchased, in the case of a packaged software design). The first step in implementation is system construction, during which the system is built and tested to ensure it performs as designed. Deliverables during this step include programs, the test plan, user documentation and the tested system. A conversion strategy is adopted to implement the system, and the system is implemented [Avison & Fitzgerald, 2003; Dennis & Wixom, 2000; Jackson, 1983; Kendall & Kendall, 1999; Pressman, 2001; Satzinger et al., 2002; Stair & Reynolds, 2003; Turban et al., 2001].

A key aspect of the implementation phase is the training of the final users of the system. Training increases user efficiency. We strongly believe that a good training program helps with the usability of the software [Avison & Fitzgerald, 2003; Dennis & Wixom, 2000; Jackson, 1983; Kendall & Kendall, 1999; Pressman, 2001; Satzinger et al., 2002; Stair & Reynolds, 2003; Turban et al., 2001].


Various systems development methodologies have been produced over the years, and standards are also being compiled for software life cycle development. Before we discuss specific systems development methodologies, we will discuss one such standard, namely, the ISO/IEC 12207.

According to Singh, as reported by Gray [1996], the editor of ISO/IEC 12207, this international standard on software life cycle processes was created to establish a common international framework to acquire, supply, develop, operate and maintain software. ISO/IEC 12207 was proposed in 1988 and published in August 1995.
ISO/IEC 12207 offers a framework for software life cycle development, from conception through to the systems retirement. It is especially suitable for acquisitions because it recognises the distinct roles of acquirer and supplier. The standard is intended for two-party use where an agreement or contract defines the development, maintenance or operation of a software system. It is not applicable to the purchase of commercial off-the-shelf software products [Rosa & Moore, 1998].

This standard describes the major component processes of a complete software life cycle and the high-level relations that govern their interactions. ISO/IEC 12207 describes the following life cycle (see Figure 4.1) processes [ISO/IEC 12207, 1995; Rosa & Moore, 1998; Singh, 2001]:
- Primary processes: Acquisition, supply, development, operation and maintenance.
- Supporting processes: Documentation, configuration management, quality assurance, verification, validation, joint review, audit, and problem resolution.
- Organisation processes: Management, infrastructure, improvement and training.

![Figure 4.1. ISO/IEC 12207 Standard](image)

ISO/IEC 12207 also describes how to tailor the standard for a project [Rosa & Moore, 1998].

The 12 engineering activities in ISO/IEC 12207 are listed below [Gray, 1996]:
- System requirements analysis


- System architectural design
- Software requirements analysis: Concludes with successful reviews followed by the establishment of a baseline for the software requirements
- Software architectural design
- Software detailed design
- Software coding and testing
- Software integration
- Software qualification testing: Concludes with successful audits followed by the establishment of a baseline for the software design and code
- System integration
- System qualification testing: Concludes with successful audits followed by the establishment of a baseline for the design and code of each software configuration item
- Software installation
- Software acceptance test.

This standard does not explicitly mention usability. It does, however, allude to it in the system qualification testing and the software acceptance testing. It may, however, be a bit too late in the design process to look at this issue for the first time.

4. Software Life Cycle Methodologies

There are three main systems development methodologies that use the phases of the software process in a variety of ways. These methodologies can generally be classified as belonging to one of three categories:

- Structured methodology.
- Objected-oriented methodology.
- Agile methodology.

Each of these methodologies has a number of models following the philosophy of the methodologies (e.g. the waterfall model within structured methodologies specific software process models uses the generic process framework activities in various ways, applies a different emphasis to these activities and defines a workflow that involves each framework activity in a different manner. Each model uses a number of methods. For example UML is used on OMT). The software engineering process model is the glue that holds and enables rational development of software. Software engineering methods provide the technical ‘how to’s’ for building software, and software engineering tools provide automated/semi automated support for the processes and methods. We will briefly discuss these methodologies in the context of the generic software process.

4.1. Structured Software Life Cycle Methodologies

Traditional structured development approaches include methodologies such as Structured Analysis and Design Techniques (SADT) [Ross, 1985], The Yourdon Systems Method (YSM) [Yourdan Inc,
1993], Specification and Description Language (SDL) [Belina & Hogrefe, 1989], Information Engineering and Jackson System Development (JSD) [Jackson, 1983], the Dennis and Wixom methodology [Dennis & Wixom, 2000], etc. These methodologies all have the following general phases in common: planning, analysis, design and implementation. Most of these development approaches follow the waterfall approach, or are iterative variations on the waterfall approach. Below is a brief summary of the examples of structured development methodologies:

4.1.1. Waterfall Development

The waterfall development process proceeds in sequence from one phase to the next, as illustrated in Figure 4.2. It is, however, possible to go backwards in the development cycle (e.g. from design back to analysis). This development methodology is very close to the generic software development process.

Pressman [2005] identifies five phases in the waterfall model. These phases are:

- Communication: This phase is made up of the following sub-phases – project initiation and requirements gathering. This phase does not map on to the generic software process model. This is, however, an improved addition.
- Planning: This phase is made up of the following sub-phases – estimating the feasibility of the project, scheduling the activities of the project and tracking the project. This phases maps directly on to the generic software process model.
- Modelling: This phase is made up of the following sub-phases – analysing the problem and designing a solution to the problem. This phases maps directly on to the generic software process model.
- Construction: This phase is made up of the following sub-phases – coding the software and testing the software. This phases maps directly on to the generic software process model.
4.1.2. Parallel Development

The parallel development methodology attempts to address the problem of long delays between the analysis phase and the delivery of the system. Instead of doing the design and implementation in sequence, it performs a general design for the whole system and then divides the project into a series of distinct subprojects that can be designed and implemented in parallel, as illustrated in Figure 4.3. The parallel development methodology is different from the generic development process in that several design and implementation subsets are done in parallel.

Dennis and Wixom [2000] describe the phases of the parallel development methodology as follows:

- Planning: The planning phase is the process of understanding why the information system should be built, and the strategy for building the information system is developed. This process follows a sequential format.
• **Analysis:** The analysis phase analyses the business environment, the proposed nature of the information system, and how the information system will be used. This process follows a sequential format.

• **Design:** In the design phase a design strategy is developed, taking into consideration the relevant outcomes. This process follows a parallel format for a partial subset of the project.

• **Implementation:** In this phase the information system is coded, tested and implemented. This process follows a parallel format for a partial subset of the project. Final implementation is then an integrated process of the design and implementation parallel phases.

Dennis and Wixom [2000] do not fully explain how the parallel development aspects of this methodology works.

**4.1.3. Rapid Application Development**

Rapid application development (RAD) attempts to address the weaknesses of the structured development methodologies, the long development times and the difficulty in understanding a system from a paper-based description. RAD methodologies adjust the generic software processes’ phases to get some part of the system developed quickly and into the hands of the users [Dennis & Wixom, 2000]. Below is a summary of the different types of RAD design methodologies:

• **Prototyping:** The prototyping methodology performs the analysis, design and implementation phases concurrently, and all three phases are performed repeatedly in a cycle until the system is completed, as illustrated in Figure 4.5. The prototyping methodology has the same elements as the generic software process. The differences are that the analysis, design and implementation phases run concurrently, and all three phases are performed repeatedly in a cycle until the system is completed.

• **Throwaway Prototyping:** The throwaway prototyping methodology is similar to the prototyping methodology in that it includes the development of prototypes. Throwaway prototypes, however, are done at a different stage in the development process, as illustrated in Figure 4.6. The throwaway prototyping methodology has the same elements as the generic software process. The difference is that the analysis, design and implementation phases are interactive – all three phases are performed repeatedly until the prototype is designed and accepted. The prototype is tested and re-analysed, then redesigned and then implemented.
4.1.4. Dennis and Wixom’s interpretation of the Traditional Systems Development Methodology

We will now briefly discuss the Dennis and Wixom [2000] interpretation of the traditional development methodology, as illustrated in Figure 4.7. This is a contemporary approach to structured development. The Dennis and Wixom [2000] methodology consists of the following phases:

- Planning (why build the system?): Identify business values, analyse feasibility, develop work plan, staff the project, and control and direct project.
- Analysis (who, what, when, where will the system be?): Analysis, information gathering, process modelling and data modelling.
- Design (how will the system work?): Physical design, architecture design, interface design, database and file design, and program design.
- Implementation (system delivery): Construction and installation of system.

Dennis and Wixom [2000] describe their user interface design aspect as consisting of:
- Develop use scenarios (generic user).
- Design interface structure.
- Design interface standards.
- Design user interface template.
- Design user interface.
- Evaluate user interface.

Although the ‘interface design’ is included in the Dennis and Wixom methodology, we feel that these steps are conducted much too late in the design phase. Most of the other structured development methodologies do not even address the issue. The structured development approach therefore relegates the design of the user interface (and the human-related issues) to the design phase of the development life cycle – this is quite late in the development process. The user interface will only be tested in the implementation stage.

We assessed the Dennis and Wixom interpretation of the traditional development methodology against each of the components depicted in Figure 1.3. of Chapter 1. We did this comparison to investigate the versatility of the methodology. Table 4.2 (Section 7) summarises our findings.

4.1.5. Mutations of the Classical Structured Development Methodology

There are several mutations of the classical structured development methodology. A few of these will be briefly discussed. All these mutations of the classical structured development methodology contain elements of the generic software process. The difference is that each mutation was designed to focus and solve particular problems. We believe that while solving some of these problems, other problems were created.

4.1.5.1. Incremental Methodology

With this approach, software is constructed step by step in the same way that a building is constructed [Schach, 2002]. This methodology applies a linear sequence in a staggered fashion over a period of defined time. Each of the linear sequences produces a deliverable ‘increment’ of the software [Pressman, 2001]. Schach [2002] further elaborates that while the proposed software product is in the process of being developed, each step adds to the previous steps. In effect, the design is extended and another module is coded. The construction of the complete product proceeds incrementally until the project is completed. The incremental methodology is depicted in Figure 4.8. The product is designed, implemented, integrated and tested as a series of incremental builds, where a building consists of code pieces from various modules interacting to provide a specific function.
capability [Schach, 2002]. One problem that many have been created is that the analysis and re-
analysis is not user centred.

4.1.5.2. Extreme Programming

Extreme Programming (also considered as an agile method), as illustrated in Figure 4.9, is based on
the incremental methodology. The goal behind extreme programming is to support the quick
development of software [Avison & Fitzgerald, 2003]. The software development team determines
the various features (stories) that the client would like in their product. For each feature, the team
informs the client how long it will take to implement that feature and how much it will cost. The
client selects the features to be included in each successive build using a cost-benefit analysis. The
proposed build is broken down into smaller pieces termed ‘tasks’. A programmer first draws up test
cases for a task. Then, using a technique called pair programming, the programmer implements the
task, ensuring that all the test cases work correctly. The task is then integrated into the current
version of the product [Schach, 2002]. Extreme programming can, in short, be described as a series
of principles for the development of software rapidly, rather than a step-by-step methodology
[Avison & Fitzgerald, 2003]. The problem with this approach is that it is not a logical step-by-step
approach.

Figure 4.8. Incremental Methodology
4.1.5.3. **Synchronise-and-Stabilise Methodology**

The requirements analysis phase for the synchronise-and-stabilise methodology is conducted by interviewing numerous potential customers for the proposed system, which leads to a list of features with priorities set by the customer. A specification document is drawn up, based on the customer’s wish list. The work is divided into three of four builds as follows:

- The first build consists of the most critical features.
- The second build consists of the next critical features, and so on.
- Each build is carried out by a number of small teams working in parallel.
- At the end of each day all the teams synchronise – that is, they put together the partially completed components and test and debug the resulting product. Stabilisation is performed at the end of each build. Any remaining faults that have been detected are fixed, and the build is frozen – that is, no further changes will be made to the specification [Schach, 2002].

The problem with this approach is that it may be difficult to project manage the entire process.
4.1.5.4. **Spiral Methodology**

This methodology (Figure 4.10) combines the iterative characteristics of prototyping with the control and systematic nature of the linear sequential methodology [Boehm, 1988; Pressman, 2001]. The idea of minimising risk via the use of prototypes and other means, is the underlying philosophy of the spiral methodology [Schach, 2002]. The problem with this approach is that it is not user centred.

![Simplistic version of spiral methodology](image)

**Figure 4.10.** Simplistic version of spiral methodology

### 4.2. **Object-oriented Methodologies**

Booch [1991] suggests that the concept of object-orientation emerged simultaneously in a number of different fields in the 1970s, including computer architecture and operating systems, databases, cognitive science, and artificial intelligence. Bahrami [1999], on the other hand, associates the development of object orientation with the early programming languages – in particular, Simula and Smalltalk. The basic object-oriented concepts are quite different from traditional information systems development, since there is philosophically a fundamental difference in the manner in which the problems are approached [Avison & Fitzgerald, 2003].
Object-oriented development also follows the typical phases of the generic software process. Although the distinctions between the analysis, design and implementation phases are still important and useful from a conceptual point of view, in practice the distinctions become blurred, and object-oriented system development typically proceeds like this [Bahrami, 1999; George et al., 2007; Rumbaugh et al., 1991; Satzinger & Orvik, 2001; Satzinger et al., 2002; Schach, 2002; Schach, 2005; Strumpf & Teague, 2005; Unhelkar, 2005a; Unhelkar, 2005b]:

- Requirements phase.
- Object-oriented analysis phase.
- Object-oriented design phase.
- Object-oriented programming phase
- Integration phase.
- Maintenance phase.
- Retirement.

We briefly discuss the requirements phase, the analysis phase and the design phase, as these are key to this dissertation. In the requirements phase, much like the structured software approach, the design team meets with the clients and gathers the relevant data to determine what is needed by the organisation. The analysis phase does not really end abruptly. The design and implementation activities are often done in parallel with the analysis activities. After the system definition is agreed to and the main use cases have been identified, two major activities in the object-oriented analysis process are usually carried out in parallel, with lots of iteration:

- Build a class diagram with the capability to satisfy the requirements.
- Develop scenarios through sequence diagrams.

The object-oriented design phase, like traditional system design, is the phase that takes the requirements model and uses it to develop more physical models that show how the new system will actually be implemented. The user interface is designed, controls are designed, and technical issues affecting implementation are resolved.

The user interface objects and the communication protocols are added to the requirements model and scenarios during object-oriented design. The user interface objects required in the system can be shown on a class diagram.

There is a great deal of diversity within the object-oriented community. Many object-oriented designers and developers, for example, seem to focus almost entirely on programming language issues. They tend to cast all discussions in terms of the syntax and semantics of their chosen object-oriented programming language. For example, to fully leverage IBM's design approach, IBM assumes the target language to be Smalltalk. Often, an evaluation of methodology requires the
An evaluator to understand the target platforms for which the methodology is intended [The Object Agency, 1993].

Another sector of the object-oriented community is interested in formality and rigour. To this group, software engineering is largely very systematic, repeatable and transferable. They view object-oriented software engineering as primarily an engineering process with well-defined deliverables. The quality of the resulting products (and the process itself) can be evaluated in a quantitative, as well as qualitative, manner [The Object Agency, 1993].

The object-oriented development approach in general lends itself to the development of more effective user interfaces because of the iterative design process, although this process does not seem to be effectively managed, and guidelines for doing so are often absent.

There are various object-oriented methodologies, such as Objectory [Jacobson, 1994], Unified Modelling Language [Bahrami, 1999], Coad and Yourdon Method [Coad & Yourdon, 1991a], Booch Method [Booch, 1987], Object Modelling Technique [Rumbaugh et al., 1991], IBM approach [IBM, 1990a; IBM, 1990b; IBM, 1990c; IBM, 1999] and Object-oriented Business Engineering [Jacobson, 1994], etc. We will briefly discuss the following: the object modelling technique, the Coad and Yourdan methodology and the IBM methodology. We assessed the object modelling technique, the Coad and Yourdan methodology and the IBM methodology against each of the components depicted in Figure 1.3. of Chapter 1. We do this comparison by investigating the versatility of the methodologies. Table 4.2 (section 7) summarises our findings.

### 4.2.1. The Object Modelling Technique

The Object Modelling Technique (OMT) [Rumbaugh et al., 1991] has three distinct phases, which are: analysis, system design and object design:

- The goal of the analysis phase is to design a model of what the proposed system will do. The model is expressed in terms of objects and relationships, dynamic control flow, and functional transformations. The process of capturing requirements and consulting with the client should continue throughout analysis. The analysis phase has the following sub-phases: write or obtain an initial description of the problem (problem statement); build an object model; develop a dynamic model; construct a functional model; and, verify, iterate and refine the three models.

- During the systems design phase, the high-level structure of the system is chosen. This means that the systems design phase focuses on the layout for the components that are needed to construct and complete the software. The information from the analysis phase is used to develop subsystems which are then allocated to processes and tasks. There are several canonical architectures that can serve as a suitable starting point.

- During object design the analysis model is elaborated on, and a detailed basis for implementation is provided. Decisions are made that are necessary to realise the system without descending into the particular details of an individual language or database system. This phase has the following
sub-phases: obtain operations for the object model from the other models; design algorithms to implement operations; optimise access paths to data; implement software control by fleshing out the approach chosen during system design; adjust class structure to increase inheritance; design implementation of associations; determine the exact representation of object attributes; and, package classes and associations into modules.

4.2.2. The Coad and Yourdan Methodology

The Coad and Yourdon [Coad & Yourdon, 1991a] methodology consists of two phases – the object-oriented analysis and the object-oriented design phase:

- The object-oriented analysis phase identifies and defines classes and objects which directly reflect the problem domain and the system’s responsibilities within it. The analysis phase has the following sub-phases: identify objects, identify structures, identify subjects, define attributes and define services.
- The object-oriented design phase identifies and defines additional classes and objects, and reflects on the implementation of the requirements. It has the following sub-phases: design the problem domain component, design the human interaction component, design the task management component and design the data management component.

In the Coad and Yourdon [1991b] methodology there is therefore an active component for the design of the interaction between human and machine. This component, the human interaction component, consists of the following activities: classify the humans, describe the humans and their task scenarios, design the command hierarchy, design the detailed interaction, continue to prototype, design the human interaction component classes, and design and account for graphical user interfaces (when applicable).

4.2.3. The IBM Methodology

The IBM methodology [IBM, 1990a; IBM, 1990b; IBM, 1990c; IBM, 1999] consists of two phases: the object-oriented design phase and the business model phase:

- The object-oriented design phase has the following sub-phases: Define business transactions, capture the user's model, specify the objects, build the view, and code and test the view.
- The business model design phase has the following sub-phases: Find the technical model objects, implement the model objects, code and test the classes, and build the objects.

The methodology therefore includes two specific user-oriented phases, i.e. capture the user’s model phase and build the view phase. These two phases include the following sub-components:

- Model the user's objects, model the user's behaviour, enhance the user's model, provide natural interaction techniques, extract the object, document the user's model, and validate and iterate.
- Design direct manipulation actions, decompose the model objects, define instance variables, and design the windows.
4.3. Agile Methodologies

Manufacturing companies operate in an increasingly volatile business environment. The company that can constantly reorganise its human and technical resources to deliver improved products and services before its rivals, will attain business success. Customers are demanding that products are customised to meet their individual needs, and are no longer willing to be constrained by manufacturers adopting the Henry Ford dictate of being able to buy any Model T car as long as it is black. In the manufacturing industry the agile approach can be defined as a strategic framework which forces a company to respond to changing customer demands and market opportunities rather than optimising internal processes. Agile manufacturing is a strategic, top-down, long-term approach to manufacturing, which focuses on the ability of the business to continually transform itself as it responds to a constantly changing marketplace [Balint & Nottingham, 1997]. There are close parallels between the manufacturing industry’s volatile business environment and that of the electronic commerce business environment. Some agile development methodologies (ADM) are being used in the design and development of electronic commerce applications.

ADM is a practice-based methodology for modelling and documentation of software-based systems [Aydin et al., 2004]. ADMs is a collection of values, principles and practices for modelling software that can be applied to a software development project in an effective and lightweight manner. Ambler [2003] claims that ADMs are more effective than traditional development, because ADMs are just “barely good enough”. ADMs do not have to be perfect.

Abrahamsson et al. [2003] report that scientific research on ADMs is scarce. The comparative analysis that they performed used the method’s life cycle coverage, project management support, type of practical guidance, fitness-for-use and empirical evidence as the analytical lenses. The results show that agile software development methodologies, without rationalisation, cover certain/different phases of the software development life cycle and most of them do not offer adequate support for project management. Yet, many methodologies still attempt to strive for universal solutions (as opposed to situation appropriate) and the empirical evidence is still very limited.

ADM advocates subscribe to the following principles [Agile Alliance, 2003; Satzinger & Orvik, 2001; Williams & Cockburn, 2003]:

- Individuals and interactions are given preference to, over processes and tools.
- Working software is given preference to, over comprehensive documentation.
- Customer collaboration is given preference to, over contract negotiation.
- Responding to change is given preference to, over following a plan.

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ADMs follow a three-pronged approach based on values, principles, and practices [Ambler, 2003]. The values of ADMs are:
• Communication: Promotes communication between the team and the project stakeholders, as well as between developers on their team.

• Simplicity: It is important that developers understand that ADMs are critical for simplifying both software and the software process. It is much easier to explore an idea and improve upon it as one’s understanding increases, by drawing a diagram or two, instead of writing tens or even hundreds of lines of code.

• Feedback: By communicating ideas through diagrams, developers quickly gain feedback, enabling the developers to act on that advice.

• Courage: Developers need to make important decisions and be able to change direction by either discarding or refactoring their work when some of their decisions prove inadequate.

• Humility: Developers have the humility to recognise that they do not know everything, and that their fellow developers, their customers, and in fact all project stakeholders also have their own areas of expertise and have value to add to a project.

The principles of ADMs are:

• Assume simplicity: The simplest solution is the best solution.

• Embrace change: Requirements evolve over time. The implication is that the project environment changes as the development efforts progress, and, as a result, the approach to development must reflect this reality.

• Enabling the next effort is the secondary goal: A system should be robust enough to enable it to be extended over time.

• Incremental change: Develop a small model, or perhaps a high-level model, and evolve it over time (or simply discard it when you no longer need it) in an incremental manner.

• Maximise stakeholder investment: Stakeholders deserve to invest their resources the best way possible and not to have resources wasted by the team.

• Model with a purpose: Developers need to understand their project well, they need to communicate their approach to senior management to justify their project, and they may need to create documentation that describes their system to the people who will be operating and/or maintaining/evolving it over time.

• Multiple models. Developers may need to use multiple models to develop software, because each model describes a single aspect of their software.

• Quality work: Nobody likes inaccurate work.

• Rapid feedback: The time between an action and the feedback on that action, is critical. By working with other people on a model, particularly when one is working with a shared modelling technology (such as a whiteboard, CRC cards or essential modelling materials such as sticky notes) you are obtaining near-instant feedback on your ideas. Working closely with your customer to understand the requirements, to analyse those requirements, or to develop a user interface that meets their needs, provides opportunities for rapid feedback.

• Software is your primary goal: The goal of software development is to produce software that meets the needs of your project stakeholders in an effective manner.
• Travel light. Every artifact that you create, and then decide to keep, will need to be maintained over time. If you decide to keep seven models, then whenever a change occurs (a new/updated requirement, a new approach is taken by your team, a new technology is adopted, etc.) you will need to consider the impact of that change on all seven models, and then act accordingly. A development team that decides to develop and maintain a detailed requirements document, a detailed collection of analysis models, a detailed collection of architectural models and a detailed collection of design models, will quickly discover it is spending the majority of its time updating documents, instead of writing source code.

The practices of ADMs are:

• Active stakeholder participation: The need to have on-site access to users who have the authority and ability to provide information pertaining to the system being built, and to make pertinent and timely decisions regarding the requirements, and prioritisation thereof.

• Apply the right artifact(s): Each artifact has its own specific applications. For example, a UML activity diagram is useful for describing a business process, whereas the static structure of a database is better represented by a physical data or persistence model.

• Collective ownership: Everyone can work on any model, and, in fact, any artifact on the project, if they need to.

• Consider testability: When modelling, one should be constantly asking oneself "How are we going to test this?", because if one cannot test the software that is being built, one should not be building it.

• Create several models in parallel: Because each type of model has its strengths and weaknesses, no single model is sufficient for one’s modelling needs.

• Create simple content: One should keep the actual content of the models (requirements, analysis, architecture or design) as simple as possible, while still fulfilling the needs of the project stakeholders.

• Depict models simply: A simple model that shows the key features one is trying to understand, perhaps a class model depicting the primary responsibilities of classes and the relationships between them, often proves to be sufficient.

• Display models publicly: Display the models publicly, often on something called a ‘modelling wall’ or a ‘wall of wonder’.

• Iterate to another artifact: When one is working on a development artifact, such as a use case, CRC card, sequence diagram, or even source code, and one finds that one is ‘stuck’, then one should consider working on another artifact for the time being. By iterating to another artifact one immediately becomes ‘unstuck’ because one is making progress working on that other artifact.

• Model in small increments: Incremental development in which one organises a larger effort into smaller portions that one releases over time, hopefully in increments of several weeks or a month or two, increases agility by enabling one to deliver software into the hands of the users faster.
• Model with others: Developers often find that they are modelling to understand something, that they are modelling to communicate an idea to others, or are seeking to develop a common vision for the project. This is a group activity – one in which developers want the input of several people working together effectively.

• Prove it with code: A model is an abstraction – one that should accurately reflect an aspect of whatever the developer is building. Will the model work? To determine this, one should prove the model with code.

• Use the simplest tools. The vast majority of models can be drawn on a whiteboard, on paper or even the back of a napkin. Whenever one wants to save one of these diagrams, one can take a picture of it with a digital camera, or even simply transcribe it onto paper.

There are various agile development methodologies [Abrahamsson et al., 2003]. For example:

• Adaptive software development [Highsmith, 2000] offers solutions for the development of large and complex systems. This methodology encourages incremental and iterative development, with constant prototyping. Adaptive software development attempts to provide a framework with enough guidance to prevent projects from falling into ‘chaos’.

• Agile modelling [Ambler, 2002] focuses on modelling practices and cultural principles. The underlying idea is to encourage developers to produce sufficiently advanced models to support acute design needs and documentation purposes. The aim is to keep the number of models and documentation as low as possible. Cultural issues are addressed by depicting ways to encourage communication, and to organise team structures and ways of working.

• The Crystal family of methodologies [Cockburn, 1998; Cockburn, 2000; Cockburn, 2002] includes a number of different methodologies from which to select the most suitable one for each individual project. Besides the methodology, the Crystal approach also includes principles for tailoring these methodologies to fit the varying circumstances of different projects. Each member of the Crystal family is marked with a colour indicating the ‘heaviness’ of the method. Crystal suggests choosing the appropriately – coloured method for a project based on its size and criticality. Larger projects are likely to ask for more coordination and heavier methodology than smaller ones. Crystal methodologies are open for any development practices, tools or work products, thus allowing the integration of, for example, XP and Scrum practices.

• Dynamic systems development method [DSDMConsortium, 1997; Stapleton, 1997] has, as a fundamental idea, that instead of fixing the amount of functionality in a product and then adjusting time and resources to reach that functionality, it is preferred to fix time and resources, and then adjust the amount of functionality accordingly. Dynamic systems development method provides a framework for an iterative and incremental approach to the development of a system. The origins of Dynamic systems development method are in rapid application development.

• Feature-driven development [Coad et al., 2000] is a process-oriented software development method for developing business critical systems. The Feature-driven development approach focuses on the design and building phases. The Feature-driven development approach embodies iterative development with the practices believed to be effective in industry. The specific blend
of these ingredients makes the Feature-driven development processes unique for each case. It emphasizes quality aspects throughout the process and includes frequent and tangible deliveries, along with accurate monitoring of the progress of the project.

- Internet-speed development [Baskerville et al., 2001; Baskerville & Pries-Heje, 2001; Cusumano & Yoffie, 1999] refer to a situation where software needs to be released fast, thereby requiring short development cycles. ISD Internet-speed development puts forth a descriptive, management-oriented framework for addressing the problem of handling fast releases. This framework consists of time drivers, quality dependencies and process adjustments.

- Pragmatic programming [Hunt & Thomas, 2000] introduces a set of programming ‘best practices’. It puts forward techniques that concretely augment the practices discussed in the other agile methodology. Pragmatic programming covers most programming practicalities. The ‘method’ itself is a collection of short tips that focus on day-to-day problems, there are a total of 70 of them. These practices take a pragmatic perspective and place focus on incremental, iterative development, rigorous testing, and user-centred design.

- Scrum [Schwaber, 1995; Schwaber & Beedle, 2002] approach has been developed for managing the software development process in a volatile environment. It is an empirical approach based on flexibility, adaptability and productivity. Scrum leaves open for the developers to choose the specific software development techniques, methods and practices for the implementation process. It involves frequent management activities aiming at consistently identifying any deficiencies or impediments in the development process as well as the in the practices that are used.

Each ADM has its own approach to the development of an information system. The overall defect with these approaches can be illustrated from a manufacturing industry perspective, when, if agility is applied, the product results can be measured. There is only so much of customisation that can be made on a C Class Mercedes. In contrast, in the IT industry it is hard to measure the outcome of the product.

Furthermore, from an interaction perspective, ADM do not explicitly state how and where usability should be considered in the development of the product. Agile methodologies pay little attention to usability. The results of work done by Jokela and Abrahamsson [2004] reveal that, for example, extreme programming pays almost no attention to the usability of the software, apart from some actions that can be regarded as implicit usability evaluations. Several researchers have, however, recently worked on the development of approaches for integrating usability into AMDs [Constantine & Lockwood, 2003; Patton, 2002]. ADMs also do not seem to pay much attention to documenting their activities. Andrew and Lethbridge [2002] point out that document content can be relevant even if it is not up to date, and that documentation is an important tool for communication.
5. Interaction Design

There are two types of users for most computer systems: those with experience and those without. Interfaces should be designed to be suitable for both types of users. Novice users are most concerned with the ease of learning, i.e. how quickly they can learn new systems. Expert users are usually most concerned with ease of use [Dennis & Wixom, 2000]. Inexperienced users are often not prepared or not equipped to learn the computer-oriented details typically required of experienced users. Often, inexperienced users expect to walk up and use an application as easily as they use the telephone or a car [Turban, 1995] (even though initially these things have to be learned).

One of the problems with the traditional methodology for software development is that it does not clearly identify a role for interaction design issues at any point in development. User interface concerns are mixed in with wider development activities. This may result in one of two problems. Either interaction design issues are ignored, or they are relegated to the later stages of design, as an afterthought. In either case, the consequences can be disastrous. If interaction design issues are ignored, there is a good chance that problems will occur in the testing and maintenance stages. If interaction design is relegated to the later stages in the development cycle, then it may prove very expensive to ‘massage’ application functionality into a form that can be readily accessed by the user. In either case, the cost of introducing ‘usability’ issues will rise, the later one postpones it in the development cycle.

With the widespread introduction of information and communication technology in our everyday lives, most computer users today have limited computer experience, but are expected to use such systems. Most computer users have limited computer experience in a particular domain. The interaction design proponents aim to focus more on these human and end-user aspects. In this section we will discuss several interaction design related software process methodologies.

5.1. A Simple Interaction Design Methodology

Preece et al. [2002] suggest an interaction design model that is based on their observations of interaction design and on their research. This approach incorporates interaction design and encourages a user focus. The outputs from each activity are not specified in the methodology. The methodology is a possible framework for designing interactive products (see Figure 4.11). The model is not intended to be prescriptive; Preece et al. [2002] state that this model does not have to be used to design all interactive software. This methodology consists of: identify needs/establish requirements; evaluate; build an interactive version; and, re-design. Mandel [1997] suggests a similar development methodology to that of Preece et al. [2002]. Other life cycle methodologies that focus on interaction design aspects include the Star methodology of Hartson and Hix [1989].
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5.2. Interaction Design Related Life Cycle Methodologies

The development of good user interface designs may amount to an unattractive choice between dismissing programmers to hire interaction design specialists, or investing in the re-training of existing personnel in interaction design techniques [Downton, 1993].

Common to all the systems methodologies is that at some stage designers have to take time out to design the method of interaction between users and machine. Figure 4.12 shows how an awareness of interaction design guidelines can be exploited at various stages in the development cycle [Downton, 1993].

Figure 4.11. A simple Interaction Design Methodology [Preece et al., 2002]
Figure 4.13 shows a variety of ways in which practitioner and specialist level knowledge can be applied to the software process. These techniques are usually best applied within multi-disciplinary project groups which include expertise in the human sciences, as well as personnel with computer science and engineering backgrounds [Downton, 1993]. This approach can also be applied to the development of electronic commerce websites.
Both of these approaches are an attempt to improve the traditional systems development methodology by focusing on the human aspects of the systems development. There are methodologies that strongly focus on interaction design. In the next section we discuss one such methodology – the usability engineering life cycle methodology.

### 5.3. Usability Engineering Life Cycle Methodology

Mayhew [1999] suggests the following usability engineering life cycle methodology, as illustrated in Figure 4.14.

The usability engineering life cycle consists of several types of tasks, as follows:

- Structured usability requirements analysis tasks.
- Explicit usability goal setting tasks, driven directly from requirements analysis data.
- Tasks supporting a structured, top-down approach to user interface design, driven directly from usability goals and other requirements data.
- Objective usability evaluation tasks for iterating design towards usability goals.

We will now briefly discuss the phases of usability engineering life cycle methodology:
5.3.1. Phase One: Requirements Analysis

There are several facets to this phase:

- **User profile:** A description of the specific user characteristics relevant to user interface design (e.g. computer literacy, expected frequency of use, level of job experience) is obtained for the intended user population. This will drive tailored user interface design decisions and also identify major user categories for study in the contextual task analysis task.

- **Contextual task analysis task:** A study of users’ current tasks, workflow patterns, and conceptual frameworks is made, resulting in a description of current tasks and workflows and an understanding and specification of underlying user goals. These will be used to set usability goals and drive work reengineering and user interface design.

- **Usability goal setting:** Specific qualitative goals, reflecting usability requirements extracted from the user profile and contextual task analysis, and quantitative goals, defining minimum acceptable user performance and satisfaction criteria based on a subset of high-priority qualitative goals, are developed. These usability goals focus later design efforts and form the basis for later iterative usability evaluation.

- **Platform capabilities and constraints:** The user interface capabilities and constraints (e.g. windowing, direct manipulation, colour) inherent in the technology platform chosen for the
product (e.g. Apple Macintosh, Microsoft Windows, product-unique platform), are determined and documented. These will define the scope of possibilities for user interface design.

- These first four requirements analysis tasks are documented in a work product called the product style guide.

- General design principles: Relevant general user interface design principles and guidelines available in the usability engineering literature, are gathered and reviewed. They will be applied during the design process to come, along with all other project-specific information gathered in the first four tasks.

### 5.3.2. Phase Two: Design/Testing/Development

This phase of the life cycle is divided into three levels. Design level 1 contains four tasks dealing with high-level design issues. These are:

- Work reengineering: Based on all requirements analysis data and the usability goals extracted from it, user tasks are redesigned at the level of organisation and workflow to streamline work and exploit the capabilities of automation. No user interface design is involved in this task – only abstract organisation of functionality and workflow design.

- Conceptual model design: Based on all previous tasks, initial high-level design alternatives are generated. At this level, navigational pathways and major displays are identified, and rules for the consistent presentation of work products, processes and actions, are established. Screen design detail is not addressed until level 2.

- Conceptual model mock-ups: Paper-and-pencil or prototype mock-ups of high-level design ideas generated in the previous task are prepared, representing ideas about high-level functional organisation and conceptual model design. Detailed screen design and complete functional design are not in focus here.

- Iterative conceptual model evaluation: The mock-ups are evaluated and modified through iterative evaluation techniques such as formal usability testing, in which representative end users attempt to perform representative tasks with minimal training and intervention, imagining that the mock-ups are a real product user interface. This and the previous two tasks are conducted in iterative cycles until all major usability bugs are identified and engineered out of the level 1 (conceptual model) design. Once a conceptual model is relatively stable, system architecture design can commence.

Design level 2, also with four tasks, is concerned with setting standards. These are:

- Screen design standards: A set of product-specific standards and conventions for all aspects of detailed screen design is developed, based on any mandated industry and/or corporate standards (e.g. Microsoft Windows, Apple Macintosh), the data generated in the requirements analysis
phase, and the product-specific conceptual model design arrived at during level 1. Screen design standards will ensure coherence and consistency – the foundations of usability – across the user interface.

- Screen design standards prototyping: The screen design standards (as well as the conceptual model design) are applied to the design of the detailed user interface for selected subsets of product functionality. This design is implemented as a running prototype.

- Iterative screen design standards evaluation: An evaluation technique, such as formal usability testing, is carried out on the screen design standards prototype, and then redesigned/re-evaluated iterations are performed to refine and validate a robust set of screen design standards. Iterations are continued until all major usability bugs are eliminated and usability goals seem within reach.

- Style guide development: At the end of the design/evaluate iteration in design levels 1 and 2, there is a validated and stabilised conceptual model design and a validated and stabilised set of standards and conventions for all aspects of detailed screen design. These are captured in the document called the product style guide, which already documents the results of requirements analysis tasks. During detailed user interface design, the conceptual model design and screen design standards in the products style guide should be followed to ensure quality, coherence, and consistency – the foundation of usability.

In level 3 the design is completed, based on the results of the first two levels. Consideration is given to:

- Detailed user interface design: Detailed design of the complete product user interface is carried out, based on the refined and validated conceptual model and screen design standards documented in the product style guide. This design then drives product development.

- Iterative detailed user interface design evaluation: A technique such as formal usability testing is continued during product development to expand evaluation to previously unassessed subsets of functionality and categories of users, and also to continue to refine the user interface and validate it against usability goals.

5.3.3. Phase Three: Installation

User feedback is a key factor. After the product has been installed and in production for some time, feedback is gathered for use in enhancement design, design of new release, and/or design of new but related products.

5.4. The Interaction Design Life Cycles Methodologies used in this Study

In this section we will briefly discuss the following methodologies: the Williges et al. [1987] interaction design focused life cycle methodology and the Hackos and Redish [1998] methodology.
We assessed these methodologies against each of the components depicted in Figure 1.3. of Chapter 1. We did this comparison to investigate the versatility of the methodologies. Table 4.2 (section 7) summarises our findings.

These methodologies are used by systems developers to communicate their understanding of what the users want with each other (systems developers), and not the users themselves. Wieringa [1998] has analysed various development methodologies. The comparison is for the benefit of the systems developers. Various advantages and disadvantages are identified for the different methodologies. What is clearly lacking is the effect on the outside stakeholders. In particular, usability is not considered.

### 5.4.1. The Williges et al. Interaction Design Focused Life Cycle Methodology

Williges et al. [1987] have produced an alternative methodology of systems development, as illustrated in Figure 4.15, to rectify the problems in the classic methodology of software engineering. Here, interface design drives the whole process. Apple has adopted this methodology for systems development.

The argument is that by spotting user requirements early on in the development cycle, there will be less of a demand for code re-generation and modification. It is important to understand the various techniques that can be used to support interface development early in the life cycle of a project.

![Figure 4.15. Interaction Design Life Cycle](image-url)
Figure 4.15 depicts a generalised flow diagram of the iterative design process for the development of the software interface, as proposed by Williges et al. [1987]. The methodology consists of three phases: the initial design stage in which the software interface is specified, a formative evaluation stage during which the interface evolves, and a summative evaluation stage in which the resulting system of the formative evaluation stage is tested:

- The initial design stage consists of the following six phases: Determining design objectives; task-function analysis; focus on users; dialogue design guidelines; structured walk-through; and, initial design modifications (a feedback loop to refine the design (dotted line in Figure 4.15)).
- The formative evaluation stage consists of the following four phases: Rapid prototyping; user-defined interfaces; user-acceptance testing phase; and, an iterative redesign phase.
- The summative evaluation stage consists of the following phases: Operational software interfaces; benchmarking; formal experimentation; and, a feed-forward results phase.

5.4.2. Hackos and Redish Methodology

The Hackos and Redish [1998] approach (illustrated in Figure 4.16) introduces the interface design at the inception stage of the system development. The Hackos and Redish methodology consists of the systems development phase, the interface design phase, the design and implementation phases, and the testing phase. Figure 4.16 shows how the usability analysis fits into both the design of the interface and the design of the underlying system. The systems development phase and interface design phase are conducted in parallel:

- The systems development phase is concerned with the overall system and interaction with outside stakeholders, and has the following sub-phases: Corporate objectives, technology decisions, systems analysis and data modelling.
- The interface design phase is an in-depth analysis of the design of the interface for the proposed system, and has the following sub-phases: User and task analysis, task model, user and task analysis and use model.
- The design and implementation phase is a combination of the above two phases to produce the final system, and has the following sub-phases: Paper prototyping, usability testing, prototyping with dataflow and interface, usability testing and implementation of design.
- The testing phase tests functionality and usability of the system. There are two sub-phases: function testing and usability testing.
There are various researchers who have suggested different methodologies for designing interactive Internet systems [Avison & Fitzgerald, 2003; Barry & Lang, 2001; Carter et al., 2001; Chan, 2005; Knight, 2006; Lee et al., 1999; Murugesan et al., 2001; Newman & Lamming, 1995; Pressman,
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2001; Standing, 2001; Turban et al., 2002; Vidgen, 2002. Baskerville and Pries-Heje [2001] have identified ten factors that influence the development of interactive Internet systems. These are:

- **Time pressure:** Competitive pressures may mean that any advantage is short-lived and will probably be copied by your competitors. It is important, therefore, to capitalise on these short-term advantages.

- **Vague requirements:** Requirements are often imprecise or not known at all and therefore designers have to resort to creativity and innovation. It is therefore only at implementation and use that the ‘real’ requirements are revealed.

- **Prototyping:** The prototype is constantly being redesigned as the new requirements are being understood.

- **Release orientation:** As the requirements are better understood there are frequent re-releases. Rapid application development is therefore relevant to the development of interactive Internet systems.

- **Parallel development:** Database development can take place at the same time as the graphical design, and requirements analysis and design become hard to separate.

- **Fixed architecture:** To manage the complexity, a three-tier architectural approach where business data, business logic and the user interface are separated, allowing teams to work in parallel with a degree of independence, is adopted.

- **Coding your way out:** “When the going gets tough, the developers need to code their way out of problems.” Therefore it was important to identify programmers who could write elegant and effective code quickly.

- **Quality is negotiable:** Is the software developed to achieve high quality, a quick product, or a cheap solution? With the development of interactive Internet systems, quality has always been negotiable. With the development of interactive Internet systems, the overriding view of quality tends to favour the customer perspective and experience, rather than by a defined and repeatable development process.

- **Dependence on efficient people:** The development of interactive Internet systems is completed under time pressure, and typically in small teams where all members need to ‘pull their weight.’ Key staff can make or break the project.

- **Need for structure:** The old method of systems development – for example, keeping business analysts separate from software engineering – may be inappropriate to building interactive Internet systems.
In this section we will discuss specific interactive systems design methodologies aimed at developing web-based and electronic commerce applications. We assessed these methodologies against each of the components depicted in Figure 1.3. of Chapter 1. We did this comparison to investigate the versatility of the methodologies. Table 4.2 (Section 7) summarises our findings.

### 6.1. WISDM

Vidgen *et al.* [2002] argue that the development of interactive Internet systems requires a mix of website development techniques together with traditional information systems development competencies in database and program design. Avison and Fitzgerald [2003] propose the WISDM methodology, which places emphasis on design, interaction design and the user interface, in particular (as illustrated in Figure 4.17).

![Figure 4.17. WISDM](image)

With the WISDM approach there is no priority ordering of the five aspects of the methodology matrix. Each aspect of the matrix can be emphasised alone (or with others), as appropriate during the life cycle of the project. The five aspects of the methodology matrix are:

- **Organisational analysis**: Represents value creation and stresses that strategic relationships be built and maintained with a broad range of stakeholders. The overall question that is asked is “How is the information system supposed to further the aims of the organisation using it?”
• Information analysis: Represents the requirements specification. This is a formalised specification of the information and process requirements of the organisation. The overall question that is asked is “What is the information processing function that the system is to perform?” What is of major concern is the web content analysis and management thereof.

• Work design: The classic concern of the socio-technical approach of information systems development has been with job satisfaction and genuine user participation in the development process. WISDM attempts to extend this view to incorporate all stakeholders. The overall question that is asked is “How can the system be designed to fit into the working lives of the people using the system?”

• Technical design: Represents the software model. A formalised model of the software in terms of data structure and program design is needed to support software construction. The overall question that is asked is “What are the technical specifications of the system that will come closest to meeting the identified requirements?”

• Human-Computer Interaction/Interaction design: Represents the user interface and is located as an overlapping space in the technical design and work design. The overall question that is asked is ‘How can the individual concerned best relate to the computer in terms of operating it and using the output from it?’

### 6.2. Turban’s Framework for Electronic Commerce Development

Turban et al. [2002] suggest an approach to the development of an electronic commerce application. This approach is more of a framework than a development methodology. The development process has five major steps. These are: electronic commerce architecture creation, select a development option, installation, development and operation, and maintenance. Some of these steps will be briefly discussed.

• Electronic commerce architecture creation – A system analysis approach: The main objective of this phase is to create the electronic commerce architecture. To achieve this goal, designers have to:
  - Define the business goals and vision.
  - Define the information architecture.
  - Define the data architecture.
  - Define the applications architecture.
  - Define the electronic commerce technical architecture.
  - Define the organisations architecture.
This analysis can be supported by a set of tools and methodologies, some of which are generic to other information technology applications. These phases may be done in-house, or outsourced to a consultant.

- Selecting a development option: Electronic commerce applications can be developed using several approaches. These are:
  - Use an application service provider to do the entire job: This is an agent or vendor who assembles the functions needed by the company and packages them with outsourced development, operation, maintenance and other services. The application service provider manages the application servers in a centrally controlled location, rather than on the customer’s premises.
  - Buy/lease an application and then install it (turnkey option): Buy standardised software that has the required features and is modifiable. Buying an existing package can be cost-effective and a timesaving strategy, compared with in-house application development.
  - Build the system in-house or outsource: Build customised in-house electronic commerce software.
  - Join a third-party e-marketplace, such as an auction site, a bidding site or an exchange that provides applications to participants.
  - Enter into some kind of partnership or alliance that will enable the company to use someone else’s site.
  - Use a combination of the above listed approaches.

- Installing, connecting and more: Electronic commerce applications need to be connected to the companies’ intranet/extranets. Connection to databases, other applications, business partners or exchanges, may be required.

- Deployment: Once the application has passed the relevant tests, it can be deployed. The issues there are the same as traditional information technology applications: conversion strategies, training and resistance to change.

- Operation and Maintenance: As with another information technology application, maintenance can be done in-house and/or outsourced. Due to rapid changes and changing regulations, maintenance can be problematic.

7. Comparing Systems Development Methodologies

This section will compare the various methodologies discussed in Sections 4 to 6. Before we can compare various structured, object-oriented and interaction design development approaches, we need
to argue about the method of comparing and assessing the various methodologies. There are always inherent problems in comparing various development methodologies. Therefore, before we compare the two approaches, we would refer to these possible problems and how we tried to overcome them in our approach. The Object Agency [1993] identifies the following common flaws:

- Comparing methodologies is often like comparing apples and oranges. The same term often has different meanings in different approaches. While this difference in terminology may seem academic at first glance, the appropriateness and application of these methods are significantly impacted by this distinction. We did not compare terminology, but rather how these approaches address the elements identified in Figure 3 of Chapter 1.

- Any methodology comparison must evaluate a ‘snapshot’ of methodologies. Any comparison would necessarily be restrictive in the information it reviews. We did not look at a specific version of a methodology, but rather at the general steps involved in the process.

- Using an inappropriate framework with which to conduct the evaluation. An evaluator may attempt to evaluate methods using the context (i.e. framework) from their prior development background, often disproportionately biasing their review. We did not quantify issues, but merely identified if a particular issue was addressed or not.

- Utilising reviewers who are simply ‘looking for words’ and ‘placing check marks in a checklist’ without doing the essential research. Although we looked at certain terms, we did not limit our assessment to those terms, but rather analysed the entire methodology according to how it addressed the human issues.

- Using an overly constrained, or unconstrained, definition of methodology. The definition of ‘methodology’ should be clearly stated in the introduction to any methodology comparison. Each methodology comparison must be careful in its selection of definitions, in order not to exclude viable methods or include non-viable methods. We did not look at definitions per se, but rather at whether the human elements were addressed in generic terms.

- Many methodology comparisons seek to identify and document support for particular concepts, but do not rank the degree of support. This can lead to studies showing a number of methods as being relatively equal in support from a numerical standpoint (the number indicating the method ‘addresses’ certain topics, when in reality this is not the case). As stated above, we did not quantify issues, but just identified if a particular issue was addressed or not. We did not add a summative value to these issues.

- It is, in many instances, difficult to repeat the results of a methodology comparison with any accuracy. Since few (if any) of the comparisons cite page references where a particular methodology comparison item (e.g. a term, concept, or example) is found in the methodology under review, it is difficult, if not impossible, to verify the accuracy of these methodology comparisons. We did not compare the methodologies step-by-step, but rather as to whether and when they address the human element. We acknowledge that methodologies are always in a state of flux. In theory one thing happens, and in practice the methodologies are modified to suit individual business needs.
Table 4.2 is the methodology matrix representing our comparison of the methodologies discussed. We mapped the stakeholders of Figure 1.3 in Chapter 1 on this matrix. We then compared the different phases of the development methodologies to see to what extent each phase considers the various stakeholders. For the traditional structured development methodology we used the Dennis and Wixom methodology (Section 4.1.4) as representative methodology. We analysed three object-oriented methodologies: The OMT (Section 4.2.1), Coad and Yourdan (Section 4.2.2), and IBM methodology (Section 4.2.3). For the interaction design focused methodologies we analysed the Williges et al. (Section 5.4.1) methodology and the Hackos and Redish methodology (Section 5.4.2), and for interactive systems design for the web and electronic commerce, we analysed WISDM (Section 6.1) and Turban’s Electronic Commerce Development (Section 6.2).
<table>
<thead>
<tr>
<th>Section No.</th>
<th>Approach</th>
<th>UI Component</th>
<th>Internal Users</th>
<th>Customers</th>
<th>Suppliers</th>
<th>IT Department</th>
<th>Government</th>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Internal Users</td>
<td></td>
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<td></td>
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<td></td>
<td>Suppliers</td>
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<td>IT Department</td>
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<td></td>
<td>Government</td>
<td></td>
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</tr>
</tbody>
</table>

**Traditional systems development methodology**

4.1.4 *The Dennis and Wixom methodology*

| Planning    | no | yes | not involved | not involved | actively part of | not involved |
| Analysis    | no | yes | not involved | not involved | actively part of | not involved |
| Design      | yes| yes | not involved | not involved | actively part of | not involved |
| Implementation | yes| yes | not involved | not involved | actively part of | not involved |

**The OO methodologies**

4.2.1 *Object Modelling technique [Rumbaugh et al., 1991]*

| Analysis phase | attempts | attempts | not part of | not part of | actively part of | not part of |
| System design  | no        | not involved | not part of | not part of | actively part of | not part of |
| Object design  | no        | not involved | not part of | not part of | actively part of | not part of |

4.2.2 *The Coad and Yourdan methodology*

| Analysis    | no | attempts | not part of | not part of | actively part of | not part of |
| Design      | yes| attempts | not part of | not part of | actively part of | not part of |

4.2.3 *The IBM methodology*

| OO design phase | yes | attempts | not part of | not part of | actively part of | not part of |
| Design the business model phase | no | not part of | not part of | not part of | not part of | not part of |

**Interaction design focused life cycle methodologies**

5.4.1 *Williges et. al.*

| Initial Design | yes | yes | attempts | attempts | actively part of | attempts |
| Formative Evaluation | yes | yes | attempts | attempts | actively part of | attempts |
| Summative Evaluation | yes | yes | attempts | attempts | actively part of | attempts |

5.4.2 *Hackos and Redish methodology*

| Systems development | no | attempts | attempts | attempts | actively part of | attempts |
| Interface design    | yes | yes | attempts | attempts | actively part of | attempts |
| Design and implementation | yes | yes | attempts | no | actively part of | no |
| Testing phase       | yes | yes | attempts | no | actively part of | no |
### Interactive Systems Design for the Web and Electronic Commerce

<table>
<thead>
<tr>
<th>Methodology Matrix</th>
<th>WISDM</th>
<th>Turban’s Electronic Commerce Development</th>
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<tr>
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<tr>
<td>Information analysis</td>
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<td>attempts</td>
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<tr>
<td>Technical design</td>
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<tr>
<td>Human-Computer interaction</td>
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</table>

6.1 **WISDM**

<table>
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6.2 **Turban’s Electronic Commerce Development**

<table>
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<th>WISDM</th>
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</thead>
<tbody>
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<td>vague</td>
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<tr>
<td>Installing, connecting and more</td>
<td>vague</td>
<td>vague</td>
<td>vague</td>
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<tr>
<td>Deployment</td>
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<td>vague</td>
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<tr>
<td>Operation and maintenance</td>
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**Table 4.2. Methodology Matrix**
If we examine the methodology matrix (Table 4.2) in more detail with regard to all the components reflected in Figure 1.3, we find the following with regard to the structured development and OO development methodologies:

- In the Dennis and Wixom approach, interface design is only considered in the later stages of development. The components of Figure 1.3 only partially map on to this approach, with no reference to the customers, suppliers, the IT department specifically, or the governmental issues.
- In the Object Modelling Technique [Rumbaugh et al., 1991], there is no special consideration given for the design of the user interface or any of the other components reflected in Figure 1.3.
- In the Coad and Yourdon [1991a] methodology, the human interaction component includes the actual displays and inputs needed for effective human-computer interaction. This methodology is a partial fit onto Figure 1.3. While the internal users of the system are well catered for, the other stakeholders are not actively involved in the process at all.
- The IBM methodology considers the users in the development of the system, however Figure 1.3 is still only a partial fit onto this methodology. The internal users are considered in the development of the system, but the external users and other stakeholders are sidelined.

It is clear from the above that there are several missing components in all these methodologies. The Coad and Yourdan approach explicitly takes into account the interaction design aspect and tends to ignore the other aspects of Figure 1.3. The same applies to the IBM approach. The Rumbaugh approach is very detailed, but still ignores the issue of direct mapping to the final user interface application. Although the Object Modelling Technique [Rumbaugh et al., 1991] actively employs use case scenarios and gets users’ involvement in systems design, it does not map directly into the system user interface design.

The root cause of this poor communication is that none the conventional development methodologies (including the traditional development methodologies and the object-oriented methodologies) give adequate attention to the human aspect of the systems development. Both approaches also ignore the greater business environment as shown in Figure 1.3. Many researchers have proposed ways of improving the systems interface, but most of these have not been integrated into the development techniques.

Our findings are a confirmation of the work of Monarchi and Puhr [1992]. They compare 23 object-oriented analysis and design methodologies to identify common themes and strengths and weaknesses in object-oriented analysis and design methods in general, and found that:

- There is a great deal of current literature on object-oriented systems development, but there is, as yet, little consensus or standardisation among these new development techniques.
- The user interface is typically part of the solution to a problem, rather than a part of the problem itself.
- Interface objects are associated with the user interface. They are not directly a part of the problem domain. Instead, they represent the users' view(s) of the semantic objects.
• User interfaces are a prevalent and integral part of systems development today and should be a part of any software analysis and design methodology. Interface objects are rarely addressed unless the system being modelled is one in which the interface objects are part of the problem domain (automated teller machines, for example). Iivari [1991] recognises the absence of interface objects in other analysis methods and includes them in his framework for identifying objects. A number of other authors mention that user interfaces are an element of systems, but they offer little in the way of identifying or modelling interface objects.

There is still no unified process that combines the development approaches with the usability issues. The interaction design focused methodologies attempt to do this, but they all also still possess major shortcomings, as illustrated in Table 4.2. Certain role players are still not part of the design process — such as suppliers and the government or legislative issues.

When we consider Table 4.2 specifically with regard to the interaction design focused development methodologies, we find that:

• Williges et al. [1987] tries to introduce the usability issues at a much earlier stage of the development process, but this methodology is not widely used.

• The Hackos and Redish [1998] methodology, as depicted in Figure 4.16, seems to be the most comprehensive methodology we assessed. The shortcoming of this methodology is, however, that it still ignores outside stakeholders, unless the corporate objectives phase states that the organisation should give special consideration to the external users – such as customers, suppliers and government. Hackos and Redish are silent on this issue, however, and do not elaborate on what they mean by corporate objectives. If the corporate objectives do include outside stakeholders, this is the only methodology that we investigated that does this. In fact, if this is the case, the methodology maps onto Figure 1.3 (see Chapter 1) and considers most of the aspects addressed in Figure 1.1 (see Chapter 1). The usability engineering is done in parallel with the systems development, and is integrated throughout.

When we consider Table 4.2 with regard to methodologies aimed at the web and electronic commerce, we find that:

• WISDM makes a valiant attempt to include a wide range of users and tries to introduce usability issues at an early stage. But, because there is no priority ordering of the five aspects of the methodology, some aspects may be overemphasised to the detriment of the others.

• The electronic commerce development methodology is vague, at best, on all issues. This methodology tackles specific issues in too much detail, but neglects the most important ones, such as the role of usability.

The shortcomings of all the methodologies are therefore related to the complexity of the wider environment introduced by the issues highlighted in Figures 1.1 and 1.3 of Chapter 1, and to how these aspects should inform the systems development process. None of the development
methodologies address the human component, or the issue of other stakeholders, sufficiently. Both the traditional SDLC and object-oriented methodologies fall short on the issue of human aspects and stakeholder involvement. Although we expected the object-oriented methodologies to fare better on these issues, the above results clearly illustrate that these methodologies still have a long way to go to fully integrate environmental issues. Which one fared the best? Although the Williges et al. [1987] and Hackos and Redish [1998] approaches, focusing on the user, go a long way in achieving this, several shortcomings can still be identified. WISDM and the electronic commerce development methodology also have several shortcomings. There has to be a balanced approach to systems development and interaction design development in the overall systems development process.

8. Usability as a Key Design Component

In order for electronic commerce systems development to stay relevant, and deliver systems fitting the demand of the current business environment, there is a urgent need for the establishment of a unified process to the development of electronic commerce applications, including all of the components identified in Figure 1.3 (see Chapter 1). In order to meet these demands, the existing methodology should be enhanced to bridge the usability gap and map seamlessly to contemporary business environments. Various other authors have this view [Brezillon, 2003; Buie & Vallone; Ferre et al., 2006; Hvannberg et al., 2006; Ping, 2005; Polovina & Pearson, 2006; Sutcliffe, 2004].

We believe that many of the shortcomings of the development methodology could be catered for by making the end-user of the system a primary element in the entire process, and include explicit guidelines for the inclusion of other external issues such as laws and regulations, human rights issues (including accessibility), the abilities and skills of the human resource complement of the IT department, the supplier chain, availability of technology, etc. We argue that in the requirements/analysis and design phases the following issues should, for example, as a minimum consideration, be catered for: corporate issues such as competition, local economic climate and local domestic environments, political climate both locally and internationally, legal issues both on national and international level, acts and regulations that could affect the business, human rights issues (e.g. accessibility laws/standards, access to information, etc.), the user context (geographical, cultural, socio-economic, educational, etc.), procurement issues, etc.

We further argue that most of the stakeholders identified in Figure 1.3 (see Chapter 1) should ideally be involved in the formative and summative evaluation of the proposed and delivered system. After all, if a system does not meet regulatory standards, violates human rights issues, does not meet the exact requirements of the customers, needs very specialised equipment not readily available from suppliers, is not cost-effective in terms of business transactions, does not meet the data or information requirements it is intended for, and cannot be developed by means of available skills or technology, how can it be successful? If these aspects are important, they should be explicitly catered
for in the systems development model. Extensive further research would be required to establish processes and procedures to achieve this.

A key component to all methodologies is the design phase. For the design phase to be successful, crucial information is gathered in the requirements analysis phase of the project. The design phase decides how the system will operate in terms of the hardware, software, network infrastructure, user interface, forms, reports that will be used, specific programs, databases and files that will be needed [Dennis & Wixom, 2000]. The interface design specifies how the users will move through the system (i.e. navigation methods such as menus and on-screen buttons) [Dennis & Wixom, 2000].

9. Summary

In the context of our research question we have learned the following lessons. We structure our discussion from the following perspectives: design, requirements, evaluation and general. We do this, as these are prominent considerations in the development process.

9.1. Requirements

Requirements analysis is multifaceted. The requirements/analysis and design phases in the development methodology should, at a minimum, cater for the following issues: corporate issues such as competition, local economic climate and local domestic environments; political climate both locally and internationally; legal issues both on national and international level; acts and regulations that could affect the business; human rights issues e.g. accessibility laws/standards, access to information, etc., the user context (geographical, cultural, socio-economic, educational, etc.), procurement issues, etc. (see Chapter 1, Section 2.1).

A typical requirements analysis phase should address the following [Parviainen et al., 2005]:

- Functional requirements: What the electronic commerce application is going to do.
- Non-functional requirements: For example, legal considerations that affect the information system.
- Performance requirements: For example, are we using the current computer technology optimally?
- External interface requirements: How does the computer technology (e.g. the database, networks, etc) connect one with the other?
- Design requirements/constraints: This could be, for example, limitations in the chosen language or the additional technologies that are required.
• Quality requirements: A requirement that specifies the degree to which the system possesses attributes that affect quality – e.g., correctness, reliability, maintainability or portability.

From an electronic commerce perspective it is a challenge during the requirements analysis phase to identify all the stakeholders in the particular electronic commerce system. For example:

• It is a challenge to find an experienced requirements analyst.

• The initial idea for the electronic commerce system may be wildly optimistic and utopian in nature.

• The requirements analysis phase may only be focused on the immediate electronic commerce application and may not consider some of the factors stated above.

• Requirements analysis has to consider the social context within which the system is being developed – e.g., in the Arab world people read from right to left.

Though best efforts may be made to communicate as clearly and concisely as possible, there may invariably be miscommunication/discommunication between stakeholders and requirements analysis.

With the design of electronic commerce applications there may be a misidentification of the stakeholder. For example:

• Primary stakeholder: The actual end-users of the electronic commerce system.

• Secondary stakeholder: The managers who use the electronic commerce system.

• Tertiary stakeholder: Government agencies and media organisations that may use the electronic commerce system.

9.2. Design

Common to all the development methodologies we studied is a design phase (see Section 7). The design phase decides how the system will operate, in terms of the hardware, software and network infrastructure, the user interface, forms, and reports that will be used, databases and files that will be needed [Dennis & Wixom, 2000].

The interface design specifies how the users will move through the electronic commerce system (i.e. using navigation methods such as menus and on-screen buttons) [Dennis & Wixom, 2000]. All the methodology textbooks have a token chapter or two, if at all, on the interface design. Interaction design is never covered in-depth.
9.3. Evaluation

Stakeholders should (see Chapter 1, Figure 1.3) ideally be involved in the formative and summative evaluation of the proposed and delivered system (see Section 7). After all, if a system does not meet regulatory standards, violates human rights issues, does not meet the exact requirements of the customers, needs very specialised equipment not readily available from suppliers, is not cost-effective in terms of business transactions, does not meet the data or information requirements it is intended for, and cannot be developed by means of available skills or technology, how can it be successful? If these aspects are important, they should be explicitly catered for in the systems development model.

9.4. General

One of the problems with the traditional methodology for software development and the object-oriented methodologies is that they do not in general clearly identify a role for interaction design in systems development. User interface concerns are mixed in with wider development activities. This may result in one of two problems. Either interaction design is ignored, or it is relegated to the later stages of design as an afterthought. In either case, the consequences can be disastrous. If interaction design is ignored, then there is a good chance that problems will occur in the testing and maintenance stages. If interaction design is relegated to the later stages in the development cycle, then it may prove very expensive to ‘massage’ application functionality into a form that can be readily accessed by the end user and other stakeholders. In either case the cost of introducing ‘usability’ issues will rise, the later one postpones it in the development cycle.

There is a need for the development of a unified approach to successfully incorporate usability principles in the various development methodologies.

Our findings are briefly summarised below:

- From a communication perspective, there are gaps in communication channels that exist between the software engineering community and the human-computer interaction community. These communities at times seem to communicate the same ideas in very different languages.

- In terms of our research question, we found that the development methodology is only one aspect of the success of an electronic commerce application. The development methodology should support a user-centred approach. In terms of electronic commerce applications, the chosen development methodology must cater for the interactive browsing aspect of the electronic commerce application.

In the next chapter of this dissertation we discuss our research methodology.
10. Note

Some of the works represented in this chapter has been published in a modified form, see attached CD for the full paper:


Summary of paper: This paper describes research into establishing the use of human-computer interaction principles in the development of electronic commerce applications in the South African context. It also describes the initial outcomes from our research.


Summary of paper: Systems development methodologies have been developed with the purpose of designing and developing effective information systems. This paper looks at different types of systems development methodologies with particular emphasis on how the human component and other stakeholders are involved or catered for. One general critical flaw we have identified in these processes is that the interface design is not effectively conducted or implemented, but neither are the many other stakeholder issues addressed. This paper investigates this lack of attention and recommends some improvements.


Summary of paper: The design and the development of any software product are frequently fraught with a multitude of both controllable and uncontrollable problems. The software engineer has to be a multi-skilled to successfully complete a project. In this paper we discuss issues affecting information systems, software engineering, human-computer interaction and usability. We also consider the e-shopping activity and, finally, factors affecting change. The overall purpose of this paper is to point out some of the issues that software engineers consider when developing a particular software item.


Summary of chapter: This chapter is a summary of software engineering and human-computer interaction. The chapter overviews development methodologies from a usability perspective.

Summary of chapter: This chapter is a summary of systems development methodologies and users’ involvement in the development process. The chapter overviews traditional systems development methodologies, object-oriented methodologies and human-computer interaction development methodologies from a user’s involvement perspective.
Chapter 5
The Research Methodology

This chapter is a description of the research approach and the research instrument. We look at general research techniques and research techniques used in IS. We discuss how we went about acquiring the knowledge and our chosen research technique. We also discuss the concept of generational theory in this chapter.

Before any of us were anything else, we were researchers. The child is first an explorer, a discoverer, a ‘researcher’…. Research has always been done and will always have a place as long as there are people with inquisitive minds. Swarts, 1992

1. Introduction

In this chapter we will discuss the research approach followed in investigating our research problem: ‘Do usability aspects affect the design and development of the browsing experience in electronic commerce applications?’ To place our problem in context, we have already discussed in Chapter 2 the factors influencing electronic commerce, in Chapter 3 we discussed the field of interaction design, with particular focus on the concept of usability, and in Chapter 4 we discussed the methods that are used to engineer computerised information systems and electronic commerce applications. The purpose of this chapter is to establish the research design and research methodology context for our research problem. In Section 2 we discuss the general research techniques and research techniques used in information systems. In Section 3 we discuss the research techniques used in interaction design. In particular we discuss testing and evaluation methods, as well as data collection and measurement techniques. In Section 4 we discuss our adopted research technique. In Section 5 we discuss our research design, and in Section 6 we conclude with a summary.

2. Research Techniques

‘The scientist is not the person who knows a lot but rather the person who is not prepared to give up the search for truth’ [Popper, 1989].

An essential problem in science is: ‘How do we know what we know?’, and following on from that; ‘How do we acquire knowledge’? This age-old problem has been at the core of science since its inception, and the solution to the problem is, arguably, as contentious now as it has been for centuries [Klein et al., 1990].
The Greeks felt the primary role of science was to turn ‘doxa’ (that which was believed to be true) into ‘episteme’ (that which was known to be true). But, the Sophists questioned how, and even if, this could be done. The argument since then has centred around whether knowledge can ever be proven [Klein et al., 1990]. A number of techniques have been developed in an effort to gather knowledge. In the field of information systems there has been an explosion in the amount of research being undertaken.

There are various general research tools and techniques, all designed to elicit and help analyse the data. In Section 2.1 these general techniques will be briefly discussed and in Section 2.2 we discuss research techniques specifically aimed at research in the field of information systems.

2.1. General Research Techniques

On a broad level, any research should be carried out in a systematic and programmatic manner [Hunter et al., 1983]. Several general research approaches/techniques are advocated [Cohen & Manion, 1996; Emory & Cooper, 1991; Fellows & Liu, 1997; Groebner & Shannon, 1990; McMillan & Schumacher, 1993; Melville & Goddard, 1996; Rapple & Sarkodie-Mensah, 2003; Remenyi & Williams, 1995]. Below is a summary of some of these general research techniques:

- Modelling: The process of constructing a model, a representation of a designed or actual object, process or system, a representation of a reality.

- Simulation: The use of a ‘model’ to represent the essential characteristics of reality, either a system or a process.

- Experiments: An activity or process, a combination of activities, which produces events and possible outcomes. Usually, in scientific contexts, experiments are devised and conducted as tests to investigate any relationship(s) between the activities carried out and the resultant outcomes. Hicks [1982] defines an experiment as a study in which certain independent variables are manipulated, their effect on one or more dependent variables is determined, and the levels of these independent variables are assigned at random to the experimental units in the study (see Section 4 for more details).

- Observation research: The researcher carefully observes how people act and behave in different situations. The primary objective of observation research is to systematically, but without questioning or communicating, collect data about individuals as they act naturally. Participants include humans, laboratory animals, chimpanzees (in the wild) – indeed, any beings. There are three approaches that could be used in observation research:
Naturalistic observation or ethnography: Allows researchers to study the normal behaviour of people or animals as they act in their natural environments. The observation can be non-obtrusive (non-participant) or obtrusive (participant).

Obtrusive or participant observation: The researcher joins the individual or group being observed. Everyone knows they are being observed, and by whom, in this forward and open method.

Passive observations: Passive observation is used to describe activities ranging from pure observation during which the act of observation in no way affects the situation being observed (e.g. counting the number of cigarettes a person smokes) to observations based, for example, on questionnaires (asking people how many cigarettes they smoke) in which the act of asking and the relationship between observer and observed may influence the reply given. The researcher draws conclusions from information collected during interviews, from reports and by administering questionnaires. There are several ways in which one may conduct passive observations, one may simply observe, observe the consequences of uncontrolled interventions, or observe the results of deliberate interventions. These approaches are not mutually exclusive.

• Case studies: A method in which the researcher studies an individual(s) or some activity in a unique setting, as intensely as possible. The unique setting is important since the researcher is as interested in the context of the conditions surrounding the individual or activity as in the individual or activity itself.

• Historical research: Involves studying, understanding, and explaining past events in order to arrive at conclusions about causes, effects or trends of what happened in the past or what may happen in the future.

• Evaluative research: The researcher formally and objectively appraises the outcome of a project, program, strategy, and so on. The researcher also carefully examines the chief factors that are positively or negatively influencing the performance of the activity. The primary objective is to gather data to facilitate making a decision regarding the future of the activity.

2.2. Research Techniques for Information Systems

Information systems researchers have adapted the general research techniques to suit the information systems perspective. Over the years, information systems researchers have conducted various studies on information systems research and research techniques [Alavi & Carlson, 1992; Barki et al., 1993; Baroudi & Orlikowski, 1989; Baskerville & Wood-Harper, 1996; Benbasat et al., 1984; Benbasat et al., 1987a; Benbasat & Weber, 1996; Benbasat & Zmud, 1999; Cavaye, 1996; Cheon et al., 1993; Chin & Todd, 1995; Cooper et al., 1993; Culnan & Swanson, 1986; Culnan, 1987; Darke et al.,
Some of the research techniques that are proposed/or used by these authors on information systems research are as follows (specific references of each research technique is quoted):

- **Algorithms**: Used to find a new algorithm for a problem or express an idea. For an example of algorithms see Eastman and Jansen [2003].

- **Case studies**: This technique is used to learn from the current situation in real life. It is a qualitative research technique, a careful, in-depth study of an individual or particular situation. For examples of case studies see Levine [1993], Massetti [1996], Benbasat [1987b] and Cutler [1990].

- **Content analysis**: This is a technique that uses a set of categorisation procedures for making valid and replicable inferences from data (text or images) to their context. The method combines qualitative (defining the categories) and quantitative (determining numbers within categories) aspects. For examples of content analysis see Bellamy [1994], Lacity [1994] and Roberts [1993].

- **Ethnography (participant-observation)**: This is a qualitative research technique in which a researcher attempts to understand a research situation from inside the research subject’s perspective. For examples of ethnography research see Poltrock [1994], Remm [1998], Simonsen [1997] Suchman [1995], Anderson [1994], Erlandson [1980] and Paccagnella [1997].

- **Experiments**: This is a research approach in which one variable is manipulated and the effect on another variable is observed. For examples of experiments see Dennis [1991], Dennis [1996], Hill [1993], Brooks [1980] and Jarvenpaa [1985].

It is worthy to note that Introna and Whitley [2000] are of the opinion that experimental research in the information systems context is fraught with some very serious problems. They believe that laboratory experiments are inaccurate, because the process deliberately introduces extra behaviour related to the research process, invalidating the experiment. This could possibly be called the Hawthorne effect [Adair, 1984; Holden 2001]. The Hawthorn effect [Adair, 1984;
Holden 2001] refers to changes in behaviour and performance of subjects resulting from their knowing that they are being observed.

- Grounded theory: This is a technique in which the researchers ‘ground’ themselves in empirical data before developing a theoretical framework. For an example of grounded theory see Orlikowski [1993].

- Historiography: This is a technique in which the writing of historical events is based on a critical analysis, evaluation and selection of authentic source materials and composition of these materials into a narrative subject to scholarly methods of criticism. For an example of historiography see Farhoomand and Drury [1999].

- Interviews: A technique that is used to elicit information from respondents (includes critical incident, focus group). For an example of interviews see Alvarez and Urla [2002], Belkin [1987; Hunter, 1997] and Hunter [1997].

- Literature survey: This technique is the reading of the relevant previously published material in that field, and synthesising that information. See, for example, Fan et al. [2004].

- Models: This is a ‘simplistic’ depiction of the real world. For an example of models see Seddon et al. [1999].

- Passive observations: In this approach the researcher draws conclusions from information collected during interviews, from reports and by administering questionnaires. In order not to confuse the passive observation with the observation technique in HCI we will refer to the passive observation as the Remenyi and Williams techniques (see note in Chapter 1). See, for example, Remenyi and Williams [1995].

- Simulations and game theory: This is an ‘active’ model that is executed, and the results measured. See, for example, Dukerich [1990], Klabbers [1996] and Zigurs [1994].

- Surveys: A survey consists of delivering an instrument to a sample of the target population for data collection, usually a questionnaire, although it can also be an interview [Ewusi-Mensah & Przasnyski, 1991; George, 1996; Hufnagel & Conca, 1994b; Smith, 1997].

3. Research Techniques for Interaction Design

Creating good design is like baking from a recipe. Despite following recipe directions, perfectly and deftly applying all the best cooking techniques, a good chef will still taste the batter before putting it in the oven. Usability testing fulfils the same purpose as tasting the batter. It verifies that a system or product design meets our expectations for usefulness and satisfaction, before we move into production. Like the taste test, usability testing/research is generally ‘quick and cheap’, yet likely to reveal much about the goodness of the design. Conducting a usability research is critical to ensure
quality. No development effort should be considered complete until someone has ‘tasted’ the final design [Charlton & O'Brien, 2002]. There are different schools of thought and techniques that could be applied to cooking, so too there are different techniques and methods to usability research. Since this dissertation is in the broad field of interaction design, we will discuss the methods used in the field of interaction design to collect data. In Section 3.1 and Section 3.2 the different techniques and methods for usability testing and data collection are briefly discussed.

3.1. Testing and Evaluation Methods

The process of usability engineering, or of design in general, cannot be treated as a routine process [Whiteside et al., 1988]. The testing and evaluation techniques below assist the usability practitioner to produce a usable product. Each technique is discussed as follows: the software process phases that it fits into, the users needed for the evaluation, and the main advantages and disadvantages of that particular method.

- Experiments: This is the process of establishing generic principles for systems design, with the focus on HCI. This approach can be used at any stage of the software process. Depending on the complexity of the system, at least ten users are required for the testing process. The main advantage of this approach is that it allows designers to test design hypotheses or competing alternatives in an optimal way. The main disadvantage of this approach is that the complex techniques involved require expert knowledge for maximum benefit. Sometimes experiments are conducted in a usability laboratory, and not in the real user environment [Armstrong et al., 2002; Cox & Walker, 1993; Dix et al., 1998; Preece et al., 1994], which may bias the results of the testing.

- Field observation: This approach is used in the final testing stages of the software process phases, using some form of task analysis. The approach requires three or more users. The main advantage of this approach is that it is conducted in the user’s real environment, and it provides first-hand feedback on the user's interactions in the context of the real task, and it is flexible to circumstances. The main disadvantage of this approach is that it is very costly. It is also difficult to analyse and to understand the reasons for a particular behaviour. Different observers may also differ in interpretations [Armstrong et al., 2002; Cox & Walker, 1993; Dix et al., 1998; Nielsen, 1993; Preece et al., 2002; Preece et al., 1994].

- Heuristic evaluation: This technique is used in an iterative design process in the early design stages of the software process phases. No users are required in the testing, as experts conduct the evaluation. The main advantage of this approach is that individual usability problems can be found fast. It is a relatively low-cost method. The main disadvantage of this approach is that it does not involve real users, so it does not find ‘surprises’ relating to users’ needs [Armstrong et al., 2002; Cox & Walker, 1993; Nielsen, 1993; Shneiderman, 1998].
• Focus groups: This approach is used in the requirements phase of the software process phases. Users are organised in groups of six to nine users. The main advantage of the approach is the spontaneous reactions of the group and the group dynamics. This approach allows for the finding out of opinions or factors to be incorporated in other testing methods (e.g. surveys). The main disadvantage of the approach is that the data is hard to analyse and has low validity [Hackos & Redish, 1998; Nielsen, 1993; Shneiderman, 1998].

3.2. Data Collection and Measurement Techniques

As with testing and evaluation methods, there are different data collection and measurement techniques that could be used in usability testing. Below is a summary of some of these techniques. For each technique the method in which it is used is listed, and the main advantages and disadvantages highlighted.

• Questionnaires: This technique is used in the following testing and evaluation methods: surveys and experiments. The main advantage of a questionnaire is that it is easily elaborated on and compared, provided that a validated instrument is developed. Questionnaires may be self-completed by users, and are thus easy and cheap to repeat. Questionnaires are usually appropriate to find subjective user preferences and attitudes. The main disadvantage is that pilot work is needed to validate the instrument, which could be costly and complex. Written interchanges are inherently more ‘formal’ and less natural than a spoken interchange. With the questionnaire approach, users may have to be prompted several times to complete the questionnaire. With this approach the level of communication may be less effective; questions and answers may be interpreted differently, or not be well understood by the users. Contradictions in the questionnaire may be overlooked or require a second round of questions to validate responses [Armstrong et al., 2002; Dix et al., 1998; Nielsen, 1993; Preece et al., 1994; Shneiderman, 1998].

• Interviews: This technique is used in the following areas: user requirements and task analysis. The main advantage of this approach is that it is flexible. It provides in-depth attitude probing into a particular issue and provides spontaneous information. The interview approach requires effective communication skills and the ability to explain questions better and to interpret answers better. For example, contradictions may be pointed out and explained right away. The main disadvantage is that it is time consuming and hard to analyse and compare the data. Open-ended questions’ answers must be consolidated and structured for comparison. Interviews require considerable manpower, and the interviewer may influence the reactions of the respondents [Armstrong et al., 2002; Dix et al., 1998; Nielsen, 1993; Shneiderman, 1998].

• Performance measures (e.g. reaction time, error rates): This technique is used with the following approaches: input logging and experiments. The main advantage of this technique is that of objective measures and that the results can be easily compared. The main disadvantage is that it
does not find subjective constructs (opinion, attitudes, satisfaction) [Armstrong et al., 2002; Nielsen, 1993].

- Thinking aloud: This technique is used with the following approaches: experiments and interviews. The main advantage is that it points out cognitive processes implied in the use of the system. It highlights users’ misconceptions and conceptual models. The main disadvantage is that it is unnatural for users and it may be hard for users to verbalise their thoughts. The information for the thinking aloud technique is difficult to analyse [Armstrong et al., 2002; Dix et al., 1998; Nielsen, 1993].

- Audio-video recording: This technique is used with the following approaches: observation and experiments. The main advantage is that it records all behaviours and can be kept for analysis in the future. A wealth of data on ‘body language’ reactions is also captured. The possibility of multiple analyses by different observers increases the reliability of results. The main disadvantage is that there are ethical and legal requirements to be considered. The behaviour of the respondents has to be somehow categorised. This is a very costly and lengthy approach (e.g. ten hours to satisfactorily analyse one hour of videotape) [Cox & Walker, 1993; Nielsen, 1993; Preece et al., 2002; Shneiderman, 1998].

- Input logging: This technique is used in the final testing stages of the systems development life cycle and in follow-up studies. At least twenty users are required for valid input log analysis. The main advantage of this approach is that it finds highly used (or unused) features in the software that is being tested. The input logging technique can run continuously as the user uses the software, and thus the users may see this as a non-intrusive approach. The data is gathering automatically and a permanent record of the interaction can be kept. The main disadvantage of this approach is that analysis programs are needed for huge masses of data. The data is at a very fine level and requires time-consuming data consolidation and reduction. The users’ privacy may be violated [Cox & Walker, 1993; Nielsen, 1993; Preece et al., 2002].

- Surveys (User feedback): This technique is used in the user requirements phase as well as follow-up studies. Hundreds of users are required for this technique to be successful. The main advantage of this approach is that it can track changes in user requirements. Surveys can be used to analyse users’ opinions of the working system in its real environment. The main disadvantage of this approach is that sampling procedures and field tests organisation require a lot of preparation work, and is thus costly [Armstrong et al., 2002; Cox & Walker, 1993; Shneiderman, 1998]. Survey research design has been used in other HCI research; see for example Miller [1997], Moustakis, et al. [Moustakis et al., 1996], Ivari [1997], Katz [1997], Gould [1999] and Karat [1988]. In this dissertation, the survey research design was adopted.
4. Research Techniques Adopted

In Sections 2 and 3 we discussed the various techniques that are used to conduct research in general, in information systems and in the field of HCI. There are many overlaps between these techniques. Figure 5.1 outlines the research techniques that we used in this dissertation. The overall approach used was a quasi-experiment based on passive observation [Remenyi & Williams, 1995] The technique for collecting the data was a survey using the questionnaire technique – in particular, Likert scales and open-ended questions. In this section we will discuss the research methods used in our research in more detail. We will discuss the different experimental research techniques that are available to a researcher, and briefly explain each process. We will also motivate why we used the quasi-experimental design technique for this dissertation. This is followed by a discussion on the actual research process used (see Section 5).

![Figure 5.1. Research Techniques Adopted](image)

### 4.1. Experimental Research Design

Under the auspices of experimental design there are various approaches [Welman & Kruger, 1999]:

- True experimental research: Is that which tests causal relationships by observing the behaviour of the subject under conditions where some variables are controlled and others manipulated [LoBiondo-Wood & Haber, 1994]. The term ‘experiment’ should be confined to those actions or series of actions where it is possible to do all of the following:
  - Randomly assign the subjects of the experiment to either an experimental group (to which something is done) or a control group (to which the thing done to the experimental group is not done).
  - Manipulate (do something to) the experimental group.
  - Ensure that in all other important aspects, the factors affecting the experimental and control groups remains the same.
• Quasi-experimental research: The goal of quasi-experimental research is to test cause and effect by observing how subjects react to phenomena [LoBiondo-Wood & Haber, 1994]. In quasi-experimental research full control is not possible, because one or more of the three characteristics of experimental research is missing. There are many different procedures that are used in quasi-experimental research. Two of the most common are: using a non-equivalent control group, and time series design.

• Non-experimental research: Is the investigation of phenomena as they really are. No attempt is made to change the subject of the research in the process [Emory & Cooper, 1991; LoBiondo-Wood & Haber, 1994; McMillan & Schumacher, 1993].

Non-experimental research design describes a phenomenon that has occurred, or examines relationships between subjects without suggesting a direct cause-and-effect relationship [McMillan & Schumacher, 1993]. McMillan and Schumacher [1993] describe four types of non-experimental designs:

• Descriptive design: Describing an existing phenomenon by using numbers to characterise individuals or a group.

• Correlational design: Which is concerned with assessing relationships between two or more phenomena.

• Ex post facto design: Which is used to explore possible relationships among variables that cannot be manipulated by the researcher.

• Survey research design: Where the investigator selects a sample of subjects and administers a questionnaire or conducts interviews to collect data. To survey means to question users/persons and record their responses for analysis [Emory & Cooper, 1991].

We can classify experimental research designs into a simple threefold classification by asking some key questions (see Figure 5.2). First, does the design use random assignment to groups? If random assignment is used, we call the design a randomised experiment or true experiment. If random assignment is not used, then we have to ask a second question: Does the design use either multiple groups or multiple waves of measurement? If the answer were ‘yes’, we would label it a quasi-experimental design. If ‘no’, we would call it a non-experimental design.
When reconsidering the questions in Figure 5.2 and the research design, it emerged that a combination of quasi-experimental design and non-experimental design was used in this research, Table 5.1 is used to illustrate this in the context of our research. As per the definition of non-experimental design, the respondents drastically changed their attitudes to the different experiments because of the differences in the websites due of the particular questions that they were asked in the questionnaire instrument.

<table>
<thead>
<tr>
<th>Question</th>
<th>Response</th>
<th>Reasoning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is random assignment used?</td>
<td>No</td>
<td>The heterogeneity of the population did not allow this.</td>
</tr>
<tr>
<td>Is there a control group or multiple measure?</td>
<td>Yes</td>
<td>There was a control group and a test group in the experiment.</td>
</tr>
</tbody>
</table>

**Table 5.1. Type of Experiment**

In choosing our research approach we have tried to mitigate the problems (Hawthorne effect) that Introna and Whitley [2000] describe in Section 2 by being rigorous in the design of our experiment.

### 4.2. Surveys

The most appropriate applications for a survey are those where conditions indicate that respondents are uniquely qualified to provide the desired information. Factors such as age, income, educational background and cultural setting would be appropriate topics on which data can be collected by means of surveys [Emory & Cooper, 1991].
4.2.1. Summary of other Survey research

Other HCI researchers have used the survey approach in their research, and we summarise some of this research below (we do not go into detail). We studied these approaches in developing an approach that was suitable for our purposes.

- Miller [1997]: Miller notes that questionnaires regarding computer experience in a Windows environment were seemingly nonexistent. A reliable means of measuring experience in a Windows environment could substantially facilitate both human-computer interaction research and training. Miller describes the procedures used to develop and test the reliability of the Windows Computer Experience Questionnaire (WCEQ). Miller used the following tools to analysis the data: Cronbach Alpha, Correlation between the items, Factor analysis.

- Iivari [1997]: Iivari examined the significance of organisational level users, their task variety and computer experience as determinants of use participation, including age, gender, education, computer training, organisational tenure and job tenure as control variables. Iivari used multiple regression to analysis the data.

- Katz [1997]: The aim of Katz’s work was to study the attitudes toward voice response units and telephone answering machines or devices. The survey tries to provide an empirical understanding of these forms of technologically mediated interpersonal communications. Katz’s analysis of the data was a comparison based on the answer percentages, comparison of factor analyses between voice response units and telephone answering machines.

- Moustakis [1996]: Moustakis reports on a survey of 103 experts specialising in machine learning, who were asked to rate machine learning method appropriate to intelligent task. The aim of the article is to assess the perception of experts in machine learning method effectiveness for a wide range of tasks. Moustakis’ used the Cronbach Alpha test, Anova and Factor analysis to analysis the data.

The above researchers have used the questionnaire and survey techniques in their research. They have also used Likert-scale-type questions. In their analysis they used the following techniques: Cronbach Alpha tests, comparisons and Anova. The survey research technique is thus an acceptable HCI approach to data collection. There are a number of acceptable statistical techniques that can be used to analyse the data, and we will discuss some of them in the sections to follow.

4.2.2. Questionnaires

A questionnaire is a set of written questions requiring a written response, which describes past behaviours, user expectations, attitudes and opinions towards the system [Human Factors: Guide,
1993]. Below we will briefly discuss the advantages, disadvantages and the appropriate use of questionnaires. The questionnaire approach has been adopted in this dissertation.

Questionnaires have the following advantages [Charlton, 2002; Dix et al., 1998; Nielsen, 1993; Preece et al., 2002; Shneiderman, 1998]:

- Questionnaires are cheap and easy to apply to large samples of users.
- Questionnaires can quickly provide both quantitative and/or qualitative data (see Appendix E).

Questionnaires are, however, plagued with some disadvantages [Charlton, 2002; Dix et al., 1998; Nielsen, 1993; Preece et al., 2002; Shneiderman, 1998]:

- Questions are fixed: There is seldom the possibility to include new questions on request from the respondent, and they cannot be explained in more detail in a standardised way. When questions require clarification, the evaluator should be present and should help the respondent, but in such a way that it does not influence the subject's opinion.
- The evaluator cannot always control the situation or the manner in which the questionnaire is answered (e.g. see Chapter 9, Section 3.1 – the UNISA server crashed during the conducting of the experiment).
- As with any other research technique, misrepresentativeness of the sample may produce wrong results.

Questionnaires can be used for usability evaluation for the following reasons [Charlton, 2002; Dix et al., 1998; Nielsen, 1993; Preece et al., 2002; Shneiderman, 1998]:

- To assess, in a standard and formal way, subjective judgments, attitudes, opinions or feelings about the usability of all or part of an existing system, or a prototype or release version of a system.
- To check the acceptance of the total system, usually within the user's normal operating environment.
- To measure subjective responses in an experimental context (see Chapter 6, Section 5 and Appendix E).

4.2.2.1. Principles of Questionnaire Design and Application

Questionnaires have had a great deal of use in experimental and survey work in all types of evaluations. Once users have experience with a system, it is fairly easy to ask them questions about the experience. The questions can be quite general, specific in details that the evaluation seeks to address, or very open requests for comments about the system [Karat, 1988]. The following
considerations should be made when designing a questionnaire [Charlton & O'Brien, 2002; Dix et al., 2004; Human Factors: Guide, 1993; Preece et al., 2002; Shneiderman, 1998]:

- Designing a questionnaire is not like writing a book. Long questionnaires, asking for everything about the system or service, are very boring for users, difficult to analyse and, in general, not worth the cost. Compiling a successful questionnaire requires previous interviews with potential users, extracting the critical information they will be asked for.

- Questionnaires should be checked (piloting phase) prior to the answering in the real trials. Checks for reliability and validity are important, and, once you have a good questionnaire, it can be used in many phases, or adapted to different systems or services.

- A questionnaire with many open-ended questions is not a good questionnaire. These are usually included when there has not been the possibility to interview respondents. However, these data are very often of little utility. It is better to conduct a few interviews than to propose open-ended questions.

- Multiple-choice questions are suited to those issues that are comprehensively addressed (you have all the possible response alternatives, and there are no more). These questions are not suitable for subjective measurement.

- Ranking questions are very seldom used, and not appropriate when there are many options to be ranked. Their analysis can be very difficult.

- Usually rating scales are discrete scales. A well-designed questionnaire very often produces very good results, and can be used to compare subjective opinions over different situations, systems and development phases. Although they seem very easy to design and perform, appropriate instructions must be given to subjects answering them: it should not happen that we have differences – not because of different subjects’ opinions, but because of differing understanding of what we ask them. Discrete scales will be discussed in detail in the next section.

- Continuous rating scales are only appropriate for really continuous variables. They are more difficult to answer and analyse, but have proven very useful in experimental situations to obtain subjective data with great precision.

Our questionnaire instrument consisted of questions on discrete scales with sections where the respondent could comment on the chosen choices.

4.2.2.2. Discrete numerical rating scales

In discrete numerical rating scales, also known as Likert-type scales, numbers (1-5, 1-7, 1-9, etc.) denote the scale divisions, and the intervals are assumed to represent equal intervals of magnitude of some measure [Emory & Cooper, 1991]. Emory and Cooper [1991] simply propose a numerical
range with anchors in the extremes, but without marking the intermediate points. They usual range from 1 to 5 or 1 to 9, although this is very arbitrary. See Figure 5.3. However, it has been shown that using more numbers increases the complexity for both the researcher and the respondent, and it adds no more precision.

The calendar function is important to the course that I author.

| 1 Strongly Agree | 2 Agree | 3 Undecided | 4 Disagree | 5 Strongly Disagree |

Figure 5.3. Likert Scale Question

These types of scales are widespread in many research fields, are very easy to respond to by subjects, can be analysed very quickly and, provided that researchers follow the recommendations to design them, provide very good results. Likert-type scales were used in our questionnaire instrument.

4.3. Statistical Tools

There are wide categories of statistical analysis tools that can be used for questionnaire data analysis [Emory & Cooper, 1991; Groebner & Shannon, 1990; Keller, 2005; Kvanli et al., 2003]. Researchers in interaction design use different analysis methods on their data. For example, Miller [1997] uses Cronbach’s Alpha, correlation between the items, and factor analysis. Iivari [1997], on the other hand, uses multiple regression, while Katz [1997] uses comparisons based on the answer percentages, comparison of factor analyses between voice response units and telephone answering machines; and, finally, Moustakis [1996] uses Cronbach Alpha test, Anova and factor analysis. For the analysis of the data in this dissertation we have used the following statistical techniques:

- Box plots: Box and whisker plots is a graphical representation showing the mean, the confidence interval of the mean, and maximum and minimum values of one variable in several groups [Kvanli et al., 2003]. They are very useful in detecting the presence of outliers. If any extreme values are present as indicated in a box plot, one could consider whether these cases should be excluded from subsequent statistical analysis [Tabachnick & Fidell, 1996]. In the context of our research we used this technique to better visually understand the data. We used box plots in this dissertation. Internet users are vast and varied, and we did not want to pollute our analysis by assuming anything about the data.

- Central tendency statistics: The central tendency statistics allows us to compare two populations, and enables us to determine whether two groups have equivalent or different mean scores. The mean is defined as the arithmetic average of an attribute. It is the sum of the observed values in the distribution divided by the number of observations. In the context of our research, we used this technique to compare our population means.
• Paired sample $t$-test: The paired sample $t$-test reduces two or more samples to the equivalent of a one-sample case [Emory & Cooper, 1991]. We use this technique to compare the means. In the context of our research we used this technique to compare the mean values for the entire Site A results with that of the Site B results. The interpretation rule for the test is as follows.

  o If $p$ value is less than or equal $p \leq 0.05$, statistically there is significant difference between groups. By significant difference we mean that our value $p$ value is smaller than the significance level of 0.05.

  o If $p$ value is greater than $p > 0.05$, statistically there is no significant difference between groups. By no significant difference we mean that our value $p$ value is larger than the significance level of 0.05.

• One-way Anova: The analysis of variance is a procedure that tests to determine whether differences exist between two or more population means. The Anova technique partitions the total variation among scores into between-groups and within-groups variance. The $F$ ratio, the test statistic, determines if the differences are sufficiently large to reject the null hypothesis. A large $F$ ratio indicates that most of the variation in the response variable is due to the treatment rather than to random causes. The interpretation rule is as follows.

  o If the $p$ value is less than or equal $p \leq 0.01$, statistically there is significant difference between groups. By significant difference we mean that our calculated value is greater than the critical value.

  o If $p$ value is greater than $p > 0.01$, statistically there is no significant difference between groups. By no significant difference we mean that our calculated value is smaller than the critical value.

As part of the Anova test we conducted the Levene test. This is a test for homogeneity of variance test. The Levene test tests for equality of group variances. This test is not dependent on the assumption of normality.

• Multiple Comparison: This test is used when there is unequal sample size. Multiple comparison tests use group means and incorporate the mean square error term of the $F$ sampling distribution. Together they produce confidence intervals for the population means and a criterion score against which differences between the mean values may be compared. In the context of our research we used this technique to find homogeneous groups within the population. For the purposes of our research we used the Scheffé test. The Scheffé test performs simultaneous joint pairwise comparisons for all possible pairwise combinations of means, using the $F$ sampling distribution.

• Kruskal-Wallis: With the Kruskal-Wallis test we will investigate the samples to see if the groups have equal means. With the Kruskal-Wallis, as compared to the Anova test, the assumption of normal population is not necessary. This makes it an ideal technique for samples exhibiting
nonsymmetric (skewed) pattern. It is also less sensitive than the Anova test to assumptions of equal variances. The Kruskal-Wallis test is a one-way analysis of variance by ranks. The data is prepared by converting values to ranks for each observation being evaluated. The ranks range from highest to lowest of all data points in the aggregated samples. The ranks are then tested to determine if they are samples from the same population. The difference (Df) is the number of sample groups and we use the p value to accept or reject the hypothesis based on the chi-square critical values table. The interpretation rule for this test’s results is as follows.

- If p value is less than or equal $p \leq 0.01$, there is a statistical difference in the groups. By significant difference we mean that our calculated value is greater than the critical value.
- If p value is greater than $p > 0.01$, there is no statistical difference in the groups. By no significant difference we mean that our calculated value is smaller than the critical value.

5. Research Design

In this section we will discuss our research approach used in this dissertation.

5.1. Passive Observation Research Process – Our Method of Choice

Research methodologies are important, but it must always be remembered that they provide guidelines rather than firm prescriptions as to how research should be conducted. For our research we adapted the research approach suggested by Remenyi and Williams [1995]. The passive observation research technique is the most commonly used approach in Information Systems research [Remenyi & Williams, 1995]. As stated earlier, passive observations occur when the researcher draws conclusions from information collected during interviews, from reports and by administering questionnaires. Remenyi and Williams [1995] propose a research process including the passive observation technique combined with several of the abovementioned techniques, as illustrated in Figure 5.4. This process has been adapted for our research. Our approach followed the following steps: literature review; assessment of established theoretical frameworks; theoretical conjecture; empirical generalised formulation; measuring instrument; conducting the survey; pilot study; sampling; and, testing/analysis. Each step will be discussed in turn.

1. Literature Review
2. Assessment of established theoretical frameworks
3. Theoretical Conjecture
4. Hypothesis/Empirical Generalised Formulation
5. Measuring Instrument
6. Sampling
7. Testing/Analysis
8. Confirmation of Theoretical Conjecture and Development of Fuller/Refined Theory

Figure 5.4. Steps in Passive Observation Research Process
5.2. Literature Review

As reported by Remenyi and Williams [1995], it is important for a researcher to evaluate the available literature on the subject being researched, to review the current theories and models made by other researchers in the field and to identify unsolved problems. Melville [1996] states that a research problem should be well understood and that a full demarcation of the research problem is also necessary. The research problem was explained in Chapter 1.

During an extensive study on the available literature on electronic commerce, interaction design and systems development, it was apparent that there are major gaps in the integration of electronic commerce development, interaction design and systems development. See Chapters 2, 3 and 4.

5.3. Assessment of the Established Theory

Remenyi and Williams [1995] report that it is important to decide early on if the identified problem in the literature is sufficiently explicit and generally accepted by researchers in the field as a relevant problem, for the researcher to be able to develop a theoretical framework and to derive a workable and testable hypothesis.

A literature review on electronic commerce (Chapter 2) revealed that, from a South African perspective, electronic commerce is growing very slowly. There are generic models for developing electronic commerce applications, but very few domain-specific models exist. Strong interaction design is not a well-integrated focus of the existing electronic commerce models. A literature review revealed that a large number of researchers have been involved in interaction design research (Chapter 3). There are generic guidelines that exist for design electronic commerce applications with usability in mind. However, communication gaps exist between systems developers and interaction design advocates. A review of the literature on systems development (Chapter 4) revealed that there are various approaches to systems development. However, most systems development methodologies do not integrate interaction design at the conception stages of the software project.

5.4. Theoretical Conjecture

Advances in computer and telecommunication technologies are making it cheaper for people to buy and use computers. More people are now connecting to the Internet and using the services provided on the Internet. One such service that people are using is that of electronic commerce. However, poorly designed and developed electronic commerce applications make it difficult for end-users to fully harness the electronic commerce application. Users who cannot use the electronic commerce application will find a more user-friendly electronic commerce site or they will abandon the electronic commerce website.
We examine the different elements in the development of an electronic commerce application. We examine the different types of electronic commerce. We examine interaction design and software development process. In our research our objective is to understand the effect of usability on the browsing experience of electronic commerce applications. From the information gathered during the literature review on the variables or factors that are considered to be critical for successful web usability, the following theoretical conjecture was made:

‘Usability influences the design and development of the browsing experience in electronic commerce applications’.

This supplies a suitable basis for the investigation of the effects of interaction design.

5.5. Empirical Generalisation

In order to test a theory, that theory must be stated as a set of clearly defined empirical generalisations. The empirical generalisation for this research is:

_Do usability aspects affect the design and development of the browsing experience in electronic commerce applications?

In order for us to effectively answer this question, we considered the following hypothesis (see Chapter 6, Section 5 for more details):

\[ H_0: \text{instructions} \quad \text{Instructions do not affect the activities of a website user.} \]

\[ H_1: \text{instructions} \quad \text{Instructions affect the activities of a website user.} \]

\[ H_0: \text{response times} \quad \text{Response times of websites do not affect the activities of a website user.} \]

\[ H_2: \text{response times} \quad \text{Response times of websites affect the activities of a website user.} \]

\[ H_0: \text{visual aids} \quad \text{Visual aids assisting with communication features of the website do not affect the website users’ activities.} \]

\[ H_3: \text{visual aids} \quad \text{Visual aids assisting with communication features of the website affect website users’ activities.} \]

\[ H_0: \text{impression} \quad \text{The website users’ reactions to the website do not affect their activities on the website.} \]

\[ H_4: \text{impression} \quad \text{The website users’ reactions to the website affects their activities on the website.} \]

\[ H_0: \text{appearance} \quad \text{The visual appearance of the website do not affect the website users.} \]

\[ H_5: \text{appearance} \quad \text{The visual appearance of the website affects the website users’ activities.} \]

\[ H_0: \text{navigation} \quad \text{Navigation of a website does not affect the activities of the website user.} \]
5.6. Measuring Instrument

Remenyi and Williams [1995] report that in the social sciences the collection of data for the purpose of testing a theory frequently requires the preparation of a questionnaire sometimes referred to as a measuring instrument. Melville [1996] indicates that data have to be measured somehow. Any device used for this measurement is called an instrument.

Averweg [1998] reports that in social science studies, when measuring attitudes of people, researchers generally follow the technique of preparing a questionnaire (or attitude scale). A questionnaire is defined as “an information form that attempts to measure the attitudes or beliefs of an individual”. Emory [1991] indicates that the measuring instrument should be easy and efficient to use. The important criteria for instruments are validity, reliability and practicality.

Once the area of research has been identified, it is necessary to administer the measuring instrument. The questionnaire was designed with a preamble to each experiment (see Chapter 6, Section 5 and Appendix E). The preamble defined the experiment and then tested the respondent’s attitude to the concept.

5.7. Doing the Survey

In keeping with the chosen research methodology, the following approach was used in the data collection:

5.7.1. Pilot Study

A pilot study was conducted to evaluate the clarity of the questionnaire. The respondents were interviewed at their premises. Their comments led to refinement of the questionnaire instrument. Their contributions are gratefully acknowledged.

5.7.2. The Questionnaire

The questionnaires were sent out during the period November 2001 to June 2002. The questionnaire instrument (see Appendix E) consisted of two parts:

Part 1 of the questionnaire consisted of the following sections:

- An enticing introduction aimed at motivating the respondents.
5.8. Sample Selection

It is often not practical or possible to study an entire population [Melville & Goddard, 1996]. Remenyi and Williams [1995] concur that because it is never possible to test the theory against all members of the target population, it is necessary to select a sample of the overall population on which to conduct the test. Our target population was the N-gen (see below).

Generational theory is the social history that describes and explains changes in public attitudes [The Generational Model, 2000]. The Oxford Modern English Dictionary [Oxford Modern English Dictionary, 1995] defines a generation as:

- “all the people born at a particular time, regarded collectively”, as well as
- “the average time in which children are ready to take the place of their parents”.

In Table 5.2 we have a list of the popular categories used to define the generations of the late 20th century [Codrington, 2000].

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>Generation X (Xer)</td>
<td>People born between 1961 and 1981</td>
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<tr>
<td>Generation Y</td>
<td>Children born at the end of the 1970s</td>
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<tr>
<td>Millennial Generation</td>
<td>Children born during the early 1980s</td>
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<tr>
<td>Oh-Oh teens</td>
<td>Children who are teenagers during the Oh-Oh (2000-2009) years and born mainly between 1989 and 1994 (Oh-Oh: years that have two 00s in them, such as 2000, 2001, 2002, through to 2009)</td>
</tr>
</tbody>
</table>
An Investigation into the Influence of Usability on the Development of the Browsing Experience of E-Commerce Applications

Shawren Singh

Net Generation (N-gen) Many of those born between 1977 and 1997 have become the N-gen influenced by intensive Internet usage

Nintendo Generation Children between the ages of 3 and 18, and entering school in the 1990s influenced by Nintendo technology

Children of the Chaos Generation Children influenced by a non-linear culture, probably since the middle 80s.

Table 5.2. Generation Categories (source Miller [2003])

In Table 5.3 we show the different generations that were born and the time spans.

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<tbody>
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<td>Generation X</td>
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<tr>
<td>Nintendo gen.</td>
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<td>Child of Chaos</td>
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</table>

Table 5.3. Adolescents born in the different generations (shaded areas indicate birth years) (source Miller [2003])

As stated earlier, the N-gen is the focus of this research. According to Tapscott [1998] the N-gen has been:

- Influenced by digital environment, particularly by the Internet.
- Uses the Internet for entertainment, communicating, shopping and more activities as new digital technologies are released on the web.
- They have new tools for inquiry, analysis, self-expression, influence and play via the Internet, by means of chat rooms, e-mail, web pages and gaming.

Miller [2003] uses cognitive, affective and physical perspectives to describe the influences of the digital world on the N-gen. This is summarised in Table 5.4.
Cognitive

Using the Internet they have to:

- Develop critical skills to judge if the information has any value.
- Develop critical skills as they interact with each other in chat rooms or via e-mail.
- Develop evaluation skills to see if the information is fact or fiction.
- Develop investigative skills to find the required information.
- Develop thinking skills to maintain an online conversation.
- Develop thinking skills to find required information.
- Develop writing skills in online chat and e-mail.
- Question the implicit value contained in the information, as there is so much information.
- Search for their own information.

Affective

- The N-gen enjoy using the Web.
- As young people hungry for expression, discovery and their own self-development, they use the Web.
- They control the media, creating their own environment, developing their own feeling of autonomy and sense of values.
- They learn social skills and social responsibility in chat rooms.

Physical - participative

- Using the Web, this generation is active, they participate, inquire, argue, play, shop, criticise, ridicule, fantasise, seek and inform.
- They want to be users, not just viewers or listeners.

| Table 5.4. Influences of the digital world on the information processing capabilities of the N-gen |
| (source Miller [2003]) |

As the main topic of the research is not generational theory, a more in-depth discussion is beyond the scope of this dissertation.

The sample selected include participants from the N-gen who were from universities and technikons in South Africa (University of Durban-Westville, University of Natal, University of the Western Cape and Cape Technikon. The sample was selected using the judgment sample technique [Emory & Cooper, 1991]. Judgment sampling is a strategy in which the person taking the sample has direct or indirect control over which items are selected for the sample. Judgment sampling is appropriate when decision makers feel that some population members have more or better information than other members [Emory & Cooper, 1991; Groebner & Shannon, 1990].

5.9. Testing and Analysis

In total, 219 questionnaires were received. Once the data had been collected, the empirical generalisation needed to be tested. Each of the 64 statements (32 in Part 1 + 32 in Part 2) in the questionnaire instrument was on a 5-point Likert scale intended to obtain information on a
respondent’s attitude towards specific criteria evidence items. Emory [1991] states that statements must meet two criteria:

- Each statement is believed to be relevant to the attitude being studied.
- Each is believed to reflect a favourable or unfavourable position on the attitude.

All 32 statements were equally weighted. Each of the responses to these statements was scored with the following scale values:

- Strongly Agree 1
- Agree 2
- Undecided 3
- Disagree 4
- Strongly Disagree 5

The statements that were negatively stated, for example question 13 in Section 2 of the questionnaire or question 29 in Section 3 of the questionnaire, for the statistical analysis these scale values were scored in the reverse (i.e. ‘Strongly Agree’ 5; etc).

6. Summary

Noticeably, there are various methods of doing research. A researcher has to choose the approach that best suits their problem. This may even be a combination of methods. The chosen method provides the framework by which the researcher will attempt to solve the research problem. In this chapter an overview of the methodologies used for information systems and interaction design research areas was given. The empirical methodology that was used to conduct this research, the administration of the questionnaire instrument and the analysis of the results, were stated. In the next chapter we discuss the experimental websites.
### An Investigation into the Influence of Usability on the Development of the Browsing Experience of E-Commerce Applications

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### Figure 1.7: Structure of the Dissertation

- **Setting the Scene**
  - Electronic Commerce
  - Interaction Design
  - Systems Development

- **Theoretical Framework**
  - Research Methodology
  - The Experiment
  - Experimental Results

- **Knowledge Acquisition Process**
  - Data Analysis and Findings
  - Conclusion

- **Answer Research Question**

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Chapter 6
The Experiment

In this chapter we discuss the design of the experimental website. There were two websites designed. In Site A we did not consider the usability factors of consistency, navigation and structured information. Site B was designed after taking into consideration usability factors, namely, consistency, navigation and structured information. Both website designs considered information systems design principles. Respective web users looked at these two websites and completed a questionnaire based on their perceptions of the websites.

The most important and urgent problems of the technology of today are no longer the satisfactions of the primary needs or of archetypal wishes, but the reparation of the evils and damages by the technology of yesterday. Dennis Gabor, 1970

1. Introduction

In the previous chapter we discussed the research methodology that we used in this study. In the context of our research question: ‘Do usability aspects affect the design and development of the browsing experience in electronic commerce applications?’ we designed experimental websites to test the effects of usability on the user.

In Chapter 5 we discussed our research design. The first 4 steps of our research design were addressed in Chapters 1 to 4 of this dissertation. This Chapter will address the measuring instrument and the sampling technique in more detail. Chapter 7 will discuss the analysis of the collected data. Our research question requires us to test the effect of usability on actual electronic commerce websites. Since this proved to be difficult, due to several constraints (see Chapter 2 Section 6), we designed two experimental websites for the purpose. The purpose of the experiment was to investigate users’ perceptions of usability concepts to the general browsing experience. We chose only a limited number of usability concepts to test. These are consistency, navigation and structured information.

In Chapter 3, Section 3.5 we discussed electronic commerce usability. In that section we summarised several approaches to electronic commerce usability. Overall, electronic commerce researchers agree that electronic commerce websites should be consistent in the interface design, follow an understandable navigation strategy and the information should be presented in a structured format.
In the design of our experimental website A we deliberately broke usability and HCI rules, as follows:

- **Consistency:** This refers to designing interfaces to have similar operations and use similar elements for achieving similar tasks [Preece *et al.*, 2002]. The site was illogically designed with different icons behaving differently.

- **Navigation:** This refers to avoiding orphan pages, long pages with excessive white spaces that force scrolling, narrow, deep, hierarchical menus that force users to burrow deep into the menu structure, and non-standard link colours, as well as providing navigation support, such as a strong site map that is always present. There should also be a consistent look and feel for navigation and information design [Preece *et al.*, 2002]. Navigation was unstructured and totally linear in Site A.

- **Structured information:** This refers to whether it is easier for users to perceive a structured content layout [Stone *et al.*, 2005]. The information did not follow a logical pattern and random bits of trivial information were provided. The site had poor spelling and grammar usage.

In contrast, in the design of site B we aimed to apply these concepts:

- **Consistency:** The site was logically designed with predictable icon functionality.

- **Navigation:** Navigation was structured and was hyper linked to all pages.

- **Structured information:** Information followed a structured approach. We grouped the information that was provided. The information was grouped as: introduction to the city, points of interest in the city and directions to the city.

We also designed a questionnaire to measure the respondent’s attitudes to the two websites (see Section 6). We will first discuss the design of the experimental websites in Section 2. In Section 3 we describe the experimental websites. In Section 4 we compare the two websites with each other and point out the usability issues. In Section 5 we discuss the questionnaire design and in Section 6 we discuss the administration of the questionnaire. In Section 7 we discuss how we conducted our experiment. This is followed by a summary.

### 2. Website Design

We used a simple iterative design approach when it came to the design of the web pages. The web page design process was composed of two phases. The first phase was the wire frame mock-up and the second phase was the populating of the chosen wire frame model.

Figure 6.1 is a global view of the website design process. We first designed the pre-test website, which was tested by a group of users to ensure that it worked and was tested for consistency in the interface, navigation and structure of the information. We used the evaluation comments from this
pre-test website to design test website B. We also created an alternative website A. Test website B followed usability principles, while test website A did not follow the chosen usability principles. Both test websites were tested to ensure that they worked. In the next section we will discuss the website design process in detail.

![Diagram of website design process]

**Figure 6.1. Website Design for this Experiment**

### 2.1 Wire frame model – Pre-Test Page

Before designing the test website, we designed a few simple wire framed test pages. Figure 6.2, 6.3 and 6.4 are an illustration of these wire frame websites. There were three basic areas on the web page:

- **Area A:** Was used for the title of the page and navigation.
- **Area B:** Was used for navigational information.
- **Area C:** Was used to display the chosen information.
All sites were tested by a group of independent testers, from a functionality and clarity perspective. All the wire frames’ codes were written in HTML using a text editor. The wire frame versions were evaluated on the following criteria:

- Cross-platform design: Will the web page work on differently configured machines? By this we mean different computers with different hardware set-ups, e.g. different ram size, different graphics adaptors and different processors.
- Was tested to ensure that the pages rendered the same on different machines.
• Did the web page work on different web browsers, such as Mosaic, Internet Explorer and Netscape?

The 4 test subjects were expert web users from the University of Durban-Westville.

After evaluating the different wire frame versions, we opted for wire frame version 3. Test subjects liked the look and feel of wire frame version 3. From the perspective of electronic commerce design and usability, one must test and retest the design. By designing different versions and testing them, we used a satisfying solution.

2.2. **Designing the Pre-test Page**

The next step was to populate the web page. The data that we used to populate the test websites were from an existing website [Durban, 2001]. The overall purpose of the existing website was to provide information on surrounding towns of a South African city, namely Durban. The populated web page is illustrated in Figure 6.5. All pages for the pre-test websites used the same:

- Colour schemes: The navigation bar area was grey (Area B on Figure 6.5), the display area (Area C on Figure 6.4) had a single grey line separating it from the other areas.
- Layouts: The pages followed the three different display areas as shown in Figure 6.4.
- Pictures: Picture files were jpg files of the same byte size.
- Server: All pages were stored on the same server.
- Size: All pages were under 5000 bytes in size.
2.3. Testing the Pre-test Page

As discussed in Chapter 3 (Interaction Design) and Chapter 4 (Systems Design), it is always prudent to test the software before going into production. The pre-test page was tested again for functionality and clarity, and comments from the respondents were used to improve the page. This site was tested for:

- Does the page render/display on different browsers? As stated earlier, we used a simple text editor to avoid proprietary software related problems.
- Did the pictures render/display in good quality? By this we meant: were the items in the picture visible, clear and easy to see and was the picture a crisp image?
- Were the fonts legible?
• Did the web page render/display on differently configured computers? (Differently configured machines in terms of speed, display units, graphics capabilities).

• Did the server on which the website resided work?

• Did the web page download within a reasonable time?

The respondents to the test website were all expert users from the School of Computing at the University of South Africa. Two leading usability experts also tested the site: Alan Dix and Ahmed Seffah. Comments from the respondents were used to improve the website. These comments were:

• Reduce the size of all pictures.

• The ALT text attribute was added to pictures and the navigation icon. When users scrolled over the picture of the navigation icon, a message popped up. In the case of the navigation icons the message indicated where the link would take you.

2.4. Design of the final test website

The final website design was based on wire frame version 3. This website was again tested, as stated in Section 2.3. A field study was conducted to evaluate the test website. A simple observation approach [Dix et al., 2004; Nielsen, 1993] was used with a group of nine subjects (Nielsen [1993] suggests a group of three or more subjects). The sample group was chosen from a group of South African students with diverse educational, cultural and language (English, Afrikaans, Zulu, Sotho) backgrounds. The test subjects were observed in their natural study environment. The respondents were pleased with the design of the website.

3. Experimental Test Pages

The next step in our experiment was that we created two different versions of the website (Site A and Site B) for our experiment, as illustrated in Figures 6.6 and 6.7.

The experiment was designed with the following usability issues in mind: Site A (see Figure 6.6) did not adhere to the specified usability and HCI guidelines. The guidelines that were broken were:

• Consistency: The navigation tools on website A were inconsistent and did not always take you to the expected location, or in some cases did not work at all. We argue that consistency is a key success factor in designing interactive software.

• Navigation: We argue that well planned navigation enhances the users digital experience. Navigation was unstructured and totally linear in Site A. Both websites A and B had excessive white spaces that forced scrolling. Website A had no defined menu system as well as non-standard link colours.
• Structured information: Information on website A did not follow a structured approach and random bits of trivial information were provided. The site was illogically designed with poor spelling and grammar usage. We argue that by providing a structured information layout the users can successfully accomplish their activities on the particular website.

We by no means suggest that the other usability guidelines are less important. The reason for using this limited set of guidelines in this research was to avoid polluting the results of the questionnaire with too many variables. This would have made the statistical analysis difficult and perhaps inconclusive.

Site B (see Figure 6.7) followed usability and HCI rules, taking the guidelines of the usability principles into consideration when designing the site, except for white spaces. The differences in the websites are discussed in detail in the next section.
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Figure 6.6. Site A
4. **Comparison of the Web Pages**

In this section we compare the two web pages. For illustration purposes we have taken only one screen dump of the proposed websites, representing the common problems.

In Figure 6.8 the first column is a screen dump of website B, in the second column is a series of numbers, and in the third column is a screen dump of website A. There are two screen dumps per column. These screen dumps are of the same web page, the upper half of the web page and the lower half of the web page. We will now compare the websites using the series of numbers. In Table 6.1 the number column is the key to Figure 6.8.
<table>
<thead>
<tr>
<th>No</th>
<th>Site A</th>
<th>Site B</th>
<th>Usability A</th>
<th>Usability B</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Website on the same server</td>
<td>Website on the same server</td>
<td><strong>Consistency</strong>&lt;br&gt;From a consistency perspective it was expected that both websites would behave in a predictable manner because they were on the same server.</td>
<td><strong>Consistency</strong>&lt;br&gt;From a consistency perspective it was expected that both websites would behave in a predictable manner because they were on the same server.</td>
<td><strong>Consistency</strong>&lt;br&gt;Same platform&lt;br&gt;<strong>Site A</strong>&lt;br&gt;Same page layouts, with variations in the text and fonts.&lt;br&gt;Page was under 5000kb.&lt;br&gt;<strong>Site B</strong>&lt;br&gt;Same page layouts, same fonts.&lt;br&gt;Page was under 5000kb.</td>
</tr>
<tr>
<td>2</td>
<td>JPG index to home page does not work on some pages or sent user to a different page.</td>
<td>JPG index to home page works</td>
<td><strong>Consistency</strong>&lt;br&gt;No consistency in navigation.&lt;br&gt;<strong>Navigation</strong>&lt;br&gt;Unpredictable navigation.&lt;br&gt;<strong>Structured Information</strong>&lt;br&gt;Unpredictable navigation affected the structure of the information.</td>
<td><strong>Consistency</strong>&lt;br&gt;Consistency in navigation.&lt;br&gt;<strong>Navigation</strong>&lt;br&gt;Structured navigation.&lt;br&gt;<strong>Structured Information</strong>&lt;br&gt;Hierarchical navigation aided in the structuring of information.</td>
<td><strong>Navigation</strong>&lt;br&gt;<strong>Site A</strong>&lt;br&gt;Linear link structure.&lt;br&gt;Inconsistent navigation.&lt;br&gt;The next page was unpredictable.&lt;br&gt;<strong>Site B</strong>&lt;br&gt;Nonlinear, hierarchical, predictable linking structure, users could jump from town to town.&lt;br&gt;Navigation consistent – user could predict what the next page was.</td>
</tr>
<tr>
<td>No</td>
<td>Site A</td>
<td>Site B</td>
<td>Usability A</td>
<td>Usability B</td>
<td>Comment</td>
</tr>
<tr>
<td>----</td>
<td>------------------------------------</td>
<td>------------------------------------</td>
<td>----------------------------------</td>
<td>----------------------------------</td>
<td>-------------------------------------------------------------------------</td>
</tr>
<tr>
<td>3</td>
<td>Previous page and next page</td>
<td>Previous page and next page</td>
<td>Consistency</td>
<td>Consistency</td>
<td>Non-standard link colour. The standard accepted link colour is blue; when</td>
</tr>
<tr>
<td></td>
<td>navigation</td>
<td>navigation</td>
<td>yes</td>
<td>yes</td>
<td>clicked it turns purple. Link colour used was blue; when clicked it turns red. This was applied to both sites.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Navigation</td>
<td>Navigation</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>yes</td>
<td>yes</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Structured Information</td>
<td>Structured Information</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>yes</td>
<td>yes</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>No navigation panel</td>
<td>Navigation panel</td>
<td>Consistency</td>
<td>Consistency</td>
<td>Non-standard link colour. This was applied to both sites.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Through all the pages there was no navigation panel.</td>
<td>Through all the pages there was a navigation panel.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Navigation</td>
<td>Navigation</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Unpredictable navigation.</td>
<td>Aided with predictable navigation.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Structured Information</td>
<td>Structured Information</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Affected the structure of the information.</td>
<td>Aided in keeping the information structured.</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Display area with minor changes -</td>
<td>Display area with Times New Roman font</td>
<td>Consistency</td>
<td>Consistency</td>
<td></td>
</tr>
<tr>
<td></td>
<td>different font type</td>
<td></td>
<td>Inconsistent fonts</td>
<td>Consistent fonts</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Display area with minor changes</td>
<td>Display area continued</td>
<td>Consistency</td>
<td>Consistency</td>
<td></td>
</tr>
<tr>
<td></td>
<td>continued</td>
<td></td>
<td>Inconsistent fonts</td>
<td>Consistent fonts</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>No JPG index to home page</td>
<td>JPG index to home page</td>
<td>Consistency</td>
<td>Consistency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Inconsistent unpredictable navigation. Users did not know where the link would take them to.</td>
<td>Consistent predictable navigation.</td>
<td>Non-standard link colour.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Navigation</td>
<td>Navigation</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Affectd navigation.</td>
<td>Meant to aid in navigation.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Structured Information</td>
<td>Structured Information</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Did not assist in structure of information.</td>
<td>Meant to assist in structure of information.</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>Site A</td>
<td>Site B</td>
<td>Usability A</td>
<td>Usability B</td>
<td>Comment</td>
</tr>
<tr>
<td>----</td>
<td>------------------------------------------------------------</td>
<td>------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------</td>
</tr>
<tr>
<td>8</td>
<td>No previous page and next page navigation</td>
<td>Previous page and next page navigation</td>
<td>Consistency</td>
<td>Consistency</td>
<td>Non-standard link colour.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Inconsistent navigation</td>
<td>Consistent predictable navigation.</td>
<td><strong>Structured information</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Navigation</td>
<td>Navigation</td>
<td>Site A</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>May have affected navigation.</td>
<td>Aided in navigation.</td>
<td>Unstructured information, hard to predict the next page, this is seen</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Structured Information</strong></td>
<td><strong>Structured Information</strong></td>
<td>from the perspective of the manner in which the information is presented</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Did not assist in structure of the page.</td>
<td>Assisted in structure of information.</td>
<td><strong>Site B</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Structured information, easy to predict the next page – users would</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>know what to expect.</td>
</tr>
<tr>
<td>9</td>
<td>Copyright information</td>
<td>Copyright information</td>
<td><strong>Consistency</strong></td>
<td><strong>Consistency</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>yes</td>
<td>yes</td>
<td></td>
</tr>
</tbody>
</table>

**Table 6.1.** The key to Figure 6.8
Figure 6.8. Comparison of the two Websites
5. Questionnaire Design

The questions were adapted from several questionnaires [Dix et al., 2004; Preece et al., 2002; Preece et al., 1994; Shneiderman, 1998]. The questionnaire was refined with the help of Prof. Alan Dix (Lancaster University). A group of persons from the N-gen were asked to read each statement and to state the level of their agreement with each statement, using a five-point Likert scale. Our questionnaire had the following categories with questions for each category and a space for comments on the particular category:

- Instructions (see Appendix E, page 341).
- Speed of website (see Appendix E, page 341).
- Visual Aids (see Appendix E, page 341).
- Overall reaction to Digital Durban website (see Appendix E, page 342).
- Appearance of the website (see Appendix E, page 342).
- Movement through the website (see Appendix E, page 343).
- General impressions (see Appendix E, page 344).
- Further comments (see Appendix E, page 344).

Each category had a number of Likert scale questions in the questionnaire that ‘measured’ the perceptions/attitudes relating to the issues involved with the subsections. A single composite value was determined for each subsection by adding the individual Likert scale scores for each respondent. These values are used in the statistical analysis.

We briefly explain each subsection and list the questions that were used to determine the composite value subsection.

- **Instructions**: Instructions are a powerful mechanism to assist users in understanding the actions of the website and features of the website. Poor/vague instructions or the lack of instructions will affect the overall usability of a website. The values assigned to ‘Instructions’ are composed from the combined values of responses to the following questions:
  - Instructions on the website are easy to read.
  - Instructions on the website are clearly marked.
  - Use of terminology throughout the website was inconsistent.
The maximum score in this subsection could have been 15 (which is on the negative side) and the minimum scored could be 3 (which is on the positive side). A neutral score was 9.

- **Speed of website:** In Chapter 3, Section 3.5 we mentioned that users have an instant gratification for information. Websites that have a perceived ‘slower’ response time will affect the users’ overall perceived usability of the website. The values assigned to ‘Speed of website’ are composed from the combined values of responses to the following questions:
  - It is important that the website processes my request quickly.
  - Web material did not appear quickly on my screen.
  - A fast response time is important to my activities on the web.

The maximum score in this subsection could have been 15 (which is on the negative side) and the minimum score could be 3 (which is on the positive side). A neutral score was 9.

- **Visual Aids:** Alternative means of communication is always a usability plus. When a user has a different/unique ‘opportunity/problem’, the human touch is an effective tool. These communication tools would include phone, fax and e-mail. A picture is worth a 1000 words. Relevant, good quality pictures can enhance the usability of a website. The values assigned to ‘Visual’ aids are composed from the combined values of responses to the following questions:
  - Help features such as phone, fax or e-mail are important aspects of a website.
  - The quality of still pictures/photographs on the website were bad.
  - Colour usage on the website was consistent.
  - The amount of colour used on the website was inadequate.

The maximum score in this subsection could have been 20 (which is on the negative side) and the minimum score could be 4 (which is on the positive side). A neutral score was 12.

- **Reaction to the website:** Usability is a unique mixture of art and science. The intangible or soft aspects of the website will affect the user’s perceived usability of the website. For example, if a user perceives a website as being ‘dull’, that user may not want to use that website. The values assigned to ‘Reaction to the website’ are composed from the combined values of responses to the following questions:
  - This website is: ... terrible, ... dull, ... wonderful, ... stimulating, ... flexible.

The maximum score in this subsection could have been 25 (which is on the negative side) and the minimum score could be 5 (which is on the positive side). A neutral score was 15.

- **Appearance of the website:** A well planned appearance for a website will improve usability. For example, visual clues to what is important, legible fonts and good quality pictures that are rendered on all computers, have a effect on the perceived usability of the website. The values
assigned to ‘Appearance of the website’ are composed from the combined values of responses to the following questions:

- Characters on the screen were hard to read.
- Images such as pictures and graphics on the screen were fuzzy.
- Character shapes (fonts) were illegible.
- The use of bold text was unhelpful.
- Screen layouts were helpful.
- The amount of information on-screen was digestible.
- The information arrangement on-screen was illogical.
- The screens sequence was logical.
- The next screen in the sequence was unpredictable.
- Going back to the previous screen was easy.

The maximum score in this subsection could have been 50 (which is on the negative side) and the minimum score could be 10 (which is on the positive side). A neutral score was 30.

- **Movement through the website**: Since most users ignore the readme file, or in this case will only read the help tutorial/FAQs when they have reached a bottleneck, issues such as finding your way back to a safe place become critical. Therefore, navigation on the website should be well defined and ‘logical’. This type of ‘predictable’ navigation improves the usability of the website. The values assigned to ‘Movement through the website’ are composed from the combined values of responses to the following questions:

  - Learning to navigate around the website was difficult.
  - On-line help features are unimportant to my activities on the web.
  - The link structure was useful in the navigation of the website.
  - The website was inconsistently designed.
  - Navigation icons were placed in strategic areas.

The maximum score in this subsection could have been 25 (which is on the negative side) and the minimum score could be 5 (which is on the positive side). A neutral score is 15.

- **General impressions of the website**: If users like the performance of the website, they will revisit the website. Good usability will encourage users to revisit websites. The values assigned to ‘General impression of the website’ are composed from the combined values of responses to the following questions:
I wanted to continue working with the Digital Durban website.

I will not use websites that perform like Digital Durban.

The maximum score in this subsection could have been 10 (which is on the negative side) and the minimum score could be 2 (which is on the positive side). A neutral score is 6.

The following composite value questions were related to consistency. These are ‘instructions’; ‘speed of website’ and ‘overall reaction’. While the composite value questions relating to structured information were, ‘visual aids’ and ‘general information’. Finally the composite value questions relating to navigation were, ‘appearance of website’ and ‘movement through website’.

6. Administration of the Questionnaire

The experiment consisted of three sets of instructions. The first set of instructions was for the moderators of the experiment. The second and the third set of instructions were for the respondents. Each of these will now be discussed.

6.1. Instructions to Moderator

Prior to starting the usability test, we needed all moderators to complete the moderator/tester questionnaire, which were a brief questionnaire outlining age, sex, background, language skills and current occupation. This information was optional. The instructions to the moderators for the respondents were as follows:

- This experiment will take 40 minutes.
- Instruct the subjects to complete the demographic information and Section One of the questionnaire (pages 1 through to 3). (This should take subjects 5 minutes).

Phase 1

- Instruct the subjects to go to the following website http://osprey.unisa.ac.za/singhs/exp1/
- Moderator should instruct subjects to read the instructions on page 4 and complete the task. This should take them 10 minutes, once they have completed the task the moderator should instruct subjects to answer section 2 (pages 5 through to 7).
- Finish Phase 1 before going to Phase 2.
- Stop.

Phase 2
• Instruct subjects to read the instructions on page 8 and complete the task. This should take them 10 minutes; once they have completed the task the moderator should instruct subjects to answer section 3 (pages 9 through to 11).

• End.

Moderators were asked for their comments/observations relating to the experiment, as well as how many questionnaires were completed and handed in, including spoiled questionnaires.

6.2. Instructions to Respondents for Test A

The following set of instructions were given to the respondent:

You are required to do the following task.
1. Go to address/URL:
   http://osprey.unisa.ac.za/singhs/exp2/
   (This Website is called Richard's Bay original and is about Richard's Bay in KwaZulu Natal)

Task 1
• You have always wanted to visit Richard's Bay in KwaZulu Natal, so your friend has recommended that you visit the above website before you make up your mind.

To aid you in your task please follow the following tips:

• Login to your machine.
• Locate and launch the browser.
• Type in the address/URL in the address box of the browser.
• Find Richard's Bay.
• Read about it.
• Review the rest of the website.
• End.

Once you have finished the above task proceed to Section 2.
You will be asked questions about the website.

Do not turn over until you are asked to do so by the person running the experiment!
6.3. Instructions to Respondents for Test B

You are required to do the following task.

2. Go to address/URL:
   
   http://osprey.unisa.ac.za/singhs/exp1/

   (This is a reorganised version of the Richard's Bay website)

Task 2

- You have always wanted to visit Richard's Bay in KwaZulu Natal, so your friend has
  recommended that you visit the above website before you make up your mind.

To aid you in your task please follow the following trips:

- Login to your machine.
- Locate and launch the browser.
- Type in the address/URL in the address box of the browser.
- Find Richard's Bay.
- Read about it.
- Review the rest of the website.
- End.

Once you have finished the above task proceed to Section 3.

You will be asked questions about the website.

Do not turn over until you are asked to do so by the person running the experiment!

6.4. Investigating the websites

The respondents from each institution would look at site A and then site B, or vice versa. This
allowed for a four-quadrant metric to compare respondents’ answers (see Table 6.2). Cross
comparisons could be made across the matrix. An intrinsic part of the questionnaire is its ability to
collect quantitative and qualitative data, giving the respondents the opportunity to comment on or
justify answers.

<table>
<thead>
<tr>
<th>Respondent Group</th>
<th>First Site Assessed</th>
<th>Second Site Assessed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Group</td>
<td>Site B – Adhering to HCI and Usability Guidelines</td>
<td>Site A – Violating HCI and Usability Guidelines</td>
</tr>
<tr>
<td>Experimental Group</td>
<td>Site A – Violating HCI and Usability Guidelines</td>
<td>Site B – Adhering to HCI and Usability Guidelines</td>
</tr>
</tbody>
</table>

Table 6.2. Respondent Matrix
7. **Conducting the Experiment**

The questionnaire was distributed to the following academic institutions: University of Natal (the control group), University of Durban Westville (the test group), University of the Western Cape (the test group), and Cape Technikon (the test group). The questionnaire was circulated during the academic year 2002. Lecturers and/or tutors administered the questionnaires. In total we received back 219 valid questionnaires.

8. **Summary**

Site B was designed after taking into consideration usability factors, namely, consistency, navigation and structured information. In Site A we violated the usability factors of consistency, navigation and structured information. Both website designs considered information systems design principles. Respective web users now looked at these two websites and completed a questionnaire based on their perceptions of the websites.

To conduct research of this nature required one to network with different people and ultimately ask them to help with the research experiment. Researchers have to find novel ways of getting people and/or respondents to assist with conducting experiments. Our approach was to befriend local South African academics, offer them some acknowledgment for assisting with the research, and hope they would help. Respondents to the questionnaires were offered the opportunity to be involved in a research project. In the next chapter we analyse the responses to the questionnaire instrument.
Chapter 7

Experimental Results

In this chapter we apply several statistical techniques to the data collected during our experiment. We analyse the outcomes of the statistical analysis and provide an explanation for the results. Our overall observation is that usability cannot be the only determinant for making web applications usable.

*Something has dropped in the water, in the river. You cannot see the things dropped within the water by agitating the water. Just stand still for some time. As soon as the water is settled up, you’ll see the things as they are.*

Srila Prabhupada

1. Introduction

In the previous chapter we discussed the design and development of the test websites. In this chapter we analyse the experimental results of the observations on the test websites. In Section 2 we discuss the characteristics of the chosen sample. In Section 3 we conduct statistical analysis on Site A and Site B. Section 3.1 discusses the results of the central tendency statistics, Section 3.2 discusses the results of the paired sample $t$-test, and Section 3.3 is a summary of the central tendency statistics and paired sample $t$-test. In Section 4 we conduct statistical analysis with specific focus on the institution as dependent variable. In Section 4.1 we discuss the results of the Anova test, in Section 4.2 we discuss the results of the multiple comparison test, in Section 4.3 we discuss the results of the Kruskal-Wallis test, and Section 4.4 is a summary of the statistics for the institution as independent variable. In Section 5 we present the statistical analysis and results of the other independent variables, followed by a summary in Section 6 of all the statistical analyses. In the questionnaire we had several questions relating to culture and language of our chosen group. These questions were related to the respondents’ home language, their choice of language, gender, population group and home province. We did not conduct in-depth statistical analysis on these factors. We conclude with a summary.

The empirical generalisation stated in Chapter 5, Section 5.5 will now be tested. The empirical generalisation is:

*Do usability aspects affect the design and development of the browsing experience in electronic commerce applications?*

In order for us to effectively answer this question, we considered the following hypotheses:
### Table 1: Hypotheses for Usability Concepts

<table>
<thead>
<tr>
<th>Usability Concept</th>
<th>Hypothesis</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Consistency</strong></td>
<td>H&lt;sub&gt;0&lt;/sub&gt; instructions</td>
<td>Instructions do not affect the activities of a website user.</td>
</tr>
<tr>
<td></td>
<td>H&lt;sub&gt;1&lt;/sub&gt; instructions</td>
<td>Instructions affect the activities of a website user.</td>
</tr>
<tr>
<td><strong>Navigation</strong></td>
<td>H&lt;sub&gt;0&lt;/sub&gt; response times</td>
<td>Response times of websites do not affect the activities of a website user.</td>
</tr>
<tr>
<td></td>
<td>H&lt;sub&gt;2&lt;/sub&gt; response times</td>
<td>Response times of websites affect the activities of a website user.</td>
</tr>
<tr>
<td><strong>Structured Information</strong></td>
<td>H&lt;sub&gt;0&lt;/sub&gt; visual aids</td>
<td>Visual aids assisting with communication features of the website do not affect the website users’ activities.</td>
</tr>
<tr>
<td></td>
<td>H&lt;sub&gt;3&lt;/sub&gt; visual aids</td>
<td>Visual aids assisting with communication features of the website affect website users’ activities.</td>
</tr>
<tr>
<td><strong>Consistency</strong></td>
<td>H&lt;sub&gt;0&lt;/sub&gt; impression</td>
<td>The website users’ reactions to the website do not affect their activities on the website.</td>
</tr>
<tr>
<td></td>
<td>H&lt;sub&gt;4&lt;/sub&gt; impression</td>
<td>The website users’ reaction to the website affects their activities on the website.</td>
</tr>
<tr>
<td><strong>Navigation</strong></td>
<td>H&lt;sub&gt;0&lt;/sub&gt; appearance</td>
<td>The visual appearance of the website do not affect the website users.</td>
</tr>
<tr>
<td></td>
<td>H&lt;sub&gt;3&lt;/sub&gt; appearance</td>
<td>The visual appearance of the website affects the website users’ activities.</td>
</tr>
<tr>
<td></td>
<td>H&lt;sub&gt;4&lt;/sub&gt; navigation</td>
<td>Navigation of a website does not affect the activities of the website user.</td>
</tr>
<tr>
<td></td>
<td>H&lt;sub&gt;6&lt;/sub&gt; navigation</td>
<td>Navigation of a website affects the activities of the website user.</td>
</tr>
<tr>
<td><strong>Structured Information</strong></td>
<td>H&lt;sub&gt;0&lt;/sub&gt; general</td>
<td>The overall structure of the website does not affect the users.</td>
</tr>
<tr>
<td></td>
<td>H&lt;sub&gt;7&lt;/sub&gt; general</td>
<td>The overall structure of the website affects the users.</td>
</tr>
</tbody>
</table>

These questions are answered in the context of the two experimental website designs discussed in Chapter 6.

### 2. The Characteristics of the Chosen Sample

Before going into the detailed explanation of the statistical analysis, it is important for us to know the characteristics of the sample. By understanding the sample we can draw more informed conclusions about our results. The first section of the questionnaire elicited demographical information about the respondents. This can be summarised under the following headings: persona, geographic location, institution, education and technology.
Table 7.1 reflects the information relating to demography of the population. This table shows as a percentage the respondents’ age, home language, their first choice of language, language spoken in conversation with friends, gender and population group.

<table>
<thead>
<tr>
<th>Respondents Age</th>
<th>Home Language</th>
<th>What is your first choice of language</th>
</tr>
</thead>
<tbody>
<tr>
<td>17-18yrs</td>
<td>English 39.4</td>
<td>English 77.2</td>
</tr>
<tr>
<td>19-20yrs</td>
<td>Afrikaans 5.6</td>
<td>Afrikaans 2.8</td>
</tr>
<tr>
<td>21-22yrs</td>
<td>Zulu 20.4</td>
<td>Zulu 9.8</td>
</tr>
<tr>
<td>23-24yrs</td>
<td>Sotho 17.1</td>
<td>Sotho 7.0</td>
</tr>
<tr>
<td>25-30yrs</td>
<td>Other African 6.9</td>
<td>Other African Language 3.3</td>
</tr>
<tr>
<td>31-40yrs</td>
<td>Other 10.6</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Language spoken in conversation with friends</th>
<th>Gender</th>
<th>Population group</th>
</tr>
</thead>
<tbody>
<tr>
<td>English 68.5</td>
<td>Male 52.4</td>
<td>Indigenous African (IA) 61.3</td>
</tr>
<tr>
<td>Afrikaans 2.8</td>
<td>Female 47.6</td>
<td>South African of mixed descent (SAM) 22.1</td>
</tr>
<tr>
<td>Zulu 13.9</td>
<td></td>
<td>Afro-Asian (AA) 11.3</td>
</tr>
<tr>
<td>Sotho 8.3</td>
<td></td>
<td>Afro-European (AE) 4.4</td>
</tr>
<tr>
<td>Other African Language 5.1</td>
<td></td>
<td>Other 1.0</td>
</tr>
<tr>
<td>Other 1.4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 7.1. Demography of the Population

Table 7.2 reflects the information relating to geographic location. This table shows as a percentage the respondents’ home province and country of origin.
Table 7.2. Geographic Location

Table 7.3 reflects the information relating to the chosen institutions. This table shows as a percentage the number of respondents per institution and the language used by course instructors.

<table>
<thead>
<tr>
<th>Home Province</th>
<th>Country of origin</th>
</tr>
</thead>
<tbody>
<tr>
<td>KwaZulu Natal</td>
<td>East &amp; Southern Africa</td>
</tr>
<tr>
<td>Western Cape</td>
<td>West Africa</td>
</tr>
<tr>
<td>Eastern Cape</td>
<td>South Asia</td>
</tr>
<tr>
<td>Gauteng</td>
<td>Eastern Europe &amp; Central</td>
</tr>
<tr>
<td>Free State</td>
<td>Asia</td>
</tr>
<tr>
<td>Northern Province</td>
<td>Rest of Europe</td>
</tr>
<tr>
<td>Northern Cape</td>
<td>Americas</td>
</tr>
<tr>
<td>Mpumalanga</td>
<td></td>
</tr>
<tr>
<td>North West Province</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
</tr>
</tbody>
</table>

| Table 7.3. Institutional Information

Table 7.4 reflects the information relating to respondents’ level of education. This table shows as a percentage the highest academic qualifications per respondent, if respondents are registered for formal studies, the status of their present studies and the type of qualification that they are registered for.
Table 7.4. Level of Education

Table 7.5 reflects the information relating to the respondents’ technology acceptance. This table shows as a percentage the number of respondents who have access to e-mail, and their current perception about their level of web experience. It is worthy to note that the vast majority of respondents (83.1%) considered themselves to be less than expert users.
Table 7.5. Technology Acceptance

Table 7.6 indicates how often the respondents used a computer and how often they used the Internet. From an inspection of Table 6.5 and 6.6 the vast majority of respondents had access to and used computer technologies.

Table 7.6. Technology Usage

Table 7.7 indicates the significance of the Internet to the respondents. The vast majority of respondents (60.5% (16.6+43.9)) found it difficult to find useful material on the Internet, 66.5% (23.8+42.7) of the respondents indicated that they would seek help from others when using the Internet and 89.3% (65.4+23.9) of the respondents considered the Internet to be useless to them.
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An Investigation into the Influence of Usability on the Development of the Browsing Experience of E-Commerce Applications

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Table 7.7. The value of the Internet

<table>
<thead>
<tr>
<th></th>
<th>I often have difficulty finding useful material on the Internet.</th>
<th>I often seek help from others when surfing the Internet.</th>
<th>I consider the Internet to be useless to me personally.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly agree</td>
<td>16.6%</td>
<td>23.8%</td>
<td>65.4%</td>
</tr>
<tr>
<td>Agree</td>
<td>43.9%</td>
<td>42.7%</td>
<td>23.9%</td>
</tr>
<tr>
<td>Undecided</td>
<td>20.0%</td>
<td>8.3%</td>
<td>2.4%</td>
</tr>
<tr>
<td>Disagree</td>
<td>16.1%</td>
<td>20.4%</td>
<td>3.4%</td>
</tr>
<tr>
<td>Strongly disagree</td>
<td>3.4%</td>
<td>4.9%</td>
<td>4.9%</td>
</tr>
</tbody>
</table>

In summary, the chosen sample for this study can be characterised as follows: the vast majority of the respondents (75.7%) were between the ages of 19 and 22. This sample group’s first choice of communication language was English (77.2%). There were almost an equal number of males (52.4%) to females (47.6%); 92.2% of respondents had access to and used e-mail. The majority of respondents conservatively (56.6%) considered themselves as intermediate users, while 17.5% considered themselves as novice users. Based on these results it is assumed that the chosen sample group has had a reasonable interaction with computer technology.

2.1. Distribution of response to questions

For the purposes of this analysis we did not exclude any respondents in our statistical analysis. The underlying reason for this is that the Internet is a tool that is used by a wide variety of users, ranging from naïve and novice to skilled and expert users, as well as users with different cultural and linguistic backgrounds. We constructed box plots to graphically indicate the distribution of responses. The various box plots are discussed in detail in Appendix H. The box plots are constructed for the composite values of instructions, speed of website, visual aids, reaction to website, appearance of the website, movement through the website and general impressions. We use institution as the dependent variable for the statistical analysis. We do this to avoid the results becoming diluted by having too many dependent variables. The box plots show the responses for Site A and Site B (Appendix H). Table 7.8 is a summary of the observations from the box plot analysis.
## Instructions

The median for Cape Technikon, University of Western Cape and University of Durban-Westville are similar; the exception is the University of Natal which has a lower median than the other institutions. University of Natal has a high concentration of scores at the low end. The responses for University of Natal display considerably more variety.

The medians for Cape Technikon and University of Durban-Westville are similar; the median for University of Western Cape and University of Natal are higher. University of Western Cape has a high concentration of scores at the higher end.

The medians for Cape Technikon and University of Natal are not indicated on the box plots, the medians for University of Western Cape and University of Durban-Westville are similar. University of Western Cape has a high concentration of scores at the higher end.

The medians for Cape Technikon and University of Natal are higher than University of Western Cape and University of Durban-Westville; University of Western Cape and University of Durban have similar medians.

The medians for Cape Technikon and University of Natal are not indicated in the box plots.

The medians for Cape Technikon are similar; the median for University of Western Cape and University of Natal are not indicated on the box plot.

The University of Natal has a high concentration of scores at the higher end.

The medians for the various institutions vary, with Natal University having the lowest median.

The University of Western Cape has a higher median than the other institutions; Cape Technikon, University of Durban-Westville and University of Natal have similar medians.

<table>
<thead>
<tr>
<th></th>
<th>Site A</th>
<th>Site B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instructions</td>
<td>The median for Cape Technikon, University of Western Cape and University of Durban-Westville are similar; the exception is the University of Natal which has a lower median than the other institutions. University of Natal has a high concentration of scores at the low end. The responses for University of Natal display considerably more variety.</td>
<td>The medians for Cape Technikon and University of Durban-Westville are similar; the median for University of Western Cape and University of Natal are higher. University of Western Cape has a high concentration of scores at the higher end.</td>
</tr>
<tr>
<td>Speed of Website</td>
<td>The medians for Cape Technikon and University of Western Cape are similar, the median for University of Durban-Westville is higher, and the median for University of Natal is not indicated on the box plot.</td>
<td>The medians for Cape Technikon and University of Natal are not indicated on the box plots, the medians for University of Western Cape and University of Durban-Westville are similar. University of Western Cape has a high concentration of scores at the higher end.</td>
</tr>
<tr>
<td>Visual Aids</td>
<td>The median for Cape Technikon and University of Natal are higher than University of Western Cape and University of Durban-Westville; University of Western Cape and University of Durban have similar medians.</td>
<td>The medians for Cape Technikon and University of Natal are not indicated in the box plots.</td>
</tr>
<tr>
<td>Reaction to website</td>
<td>The median for Cape Technikon is lower than University of Western Cape and University of Durban-Westville; University of Western Cape and University of Durban-Westville have similar medians while the median for University of Natal is not indicated on the box plot.</td>
<td>The University of Western Cape and University of Natal have higher medians than Cape Technikon. The median for University of Natal is in the upper 75% of the box plot.</td>
</tr>
<tr>
<td>Appearance of the website</td>
<td>The medians for the various institutions vary, with Natal University having the lowest median.</td>
<td>The University of Western Cape has a higher median than the other institutions; Cape Technikon, University of Durban-Westville and University of Natal have similar medians.</td>
</tr>
</tbody>
</table>
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An Investigation into the Influence of Usability on the Development of the Browsing Experience of E-Commerce Applications                  Shawren Singh

<table>
<thead>
<tr>
<th>Navigation through the website</th>
<th>Site A</th>
<th>Site B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cape Technikon and University of Durban-Westville have similar medians, University of Natal has a slightly higher median and University of Western Cape has the highest median. University of Western Cape has a high concentration of scores at the higher end.</td>
<td>Cape Technikon and University of Durban-Westville have similar medians, University of Natal has a lower median, while University of Western-Cape’s median is not indicated on the box plot.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>General impressions</th>
<th>Site A</th>
<th>Site B</th>
</tr>
</thead>
<tbody>
<tr>
<td>University of Natal’s median is indicated on the box plot while the other institutions are not indicated on the box plots.</td>
<td>For all institutions the medians are in the upper 75% of the box plot.</td>
<td></td>
</tr>
</tbody>
</table>

Table 7.8. Summary of the observations from the box plot analysis

The box plot analysis has revealed that there is variety in the data. On the surface it has indicated that there are several factors that have influenced the data. We will carry out further statistical investigation to try to determine what these factors could be.

Now that we have a picture of what the data look like, we have to test the questionnaire instrument for reliability.

2.2. Overall Questionnaire Instrument Reliability

The overall questionnaire data were tested for reliability using Cronbach’s Alpha. The composite values were used in the Cronbach’s Alpha Test. A Cronbach’s Alpha of .6224 was reported for the overall questionnaire. Nunnally [1978] suggests a Cronbach’s Alpha score of above 0.7 for test reliability. However, a Cronbach’s Alpha score of at least 0.6 is considered an acceptable level for this kind of research [Srinivasan, 1985].

3. Statistical Analysis of Site A and Site B

We will now administer the following statistical techniques to the questionnaire data: central tendency statistics and paired sample $t$-tests. Each statistical technique’s result will be discussed. These statistical tests will be used to either accept or reject the hypothesis. We compare the various websites to investigate if there is a difference in the perceived attitudes of the respondents based on the sites they saw.

3.1. Central Tendency Statistics

In this analysis we used the mean values of the central tendency statistics to do a multi-level comparison of the different test groups. The central tendency statistics enables us to determine whether two groups have equivalent or different mean scores. The central tendency statistics was used to investigate whether the Site B respondents showed a significantly different response from
Site A respondents (See Appendix I and J). The higher the mean value, the worse the website is perceived, and the lower the mean value the better the website is perceived. This was also done for the control site. We conducted comparisons of the different groups. We compared the means to investigate the perceived differences in respondents’ attitudes. We compared the control site with the experimental site, as illustrated in Figure 7.1. We conducted:

- Vertical comparison (1) of control Site B with Site A.
- Vertical comparison (2) of control Site A with Site B.
- Horizontal comparison (3) of control Site B with control Site A.
- Horizontal comparison (4) of Site A with Site B.
- Cross comparison (5) of control Site B with Site B.
- Cross comparison (6) of Site A with control Site A.

![Figure 7.1. Test Comparisons](image)

### 3.1.1. Central Tendency Statistics for Test Site and Control Site

In this section we conduct an analysis of the vertical comparisons, horizontal comparisons and a cross comparison of the central tendency statistics.

#### 3.1.1.1. Vertical Comparison 1

In this test we compare the results for control site B with experimental site A, as illustrated in Table 7.9. Both sites were seen first. Control site B followed the usability principles, while site A did not follow usability principles. The mean values for six of the seven factors are much higher (†) for site A with the exception of ‘appearance of website’. This indicated that the respondents’ perceptions of the two websites differed. Overall website B was seen as a better website than website A.
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<table>
<thead>
<tr>
<th>Composite Values</th>
<th><strong>Control Site B</strong></th>
<th><strong>Site A</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(Seen First)</td>
<td>(Seen First)</td>
</tr>
<tr>
<td></td>
<td>Follow usability guidelines</td>
<td>Ignored some usability guidelines</td>
</tr>
<tr>
<td></td>
<td><strong>Mean</strong></td>
<td><strong>Mean</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Std.</strong></td>
<td><strong>Std.</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Deviation</strong></td>
<td><strong>Deviation</strong></td>
</tr>
<tr>
<td><strong>Instructions</strong></td>
<td>5.2000</td>
<td>10.9184</td>
</tr>
<tr>
<td></td>
<td>1.61933</td>
<td>2.08129</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Con B better than A</td>
</tr>
<tr>
<td><strong>Speed of website</strong></td>
<td>1.8000</td>
<td>11.5146</td>
</tr>
<tr>
<td></td>
<td>.42164</td>
<td>1.75785</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Con B better than A</td>
</tr>
<tr>
<td><strong>Visual aids</strong></td>
<td>9.0000</td>
<td>12.7200</td>
</tr>
<tr>
<td></td>
<td>1.41421</td>
<td>2.17607</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Con B better than A</td>
</tr>
<tr>
<td><strong>Reaction to website</strong></td>
<td>13.2000</td>
<td>14.7344</td>
</tr>
<tr>
<td></td>
<td>1.13529</td>
<td>2.16281</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Con B better than A</td>
</tr>
<tr>
<td><strong>Appearance of the website</strong></td>
<td>30.1000</td>
<td>29.3859</td>
</tr>
<tr>
<td></td>
<td>2.96086</td>
<td>3.79070</td>
</tr>
<tr>
<td></td>
<td>↓</td>
<td>A better than Con B</td>
</tr>
<tr>
<td><strong>Movement through the website</strong></td>
<td>9.9000</td>
<td>14.5102</td>
</tr>
<tr>
<td></td>
<td>1.96921</td>
<td>2.50433</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Con B better than A</td>
</tr>
<tr>
<td><strong>General impressions</strong></td>
<td>5.4000</td>
<td>5.7512</td>
</tr>
<tr>
<td></td>
<td>1.34990</td>
<td>1.26861</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Con B better than A</td>
</tr>
</tbody>
</table>

Table 7.9. Vertical Comparison 1

3.1.1.2. **Vertical Comparison 2**

In this test we compare the results of control site A with site B, as illustrated in Table 7.10. Both sites were seen second. Control group site A did not follow usability principles, site B followed usability principles. The mean values for all the factors for site B are much higher (↑) than for site A. This indicated that the respondents’ perceptions of the various factors were different. Website A was seen overall as a better website than website B.
Table 7.10. Vertical Comparison 2

3.1.1.3. Horizontal Comparison 3 (central tendency statistics for Control Site)

Table 7.11 gives the descriptive statistics for the composite values for the control site, when we compare the mean values for sites A and B. With this test, site B was seen first and site A was seen second. The initial impression for the control site is that site B (which followed usability principles) fared better. There are higher (↑) mean values for site A for the composite values: Instructions, Communication, and Movement through the website. There was, however, a set of lower (↓) mean values for the composite values: ‘Speed of website’, ‘Appearance of the website’ and ‘General Impressions’. These were three of the seven variables that we investigated.
Table 7.11. Descriptive Statistics for Control Site- Horizontal Comparison 3

3.1.1.4. Horizontal Comparison 4

Table 7.12 gives the descriptive statistics for the site A and B. Test site A was seen first and site B was seen second. When we compare the mean values for site A and B, the initial impression is that site B (which followed usability principles) fared better. The users perceived only the ‘instructions’ and ‘speed of website’ A to be better than that of website B (↓).
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### Composite Values

<table>
<thead>
<tr>
<th></th>
<th>Site A (Seen First)</th>
<th>Site B (Seen Second)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Std. Deviation</td>
</tr>
<tr>
<td>Instructions</td>
<td>10.9184</td>
<td>2.08129</td>
</tr>
<tr>
<td>Speed of Website</td>
<td>11.5146</td>
<td>1.75785</td>
</tr>
<tr>
<td>Visual aids</td>
<td>12.7200</td>
<td>2.17607</td>
</tr>
<tr>
<td>Reaction to the website</td>
<td>14.7344</td>
<td>2.16281</td>
</tr>
<tr>
<td>Appearance of the website</td>
<td>29.3859</td>
<td>3.79070</td>
</tr>
<tr>
<td>Movement through the website</td>
<td>14.5102</td>
<td>2.50433</td>
</tr>
<tr>
<td>General impressions</td>
<td>5.7512</td>
<td>1.26861</td>
</tr>
</tbody>
</table>

Table 7.12. Descriptive Statistics – Horizontal Comparison 4

#### 3.1.1.5. Cross Comparison 5 and 6

We now compared means of the control site with the test site; see Table 7.13 and Table 7.14. We noticed that there is a statistical difference in both the results for site A and site B.

<table>
<thead>
<tr>
<th></th>
<th>Seen First</th>
<th>Seen Second</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Site A</td>
<td>Control Site A</td>
</tr>
<tr>
<td></td>
<td>Ignored some usability guidelines</td>
<td>Ignored some usability guidelines</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>Std. Deviation</td>
</tr>
<tr>
<td>Instructions</td>
<td>10.9184</td>
<td>2.08129</td>
</tr>
<tr>
<td>Speed of website</td>
<td>11.5146</td>
<td>1.75785</td>
</tr>
<tr>
<td>Visual aids</td>
<td>12.7200</td>
<td>2.17607</td>
</tr>
<tr>
<td>Reaction to the website</td>
<td>14.7344</td>
<td>2.16281</td>
</tr>
<tr>
<td>Appearance of the website</td>
<td>29.3859</td>
<td>3.79070</td>
</tr>
<tr>
<td>Movement through the website</td>
<td>14.5102</td>
<td>2.50433</td>
</tr>
<tr>
<td>General impressions</td>
<td>5.7512</td>
<td>1.26861</td>
</tr>
</tbody>
</table>

Table 7.13. Cross Comparison of Groups
Table 7.14. Cross Comparison of Groups

The central tendency statistics matrix comparison has indicated that by doing different comparisons and comparing the results, the results may not be what one expects. For example, in Table 7.13, when seen first, site A was perceived worse than when seen second, and in Table 7.14, when seen first, site B was perceived better than when seen second.

3.1.2. Summary of the Central Tendency Statistics

In this section we give a summary of the comments of the central tendency statistics. The comparisons and analyses are as follows (see Table 7.15):

- Vertical Comparison 1: Followed usability (Con. Group B) with ignored usability (Site A). On the first impression control site B was better than Site A, as expected.

- Vertical Comparison 2: Ignored usability (Con. Group A) with followed usability (Site B). On the second impression control site A was better than Site B, which is unexpected.

- Horizontal Comparison 3: Followed usability (Con. Group B) with ignored usability (Con. Group A). On the first impression control site B was, overall, better than control site A, as expected. One now begins to question the premise that usability affects the browsing experience.

- Horizontal Comparison 4: Ignored usability (Site A) with followed usability (Site B). On the second impression Site A was better than Site B, which is unexpected. This seems to indicate that the respondents became more aggressive in their responses. The users then became more critical in their assessment of the other factors as they progressed through the questionnaire (†). A possible reason for their becoming more critical could be attributed to the order effect [Barker, 2000; ciadvertising.org, 2004; Drury & Farhoomand, 1997; Wang et al., 2000]. This indicates that usability aspects affect the design and development of the browsing experience.
• Cross Comparison 5: Ignored usability (Site A) with ignored usability (Con. Group A). If respondents saw Site A first, their impressions were worse for Site A than if they saw control site A second; they saw the better designed website first. This is expected. For both site A and A the test group’s respondents showed a significant more aggressive response than for the control site. The only exception being appearance of the website for both groups. This indicated that the respondents were happy with the appearance of the website, but not with the other factors.

• Cross Comparison 6: Followed usability (Con. Group B) with followed usability (Site B). If respondents saw control site B first, their impressions of Site B were better than when respondents saw Site B second; they saw the worse-designed website first, which is unexpected. For both site B and B the test group’s respondents showed a significantly less aggressive response than for the control site, the only exception being the appearance of the website for both groups. This indicated that the respondents were unhappy with the appearance of the website but the other factors were not important.

Our analysis revealed that the second website always fared poorly in eyes of the respondents. A striking feature of the results of this experiment is that because respondents were able to compare the two websites (site A and site B) at the same sitting, the respondents became much more ‘critical’ of how they expected the second website to perform, even though they saw the ‘badly’ designed website first. It seems that they could see the difference that design according to HCI and usability principles made on the quality of the website, and therefore may have ‘demanded’ more. The aphorism that ‘ignorance is bliss’ is therefore true – given the differently designed websites, the respondents aggressively commented on what they considered as poor design. This can be explained by the order effect [Barker, 2000; ciadvertising.org, 2004; Drury & Farhoomand, 1997; Wang et al., 2000]
### Table 7.15. Summary of Central Tendency Statistics

Our overall finding with the central tendency statistics is that by doing different types of comparisons, the data may reveal more information or different information. A standard horizontal comparison would be misleading. We now conduct further statistical analysis to investigate the premise that usability affects the browsing experience.
3.2. Paired Sample t-test

One of the most common experimental designs is the ‘pre-post’ design. A study of this type often consists of two measurements taken on the same subject, one before and one after the introduction of a treatment or a stimulus. The basic idea is simple: if the treatment had no effect, the average difference between the measurements is equal to 0 (zero) and the null hypothesis holds. On the other hand, if the treatment did have an effect (intended or unintended), the average difference is not 0 (zero) and the null hypothesis is rejected. The Paired sample t-test procedure is used to test the hypothesis of no difference between two variables. The paired sample t-test reduces two samples to the equivalent of a one-sample case [Emory & Cooper, 1991]. We use this technique to compare the means of the different groups. For the purposes of this study, we compare the results of Site A with Site B. Table 7.16 is a summary of the statistics for the control group and experimental group.

<table>
<thead>
<tr>
<th>Composite Values</th>
<th>All Site A</th>
<th>All Site B</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ignored some usability guidelines</td>
<td>Follow usability guidelines</td>
</tr>
<tr>
<td>Instructions</td>
<td>Mean: 10.9266</td>
<td>Mean: 9.4124</td>
</tr>
<tr>
<td></td>
<td>Std. Deviation: 2.12138</td>
<td>Std. Deviation: 1.74658</td>
</tr>
<tr>
<td>Speed of website</td>
<td>Mean: 11.5241</td>
<td>Mean: 11.4813</td>
</tr>
<tr>
<td></td>
<td>Std. Deviation: 1.73615</td>
<td>Std. Deviation: 1.50391</td>
</tr>
<tr>
<td>Visual aids</td>
<td>Mean: 12.6910</td>
<td>Mean: 12.9101</td>
</tr>
<tr>
<td></td>
<td>Std. Deviation: 2.09655</td>
<td>Std. Deviation: 2.17921</td>
</tr>
<tr>
<td>Reaction to the website</td>
<td>Mean: 14.6686</td>
<td>Mean: 14.8994</td>
</tr>
<tr>
<td></td>
<td>Std. Deviation: 2.11773</td>
<td>Std. Deviation: 2.41928</td>
</tr>
<tr>
<td>Appearance of the website</td>
<td>Mean: 29.2980</td>
<td>Mean: 29.5232</td>
</tr>
<tr>
<td></td>
<td>Std. Deviation: 3.71985</td>
<td>Std. Deviation: 3.64936</td>
</tr>
<tr>
<td>Movement through the website</td>
<td>Mean: 14.5089</td>
<td>Mean: 14.6450</td>
</tr>
<tr>
<td></td>
<td>Std. Deviation: 2.36824</td>
<td>Std. Deviation: 2.45034</td>
</tr>
<tr>
<td>General impressions</td>
<td>Mean: 5.7557</td>
<td>Mean: 5.8182</td>
</tr>
<tr>
<td></td>
<td>Std. Deviation: 1.27502</td>
<td>Std. Deviation: 1.18124</td>
</tr>
</tbody>
</table>

Table 7.16. Summary of the Statistics for paired t-test

We note that there are differences to the mean values for all composite values, as indicated in Table 7.16. This indicates that there are perceived differences in the attitudes to Site A and Site B. Further analysis of the statistics in Table 7.17 is as follows:
### Table 7.17. Summary of the Statistics

We briefly discuss these statistics below.

#### 3.2.1. Instructions

The paired mean difference is marginally high. This suggests that instructions have an effect on the perceived usability of the websites. This indicates that instructions on a website are important for the success of the website. Therefore $H_0$ - instructions is rejected. These results are also confirmed by some of the open responses:

- “for someone who is familiar with the place the instructions were very clear, but I think even to someone who isn't, it is still clear for understanding” – comments from Site B.
- “easily marked, standard format, recognisable and navigable” – comments from Site B.
- “well, it’s a very simple website but it goes straight to the point. So I personally liked it” – comments from Site B.
- “everything was clearly stated and understandable” – comments from Site B.
- “instructions on the website are easy to be understood” – comments from Site B.
- “terminology throughout the website is relatively consistent. This indicates that a well-defined series of helpful instructions will enhance the users experience on the web” – comments from Site B.
This indicates that a well-defined series of helpful instructions will enhance the user’s experience on the web.

3.2.2. Remainder of Dependent Variables: Speed of website; Visual Aids; Reaction to the website; Appearance of the website; Movement through the website and General Impressions

The paired mean difference for all the remaining composite values are lower. This suggests that when the respondents looked at the sites they had different perceptions of the websites. This is reinforced by some of the comments of the respondents, such as:

- **Speed of website**: The paired mean difference is marginally higher than zero. This suggests that the speed of the website has an effect on the perceived usability of the website, but it seems that the respondents perceived both the websites differently. From the comments of the respondents there were mixed feelings, such as:
  - “As many people use the website, I think patience is needed” – comments from site A.
  - “the speed of the website is the (most) motivation to be interested on it rather that waiting a couple of minutes waiting for it”– comments from site B.
  - “the speed of the website is very important”– comments from site B.
  - “speed is important like if you search for website. I think it must be appear quickly”– comments from site B.
  - “very happy about the speed of this website”– comments from site B.
  - “this is the first fastest website I ever browse in”– comments from site B.
  - “speed is very important when searching on the web. When you search you expect response now not sit there for five minutes waiting” – comments from site B.

- **Visual aids**: “slightly bland, made me slightly uninterested”, “it needs a well-structured design” – comments from site B.

- **Reaction to the website**: “its too simple they could have just printed and circulated a magazine, since users cannot browse on the page”, “the site provided answers to many questions that I would've posed, but I'd make the site a bit more inviting 'Lively’” – comments from site B.
• **Appearance of the website:** “going back to the previous page was easy. Going to the page I wanted to was not”, “the key 2 make the web visitor interested should be recognised”– comments from site A.

• **Movement through the website:** “navigation was difficult. No back/forward button at bottom of screen. No menu/layout on the left as with the previous website’, ‘navigation icons could be bigger, and by moving over them with the mouse, the destination should be more helpful than 'page004.html” – comments from site A.

• **General impressions:** “one more note on navigation, it was bad”, “easy navigation is important to me and on this website navigation was not well organised i.e. I did not know where I was going next”, “it’s boring an[d] non-stimulating”– comments from site A.

We therefore accept $H_0$- response times, $H_0$- visual aids, $H_0$- impression, $H_0$- appearance, $H_0$- navigation, $H_0$- general- These statistics reveal an apparent contradiction to our hypothesis. We have established that the changes in the design affect the users’ perceptions of the websites. The actual design of the experiment could have affected the findings; issues such as the order effect [Barker, 2000; ciadvertising.org, 2004; Drury & Farhoomand, 1997; Wang *et al*., 2000] and the Hawthorne effect [Adair, 1984; Holden 2001] may have affected the respondents.

### 3.3. Overall Summary of the Central Tendency Statistics and Paired Sample t-test

In Table 7.18 we have the overall summary of the central tendency statistics and paired sample $t$-tests. Our overall finding from the paired sample $t$-test was that the factors did not influence the usability of the websites. When we compared the results of Site A with Site B there were perceptual attitudinal differences. It seems that the concept of usability may affect aspects of design process.
<table>
<thead>
<tr>
<th>Composite Values</th>
<th>Comments from central tendency statistics</th>
<th>Comments from paired sample t-test</th>
<th>Overall Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instructions</td>
<td>Overall B is better</td>
<td>Reject H₀: instructions</td>
<td>The better designed website contradicts the paired t-test results</td>
</tr>
<tr>
<td>Speed of website</td>
<td>Websites faired the same</td>
<td>Accept H₀: response times</td>
<td>Speed did not have an effect</td>
</tr>
<tr>
<td>Visual aids</td>
<td>Websites faired the same</td>
<td>Accept H₀: visual aids</td>
<td>Visual communication did not have an effect</td>
</tr>
<tr>
<td>Overall reaction</td>
<td>Websites faired the same</td>
<td>Accept H₀: impression</td>
<td>Overall reaction was the same</td>
</tr>
<tr>
<td>Appearance of the website</td>
<td>Overall A is better</td>
<td>Accept H₀: appearance</td>
<td>The poorly designed website faired better</td>
</tr>
<tr>
<td>Movement through the website</td>
<td>Websites faired the same</td>
<td>Accept H₀: navigation</td>
<td>Navigation did not have an effect</td>
</tr>
<tr>
<td>General Impressions</td>
<td>Overall A is better</td>
<td>Accept H₀: general</td>
<td>The poorly designed website faired better</td>
</tr>
</tbody>
</table>

Table 7.18. Overall Summary of the Central Tendency Statistics and Paired Sample t-test

4. **Statistical analysis with specific focus on Institution as dependent variable**

In this section we will focus on the effect to respondents’ perceived attitudes to the websites using the independent variable Institution. We use institution as independent variable because the respondents came from different educational institutions. We will look at the other independent variables, i.e. web experience, gender, qualifications, home language, course language, language of choice, population and province, in Section 5. We will administer the following statistical techniques to the questionnaire data: Anova, multiple comparison, and Kruskal-Wallis test.

4.1. **Anova descriptive statistics**

The analysis of variance is a procedure that determines whether differences exist between two or more population means. This test is ideal, because we will compare two different groups: the respondents to site A (ignored usability) and site B (followed usability). Institution is used as the dependent variable.

We conducted a one-way Anova test on the data using SPSS. Table 7.19 is a summary of the descriptive statistics for the Anova test and the Anova between the groups. In the context of this study, F is used for statistical inference and p is used for interpretation purposes.
## Chapter 7

An Investigation into the Influence of Usability on the Development of the Browsing Experience of E-Commerce Applications

Shawren Singh

### Composite Values

<table>
<thead>
<tr>
<th></th>
<th>Site A</th>
<th>Site B</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Std. Deviation</td>
</tr>
<tr>
<td><strong>F</strong></td>
<td><strong>Sig -p</strong></td>
<td><strong>F</strong></td>
</tr>
<tr>
<td>Instructions</td>
<td></td>
<td></td>
</tr>
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<td>Cape Technikon</td>
<td>10.6923</td>
<td>2.20106</td>
</tr>
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<td>1.94335</td>
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<td>11.0513</td>
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<td>10.6000</td>
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<td>1.80280</td>
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<td><strong>Control group</strong></td>
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<td>13.7000</td>
</tr>
<tr>
<td>Reaction to the website</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## An Investigation into the Influence of Usability on the Development of the Browsing Experience of E-Commerce Applications

Shawren Singh

<table>
<thead>
<tr>
<th>Site A</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Anova Between Groups</th>
<th>Site B</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Anova Between Groups</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
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<td>University of Western Cape</td>
<td>15.5000</td>
<td>2.50881</td>
<td></td>
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</tr>
<tr>
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<td></td>
<td>Control group University of Natal</td>
<td>13.4000</td>
<td>2.27058</td>
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<td>B better than A</td>
</tr>
<tr>
<td>University of Western Cape</td>
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<td>2.50881</td>
<td></td>
<td>University of Durban-Westville</td>
<td>14.9250</td>
<td>2.04862</td>
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<td>A better than B</td>
</tr>
<tr>
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</tr>
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<td></td>
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<td>2.12132</td>
<td></td>
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</tr>
<tr>
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<td>14.0392</td>
<td>1.81064</td>
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<td>University of Durban-Westville</td>
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<td>2.56974</td>
<td></td>
<td>A better than B</td>
</tr>
<tr>
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<td>14.1000</td>
<td>1.96921</td>
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</tr>
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<td>Control group University of Natal</td>
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<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Appearance of the Website

<table>
<thead>
<tr>
<th>Site A</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Anova Between Groups</th>
<th>Site B</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Anova Between Groups</th>
<th>Comment</th>
</tr>
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<tbody>
<tr>
<td>Cape Technikon</td>
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<td>30.6957</td>
<td>4.34035</td>
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<td>University of Western Cape</td>
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<td>4.34035</td>
<td></td>
<td>University of Durban-Westville</td>
<td>29.3462</td>
<td>3.58143</td>
<td></td>
<td>B better than A</td>
</tr>
<tr>
<td>University of Durban-Westville</td>
<td>29.3462</td>
<td>3.58143</td>
<td></td>
<td>Control group University of Natal</td>
<td>29.5000</td>
<td>2.12132</td>
<td></td>
<td>A better than B</td>
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<td>29.3462</td>
<td>3.58143</td>
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<td>University of Durban-Westville</td>
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<td>A better than B</td>
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<tr>
<td>Control group University of Natal</td>
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<td></td>
<td></td>
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</tbody>
</table>

### Movement through the Website

<table>
<thead>
<tr>
<th>Site A</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Anova Between Groups</th>
<th>Site B</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Anova Between Groups</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cape Technikon</td>
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<td>1.81064</td>
<td></td>
<td>University of Western Cape</td>
<td>15.7736</td>
<td>2.67928</td>
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</tr>
<tr>
<td>University of Western Cape</td>
<td>15.7736</td>
<td>2.67928</td>
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<td>14.0366</td>
<td>2.56974</td>
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<tr>
<td>University of Durban-Westville</td>
<td>14.0366</td>
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<td>1.96921</td>
<td></td>
<td>B better than A</td>
</tr>
<tr>
<td>Control group University of Natal</td>
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<td>1.96921</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### General Impressions

<table>
<thead>
<tr>
<th>Site A</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Anova Between Groups</th>
<th>Site B</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Anova Between Groups</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 7.19. Summary of Descriptive Statistics for Anova and the Anova between the groups

From looking at the mean values for site B, the general pattern seems to suggest that as the respondents looked at site B. Their perceptions to site B changed. There are 15 mean values that are higher (↑ – perceived worse) and there are 13 that are lower (↓ – perceived better).

4.1.1. Interpreting the Anova

In Table 7.20 is a summary presentation of the \( p \) values of the Anova statistic from Table 7.13. We use these values to accept or reject our hypothesis.
### Table 7.20. Summary of $p$ values for Anova

<table>
<thead>
<tr>
<th>Composite Values</th>
<th>Site A $p$ value</th>
<th>Comment</th>
<th>Site B $p$ value</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instructions</td>
<td>.492 &gt; 0.01</td>
<td>Accept $H_0$: instructions</td>
<td>.817 &gt; 0.01</td>
<td>Accept $H_0$: instructions</td>
</tr>
<tr>
<td>Speed of website</td>
<td>.007 &lt; 0.01</td>
<td>Reject $H_0$: response times</td>
<td>.304 &gt; 0.01</td>
<td>Accept $H_0$: response times</td>
</tr>
<tr>
<td>Visual aids</td>
<td>.242 &gt; 0.01</td>
<td>Accept $H_0$: visual aids</td>
<td>.930 &gt; 0.01</td>
<td>Accept $H_0$: visual aids</td>
</tr>
<tr>
<td>Reaction to the website</td>
<td>.000 &lt; 0.01</td>
<td>Reject $H_0$: impression</td>
<td>.001 &lt; 0.01</td>
<td>Reject $H_0$: impression</td>
</tr>
<tr>
<td>Appearance of the website</td>
<td>.016 &lt; 0.01</td>
<td>Reject $H_0$: appearance</td>
<td>.001 &lt; 0.01</td>
<td>Reject $H_0$: appearance</td>
</tr>
<tr>
<td>Movement through the website</td>
<td>.000 &lt; 0.01</td>
<td>Reject $H_0$: navigation</td>
<td>.000 &lt; 0.01</td>
<td>Reject $H_0$: navigation</td>
</tr>
<tr>
<td>General impressions</td>
<td>.390 &gt; 0.01</td>
<td>Accept $H_0$: general</td>
<td>.528 &gt; 0.01</td>
<td>Accept $H_0$: general</td>
</tr>
</tbody>
</table>

#### 4.1.2. Summary of the Anova Test

In this section there is a summary of the Anova test. The explanation of Anova Test is as follows (see Chapter 5, Section 4.3). The bracketed number is the degrees of freedom of the numerator (here it is the between groups) and the denominator (here it is the within groups):

4.1.2.1. **Instructions**

The Anova Test results for Site A and Site B are as follows:

- **Site A:** $F(3, 192) = .806; p = .492 > 0.01$ (Not significant, the $p$ value is high, we therefore accept $H_0$: instructions - in the context of this study on the surface it seems that instructions did not have the same attitudinal perceptions for respondents of the site).

- **Site B:** $F(3, 186) = .311; p = .817 > 0.01$ (Not significant, the $p$ value is high, we therefore accept $H_0$: instructions - in the context of this study on the surface it seems that instructions did not have the same attitudinal perceptions for respondents of the site).

This non-significance is illustrated by the following comments:

- “Everything was clearly stated and understandable”— taken from Site A for University of the Western Cape.

- “Improve the website design” – taken from Site A for Cape Technikon.
• “Instructions were clear to me but maybe not to a beginner user of the web” – taken from Site A for University of Natal.

### 4.1.2.2. Speed of Website

The Anova Test results for Site A and Site B are as follows:

- Site A: F(3, 202) = 4.153; \( p = .007 < 0.01 \) (Significant, the \( p \) value is small, we therefore reject \( H_0 \): response times in the context of this study it seems that speed of website did affect the attitudinal perceptions of respondents).

- Site B: F(3, 186) = 1.220; \( p = .304 > 0.01 \) (Not significant, the \( p \) value is high, we therefore accept \( H_0 \): on the surface it seems that speed of website did not have the same attitudinal perceptions for respondents of the site).

There was no intentional effort to reduce the download speed of the website. This led us to believe that a ‘critical nature’ of the user set in – the immediate comparison caused the user to rethink the qualities of the website. This is illustrated by the following comments:

- “Slightly slower than last time” – taken from Site B for University of Natal.
- “This is the first fastest website I ever browse in” – taken from Site A for Cape Technikon.

### 4.1.2.3. Visual Aids

The Anova Test results for Site A and Site B are as follows:

- Site A: F(3, 196) = 1.408; \( p = .242 > 0.01 \) (Not significant, the \( p \) value is high, we therefore accept \( H_0 \): visual aids did not have the same attitudinal perceptions for respondents of the site).

- Site B: F(3, 179) = .149; \( p = .930 > 0.01 \) (Not significant, the \( p \) value is high, we therefore accept \( H_0 \): visual aids did not have the same attitudinal perceptions for respondents of the site).

The users found the level of visual communication adequate as illustrated by the following comments:

- “The colours were not bad” – taken from Site A for Cape Technikon.
- “The colours used on this site are beautiful and natural not too colourful or dull” – taken from Site A for Cape Technikon.
- “I like the colour & pictures; it is so natural” – taken from Site A for Cape Technikon.

It is clear that the colours used on the website invoked some type of reaction from the users.
4.1.2.4. Reaction to website

The Anova Test results for Site A and Site B are as follows:

- Site A: F(3, 188) = 6.675; \( p = .000 < 0.01 \) (Significant, the \( p \) value is small, we therefore reject \( H_0 \)- impression: in the context of this study it seems that reaction to website did affect the attitudinal perceptions of respondents).

- Site B: F(3, 174) = 5.609; \( p = .001 < 0.01 \) (Significant, the \( p \) value is small, we therefore reject \( H_0 \)- impression: in the context of this study it seems that reaction to website did affect the attitudinal perceptions of respondents).

The design of both websites invoked strong feeling in the users as illustrated by the following comments:

- “Durban is a lively city full colour & people & places the website does not do this justice” – taken from Site A from University of Western Cape.

- “The website is interesting when you read but the[r]e is lack of further details and pictures are not clear for it to be attractive” – taken from Site A from University of Western Cape.

- “There was nothing different about it. It looks as though it is not Durban. It is somehow a reflection on New York city which I find disturbing” – taken from Site A from University of Western Cape.

4.1.2.5. Appearance of the website

The Anova Test results for Site A and Site B are as follows:

- Site A: F(3, 180) = 3.556; \( p = .016 < 0.01 \) (Significant, the \( p \) value is small, we therefore reject \( H_0 \)- appearance: in the context of this study it seems that appearance of the website did affect the attitudinal perceptions of respondents).

- Site B: F(3, 160) = 6.211; \( p = .001 < 0.01 \) (Significant, the \( p \) value is small, we therefore reject \( H_0 \)- appearance: in the context of this study it seems that appearance of the website did affect the attitudinal perceptions of respondents).

The look and feel of the website affected the users as illustrated by the following comments:

- “The screen[s] were very well organised in a logical order i.e. menu on left of screen -> worked its way down the menu” – taken from Site A for University of Natal.

- “Just good” – taken from Site A for Cape Technikon.

- “Everything as far as I'm concerned is up-to scratch” – taken from Site A for University of Western Cape.
4.1.2.6. **Movement through the website**

The Anova Test results for Site A and Site B are as follows:

- **Site A:** $F(3, 192) = 6.706; p = .000 < 0.01$ (Significant, the $p$ value is small, we therefore reject $H_0$: in the context of this study it seems that movement through the website did affect the attitudinal perceptions of respondents).

- **Site B:** $F(3, 170) = 8.033; p = .000 < 0.01$ (Significant, the $p$ value is small, we therefore reject $H_0$: in the context of this study it seems that movement through the website did affect the attitudinal perceptions of respondents).

It is clear that the navigation or lack of it affected the users, as illustrated by the following comments:

- “Needed navigation buttons/heading links on the side instead of going thru every page” – taken from Site B for Cape Technikon.

- “No links whatsoever” – taken from Site B for Cape Technikon.

- “Navigation was difficult. No back/forward button at bottom of screen. No menu/layout on the left as with the previous website” – taken from Site B for University of Natal.

4.1.2.7. **General Impressions**

The Anova Test results for Site A and Site B are as follows:

- **Site A:** $F(3, 201) = 1.008; p = .390 > 0.01$ (Not significant, the $p$ value is high, we therefore accept $H_0$: in the context of this study on the surface it seems that general impressions did not have the same attitudinal perceptions for respondents of the site).

- **Site B:** $F(3, 172) = .742; p = .528 > 0.01$ (Not significant, the $p$ value is high, we therefore accept $H_0$: in the context of this study on the surface it seems that general impressions did not have the same attitudinal perceptions for respondents of the site).

This non-significance is illustrated by the following comments:

- “I did’nt know left from right. No links to direct me, left me with a really bad hair do” – taken from Site B for Cape Technikon; a novice user.

- “This website is so wonderful” – taken from Site A for Cape Technikon; a naïve user.

- “Nice and simple, not memorable, but serves its purpose well” – taken from Site A for University of Natal; a skilled user.

- “Easy navigation is important to me and on this website navigation was not well organised i.e. I did not know where I was going next” – taken from Site B for University of Natal; a skilled user.
4.1.3. Levene statistic

The next step in the statistical analysis was to administer a Levene statistic for the test of homogeneity of variance, as illustrated in Table 7.21. In the context of this study we wanted to investigate if the respondents had the same attitudes to website A and website B.

<table>
<thead>
<tr>
<th>Composite Values</th>
<th>Levene Statistic</th>
<th>Significant ((p))</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Site A</td>
<td>Site B</td>
</tr>
<tr>
<td>Instructions</td>
<td>.283</td>
<td>.286</td>
</tr>
<tr>
<td>Speed of website</td>
<td>1.426</td>
<td>4.943</td>
</tr>
<tr>
<td>Visual aids</td>
<td>1.640</td>
<td>1.861</td>
</tr>
<tr>
<td>Reaction to website</td>
<td>2.158</td>
<td>1.195</td>
</tr>
<tr>
<td>Appearance of the website</td>
<td>1.489</td>
<td>1.246</td>
</tr>
<tr>
<td>Movement through the website</td>
<td>2.905</td>
<td>.336</td>
</tr>
<tr>
<td>General impressions</td>
<td>1.038</td>
<td>4.907</td>
</tr>
</tbody>
</table>

Table 7.21. Test of Homogeneity of Variance

4.1.3.1. Interpreting the Levene Statistic

Homogeneity refers to the degree of similarity within data values [Kvanli et al., 2003]. There seems to be no evidence of homogeneity of variance, since the \(p\) values are all much larger than the critical value of 0.05, except for two factors that have \(p\) values of .003 (namely, speed of website and general impression). This means that the sample group is heterogeneous.

4.1.3.2. Summary of the Levene test

There were significant variations in the respondents’ attitudes to the factors, and the sample was therefore found to be heterogeneous. The factors did influence the respondents’ attitudes on usability. Even within a so-called well selected group of users, their perceptions to the factors tested in the websites varied considerably. This is a clear indication to us that the users of the Internet are heterogeneous. These is a conception by designers to design for the ‘ideal’ user who can find his way around a website. This is not true. An expert user can be relegated to the ranks of a novice user.

4.2. Multiple Comparison

The next step of the analysis that was conducted was a Scheffé test. This test is used when there is unequal sample size. The test allows for multiple comparisons. Groups are divided into homogeneous subsets, thus showing which means do not differ from one another (i.e. the members within each subset). In the context of this study we wanted to investigate to determine if there are homogeneous subgroups within groups.
4.2.1. Interpreting the Scheffé test

With the Levene statistic we conclude that the sample group was heterogeneous. The Scheffe test reveals that within this sample there are homogeneous subsets. We conclude that for each subset group, respondents had similar perceptions on the composite value tested. For each composite value a multiple comparison test was conducted (for Site A and B). The overall analysis revealed that there are respondents from a subgroup at a particular institution that correspond with respondents from a subgroup at another institution. The subgroups are summarised in Table 7.22. If we look at the combination of responses across all institutions, we get different groupings, but we cannot really pinpoint the reasons (finding this is beyond the scope of this dissertation). A multitude of factors could contribute to this – for example, similarities in economic factors (institutional and respondents), geography, cultural factors, politics, institutional, and respondents’ acceptance of technology (see Chapter 1, Figure 1.1. The Business environment).
<table>
<thead>
<tr>
<th>Composite Values</th>
<th>Site A Comment</th>
<th>Site B Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Instructions</strong></td>
<td>Institutional attitudes are the same. All the respondents agree – one group.</td>
<td>Institutional attitudes are the same. All the respondents agree – one group.</td>
</tr>
</tbody>
</table>
| **Speed of Website** | There are 2 subsets:  
  Subset 1  
  • Control group  
  University of Natal  
  • Cape Technikon  
  University of Western Cape  
  Subset 2  
  • Cape Technikon  
  University of Western Cape  
  • University of Durban-Westville | There are groupings from different institutions that agree.  
  There are differences within Cape Technikon and University of Western Cape. | Institutional attitudes are the same. All the respondents agree – one group. |
| **Visual Aids** | Institutional attitudes are the same. All the respondents agree – one group. | Institutional attitudes are the same. All the respondents agree – one group. |
| **Reaction to website** | There are 2 subsets:  
  Subset 1  
  • Control group  
  University of Natal  
  • Cape Technikon  
  University of Durban-Westville  
  Subset 2  
  • Cape Technikon  
  University of Durban-Westville  
  • University of Western Cape | There are groupings from different institutions that agree.  
  There are differences within Cape Technikon and University of Durban-Westville. | There are 2 subsets:  
  Subset 1  
  • Control group  
  University of Natal  
  • Cape Technikon  
  Subset 2  
  • Cape Technikon  
  University of Durban-Westville  
  • University of Western Cape | There are groupings from different institutions that agree.  
  There are differences within Cape Technikon.
## Chapter 7

### An Investigation into the Influence of Usability on the Development of the Browsing Experience of E-Commerce Applications

Shawren Singh

<table>
<thead>
<tr>
<th>Composite Values</th>
<th>Site A</th>
<th>Comment</th>
<th>Site B</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appearance of the website</td>
<td>Institutional attitudes are the same. All the respondents agree – one group.</td>
<td></td>
<td>There are 2 subsets: <strong>Subset 1</strong>  - Cape Technikon  - University of Durban-Westville  - Control group University of Natal</td>
<td>There are groupings from different institutions that agree.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Subset 2</strong>  - University of Durban-Westville  - Control group University of Natal  - University of Western Cape</td>
<td>There are differences within University of Durban-Westville and University Natal.</td>
</tr>
</tbody>
</table>

| Movement through the website | Institutional attitudes are the same. All the respondents agree – one group. | | There are 2 subsets: **Subset 1**  - Control group University of Natal  - Cape Technikon | There are groupings from different institutions that agree. |
| | | | **Subset 2**  - Cape Technikon  - University of Durban-Westville  - University of Western Cape | There are differences within Cape Technikon. |

| General Impression | Institutional attitudes are the same. All the respondents agree – one group. | | Institutional attitudes are the same. All the respondents agree – one group. | |

**Table 7.22.** Subsets of Groups

### 4.2.2. Analysis of the Different Subgroups

In this section we will analyse the different subgroups of the Scheffe test. To do this we deconstruct the composite values (see Chapter 6, Section 5) and we look at each question item. We reapply the Scheffe test to the deconstructed composite values (the individual questions).

#### 4.2.2.1. Speed of Website

The values assigned to ‘Speed of website’ are composed from the combined values of responses to the following questions:

- It is important that the website process my request quickly.

- Web material did not appear quickly on my screen.
• A fast response time is important to my activities on the web.

For ‘speed of website’ there were two subgroups (see Table 7.22). On closer analysis the following is revealed about Site A, as illustrated in Table 7.23.

<table>
<thead>
<tr>
<th>Question</th>
<th>It is important that the website process my request quickly</th>
<th>Web material did not appear quickly on my screen</th>
<th>A fast response time is important to my activities on the web</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scheffe Test</td>
<td>Institutional attitudes are the same. All the respondents agree – one group</td>
<td>There are attitudinal variations for this question. This question related specifically to the test websites.</td>
<td>Institutional attitudes are the same. All the respondents agree – one group</td>
</tr>
</tbody>
</table>

Table 7.23. Scheffe Test for Speed of Website

There are two possible reasons for the attitudinal differences for the question: ‘Web material did not appear quickly on my screen’. The first is that the question is negatively stated and the second is that of the order effect [Barker, 2000; ciadvertising.org, 2004; Drury & Farhoomand, 1997; Wang et al., 2000]

4.2.2.2. Reaction to Website

The values assigned to ‘Reaction to the website’ are composed from the combined values of responses to the following question:

• This website is...: ...terrible, ...dull, ...wonderful, ...stimulating, ...flexible.

For ‘Reaction to website’ there were two subgroups for both Site A and B (see Table 7.22). On closer analysis the following is revealed, as illustrated in Table 7.24.
<table>
<thead>
<tr>
<th>Question</th>
<th>This website is terrible</th>
<th>This website is dull</th>
<th>This website is wonderful</th>
<th>This website is stimulating</th>
<th>This website is flexible</th>
</tr>
</thead>
<tbody>
<tr>
<td>Website</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>Scheffe Test</td>
<td>Institutional attitudes are the same. All the respondents agree – one group</td>
<td>There are attitudinal variations for this question</td>
<td>There are attitudinal variations for this question</td>
<td>There are attitudinal variations for this question</td>
<td>Institutional attitudes are the same. All the respondents agree – one group</td>
</tr>
<tr>
<td>Website</td>
<td>B</td>
<td>B</td>
<td>B</td>
<td>B</td>
<td>B</td>
</tr>
<tr>
<td>Scheffe Test</td>
<td>Institutional attitudes are the same. All the respondents agree – one group</td>
<td>There are attitudinal variations for this question</td>
<td>There are attitudinal variations for this question</td>
<td>There are attitudinal variations for this question</td>
<td>There are attitudinal variations for this question</td>
</tr>
</tbody>
</table>

**Table 7.24. Scheffe test for reaction to Website**

For the questions: ‘This website is dull,’ ‘This website is wonderful,’ and ‘This website is stimulating,’ there are 2 subgroups. These questions have stimulated different attitudinal responses from the different respondents. For the question: ‘This website if flexible,’ for site A all respondents have the same attitude, but for site B their attitudes vary.

### 4.2.2.3. Appearance of Website

The values assigned to ‘Appearance’ of the website are composed from the combined values of responses to the following questions:

- Characters on the screen were hard to read.
- Images such as pictures and graphics on the screen were fuzzy.
- Character shapes (fonts) were illegible.
- The use of bold text was unhelpful.
- Screen layouts were helpful.
- The amount of information on-screen was digestible.
- The information arrangement on-screen was illogical.
- The screens’ sequence was logical.
- The next screen in the sequence was unpredictable.
- Going back to the previous screen was easy.
For ‘Appearance of website’ there were two subgroups for both Site A and B (see Table 7.22). On closer analysis the following is revealed, as illustrated in Table 7.25.

<table>
<thead>
<tr>
<th>Question</th>
<th>Characters on the screen were hard to read</th>
<th>Images such as pictures and graphics on the screen were fuzzy</th>
<th>Character shapes (fonts) were illegible</th>
<th>The use of bold text was unhelpful</th>
<th>Screen layouts were helpful</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>Scheffe Test</td>
<td>Institutional attitudes are the same. All the respondents agree – one group</td>
<td>Institutional attitudes are the same. All the respondents agree – one group</td>
<td>Institutional attitudes are the same. All the respondents agree – one group</td>
<td>Institutional attitudes are the same. All the respondents agree – one group</td>
<td>Institutional attitudes are the same. All the respondents agree – one group</td>
</tr>
<tr>
<td>Site</td>
<td>B</td>
<td>B</td>
<td>B</td>
<td>B</td>
<td>B</td>
</tr>
<tr>
<td>Scheffe Test</td>
<td>There are attitudinal variations for this question</td>
<td>Institutional attitudes are the same. All the respondents agree – one group</td>
<td>Institutional attitudes are the same. All the respondents agree – one group</td>
<td>Institutional attitudes are the same. All the respondents agree – one group</td>
<td>There are attitudinal variations for this question</td>
</tr>
<tr>
<td>Question</td>
<td>The amount of information on-screen was digestible</td>
<td>The information arrangement on-screen was illogical</td>
<td>The screens sequence was logical</td>
<td>The next screen in the sequence was unpredictable</td>
<td>Going back to the previous screen was easy</td>
</tr>
<tr>
<td>Site</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>Scheffe Test</td>
<td>Institutional attitudes are the same. All the respondents agree – one group</td>
<td>Institutional attitudes are the same. All the respondents agree – one group</td>
<td>Institutional attitudes are the same. All the respondents agree – one group</td>
<td>There are attitudinal variations for this question</td>
<td>Institutional attitudes are the same. All the respondents agree – one group</td>
</tr>
<tr>
<td>Site</td>
<td>B</td>
<td>B</td>
<td>B</td>
<td>B</td>
<td>B</td>
</tr>
<tr>
<td>Scheffe Test</td>
<td>Institutional attitudes are the same. All the respondents agree – one group</td>
<td>Institutional attitudes are the same. All the respondents agree – one group</td>
<td>Institutional attitudes are the same. All the respondents agree – one group</td>
<td>There are attitudinal variations for this question</td>
<td>Institutional attitudes are the same. All the respondents agree – one group</td>
</tr>
</tbody>
</table>

Table 7.25. Scheffe test for Appearance of Website

For the question: ‘Characters on the screen were hard to read’ there are attitudinal differences for site B. For the question: ‘Screen layouts were helpful’ there are attitudinal differences for site B, and there is a link between this question and the question ‘The next screen in the sequence was unpredictable’. For the question: ‘The next screen in the sequence was unpredictable’ for both sites A and B respondents had attitudinal differences. This indicates that navigation plays an important role in the design of interactive websites.
4.2.2.4. Movement through Website

The values assigned to ‘Movement through the website’ are composed from the combined values of responses to the following question:

- Learning to navigate around the website was difficult.
- On-line help features are unimportant to my activities on the web.
- The link structure was useful in the navigation of the website.
- The website was inconsistently designed.
- Navigation icons were placed in strategic areas.

For ‘Movement through website’ there were two subgroups for Site B (see Table 7.22). On closer analysis the following is revealed, as illustrated in Table 7.26.

<table>
<thead>
<tr>
<th>Question</th>
<th>Learning to navigate around the website was difficult</th>
<th>On-line help features are unimportant to my activities on the web</th>
<th>The link structure was useful in the navigation of the website</th>
<th>The website was inconsistently designed</th>
<th>Navigation icons were placed in strategic areas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>Scheffe Test</td>
<td>There are attitudinal variations for this question</td>
<td>Institutional attitudes are the same. All the respondents agree – one group</td>
<td>Institutional attitudes are the same. All the respondents agree – one group</td>
<td>Institutional attitudes are the same. All the respondents agree – one group</td>
<td>There are attitudinal variations for this question</td>
</tr>
<tr>
<td>Site B</td>
<td>B</td>
<td>B</td>
<td>B</td>
<td>B</td>
<td>B</td>
</tr>
<tr>
<td>Scheffe Test</td>
<td>There are attitudinal variations for this question</td>
<td>Institutional attitudes are the same. All the respondents agree – one group</td>
<td>There are attitudinal variations for this question</td>
<td>Institutional attitudes are the same. All the respondents agree – one group</td>
<td>There are attitudinal variations for this question</td>
</tr>
</tbody>
</table>

Table 7.26. Scheffe test for Movement through Website

For the questions: ‘Learning to navigate around the website was difficult’, ‘The link structure was useful in the navigation of the website’, and ‘Navigation icons were placed in strategic areas’, respondents had different attitudinal responses. This indicated to us that movement/navigation plays an important role in the design on interactive websites.

As stated earlier there are various reasons for the attitudinal differences. The first could be the manner in which the questions were asked and the second is that of the order effect [Barker, 200;
ciadvertising.org, 2004; Drury & Farhoomand, 1997; Wang et al., 2000]. A full investigation of the reasons for the subset is beyond the scope of this dissertation.

4.2.3. Summary of the Scheffe test

We noticed that the respondents had fragmented views on the factors. We analysed the different groups and it seems that usability factors did influence the respondents’ attitudes towards the websites.

4.3. Kruskal-Wallis Test

With the Kruskal-Wallis test we will investigate the samples to see if they come from the same group. In the context of this study, this is viewed from the perspective of the similarity of the respondents’ attitudes to the perceived usability of the websites. For each composite value there is a table that depicts each institution’s mean values for Sites A and B. We can compare these means for Site A and Site B. There is a second table with a Kruskal-Wallis statistic (chi-squared). We use the chi-square test to accept or reject the null hypothesis.

4.3.1. Instructions

For the composite value ‘instructions’ the Site A and Site B mean values for each institution are listed in Table 7.27.

<table>
<thead>
<tr>
<th>Name of Institution</th>
<th>Site A – Mean Rank</th>
<th>Site B – Mean Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cape Technikon</td>
<td>94.38</td>
<td>↑ 95.30</td>
</tr>
<tr>
<td>University of Western Cape</td>
<td>101.09</td>
<td>↓ 100.81</td>
</tr>
<tr>
<td>University of Durban-Westville</td>
<td>101.95</td>
<td>↓ 91.43</td>
</tr>
<tr>
<td>Control group University of Natal</td>
<td>78.50</td>
<td>↑ 100.65</td>
</tr>
</tbody>
</table>

Table 7.27. Composite value Instructions

The Chi-Square and its $p$-values are listed in Table 7.28.
Since the $p$-value is much greater than 0.01 for both Site A and Site B, the Kruskal-Wallis test confirms the parametric test that the perception of ‘instructions’ is similar in all the groups. This means that the attitudes from the whole group are similar, i.e. the sample comes from the same group. In other words, when it came to the issue of ‘instructions’, the respondents’ attitudes were perceived as similar. This confirms the multiple comparison test in Section 4.2.

We therefore accept $H_0$: instructions for both site A and site B. This is confirmed by the following comments from the respondents:

- “Instructions on the website are easy to be understood as because are straight forward to understand” – comment taken from University of Durban-Westville.
- “Terminology through out the website is relatively consistent” – comment taken from University of Durban-Westville.
- “Everything was clearly stated and understandable” – comment taken from University of the Western Cape.
- “Easily marked, standard format, recognisable and navigable” – comment taken from University of Natal.

### 4.3.2. Speed of Website

For the composite value ‘speed of website’ the Site A and Site B mean values for each institution are listed in Table 7.29.

<table>
<thead>
<tr>
<th>Name of Institution</th>
<th>Site A – Mean Rank</th>
<th>Site B – Mean Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cape Technikon</td>
<td>88.92</td>
<td>↑ 98.98</td>
</tr>
<tr>
<td>University of Western Cape</td>
<td>99.51</td>
<td>↓ 94.74</td>
</tr>
<tr>
<td>University of Durban-Westville</td>
<td>118.85</td>
<td>↓ 97.27</td>
</tr>
<tr>
<td>Control group University of Natal</td>
<td>71.45</td>
<td>↓ 68.40</td>
</tr>
</tbody>
</table>

Table 7.29. Composite value Speed of Website

The Chi-Square and its $p$-values are listed in Table 7.30.
Since the $p$-value is much smaller than 0.01 for Site A, the Kruskal-Wallis test confirms the parametric test that the perception of ‘speed of website’ is not at the same level in all the groups. This means that the sample had varying attitudes. In other words, when it came to the issue of speed of the website, the respondents differed significantly in their attitudes. We therefore accept $H_2$ - response times to be true for site A. This confirms the multiple comparison test in Section 4.2.

However for Site B the $p$-value is much higher than 0.01. The Kruskal-Wallis test therefore confirms the parametric test that the perception of ‘speed of website’ is at a similar level in all the groups. This means that the sample had a similar attitude. In other words, when it came to the issue of speed of the website for Site B, the respondents had similar attitudes.

The respondents’ attitudes to response time between the two samples differed significantly. We accept $H_0$ - response times to be true for site B. This is confirmed by the following comment from respondents:

- “As many people uses the website, I think patience is needed” – comment taken from University of Durban Westville.
- “The speed of the website is the (most) motivation to be interested on it rather that waiting a couple of minutes waiting for it.” – comment taken from University of Durban Westville.
- “This all also depends on the speed of your processor, or lets say your computer, but other then that it is interesting website” – comment taken from University of the Western Cape.
- “Speed is important like if you search for website. I think it must be appear quickly” – comment taken from University of the Western Cape.
- “The PC can be slow & that’s not good” – comment taken from the University of the Western Cape.
- “Very happy about the speed of this website’ – comment taken from Cape Technikon.

### 4.3.3. Visual Aids

For the composite value ‘visual aids’ the Site A and Site B mean values for each institution are listed in Table 7.31.
Table 7.31. Composite value Visual Aids

The Chi-Square and its p-values are listed in Table 6.32.

<table>
<thead>
<tr>
<th>Name of Institution</th>
<th>Site A – Mean Rank</th>
<th>Site B – Mean Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cape Technikon</td>
<td>109.04</td>
<td>↓ 93.45</td>
</tr>
<tr>
<td>University of Western Cape</td>
<td>97.65</td>
<td>↓ 95.29</td>
</tr>
<tr>
<td>University of Durban-Westville</td>
<td>93.42</td>
<td>↓ 87.70</td>
</tr>
<tr>
<td>Control group University of Natal</td>
<td>131.65</td>
<td>↓ 101.20</td>
</tr>
</tbody>
</table>

Table 7.32. Chi-Square Values

Since the p-value is much greater than 0.01, the Kruskal-Wallis test confirms the parametric test that the perception of ‘visual aids’ is at the same level in all the groups. This means that the sample comes from the same group. In other words, when it came to the issue of ‘visual aids’, the respondent’s attitudes were similar. This confirms the multiple comparison test in Section 4.2.

We therefore accept $H_0$ visual aids as being true for both site A and site B. This is conformed by the following comments from the respondents:

- “The pictures on screen were not big enough, as results I don’t see well the beauty of RB” – comment taken from Cape Technikon.
- “No place for contact. Who is the webmaster” – comment taken from Cape Technikon.
- “Slightly bland, made me slightly uninterested” – comment taken from University of Natal.

4.3.4. Reaction to website

For the composite value ‘reaction to website’ the Site A and Site B mean values for each institutions are listed in Table 7.33.

<table>
<thead>
<tr>
<th>Name of Institution</th>
<th>Site A – Mean Rank</th>
<th>Site B – Mean Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cape Technikon</td>
<td>70.60</td>
<td>↑ 71.38</td>
</tr>
<tr>
<td>University of Western Cape</td>
<td>114.24</td>
<td>↓ 100.39</td>
</tr>
<tr>
<td>University of Durban-Westville</td>
<td>104.83</td>
<td>↓ 100.14</td>
</tr>
<tr>
<td>Control group University of Natal</td>
<td>67.10</td>
<td>↓ 44.75</td>
</tr>
</tbody>
</table>

Table 7.33. Composite value

The Chi-Square and its p-values are listed in Table 6.34.
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Shawren Singh

Table 7.34. Chi-Square Values

<table>
<thead>
<tr>
<th></th>
<th>Site A</th>
<th>Site B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chi-Square</td>
<td>21.315</td>
<td>19.059</td>
</tr>
<tr>
<td>p-value</td>
<td>.000</td>
<td>.000</td>
</tr>
</tbody>
</table>

Since the p-value is much smaller than 0.01, the Kruskal-Wallis test confirms the parametric test that the perception of ‘reaction to website’ is not at the same level in all the groups. This means that the sample does not come from the same group. In other words, when it came to the issue of ‘reaction to website’ the respondents differed significantly in their attitudes. This confirms the multiple comparison test in Section 4.2.

We therefore accept H₄ impression as being true for both site A and site B. This is confirmed by the following comments from the respondents:

- “Durban is the wonderful place I ever seen” – comment taken from University of Durban-Westville.
- “Need to be more attractive / draw the attention of tourists” – comment taken from University of Durban-Westville.
- “This website is …terrible, but it is wonderful and stimulating the need for computer usage” – comment taken from University of Durban-Westville.
- “…everything is fine” – comment taken from University of Western Cape.
- “The website is interesting when you read but the[re] is lack of further details and pictures are not clear for the to be attractive” – comment taken from University of Western Cape.
- “The website was very limited in its information. There was only one page about each city and no other alternative links were provided” – comment taken from Cape Technikon.

4.3.5. Appearance of the website

For the composite value ‘appearance of the website’ the mean values for each institution are listed in Table 7.35.

<table>
<thead>
<tr>
<th>Name of Institution</th>
<th>Site A – Mean Rank</th>
<th>Site B – Mean Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cape Technikon</td>
<td>78.62</td>
<td>↓ 70.05</td>
</tr>
<tr>
<td>University of Western Cape</td>
<td>110.64</td>
<td>↓ 104.68</td>
</tr>
<tr>
<td>University of Durban-Westville</td>
<td>89.69</td>
<td>↓ 74.57</td>
</tr>
<tr>
<td>Control group University of Natal</td>
<td>100.40</td>
<td>↓ 88.60</td>
</tr>
</tbody>
</table>

Table 7.35. Composite value Appearance

The Chi-Square and its p-values are listed in Table 7.36.
Since the $p$-value is much greater than 0.01 for Site A, the Kruskal-Wallis test confirms the parametric test that the perception of ‘appearance of the website’ is at the same level in all the groups. This means that the sample comes from the same group. In other words, when it came to the issue of ‘appearance of website’, the respondents’ attitudes were similar. We thus accept $H_{0-\text{appearance}}$ as true for site A. This confirms the multiple comparison test in Section 4.2.

However, for Site B the $p$-value is much smaller than 0.01; the Kruskal-Wallis test confirms the parametric test that the perception of ‘appearance of the website’ is not at the same level in all the groups. This means that the sample does not come from the same group. In other words, when it came to the issue of ‘appearance of website’ the respondents differed significantly in their attitudes with regard to Site B. This confirms the multiple comparison test in Section 4.2. We accept $H_{5-\text{appearance}}$ as being true for Site B. This is confirmed by the following comments from the respondents:

- “Good information - maybe need links to other sites/pages with more detailed information for tourists etc” – comment taken from University of Natal.
- “Offered little in depth information on attractions. Needs to convey Durban's image as exciting- however the site comes off as being a bit drab” – comment taken from University of Natal.
- “Its too simple they could have just printed and circulated a magazine, since users cannot browse on the page” – comment taken from University of Natal.
- “Could have a download movie on the city. I don’t like to read much” – comment taken from University of Natal.

### 4.3.6. Movement through the website

For the composite value ‘movement through the website’ the mean values for each institution are listed in Table 7.37.

<table>
<thead>
<tr>
<th></th>
<th>Site A</th>
<th>Site B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chi-Square</td>
<td>9.269</td>
<td>14.917</td>
</tr>
<tr>
<td>$p$-value</td>
<td>.026</td>
<td>.002</td>
</tr>
</tbody>
</table>

**Table 7.36. Chi-Square Values**
Chapter 7

An Investigation into the Influence of Usability on the Development of the Browsing Experience of E-Commerce Applications

Shawren Singh

<table>
<thead>
<tr>
<th>Name of Institution</th>
<th>Site A – Mean Rank</th>
<th>Site B – Mean Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cape Technikon</td>
<td>85.67</td>
<td>↓ 74.42</td>
</tr>
<tr>
<td>University of Western Cape</td>
<td>123.61</td>
<td>↓ 110.69</td>
</tr>
<tr>
<td>University of Durban-Westville</td>
<td>90.92</td>
<td>↓ 86.36</td>
</tr>
<tr>
<td>Control group University of Natal</td>
<td>93</td>
<td>↓ 41.90</td>
</tr>
</tbody>
</table>

Table 7.37. Composite value Movement

The Chi-Square and its p-values are listed in Table 7.38.

<table>
<thead>
<tr>
<th></th>
<th>Site A</th>
<th>Site B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chi-Square</td>
<td>14.913</td>
<td>22.165</td>
</tr>
<tr>
<td>p-value</td>
<td>.002</td>
<td>.000</td>
</tr>
</tbody>
</table>

Table 7.38. Chi-Square Values

Since the p-value is much smaller than 0.01, the Kruskal-Wallis test confirms the parametric test that the perception of ‘movement through the website’ is not at the same level in all the groups. This means that the sample does not come from the same group. In other words, when it came to the issue of ‘movement through the website’, the respondents differed significantly in their attitudes.

We therefore accept H₆-navigation as being true for both site A and site B. This is confirmed by the following comments from the respondents:

- “Easy” – comment taken from University of Natal.
- “Easy movement back and forward” – comment taken from University of Natal.
- “Navigation was difficult. No back/forward button at bottom of screen. No menu/layout on the left as with the previous website” – comment taken from University of Natal.
- “Needed navigation buttons/heading links on the side instead of going thru every page” – comment taken from Cape Technikon.

4.3.7. General Impressions

For the composite value ‘general impressions’ the mean values for each institution are listed in Table 7.39.
An Investigation into the Influence of Usability on the Development of the Browsing Experience of E-Commerce Applications
Shawren Singh

<table>
<thead>
<tr>
<th>Name of Institution</th>
<th>Site A – Mean Rank</th>
<th>Site B – Mean Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cape Technikon</td>
<td>99.82</td>
<td>↓ 91.15</td>
</tr>
<tr>
<td>University of Western Cape</td>
<td>100.29</td>
<td>↓ 86.66</td>
</tr>
<tr>
<td>University of Durban-Westville</td>
<td>110.91</td>
<td>↓ 89.67</td>
</tr>
<tr>
<td>Control group University of Natal</td>
<td>68.05</td>
<td>↑ 76.25</td>
</tr>
</tbody>
</table>

Table 7.39. Composite value General Impressions

The Chi-Square and its \( p \)-values are listed in Table 7.40.

<table>
<thead>
<tr>
<th></th>
<th>Site A</th>
<th>Site B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chi-Square</td>
<td>5.822</td>
<td>.982</td>
</tr>
<tr>
<td>( p )-value</td>
<td>.121</td>
<td>.806</td>
</tr>
</tbody>
</table>

Table 7.40. Chi-Square Value

Since the \( p \)-value is much greater than 0.01, the Kruskal-Wallis test confirms the parametric test that the perception of ‘general impressions’ is at the same level in all the groups. This means that the sample comes from the same group. In other words, when it came to the issue of ‘general impressions’ the respondents attitudes were the similar. This confirms the multiple comparison test in Section 4.2.

We accept \( H_0 \) general as being true for both site A and site B. This is confirmed by the following comments from the respondents:

- “It was boring for me as I know Durban and surrounding areas well. But could be good for tourists. Digital Durban performed well” – comment taken from University of Natal.
- “Working with the website wasn't that exciting - no great information or media. However using sites performing if Digital Durban are great because of their easy to use format and load up speeds” – comment taken from University of Natal.
- “Its boring and non-stimulating” – comment taken from University of Natal.
- “There were too few pictures! Pictures were relatively small” – comment taken from University of Natal.

4.3.8. Summary Kruskul-Wallis Test

There is an overall lower mean rank value for Site B as compared to Site A for the institutions. This lower rank mean value indicated that respondents preferred site B. From the seven different issues that were tested, three factors had respondents’ attitudes that were in the same group, this means that there were no differences in the respondents’ attitudes to those factors for both Site A and Site B. These related to: ‘Instructions’, ‘Visual aids’ and ‘General impression’. There were four factors where respondents’ attitudes differed. These factors were: ‘Response time’, ‘Impression’,
‘Appearance’ and ‘Navigation/movement through the website’. The overall conclusion is that these four factors affected the users’ usability experience of the particular website.

4.4. Summary of Statistics for Institution as Independent Variable

In the section below we briefly review the findings of all the statistics for Institution as independent variable. The summary of the statistics is presented in Table 7.41. We notice that the chosen sample is heterogeneous. Overall it seems that usability does not significantly affect users perceptions to a website. This suggests that usability is not the only consideration in the design of websites.

<table>
<thead>
<tr>
<th>Composite Values</th>
<th>Anova Site A</th>
<th>Anova Site B</th>
<th>Levene Site A</th>
<th>Levene Site B</th>
<th>Scheffe Site A</th>
<th>Scheffe Site B</th>
<th>Kruskal-Wallis Site A</th>
<th>Kruskal-Wallis Site B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instructions</td>
<td>Accept $H_0$ instructions</td>
<td>Accept $H_0$ instructions</td>
<td>heterogeneous</td>
<td>heterogeneous</td>
<td>heterogeneous</td>
<td>heterogeneous</td>
<td>Accept $H_0$ instructions</td>
<td>Accept $H_0$ instructions</td>
</tr>
<tr>
<td>Speed of website</td>
<td>Accept $H_0$ response times</td>
<td>Accept $H_0$ response times</td>
<td>heterogeneous</td>
<td>homogeneous</td>
<td>variations in attitude</td>
<td>heterogeneous</td>
<td>Accept $H_0$ response times</td>
<td>Accept $H_0$ response times</td>
</tr>
<tr>
<td>Visual aids</td>
<td>Accept $H_0$ visual aids</td>
<td>Accept $H_0$ visual aids</td>
<td>heterogeneous</td>
<td>heterogeneous</td>
<td>heterogeneous</td>
<td>heterogeneous</td>
<td>Accept $H_0$ visual aids</td>
<td>Accept $H_0$ visual aids</td>
</tr>
<tr>
<td>Reaction to the website</td>
<td>Accept $H_0$ impression</td>
<td>Accept $H_0$ impression</td>
<td>heterogeneous</td>
<td>heterogeneous</td>
<td>variations in attitude</td>
<td>variations in attitude</td>
<td>Accept $H_0$ impression</td>
<td>Accept $H_0$ impression</td>
</tr>
<tr>
<td>Appearance of the website</td>
<td>Accept $H_0$ appearance</td>
<td>Accept $H_0$ appearance</td>
<td>heterogeneous</td>
<td>heterogeneous</td>
<td>heterogeneous</td>
<td>variations in attitude</td>
<td>Accept $H_0$ appearance</td>
<td>Accept $H_0$ appearance</td>
</tr>
<tr>
<td>Movement through the website</td>
<td>Accept $H_0$ navigation</td>
<td>Accept $H_0$ navigation</td>
<td>heterogeneous</td>
<td>heterogeneous</td>
<td>heterogeneous</td>
<td>variations in attitude</td>
<td>Accept $H_0$ navigation</td>
<td>Accept $H_0$ navigation</td>
</tr>
<tr>
<td>General impressions</td>
<td>Accept $H_0$ general</td>
<td>Accept $H_0$ general</td>
<td>heterogeneous</td>
<td>homogeneous</td>
<td>heterogeneous</td>
<td>heterogeneous</td>
<td>Accept $H_0$ general</td>
<td>Accept $H_0$ general</td>
</tr>
</tbody>
</table>

Table 7.41. Summary of All Statistics for Independent Variables

Using ‘Institution’ and the independent variable did not affect the users’ perceptions. It is clear that the sample is heterogeneous.

5. Statistical Analysis on the other Independent Variables

We will now briefly look at the other independent variables, i.e. web experience; gender; qualifications; home language; course language; language of choice; population and province. To have a complete model, all the tests performed for ‘Institution’ should also be done for the other independent variables.
There are several statistical analysis techniques that can be used to analyse the data. We chose to use the Kruskal-Wallis test to illustrate the overall findings. The Kruskal-Wallis test was chosen for the following reasons:

- The assumption of normal population is not necessary for the Kruskal-Wallis test: this is ideal when one considers the Internet-targeted users.
- The Kruskal-Wallis test is less sensitive than the Anova procedure to the assumption of equal variances: the users of the Internet are vast and varied.
- The Kruskal-Wallis test is useful when the data consist of rankings within each sample: the questionnaire instrument was designed in this manner.

The Kruskal-Wallis test was administered to all independent variables, and the results are illustrated in Table 7.42:

- Overall there are 11 different groups for Site A and 12 different groups for Site B. The attitude for Site B seems to be more varied than for Site A.
<table>
<thead>
<tr>
<th>Institution</th>
<th>Web Experience</th>
<th>Gender</th>
<th>Qualification</th>
<th>Home Language</th>
<th>Course Language</th>
<th>Language of Choice</th>
<th>Population</th>
<th>Province</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site A</td>
<td>Site B</td>
<td>Site A</td>
<td>Site B</td>
<td>Site A</td>
<td>Site B</td>
<td>Site A</td>
<td>Site B</td>
<td>Site B</td>
</tr>
<tr>
<td>P= .754</td>
<td>P= .922</td>
<td>&gt; 0.01</td>
<td>&gt; 0.01</td>
<td>&gt; 0.01</td>
<td>&gt; 0.01</td>
<td>&gt; 0.01</td>
<td>&gt; 0.01</td>
<td>&gt; 0.01</td>
</tr>
<tr>
<td>Accept/Reject H3, Interaction</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>H0, interaction</td>
<td>P= .006</td>
<td>P= .414</td>
<td>P= .015</td>
<td>P= .535</td>
<td>P= .017</td>
<td>P= .723</td>
<td>P= .078</td>
<td>P= .026</td>
</tr>
<tr>
<td>Accept/Reject H2, response sets</td>
<td>Δ</td>
<td>Δ</td>
<td>Δ</td>
<td>Δ</td>
<td>Δ</td>
<td>Δ</td>
<td>Δ</td>
<td>Δ</td>
</tr>
<tr>
<td>H0, visual sets</td>
<td>P= .138</td>
<td>P= .788</td>
<td>P= .322</td>
<td>P= .717</td>
<td>P= .030</td>
<td>P= .940</td>
<td>P= .700</td>
<td>P= .057</td>
</tr>
<tr>
<td>Accept/Reject H1, impression</td>
<td>Δ</td>
<td>Δ</td>
<td>Δ</td>
<td>Δ</td>
<td>Δ</td>
<td>Δ</td>
<td>Δ</td>
<td>Δ</td>
</tr>
<tr>
<td>H0, impression</td>
<td>P= .000</td>
<td>P= .000</td>
<td>P= .005</td>
<td>P= .012</td>
<td>P= .898</td>
<td>P= .308</td>
<td>P= .906</td>
<td>P= .311</td>
</tr>
<tr>
<td>Accept/Reject H4, appearance</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>H0, appearance</td>
<td>P= .026</td>
<td>P= .002</td>
<td>P= .753</td>
<td>P= .017</td>
<td>P= .574</td>
<td>P= .921</td>
<td>P= .400</td>
<td>P= .011</td>
</tr>
<tr>
<td>Accept/Reject H5, engagement</td>
<td>Δ</td>
<td>Δ</td>
<td>Δ</td>
<td>Δ</td>
<td>Δ</td>
<td>Δ</td>
<td>Δ</td>
<td>Δ</td>
</tr>
<tr>
<td>H0, engagement</td>
<td>P= .002</td>
<td>P= .080</td>
<td>P= .208</td>
<td>P= .402</td>
<td>P= .001</td>
<td>P= .140</td>
<td>P= .186</td>
<td>P= .325</td>
</tr>
<tr>
<td>Accept/Reject H6, potential</td>
<td>Δ</td>
<td>Δ</td>
<td>Δ</td>
<td>Δ</td>
<td>Δ</td>
<td>Δ</td>
<td>Δ</td>
<td>Δ</td>
</tr>
<tr>
<td>H0, potential</td>
<td>P= .121</td>
<td>P= .806</td>
<td>P= .017</td>
<td>P= .242</td>
<td>P= .255</td>
<td>P= .986</td>
<td>P= .229</td>
<td>P= .073</td>
</tr>
<tr>
<td>Accept/Reject H7, general</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>Δ</td>
</tr>
</tbody>
</table>

**Table 7.42.** Kruskal-Wallis Test for all Independent Variables

**Key**

+ No differences within group – accept null hypothesis

Δ Differences within group – reject null hypothesis
5.1. Expanded Analysis on the Independent Variables

In Table 7.42, we have the summarised $p$ values of the different independent variables, i.e. web experience; gender; qualifications; home language; course language; language of choice; population and province. The independent variable ‘institution’ is shown as part of this table (see the shaded area). In the section to follow we do a cross comparison of the influence of all the various independent variables on individual hypotheses, a vertical comparison of the influence of independent variables on individual hypotheses and a cross comparison of the influence of individual variables across the various hypotheses.

5.1.1. Horizontal Comparison of the Influence of all the Various Independent Variables on Individual Hypotheses

In this section we will consider all the independent variables on each individual hypothesis.

We will now consider each of the hypotheses in turn.

- **H$_0$- instructions**: The general pattern for all the responses to the independent variables are similar. This suggests that when it came to instructions, all the respondents had the same attitude. So be it for Site A or Site B, which were different, instructions did not affect the attitudes of the respondents, since all the $p$ values are greater than 0.01. Our preliminary conclusion is that, considering these various factors, ‘instructions’ is not important to a positive usability experience. Thus we may accept the hypothesis that instructions do not affect the activities of a website user, and accept H$_0$- instructions for both Site A and Site B.

- **H$_0$- response times**: For all the variables except ‘Qualification’ and ‘Home language’, the respondents had a similar attitude to response time for both Site A and Site B. The preliminary conclusion here is that a fast response time does not enhance the usability experience. When it came to ‘Qualification’ and ‘Home language’, there was a difference in the general pattern. ‘Institution’ and ‘Home language’ had the same pattern relating to attitudes. This is most probably because the respondents were influenced by the ‘Institutional culture’. When it came to ‘Qualification’, both groups differed significantly in their attitudes for both Site A and Site B. Table 7.43 shows the ranked mean values from the Kruskal-Wallis test.
Table 7.43. Ranked mean values for Qualification

<table>
<thead>
<tr>
<th>Qualification</th>
<th>Site A</th>
<th>Site B</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; Grade 12</td>
<td>114.88</td>
<td>↓ 112.82</td>
</tr>
<tr>
<td>Grade 12</td>
<td>92.70</td>
<td>↓ 82.62</td>
</tr>
<tr>
<td>Certificate (postmatric)</td>
<td>86.14</td>
<td>↓ 82.17</td>
</tr>
<tr>
<td>Diploma</td>
<td>87.50</td>
<td>↑ 96.60</td>
</tr>
<tr>
<td>Bachelors degree</td>
<td>141.38</td>
<td>↓ 131.36</td>
</tr>
<tr>
<td>Higher degree</td>
<td>84.50</td>
<td>↑ 102.83</td>
</tr>
</tbody>
</table>

As the level of education increased, the mean values began to lower. This is when we compare Section 2 of the questionnaire with Section 3. There are two exceptions to this: they are for diploma and higher degree. The preliminary conclusion is: the greater the level of education, the higher the expectation for structured information. On the surface we accept the hypothesis that response times of websites affect the activities of a website user for the independent variables Qualification for Site A and Site B and Home language for Site A. This is based on the fact that the mean values for Diploma and Higher degree went up. Thus we may accept the hypothesis that response times of websites affect the activities of a website user, and accept H2: response times for these factors overall we accept H0: response times for the other independent variables.

- H0: visual aids: The general pattern in the attitudes are similar for all the independent variables, except for independent variables ‘Home language’ and ‘Course language’. Both their variables relate to language. Our preliminary conclusion is that if you are a second language English speaking person, and you are looking at an English-based web page, the language barrier may affect your usability experience. Table 7.44 shows the ranked mean values from the Kruskal-Wallis test for Home Language.

Table 7.44. Ranked mean values for Home Language

<table>
<thead>
<tr>
<th>Home Language</th>
<th>Site A</th>
<th>Site B</th>
</tr>
</thead>
<tbody>
<tr>
<td>English</td>
<td>114.70</td>
<td>↓ 97.24</td>
</tr>
<tr>
<td>Afrikaans</td>
<td>119.50</td>
<td>↓ 98.32</td>
</tr>
<tr>
<td>Zulu</td>
<td>77.00</td>
<td>↑ 91.45</td>
</tr>
<tr>
<td>Sotho</td>
<td>75.97</td>
<td>↑ 78.20</td>
</tr>
<tr>
<td>Other African language</td>
<td>98.05</td>
<td>↓ 94.32</td>
</tr>
<tr>
<td>Other</td>
<td>114.36</td>
<td>↓ 86.00</td>
</tr>
</tbody>
</table>

The mean value for all language groups changed. For the African languages, Zulu and Sotho the mean values rose, while it lowered for the other languages. This suggests that language can be a barrier and/or influence peoples perceptions of a website. Thus, we accept the hypothesis that visual communication aids of the website affect website users’ activities. We accept H3: visual aids for this
independent variable for Site A relating to ‘Home language’ and for ‘Course language’ for Site B. Overall we accept $H_{0\text{-visual}}$ for Site A and Site B.

- $H_{0\text{-impression}}$: The general pattern to the responses for all the independent variables are similar. The three variables that do not follow the general pattern are ‘Gender’, ‘Qualification’ and ‘Course language’. In Tables 7.45, 7.46 and 7.47 we analysed the ranked mean values from the Kruskal-Wallis test for these variables:

<table>
<thead>
<tr>
<th>Gender</th>
<th>Site A</th>
<th>Site B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>92.01</td>
<td>↓ 82.51</td>
</tr>
<tr>
<td>Female</td>
<td>91.99</td>
<td>↓ 90.16</td>
</tr>
</tbody>
</table>

**Table 7.45. Ranked mean values for Gender**

The mean values for both genders are lower. The males, on the surface, seem to be more ‘critical’ than the females.

<table>
<thead>
<tr>
<th>Qualification</th>
<th>Site A</th>
<th>Site B</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; Grade 12</td>
<td>104.86</td>
<td>↓ 102.48</td>
</tr>
<tr>
<td>Grade 12</td>
<td>87.91</td>
<td>↓ 85.50</td>
</tr>
<tr>
<td>Certificate (post-matric)</td>
<td>95.81</td>
<td>↓ 68.85</td>
</tr>
<tr>
<td>Diploma</td>
<td>84.44</td>
<td>↓ 63.35</td>
</tr>
<tr>
<td>Bachelors degree</td>
<td>98.45</td>
<td>↓ 85.80</td>
</tr>
<tr>
<td>Higher degree</td>
<td>54.50</td>
<td>↑ 90.17</td>
</tr>
</tbody>
</table>

**Table 7.46. Ranked mean values for Qualification**

As the academic qualification increased, the level of ‘criticism’ increased as well. The exception to this is for Higher degree.
The first language English-speaking respondents became more ‘critical’ of the second website. The other second language English-speaking people’s mean values were higher, except for Zulu. This indicates that language did affect their usability experience. Overall, we accept the hypothesis that the website users’ overall impressions affect their activities on the website. We accept H₄: impression for Site A and Site B.

- **H₅: appearance**: The independent variables that do not follow the general pattern are ‘Gender’, ‘Qualification’, ‘Course language’, ‘Language of choice’ and ‘Population’. We will analyse each in turn. Tables 7.48, 7.49, 7.50, 7.51 and 7.52 are the ranked mean values for each variable.

### Course Language

<table>
<thead>
<tr>
<th>Course Language</th>
<th>Site A</th>
<th>Site B</th>
</tr>
</thead>
<tbody>
<tr>
<td>English</td>
<td>86.13</td>
<td>↓ 71.49</td>
</tr>
<tr>
<td>Afrikaans</td>
<td>90.05</td>
<td>↑ 104.20</td>
</tr>
<tr>
<td>Zulu</td>
<td>91.30</td>
<td>↓ 71.68</td>
</tr>
<tr>
<td>Sotho</td>
<td>98.74</td>
<td>↑ 99.42</td>
</tr>
<tr>
<td>Other African language</td>
<td>92.25</td>
<td>↑ 97.44</td>
</tr>
<tr>
<td>Other</td>
<td>105.34</td>
<td>↓ 103.10</td>
</tr>
</tbody>
</table>

**Table 7.47. Ranked mean values for Course Language**

### Gender

<table>
<thead>
<tr>
<th>Gender</th>
<th>Site A</th>
<th>Site B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>86.42</td>
<td>↓ 79.16</td>
</tr>
<tr>
<td>Female</td>
<td>90.72</td>
<td>↓ 79.89</td>
</tr>
</tbody>
</table>

**Table 7.48. Ranked mean values for Gender**

### Qualification

<table>
<thead>
<tr>
<th>Qualification</th>
<th>Site A</th>
<th>Site B</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; Grade 12</td>
<td>96.38</td>
<td>↓ 82.05</td>
</tr>
<tr>
<td>Grade 12</td>
<td>84.85</td>
<td>↓ 77.92</td>
</tr>
<tr>
<td>Certificate (post-matric)</td>
<td>116.11</td>
<td>↓ 88.00</td>
</tr>
<tr>
<td>Diploma</td>
<td>73.80</td>
<td>↓ 66.50</td>
</tr>
<tr>
<td>Bachelors degree</td>
<td>93.83</td>
<td>↑ 120.07</td>
</tr>
<tr>
<td>Higher degree</td>
<td>76.25</td>
<td>↓ 51.50</td>
</tr>
</tbody>
</table>

**Table 7.49. Ranked mean values for Qualification**

### Course Language

<table>
<thead>
<tr>
<th>Course Language</th>
<th>Site A</th>
<th>Site B</th>
</tr>
</thead>
<tbody>
<tr>
<td>English</td>
<td>90.86</td>
<td>↓ 81.36</td>
</tr>
<tr>
<td>Other</td>
<td>25.50</td>
<td>↑ 92.50</td>
</tr>
<tr>
<td>Zulu</td>
<td>0</td>
<td>↑ 92.50</td>
</tr>
</tbody>
</table>

**Table 7.50. Ranked mean values for Course Language**
Chapter 7

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**An Investigation into the Influence of Usability on the Development of the Browsing Experience of E-Commerce Applications**

Shawren Singh

<table>
<thead>
<tr>
<th>Language of Choice</th>
<th>Site A</th>
<th>Site B</th>
</tr>
</thead>
<tbody>
<tr>
<td>English</td>
<td>89.98</td>
<td>↓ 80.58</td>
</tr>
<tr>
<td>Afrikaans</td>
<td>79.38</td>
<td>↓ 78.63</td>
</tr>
<tr>
<td>Zulu</td>
<td>99.53</td>
<td>↓ 72.41</td>
</tr>
<tr>
<td>Sotho</td>
<td>101.54</td>
<td>↓ 96.08</td>
</tr>
<tr>
<td>Other African language</td>
<td>93.20</td>
<td>↑ 109.30</td>
</tr>
</tbody>
</table>

**Table 7.51. Ranked mean values for Language of Choice**

<table>
<thead>
<tr>
<th>Population</th>
<th>Site A</th>
<th>Site B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indigenous African (IA)</td>
<td>94.29</td>
<td>↓ 82.97</td>
</tr>
<tr>
<td>South African of mixed descent (SAM)</td>
<td>85.22</td>
<td>↓ 78.03</td>
</tr>
<tr>
<td>Afro-Asian (AA)</td>
<td>74.41</td>
<td>↓ 70.33</td>
</tr>
<tr>
<td>Afro-European (AE)</td>
<td>77.72</td>
<td>↓ 70.50</td>
</tr>
<tr>
<td>Other</td>
<td>33.00</td>
<td>↑ 50.50</td>
</tr>
</tbody>
</table>

**Table 7.52. Ranked mean values for Population**

All of these variables play a role in the perceived usability of the website. Despite the second website following usability guidelines, the respondents became more ‘critical’ of the second website. This is indicated by the lower mean values. Further investigation is required into the acceptance or rejection of the hypothesis that visual appearance of the website affect the website users’ activities.

- **H₀-navigation:** Every independent variable did not follow the same pattern relating to attitudinal response. Without going into a detailed analysis of each variable here, navigation is a major issue when it comes to experiencing a positive usability experience on the web. Further investigation is required into the acceptance or rejection of the hypothesis that navigation of a website affects the activities of the website user.

- **H₀-general:** The independent variables that had a different attitudinal pattern were ‘Home language’, ‘Course language’, and ‘Province’. There has been a general lowering of the mean values for the second website. This is indicated in Tables 7.53, 7.54 and 7.55. Further investigation is required into this hypothesis.
Table 7.53. Ranked mean values for Home Language

<table>
<thead>
<tr>
<th>Home Language</th>
<th>Site A</th>
<th>Site B</th>
</tr>
</thead>
<tbody>
<tr>
<td>English</td>
<td>91.78</td>
<td>↓ 86.37</td>
</tr>
<tr>
<td>Afrikaans</td>
<td>80.27</td>
<td>↑ 83.68</td>
</tr>
<tr>
<td>Zulu</td>
<td>108.42</td>
<td>↓ 92.52</td>
</tr>
<tr>
<td>Sotho</td>
<td>116.44</td>
<td>↓ 88.61</td>
</tr>
<tr>
<td>Other African language</td>
<td>96.21</td>
<td>↓ 83.05</td>
</tr>
<tr>
<td>Other</td>
<td>121.80</td>
<td>↓ 95.94</td>
</tr>
</tbody>
</table>

Table 7.54. Ranked mean values for Course Language

<table>
<thead>
<tr>
<th>Course Language</th>
<th>Site A</th>
<th>Site B</th>
</tr>
</thead>
<tbody>
<tr>
<td>English</td>
<td>100.04</td>
<td>↓ 87.85</td>
</tr>
<tr>
<td>Zulu</td>
<td>119.00</td>
<td>↓ 33.00</td>
</tr>
<tr>
<td>Other</td>
<td>186.75</td>
<td>↓ 128.75</td>
</tr>
</tbody>
</table>

Table 7.55. Ranked mean values for Province

<table>
<thead>
<tr>
<th>Province</th>
<th>Site A</th>
<th>Site B</th>
</tr>
</thead>
<tbody>
<tr>
<td>KwaZulu-Natal</td>
<td>101.37</td>
<td>↓ 88.47</td>
</tr>
<tr>
<td>Western Cape</td>
<td>87.93</td>
<td>↑ 88.15</td>
</tr>
<tr>
<td>Eastern Cape</td>
<td>122.89</td>
<td>↓ 92.36</td>
</tr>
<tr>
<td>Gauteng</td>
<td>84.67</td>
<td>↓ 45.33</td>
</tr>
<tr>
<td>Free State</td>
<td>85.75</td>
<td>↑ 158.50</td>
</tr>
<tr>
<td>Northern Province</td>
<td>143.92</td>
<td>↓ 97.83</td>
</tr>
<tr>
<td>Northern Cape</td>
<td>18.00</td>
<td>Insufficient data for valid calculation</td>
</tr>
<tr>
<td>Mpumalanga</td>
<td>128.93</td>
<td>↓ 87.67</td>
</tr>
<tr>
<td>North West Province</td>
<td>2.00</td>
<td>↑ 100.50</td>
</tr>
<tr>
<td>Other</td>
<td>87.67</td>
<td>↓ 83.63</td>
</tr>
</tbody>
</table>

Despite the differences in each website, on the surface the different independent variables may have affected the respondents’ attitudes. We accept that the overall structure of the website does not affects the users. We accept $H_{0}$-general for Site A and Site B.

5.1.2. Vertical Comparison of the Influence of Individual Independent Variables on Individual Hypotheses

In Section 4.3 of this chapter we conducted a detailed analysis using the Kruskul-Wallis test of the independent variable Institution. In this vertical comparison we do not do a detailed analysis of the other independent variables. We will now consider the impact of the following independent
variables: Web experience; Gender; Qualifications; Home language; Course language; Language of choice; Population and Province on the respondents’ perceived attitudes.

5.1.2.1. Web experience

Using Web experience as the independent variable, we accept the following hypotheses, i.e. \( H_0 \) for instructions, \( H_0 \) for response times, \( H_0 \) for visual aids, \( H_0 \) for navigation, and \( H_0 \) for general for both Site A and Site B. This means that web experience had no influence on the perceptions of the users. The exception is ‘Impressions’ and ‘Appearance’. When it came to the Impressions, it is clearly indicated that different levels of web experiment users have different levels of expectations. The \( p \) values for both site A and B were below 0.01. We thus accept \( H_1 \) for impression. This means that web experience had an influence on the perceptions of the users. When it came the Appearance, there are differences between site A and Site B. The \( p \) value for site A is higher and B is below 0.01. We require further investigation here.

5.1.2.2. Gender

Using Gender as the independent variable, we accept the following hypotheses, i.e. \( H_0 \) for instructions, \( H_0 \) for response times, \( H_0 \) for visual aids, \( H_0 \) for impression, \( H_0 \) for appearance, \( H_0 \) for navigation, \( H_0 \) for general. Overall, gender seems to have no significant differences between the participants in this study. The notion that different genders are affected differently is not true for this study. This could be attributed to the following factors: all respondents are computing students; all are at university, experiencing the same teaching environment. The \( p \) values for both sites A and B were all above 0.01.

5.1.2.3. Qualifications

Using Qualification as the independent variable we accept the following hypotheses, i.e. \( H_0 \) for instructions, \( H_0 \) for response times, \( H_0 \) for visual aids, \( H_0 \) for impression, \( H_0 \) for appearance, \( H_0 \) for navigation, \( H_0 \) for general for both Site A and Site B. This means that qualification had no influence on the perceptions of the users. The exception is ‘Response’ and ‘Navigation’. The \( p \) values are less than 0.01 for ‘Response’ for both site A and B. Thus we accept \( H_1 \) for response times. This means that qualification had no influence on the perceptions of the users. What stand out are the respondents’ attitudes to response time. It seems that the higher the qualifications, the higher the need for ‘instant information gratification.’ For ‘Navigation’ there are differences in the \( p \) values for site A and B, site A is larger than 0.01 and site B is smaller than 0.01. We therefore require more investigation into this factor.

5.1.2.4. Home language

Using Home language as the independent variable, we accept the following hypotheses, i.e. \( H_0 \) for instructions, \( H_0 \) for navigation for both Site A and Site B. This means that home language had no influence on the perceptions of the users. The exceptions are ‘Response time’, the \( p \) value for site A is less than
0.01 and for site B it is higher than 0.01. It is the same for ‘Visual aids’ and ‘General’. We thus require further investigations for these factors. For ‘Appearance’ the \( p \) for site A is greater than 0.01 and for site B it is less than 0.01. We thus require further investigation for these factors. With ‘Impression’ the \( p \) values are less than 0.01. We thus accept \( H_4: \text{impression} \). This means that home language had an influence on the perceptions of the users. What stand out are the respondents’ attitudes to Impression. There seems to be a relationship between ‘Home language’ and their attitude to ‘Impressions’. This could be attributed to the diverse backgrounds of the respondents. The \( p \) values for both site A and B were below 0.01.

5.1.2.5. **Course language.**

Using Course language as the independent variable, we accept the following hypotheses i.e., \( H_0: \text{instructions} \), \( H_0: \text{response times} \), \( H_0: \text{impression} \), \( H_0: \text{appearance} \), \( H_0: \text{navigation} \) for both Site A and Site B. This means that course language had no influence on the perceptions of the users. This could be attributed to the fact that all the respondents were at English-medium universities. Overall, all the \( p \) values for both sites A and B were all above 0.01. The exception is for Site B for ‘Visual aids’ and Site A for ‘General impression’. We therefore require further investigations for these factors.

5.1.2.6. **Language of choice**

Using Language of choice as the independent variable, we accept the following hypothesis i.e., \( H_0: \text{instructions} \), \( H_0: \text{response times} \), \( H_0: \text{visual aids} \), \( H_0: \text{appearance} \), \( H_0: \text{general} \) for both Site A and Site B. This means that language of choice had no influence on the perceptions of the users. The exception is ‘Impression’ and ‘Navigation’. The \( p \) values are below 0.01 for both Site A and B. We this accept \( H_4: \text{impression} \). This means that language of choice had an influence on the perceptions of the users. What stand out are the respondents’ attitudes to ‘Impression’. There seems to be a relationship between ‘Language of choice’ and their attitude to ‘Impressions’. This again could be attributed to the diverse backgrounds of the respondents. For ‘Navigation’ the \( p \) value for site A is greater than 0.01 and for site B it is less than 0.01, we thus require further investigation for these factors.

5.1.2.7. **Population**

Using Population as the independent variable we accept all the hypothesis i.e., \( H_0: \text{instructions} \), \( H_0: \text{response times} \), \( H_0: \text{visual aids} \), \( H_0: \text{appearance} \), \( H_0: \text{navigation} \), \( H_0: \text{general} \) for Site A and Site B. This means that population had no influence on the perceptions of the users. The exception is ‘impression’. What stand out are the respondents’ attitudes to impression. The \( p \) values are below 0.01 for both Site A and B. We thus accept \( H_4: \text{impression} \). This means that population had an influence on the perceptions of the users. There seems to be a relationship between population and their attitude to impressions. This again could be attributed to the diverse backgrounds of the respondents.
5.1.2.8. Province

Using Province as the independent variable, we accept the following hypothesis, i.e., $H_0$-instructions, $H_0$-response times, $H_0$-visual aids, $H_0$-navigation- The exceptions are ‘impression’. What stand out are the respondents’ attitudes to impression. The $p$ values are below 0.01 for both Site A and B. We thus accept $H_4$-impression. There seems to be a relationship between province and their attitude to impressions. This again could be attributed to the diverse backgrounds of the respondents. For ‘Appearance’ the $p$ value for Site A is greater than 0.01 and for Site B it is less than 0.01. We thus require further investigation for this factor. For ‘General’ the $p$ value for Site A is smaller than 0.01 and for Site B it is greater than 0.01. We thus require further investigation for this factor.

5.1.2.9. Comment

When it came to the issue of ‘Impressions’, the independent variables: web experience, home language, language of choice, population and province – the null hypothesis was rejected. This indicates to us that there are several underlying factors the need to be investigated to determine why these independent variables have an influence on impressions.

5.1.3. Cross Comparison of the Influence of Individual Variables Across the Various Hypotheses

In this section we will compare the $p$ values for some of the different independent variables. Table 7.42 will be used to make the cross comparisons. There are several phenomena that are worthy of mention. These phenomena have interrelated relationships with each other. We do not, however, do a detailed analysis of these phenomena. This is left for future research. We will attempt to provide some explanation for the noticed phenomenon in Chapter 8.

- For the independent variable ‘web experience’ and the factor ‘impression’ there are several relations with other variables such as: the independent variable ‘qualification’ and the factor ‘response time’, there also seems to be a relationship between the independent variable ‘home language’ and the factor ‘impression’, and the independent variable ‘qualification’ and the factor ‘response time’. All have $p$ values below 0.01. All these independent variables follow the same pattern in that the respondents have different attitudes to the factors.

- The independent variable ‘gender’ and the factor ‘navigation’ seem to have a relationship with the following independent variables and factors. These are: ‘home language’ and ‘response time’, ‘home language’ and ‘visual’, ‘course language’ and ‘general’, and ‘province’ and ‘general’. All these independent variables follow the same pattern, in that the respondents have different attitudes to the factors. The $p$ values for Site A are below 0.01 and the $p$ values for Site B are greater than 0.01.
• The independent variables ‘web experience’ and the factor ‘navigation’ seem to have a relationship with the following independent variables and factors: ‘gender’ and ‘impression’, ‘gender’ and ‘appearance’, ‘qualification’ and ‘impression’, language of choice and ‘appearance’, ‘population’ and ‘appearance’, ‘population’ and ‘navigation’, and ‘province’ and ‘navigation’. All these independent variables follow the same pattern in that the respondents have similar attitudes to the factors. All their $p$ values are greater than 0.01.

• The independent variables ‘qualification’ and ‘navigation’ seem to have a relationship with the independent variables ‘language of choice’ and ‘navigation’. All these independent variables follow the same pattern in that the respondents have different attitudes to the factors. For Site A the $p$ values are greater that 0.01 and for Site B the $p$ values are less that 0.01.

5.1.4. Comment on Other Independent Variables

It is evident that when it comes to designing a usable website there are various implicit and explicit factors that the designers have to consider. There seems to be no one single factor that is the ‘silver bullet’ for designing usable interactive software.

6. Summary of all the Statistical Analysis

In this section we summarise our statistical analysis. To recap, we designed two websites. One website adhered to usability principles and the other did not. We then tested our hypothesis on each website. Accordingly, accepting or rejecting a hypothesis will have a different connotation based on the particular website that is being considered. In Table 6.56 we have summarised all the various statistics. Our data can be classified as ordinal data. Therefore, the Kruskal-Wallis test can be seen as the more appropriate statistical tool. We therefore take the Kruskal-Wallis test as the primary indicator to reject or accept a hypothesis. But since the Kruskal-Wallis test does not have mean values, we cannot make a decision on the ‘direction’ of the particular influence. We therefore look at the Anova test to try and explain our findings. This is presented in Table 6.57.

We notice the following, based on the mean values from the Anova test, in Chapter 6 Section 5 we discussed the maximum, minimum and neutral scores:

• For ‘Instructions’, both site A and site B had a negative influence on respondents. The mean values for site A ranged from 10.2 to 11.07, which is quite close to the neutral score but slightly on the negative side. The mean values for site B ranged from 9.03 to 9.60, which is very close to the neutral score, but slightly on the negative side. Therefore both for the ‘badly’ designed site and ‘good’ site, instructions were seen to have a negative influence on the perceptions of the websites.
• For ‘Speed of website’, both site A and site B had a negative influence on respondents. The mean values for site A ranged from 10.6 to 11.97, which is quite close to the neutral score but slightly on the negative side. The mean values for site B ranged from 10.7 to 11.60, which is quite close to the neutral score but slightly on the negative side. Therefore both for the ‘badly’ designed site and ‘good’ site, speed of website was seen to have a negative influence on the perceptions of the website. This is despite the fact that the pages were on the same server and were of equal byte size.

• For ‘Visual aids’, both site A and site B had a negative influence on respondents. The mean values for site A ranged from 12.44 to 13.70, which is quite close to the neutral score but slightly on the negative side. The mean values for site B ranged from 12.90 to 13.20, which is quite close to the neutral score but slightly on the negative side. Therefore, both for the ‘badly’ designed site and ‘good’ site, visual aids were seen to have a negative influence on the perceptions of the website.

• For ‘Overall reaction’, site A has an overall positive influence on respondents while Site B has a mixed influence on respondents. The mean values for site A ranged from 13.40 to 15.50, which is quite close to the neutral score but slightly on the positive side. The mean values for site B ranged from 13.20 to 15.55, which is quite close to the neutral score however hovering around the neutral score. Site A was considered ‘good’ and site B ‘mixed’. Therefore for the ‘badly’ designed site overall reaction was seen to have a positive influence on the perceptions of the website. However for the ‘good’ site overall reaction was seen to have a mixed influence on the perceptions of the website.

• For ‘Appearance of website’, site A has an overall positive influence on respondents while Site B has a mixed influence. The mean values for site A ranged from 28.22 to 30.69, which is quite close to the neutral score but slightly on the positive side. The mean values for site B ranged from 28.65 to 31.46, which is quite close to the neutral score however hovering around the neutral score. Therefore for the ‘badly’ designed site appearance of website was seen to have a positive influence on the perceptions of the website. However for the ‘good’ site appearance of website was seen to have a mixed influence on the perceptions of the website.

• For ‘Movement through the website’, site A has a positive influence on respondents while Site B has a mixed influence on respondents. The mean values for site A ranged from 14.10 to 15.77, which is quite close to the neutral score but slightly on the positive side. The mean values for site B ranged from 12.50 to 15.75, which is quite close to the neutral score but this is slightly on the positive side. Therefore, for the ‘badly’ designed site movement through the website was seen to have a positive influence on the perceptions of the website. However, for the ‘good’ site
movement through the website was seen to have a mixed influence on the perceptions of the website.

- For ‘General impression’, both site A and site B had a positive influence on respondents. The mean values for site A ranged from 5.10 to 5.83, which is quite close to the neutral score but slightly on the positive side. The mean values for site B ranged from 5.40 to 5.91, which is quite close to the neutral score but slightly on the positive side. Both websites were considered ‘good’. Therefore both for the ‘badly’ designed site and ‘good’ site general impression was seen to have a positive influence on the perceptions of the websites.

We can now in Table 6.58 determine the direction of the influence, namely, whether Site A or Site B performed better by measuring the direction of the mean. We notice the following:

- When it came to ‘Instructions’ we accept hypothesis $H_0_{-\text{instructions}}$ for Site A. Instructions had a negative influence on respondents. For Site B we accept hypothesis $H_0_{-\text{instructions}}$. Instructions had a negative influence on respondents.

- When it came to ‘Speed of website’ we accept hypothesis $H_2_{-\text{response times}}$ for Site A. Speed of website had a negative influence on respondents. For Site B we accept hypothesis $H_0_{-\text{response times}}$. Speed of website had a negative influence on respondents.

- When it came to ‘Visual aids’ we accept hypothesis $H_0_{-\text{visual aids}}$ for Site A. Visual aids had a negative influence on respondents. For Site B we accept hypothesis $H_0_{-\text{visual aids}}$. Visual had a negative influence on respondents.

- When it came to ‘Overall reaction’ we accept hypothesis $H_4_{-\text{impression}}$ for Site A. Reactions to website had an overall positive influence on respondents. For Site B we accept hypothesis $H_4_{-\text{impression}}$. Reactions to website had a mixed influence on respondents

- When it came to ‘Appearance of website’ we cannot clearly accept any hypothesis, more investigation is required. This could be attributed to many factors, such as objective culture. We do not however investigate this issue. We do whoever see that for Site A appearance of website had a positive influence on respondents. For Site B we accept hypothesis $H_5_{-\text{appearance}}$. Appearance of website had a mixed influence on respondents.

- When it came to ‘Movement through the website’ we accept hypothesis $H_6_{-\text{navigation}}$ for Site A. Movement through the website had a positive influence on respondents. For Site B we accept hypothesis $H_6_{-\text{navigation}}$. Movement through the website had a mixed influence on respondents.
• When it came to ‘General impression’ we accept hypothesis $H_{0\text{-general}}$ for Site A. General impressions had a positive influence on respondents. For Site B we accept hypothesis $H_{0\text{-general}}$. General impressions had a positive influence on respondents.

In Table 7.59 we consider a horizontal view of the independent variables. We accept the following hypothesis:

• For the following factors: Web experience, gender, qualification, home language, course language, language of choice, population and province, we accept hypothesis $H_{0\text{-instructions}}$ for both Site A and Site B.

• For the following factors: Web experience, gender, course language, language of choice, population and province, we accept hypothesis $H_{0\text{-response times}}$ for both Site A and Site B. The exceptions are for qualification, we accept $H_{2\text{-response times}}$ for both Site A and Site B and for home language we accept $H_{2\text{-response times}}$ for both Site A and $H_{0\text{-response times}}$ Site B.

• For the following factors: Web experience, gender, qualification, language of choice, population and province, we accept hypothesis $H_{0\text{-visual aids}}$ for both Site A and Site B. The exceptions are for home language were we accept $H_{3\text{-visual aids}}$ for Site A and $H_{0\text{-visual aids}}$ for Site B, and for course language we accept $H_{0\text{-visual}}$ for both Site A and $H_{3\text{-visual aids}}$ for Site B.

• For the following factors: Web experience, home language, language of choice, population and province, we accept hypothesis $H_{4\text{-impression}}$ for both Site A and Site B. For the following factors gender, qualification and course language, we accept hypothesis $H_{0\text{-impression}}$ for both Site A and Site B.

• For the following factors: Gender, qualification, course language, language of choice and population, we accept hypothesis $H_{0\text{-appearance}}$ for both Site A and Site B. The exceptions are for web experience, were we accept $H_{5\text{-appearance}}$ for Site A and $H_{0\text{-appearance}}$ for Site B. For home language we accept $H_{0\text{-appearance}}$ for Site A and $H_{5\text{-appearance}}$ for Site B and for province we accept $H_{0\text{-appearance}}$ for Site A and $H_{5\text{-appearance}}$ for Site B.

• For the following factors: Web experience, gender, qualification, language of choice, and population, we accept hypothesis $H_{0\text{-general}}$ for both Site A and Site B. The exceptions are for home language, we accept hypothesis $H_{7\text{-general}}$ for both Site A and $H_{0\text{-general}}$ for Site B. For course
language we accept hypothesis $H_{7, \text{ general}}$ for both Site A and $H_{0, \text{ general}}$ for Site B; and for province we accept hypothesis $H_{7, \text{ general}}$ for both Site A and $H_{0, \text{ general}}$ for Site B.

From a vertical perspective of the different independents variables we accept the following hypothesis:

- For web experience we accept all the null hypothesis for Site A and Site B. The exceptions are: we accept $H_{4, \text{ impression}}$ for Site A and B and $H_{5, \text{ appearance}}$ for Site B.
- For gender we accept all the null hypothesis for Site A and Site B.
- For qualification we accept all the null hypothesis for Site A and Site B. The exceptions are: we accept $H_{2, \text{ response times}}$ for Site A and B, and $H_{6, \text{ navigation}}$ for Site B.
- For home language we accept $H_{0, \text{ instructions}}$ and $H_{0, \text{ navigation}}$ for Site A and B. For Site A we accept $H_{2, \text{ response times}}$ and for Site B we accept $H_{0, \text{ response times}}$. For Site A we accept $H_{3, \text{ visual aids}}$ and for Site B we accept $H_{0, \text{ visual aids}}$. For Site A and for Site B we accept $H_{4, \text{ impression}}$. For Site A we accept $H_{0, \text{ appearance}}$ and for Site B we accept $H_{5, \text{ appearance}}$. For Site A we accept $H_{7, \text{ general}}$ and for Site B we accept $H_{0, \text{ general}}$.
- For course language we accept all the null hypothesis for Site A and Site B. The exceptions are: we accept $H_{0, \text{ visual aids}}$ for Site A and $H_{3, \text{ visual aids}}$ for Site B. For Site A we accept $H_{7, \text{ general}}$ and for Site B we accept $H_{0, \text{ general}}$.
- For language of choice we accept all the null hypothesis for Site A and Site B. The exceptions are: we accept $H_{4, \text{ impression}}$ for both Site A and B. For Site A we accept $H_{6, \text{ navigation}}$ and for Site B we accept $H_{0, \text{ navigation}}$.
- For population we accept all the null hypothesis for Site A and Site B. The exceptions are: we accept $H_{4, \text{ impression}}$ for both Site A and B.
- For province we accept all the null hypothesis for Site A and Site B. The exceptions are: we accept $H_{4, \text{ impression}}$ for both Site A and B. For Site A we accept $H_{0, \text{ appearance}}$ and for Site B we accept $H_{5, \text{ appearance}}$. For Site A we accept $H_{7, \text{ general}}$ and for Site B we accept $H_{0, \text{ general}}$.

From this analysis we can conclude that usability seems to have a minimal effect on the websites. The shaded darker blocks in the table represent these exceptions. These shaded areas require further investigation.
The actual design of the experiment could have affected the findings – issues such as the order effect [Barker, 2000; ciadvertising.org, 2004; Drury & Faroomand, 1997; Wang et al., 2000] and the Hawthorne effect [Adair, 1984; Holden 2001]. See Chapter 9 for more details.
### Overall Statistics

<table>
<thead>
<tr>
<th>Comments from central tendency statistics</th>
<th>Comments from paired sample t-test</th>
<th>Anova Site A</th>
<th>Anova Site B</th>
<th>Kruskal-Wallis Site A</th>
<th>Kruskal-Wallis Site B</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Instructions</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall B is better</td>
<td>Accept $H_0$</td>
<td>Accept $H_0$</td>
<td>Accept $H_0$</td>
<td>Accept $H_0$</td>
<td>Accept $H_0$</td>
</tr>
<tr>
<td><strong>Speed of Website</strong></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Websites faired the same</td>
<td>Accept $H_0$, response times</td>
<td>Accept $H_0$, response times</td>
<td>Accept $H_0$, response times</td>
<td>Accept $H_0$, response times</td>
<td>Accept $H_0$, response times</td>
</tr>
<tr>
<td><strong>Visual Aids</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Websites faired the same</td>
<td>Accept $H_0$, visual aids</td>
<td>Accept $H_0$, visual aids</td>
<td>Accept $H_0$, visual aids</td>
<td>Accept $H_0$, visual aids</td>
<td>Accept $H_0$, visual aids</td>
</tr>
<tr>
<td><strong>Overall reaction</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Websites faired the same</td>
<td>Accept $H_0$, impression</td>
<td>Accept $H_0$, impression</td>
<td>Accept $H_0$, impression</td>
<td>Accept $H_0$, impression</td>
<td>Accept $H_0$, impression</td>
</tr>
<tr>
<td><strong>Appearance of the website</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall A is better</td>
<td>Accept $H_0$, appearance</td>
<td>Accept $H_0$, appearance</td>
<td>Accept $H_0$, appearance</td>
<td>Accept $H_0$, appearance</td>
<td>Accept $H_0$, appearance</td>
</tr>
<tr>
<td><strong>Movement through the website</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Websites faired the same</td>
<td>Accept $H_0$, navigation</td>
<td>Accept $H_0$, navigation</td>
<td>Accept $H_0$, navigation</td>
<td>Accept $H_0$, navigation</td>
<td>Accept $H_0$, navigation</td>
</tr>
<tr>
<td><strong>General Impressions</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall A is better</td>
<td>Accept $H_0$, general</td>
<td>Accept $H_0$, general</td>
<td>Accept $H_0$, general</td>
<td>Accept $H_0$, general</td>
<td>Accept $H_0$, general</td>
</tr>
</tbody>
</table>

Table 7.56. Summary of the different Statistics
### An Investigation into the Influence of Usability on the Development of the Browsing Experience of E-Commerce Applications

<table>
<thead>
<tr>
<th></th>
<th>Site A</th>
<th>Site B</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>‘Bad Site’</td>
<td>‘Good Site’</td>
</tr>
<tr>
<td><strong>Direction of Mean</strong></td>
<td>Comment</td>
<td>Comment</td>
</tr>
<tr>
<td><strong>Instructions</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cape Technikon</td>
<td>B</td>
<td>B</td>
</tr>
<tr>
<td>University of Western Cape</td>
<td>B</td>
<td>B</td>
</tr>
<tr>
<td>University of Durban-Westville</td>
<td>B</td>
<td>B</td>
</tr>
<tr>
<td>Control group University of Natal</td>
<td>B</td>
<td>B</td>
</tr>
<tr>
<td><strong>Speed of website</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cape Technikon</td>
<td>B</td>
<td>B</td>
</tr>
<tr>
<td>University of Western Cape</td>
<td>B</td>
<td>B</td>
</tr>
<tr>
<td>University of Durban-Westville</td>
<td>B</td>
<td>B</td>
</tr>
<tr>
<td>Control group University of Natal</td>
<td>B</td>
<td>B</td>
</tr>
<tr>
<td><strong>Visual Aids</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cape Technikon</td>
<td>B</td>
<td>B</td>
</tr>
<tr>
<td>University of Western Cape</td>
<td>B</td>
<td>B</td>
</tr>
<tr>
<td>University of Durban-Westville</td>
<td>B</td>
<td>B</td>
</tr>
<tr>
<td>Control group University of Natal</td>
<td>B</td>
<td>B</td>
</tr>
<tr>
<td><strong>Reaction to the website</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cape Technikon</td>
<td>P</td>
<td>P</td>
</tr>
<tr>
<td>University of Western Cape</td>
<td>B</td>
<td>B</td>
</tr>
<tr>
<td>University of Durban-Westville</td>
<td>P</td>
<td>B</td>
</tr>
<tr>
<td>Control group University of Natal</td>
<td>P</td>
<td>P</td>
</tr>
<tr>
<td><strong>Appearance of the website</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cape Technikon</td>
<td>P</td>
<td>P</td>
</tr>
<tr>
<td>University of Western Cape</td>
<td>B</td>
<td>B</td>
</tr>
<tr>
<td>University of Durban-Westville</td>
<td>P</td>
<td>B</td>
</tr>
<tr>
<td>Control group University of Natal</td>
<td>P</td>
<td>B</td>
</tr>
</tbody>
</table>
## Table 7.57. Anova Test – Influence of Mean Values

<table>
<thead>
<tr>
<th></th>
<th>Site A ‘Bad Site’</th>
<th></th>
<th>Site B ‘Good Site’</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Movement through the website</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cape Technikon</td>
<td>P</td>
<td>Overall positive influence on respondents, just below neutral.</td>
<td>P</td>
<td>Overall positive influence on respondents, just below neutral.</td>
</tr>
<tr>
<td>University of Western Cape</td>
<td>B</td>
<td></td>
<td>B</td>
<td></td>
</tr>
<tr>
<td>University of Durban-Westville</td>
<td>P</td>
<td></td>
<td>P</td>
<td></td>
</tr>
<tr>
<td>Control group</td>
<td>University of Natal</td>
<td>P</td>
<td>P</td>
<td></td>
</tr>
<tr>
<td><strong>General Impressions</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cape Technikon</td>
<td>P</td>
<td>Positive influence on respondents, just below neutral.</td>
<td>P</td>
<td>Positive influence on respondents, just below neutral.</td>
</tr>
<tr>
<td>University of Western Cape</td>
<td>P</td>
<td></td>
<td>P</td>
<td></td>
</tr>
<tr>
<td>University of Durban-Westville</td>
<td>P</td>
<td></td>
<td>P</td>
<td></td>
</tr>
<tr>
<td>Control group</td>
<td>University of Natal</td>
<td>P</td>
<td>P</td>
<td></td>
</tr>
</tbody>
</table>

**Key:**

P – Positive influence on respondents

B – Negative influence on respondents
<table>
<thead>
<tr>
<th>Composite Values</th>
<th>Anova Site A</th>
<th>Anova Site B</th>
<th>Kruskal-Wallis Site A</th>
<th>Kruskal-Wallis Site B</th>
<th>Site A Comments from Table 6.57</th>
<th>Site B Comments from Table 6.57</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instructions</td>
<td>Accept H&lt;sub&gt;0&lt;/sub&gt; instructions</td>
<td>Accept H&lt;sub&gt;0&lt;/sub&gt; instructions</td>
<td>Accept H&lt;sub&gt;0&lt;/sub&gt; instructions</td>
<td>Accept H&lt;sub&gt;0&lt;/sub&gt; instructions</td>
<td>Negative influence on respondents, just above neutral.</td>
<td>Negative influence on respondents, just above neutral.</td>
</tr>
<tr>
<td>Speed of Website</td>
<td>Accept H&lt;sub&gt;0&lt;/sub&gt; Response times</td>
<td>Accept H&lt;sub&gt;0&lt;/sub&gt; Response times</td>
<td>Accept H&lt;sub&gt;0&lt;/sub&gt; Response times</td>
<td>Accept H&lt;sub&gt;0&lt;/sub&gt; Response times</td>
<td>Negative influence on respondents, just above neutral.</td>
<td>Negative influence on respondents, just above neutral.</td>
</tr>
<tr>
<td>Visual Aids</td>
<td>Accept H&lt;sub&gt;0&lt;/sub&gt; visual aids</td>
<td>Accept H&lt;sub&gt;0&lt;/sub&gt; visual aids</td>
<td>Accept H&lt;sub&gt;0&lt;/sub&gt; visual aids</td>
<td>Accept H&lt;sub&gt;0&lt;/sub&gt; visual aids</td>
<td>Overall positive influence on respondents, just below neutral.</td>
<td>Mixed influence, values hovering around neutral.</td>
</tr>
<tr>
<td>Overall reaction</td>
<td>Accept H&lt;sub&gt;0&lt;/sub&gt; impression</td>
<td>Accept H&lt;sub&gt;0&lt;/sub&gt; impression</td>
<td>Accept H&lt;sub&gt;0&lt;/sub&gt; impression</td>
<td>Accept H&lt;sub&gt;0&lt;/sub&gt; impression</td>
<td>Overall positive influence on respondents, just below neutral.</td>
<td>Mixed influence, values hovering around neutral.</td>
</tr>
<tr>
<td>Appearance of the website</td>
<td>Accept H&lt;sub&gt;0&lt;/sub&gt; appearance</td>
<td>Accept H&lt;sub&gt;0&lt;/sub&gt; appearance</td>
<td>Accept H&lt;sub&gt;0&lt;/sub&gt; appearance</td>
<td>Accept H&lt;sub&gt;0&lt;/sub&gt; appearance</td>
<td>Overall positive influence on respondents, just below neutral.</td>
<td>Mixed influence, values hovering around neutral.</td>
</tr>
<tr>
<td>Movement through the website</td>
<td>Accept H&lt;sub&gt;0&lt;/sub&gt; navigation</td>
<td>Accept H&lt;sub&gt;0&lt;/sub&gt; navigation</td>
<td>Accept H&lt;sub&gt;0&lt;/sub&gt; navigation</td>
<td>Accept H&lt;sub&gt;0&lt;/sub&gt; navigation</td>
<td>Overall positive influence on respondents, just below neutral.</td>
<td>Overall positive influence on respondents, just below neutral.</td>
</tr>
<tr>
<td>General Impressions</td>
<td>Accept H&lt;sub&gt;0&lt;/sub&gt; general</td>
<td>Accept H&lt;sub&gt;0&lt;/sub&gt; general</td>
<td>Accept H&lt;sub&gt;0&lt;/sub&gt; general</td>
<td>Accept H&lt;sub&gt;0&lt;/sub&gt; general</td>
<td>Positive influence on respondents, just below neutral.</td>
<td>Positive influence on respondents, just below neutral.</td>
</tr>
</tbody>
</table>

**Table 7.58 The Level of Influence**
Table 7.29 Summary of Other Independent Variable Statistics

<table>
<thead>
<tr>
<th>Comments</th>
<th>H₀ general</th>
<th>H₀ navigation</th>
<th>H₀ appearance</th>
<th>H₀ impression</th>
<th>H₀ visual aids</th>
<th>H₀ response times</th>
<th>H₀ instructions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accept the null hypothesis with exceptions</td>
<td>Accept H₀</td>
<td>Accept H₀</td>
<td>Accept H₀</td>
<td>Accept H₀</td>
<td>Accept H₀</td>
<td>Accept H₀</td>
<td>Accept H₀</td>
</tr>
<tr>
<td>Accept the null hypothesis with exceptions</td>
<td>Accept H₀</td>
<td>Accept H₀</td>
<td>Accept H₀</td>
<td>Accept H₀</td>
<td>Accept H₀</td>
<td>Accept H₀</td>
<td>Accept H₀</td>
</tr>
<tr>
<td>Overall Accept the null hypothesis</td>
<td>Accept H₀</td>
<td>Accept H₀</td>
<td>Accept H₀</td>
<td>Accept H₀</td>
<td>Accept H₀</td>
<td>Accept H₀</td>
<td>Accept H₀</td>
</tr>
<tr>
<td>Accept the null hypothesis with exceptions</td>
<td>Accept H₀</td>
<td>Accept H₀</td>
<td>Accept H₀</td>
<td>Accept H₀</td>
<td>Accept H₀</td>
<td>Accept H₀</td>
<td>Accept H₀</td>
</tr>
<tr>
<td>Accept the null hypothesis with exceptions</td>
<td>Accept H₀</td>
<td>Accept H₀</td>
<td>Accept H₀</td>
<td>Accept H₀</td>
<td>Accept H₀</td>
<td>Accept H₀</td>
<td>Accept H₀</td>
</tr>
<tr>
<td>Accept the null hypothesis with exceptions</td>
<td>Accept H₀</td>
<td>Accept H₀</td>
<td>Accept H₀</td>
<td>Accept H₀</td>
<td>Accept H₀</td>
<td>Accept H₀</td>
<td>Accept H₀</td>
</tr>
<tr>
<td>Accept the null hypothesis with exceptions</td>
<td>Accept H₀</td>
<td>Accept H₀</td>
<td>Accept H₀</td>
<td>Accept H₀</td>
<td>Accept H₀</td>
<td>Accept H₀</td>
<td>Accept H₀</td>
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<tr>
<td>Overall Accept the null hypothesis</td>
<td>Accept H₀</td>
<td>Accept H₀</td>
<td>Accept H₀</td>
<td>Accept H₀</td>
<td>Accept H₀</td>
<td>Accept H₀</td>
<td>Accept H₀</td>
</tr>
<tr>
<td>Accept the null hypothesis with exceptions</td>
<td>Accept H₀</td>
<td>Accept H₀</td>
<td>Accept H₀</td>
<td>Accept H₀</td>
<td>Accept H₀</td>
<td>Accept H₀</td>
<td>Accept H₀</td>
</tr>
<tr>
<td>Accept the null hypothesis with exceptions</td>
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Chapter 7

Web Experience Gender Qualification

Shawren Singh

An Investigation into the Influence of Usability on the Development of the Browsing Experience of E-Commerce Applications
7. **Summary**

In this chapter we applied several statistical techniques to the data. We analysed the outcomes of the statistical analysis and provided an explanation for the results. Our overall observation is that usability cannot be the only determinant for making web applications usable; making an application usable may cause ‘other problems’. In the next chapter we will discuss our findings and contributions.

8. **Note**

Some of the works represented in this chapter has been published in a modified form, see attached CD for the full paper:


Summary of paper: South Africa has been described as a melting pot of different cultures, adding to the rich South African heritage, boasting eleven official languages. This cultural diversity, however, poses quite a unique challenge for designers of software, especially when one has to design electronic commerce websites. This paper describes an experiment with the net-generation and the effects that culture has on users’ perception of the web.
### FIGURE 1.7. STRUCTURE OF THE DISSERTATION

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Chapter 8
Discussion of Findings and Contributions

In this chapter we discuss our findings. We demonstrate that we need a much richer understanding of the human, social, cultural and technical world in which we design and develop interactive computer software products, so that the end-user finds the interactive product useful, usable and stimulating. Systems requirements are dynamic and they evolve over time. Users’ needs are constantly changing as well, based on time, place, circumstances and levels of empowerment, so it is difficult to have a universally accepted standard solution to designing engaging interactive computer software.

The general precept of any product is that simple things should be easy, and hard things should be possible.  
Alan Kay

1. Introduction

In this chapter we will discuss our findings in the context of our research question ‘Do usability aspects affect the design and development of the browsing experience in electronic commerce applications?’ We will discuss the findings from the following perspectives: electronic commerce in Section 2, interaction design in Section 3 and design and development in Section 4. In Section 5 we answer our research question. Section 6 we discuss other general issues identified and we conclude in Section 7.

2. Electronic Commerce

From our literature review, as described in Chapter 2, we could already deduce a number of issues with regard to electronic commerce. We briefly summarise the main issues in this section.

Electronic commerce that does not give the user an experience will not thrive [Brandt, 1999] (see Chapter 3, Section 3.4.1). Electronic commerce applications that are hard to use or difficult to understand by the users, will ultimately fail. Therefore, the goal of this dissertation was to try to find out some of the issues that might influence this user experience.

Electronic commerce development cannot be done haphazardly (see Chapter 3 Section 3.4), and needs to follow a systematic development strategy. The systems designers should use an appropriate systems development methodology that suits the particular system being developed. By
understanding the type of electronic commerce that is being conducted, an appropriate development methodology can be used. For example B2B, which is primarily concerned with business-to-business transactions, is different from C2C, which is primary concerned with customer-to-customer transactions or M-commerce or even U-commerce.

To recap we found that electronic commerce activities can be classified in a variety of ways (see Chapter 2 Section 4). These are:

- The participants in the electronic commerce activity: Our research revealed the following participant combinations: Business-to-Business (B2B), Business-to-Consumer (B2C), Consumer-to-Business (C2B) Consumer-to-Consumer (C2C), People-to-People (P2P), Non-business Electronic commerce, Intrabusiness (organisational) Electronic commerce, Business-to-Employees (B2E), Government-to-Citizen (G2C) and to others, Exchange-to-Exchange (E2E), Collaborative commerce (C-commerce), Ultimate commerce (U-commerce) and Mobile commerce (M-commerce). We did not focus on a particular subset of participants in this dissertation, but on generic electronic commerce activities instead.

- The typical electronic commerce task involved: We found that a typical electronic commerce application has three basic components:
  - A common entry point (the web page): This could be an open entry into the electronic commerce application, or as secure login before the electronic commerce application is activated. This page should be designed for maximum information representation, so that the user knows upfront what to expect.
  - An interactive activity, called the browsing phase: The application is characterised by an iterative user pre-emptive browsing experience of trying and find the desired product(s). This activity was the primary focus of the research for this dissertation.
  - A transaction processing activity, called the checkout steps: Once the desired product(s) is found, the client proceeds’ to ‘Checkout Phase’. In this phase the client is locked into a sequential (linear) system pre-emptive set of actions to get the transaction completed in a controlled manner. Although we did not focus on this activity, we argue that most of our findings with regard to the browsing experience will also be applicable to this phase.

- Our research further revealed that the majority of electronic commerce tasks could be classified as either e-shopping or e-service. Renaud et al. [2001] proposes the LSD model to characterise the e-shopping task. An original contribution of our research was to identify that e-service also has a generic task format, and we proposed the e-service task model to represent this (see Figure 2.4).
• The technology involved to support the electronic commerce activity: We found that the technology used in electronic commerce activities can be classified as hardware and network infrastructure, web server and electronic commerce software, Internet intermediary and support, and the transaction itself. We did not explicitly focus on technology issues in this dissertation, nor on legal issues.

In terms of our research question, for electronic commerce to be well grounded it should follow a systematic development process with the developer constantly applying usability checks and balances to develop an effective online shopping experience for the user, which would translate into money for the company.

3. Interaction Design

From our literature review, as described in Chapter 3, we could already deduce a number of issues with regard to interaction design. We briefly summarise the main issues in this section.

The traditional approach of soliciting sales in a brick-and-mortar commerce, such as atmosphere, placement of goods, lighting, etc., do not transfer to online commerce. It is interaction and participation that are the emotional hooks for electronic commerce, and the developers of electronic commerce sites should bear this in mind in their development strategies (see Chapter 3 Section 3.4).

Electronic commerce users have evolved to become more sophisticated and now demand powerful uncomplicated applications. Developing usable user interfaces is one facet of developing these successful powerful applications (see Chapter 3 Section 3.4).

In our research on electronic commerce users, we found that there are two types of users for most computer systems (see Chapter 3 Section 3.5): those with experience with a particular system and those without. Novice users are usually not willing to spend much time learning the computer-oriented details typically required by experienced users. They are most concerned with ease of learning, and how quickly they can learn new systems. Expert users, on the other hand, are usually concerned with ease of use [Dennis & Wixom, 2000], but also with usefulness. The interaction design of a system should cater for a variety of users.

In the context of the electronic commerce users, every time a user goes to a website that has changed (assuming it is done through a systematic development approach or otherwise), the user is relegated to the level of a novice user. The user will have to try and re-figure out the operations and structure of the site. There is also very little research from a usability perspective on the profile of electronic commerce users. For example, users of electronic commerce websites are heterogeneous (see
Chapter 3 Section 3.5), therefore electronic commerce websites should accommodate this wide variety of users.

However, usability means different things to different stakeholders. While some see usability as an additional expense, others see it as a necessary expense. With regard to usability guidelines, we have found that:

- There are general usability guidelines that can be applied to electronic commerce websites. However, usability guidelines and principles tend to be very vague and generalistic. There are few domain-specific usability guidelines and principles for electronic commerce (see Section 3.5 of Chapter 3).

- There are a whole variety of methods to apply and evaluate usability in an electronic commerce application, each with its own advantages and disadvantages. There are no universally accepted standards.

In the context of our research, usability is one aspect in the development of a successful electronic commerce website. Our general conclusion is that by identifying the key stakeholders, as well as introducing usability very early in the development process, the proposed electronic commerce website will be more successful. In terms of the electronic commerce application, there are two phases: the interactive user pre-emptive browsing and the sequential system pre-emptive checkout phase (see Chapter 1 Section 3.2). Each phase requires a special form of interaction design – the same set of usability principles cannot be applied to both phases.

4. Design and Development

In general, there are changing approaches to the development of electronic commerce applications – for example, using structured development methodologies, then object-oriented approaches and then agile approaches. Each of these development approaches has a fundamentally different approach, focus and mindset to it. These differences in the development approaches introduce different types of challenges to the development process.

From our literature review we can deduce the following about design and development of interactive systems. We structure our discussion from the following perspectives: planning, analysis, implementation and general.

4.1. Analysis: Requirements

Requirements analysis is multi-faceted. The requirements/analysis and design phases in the development methodology should, at a minimum, cater for the following issues: corporate issues such as competition, local economic climate and local domestic environments; political climate both
locally and internationally; legal issues both on national and international level; acts and regulations that could affect the business; human rights issues, e.g. accessibility laws/standards, access to information, etc.; the user context (geographical, cultural, socio-economic, educational, etc.); procurement issues, etc. (see Chapter 1, Section 2.1).

From an electronic commerce perspective, it is a challenge, during the ‘requirements analysis’ phase, to identify all the stakeholders in the particular electronic commerce application. This task is even more complex for an Internet application. For example:

- It is a challenge to get find experienced requirements analyst.
- The initial idea for the electronic commerce application may be wildly optimistic and utopian in nature.
- The requirements analysis phase may only be focused on the immediate electronic commerce application and may not consider some of the factors stated above.
- Requirements analysis has to consider the social context within which the system is being developed – for example, in the Arabic world people read from right to left.

Furthermore, a typical requirements analysis phase should address the following [Parviainen et al., 2005]:

- Functional requirements: What the electronic commerce application is going to do.
- Non-functional requirements: For example, legal considerations that affect the electronic commerce application.
- Performance requirements: For example, whether the current computer technology is being used optimally.
- External interface requirements: How does the computer technology (for example the database, networks, etc) interconnect with each other?
- Design requirements/constraints: This could be, for example, limitations in the chosen language or the additional technologies that are required.
- Quality requirements: A requirement that specifies the degree to which the system possesses attributes that affect quality – for example, correctness, reliability, maintainability or portability.

Though best efforts may be made to communicate as clearly and concisely as possible, there may invariably be miscommunication/discommunication between stakeholders and requirements analysts.
4.2. Planning: Design

Common to all the development methodologies we studied, is a design phase. The design phase decides how the system will operate in terms of the hardware, software, and network infrastructure; the user interface, forms, and reports that will be used; databases; and files that will be needed [Dennis & Wixom, 2000]. The interface design specifies how the users will move through the system (i.e. navigation methods such as menus and on-screen buttons) [Dennis & Wixom, 2000]. All the methodology textbooks have a token chapter or two, if at all, on the interface design. Interaction design is never covered in-depth. By not introducing the interact design early in the planning phase, the designers run the risk of later on coding a software interface that is inappropriate for particular users. It is therefore necessary to identify all relevant ‘interface stakeholders’ as early as possible in the planning phase.

With the design of electronic commerce applications, there may be a misidentification of the stakeholders. By misidentifying the stakeholders, the design team may design an inappropriate site for the particular target audience. For example:

- Primary stakeholder: The actual end-users of the electronic commerce application.
- Secondary stakeholder: The managers who use the system.
- Tertiary stakeholder: Government agencies and media organisations that may use the electronic commerce application.

4.3. Implementation: Evaluation

Stakeholders should (see Chapter 1, Figure 1.3) ideally be involved in the formative and summative evaluation of the proposed and delivered system. After all, if a system does not meet regulatory standards, violates human rights issues, does not meet the exact requirements of the customers, needs very specialised equipment not readily available from suppliers, is not cost-effective in terms of business transactions, does not meet the data or information requirements it is intended for, and cannot be developed by means of available skills or technology, how can it be successful? If these aspects are important, they should be explicitly catered for in the systems development model. Once the particular software is implemented, there should be a conscious constant evaluation of the software product. Users’ comments can be used to, for example, improve the interface of that particular software.

4.4. General

There is a urgent need for the development of a unified approach to successfully incorporate usability principles in the various development methodologies.
There are many shortcomings in the development methodologies (that we studied in Chapter 4) that could be catered for by making the end-user of the system a primary element in the design process, and including explicit guidelines for the inclusion of other external issues such as laws and regulations, human rights issues (including accessibility), the abilities and skills of the human resource complement of the IT department, the supplier chain and availability of technology, etc.

From a communication perspective, there are gaps in communication channels that exist between the software engineering community and the human-computer interaction community. These communities at times seem to communicate the same ideas in very different languages.

In terms of our research question, the development methodology is one aspect in the success of an electronic commerce application. The development methodology should support a user-centred approach. In terms of electronic commerce applications, the chosen development methodology must cater for the interactive browsing aspect of the electronic commerce application.

5. Answering Our Research Question

Our research question was: Do usability aspects affect the design and development of the browsing experience in electronic commerce applications? In order for us to effectively answer this question, we considered a number of hypotheses (Table 8.1). In Sections 1 to 4 we described individual sets of findings. We will now integrate them to answer the primary research question holistically.
### Usability Concept | Hypothesis | Description
--- | --- | ---
Consistency | H₀₀: instructions | Instructions do not affect the activities of a website user.  
| H₁₁: instructions | Instructions affect the activities of a website user. |
Navigation | H₀₀: response times | Response times of websites do not affect the activities of a website user.  
| H₂₂: response times | Response times of websites affect the activities of a website user. |
Structured Information | H₀₀: visual aids | Visual aids assisting with communication features of the website do not affect the website users’ activities.  
| H₃₃: visual aids | Visual aids assisting with communication features of the website affect website users’ activities. |
Consistency | H₀₀: impression | The website users’ reactions to the website do not affect their activities on the website.  
| H₄₄: impression | The website users’ reactions to the website affects their activities on the website. |
Navigation | H₀₀: appearance | The visual appearance of the website do not affect the website users.  
| H₅₅: appearance | The visual appearance of the website affects the website users activities.  
| H₀₀: navigation | Navigation of a website does not affect the activities of the website user.  
| H₆₆: navigation | Navigation of a website affects the activities of the website user. |
Structured Information | H₀₀: general | The overall structure of the website does not affect the users.  
| H₇₇: general | The overall structure of the website affects the users. |

**Table 8.1.** Research Hypotheses
An Investigation into the Influence of Usability on the Development of the Browsing Experience of E-Commerce Applications

Shawren Singh

<table>
<thead>
<tr>
<th>Usability Category</th>
<th>Concept</th>
<th>Hypothesis</th>
<th>Composite Values</th>
<th>Description of each Factor</th>
<th>Comments from central tendency statistics</th>
<th>Comments from paired sample t-test</th>
<th>Anova Site A</th>
<th>Anova Site B</th>
<th>Kruskal-Wallis Site A</th>
<th>Kruskal-Wallis Site B</th>
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<tr>
<td>Consistency</td>
<td>Instructions</td>
<td>H₀: consistency</td>
<td>Instructions</td>
<td>Instructions are a powerful mechanism to assist users in understanding the actions of the website and features of the website. Poor/vague instructions or the lack of instructions will affect the overall usability of a website.</td>
<td>Overall B is better</td>
<td>Accept H₀, instructions</td>
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<td>Consistency</td>
<td>Response time</td>
<td>H₀: response time</td>
<td>Speed of Website</td>
<td>Websites that have a perceived ‘slower’ response time will affect the users’ overall perceived usability of the website.</td>
<td>Websites fared the same</td>
<td>Accept H₀, response time</td>
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<td></td>
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</tr>
<tr>
<td>Structured Information</td>
<td>Visual Aids</td>
<td>H₀: visual aids</td>
<td>Visual Aids</td>
<td>Alternative means of visual communication is always a usability plus. When a user has a different/unique ‘opportunity/problem’ the human touch is an effective tool. These communication tools would include phone, fax and e-mail. A picture is worth a thousand words: relevant good quality pictures can enhance the usability of a website.</td>
<td>Websites fared the same</td>
<td>Accept H₀, visual aids</td>
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<tr>
<td>Consistency</td>
<td>Overall reaction</td>
<td>H₀: overall reaction</td>
<td>Overall reaction</td>
<td>Usability is a unique mixture of art and science. The intangible or soft aspects of the website will affect the user’s perceived usability of the website. For example if a user perceives a website as ‘dull’, that user may not want to use that website.</td>
<td>Websites fared the same</td>
<td>Accept H₀, overall reaction</td>
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<tr>
<td>Navigation</td>
<td>Appearance of the website</td>
<td>H₀: appearance of the website</td>
<td>Appearance of the website</td>
<td>A well planned appearance for a website will improve usability. For example, visual clues to what is important, legible fonts, good quality pictures that are rendered on all computers have an effect on the perceived usability of the website.</td>
<td>Overall A is better</td>
<td>Accept H₀, appearance of the website</td>
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<tr>
<td>Navigation</td>
<td>Movement through the website</td>
<td>H₀: movement through the website</td>
<td>Movement through the website</td>
<td>Since most users ignore the readme file or in this case will only read the help tutorial/FAQs when they have reached a bottleneck, issues such as finding their way back to a safe place become critical. Therefore navigation on the website should be well defined and ‘logical’. This type of ‘predictable’ navigation improves the usability of the website.</td>
<td>Websites fared the same</td>
<td>Accept H₀, movement through the website</td>
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</tr>
<tr>
<td>Structured Information</td>
<td>General Impressions</td>
<td>H₀: general impressions</td>
<td>General Impressions</td>
<td>If a user likes the performance of the website, the user will revisit the website. Good usability will encourage users to revisit websites.</td>
<td>Overall A is better</td>
<td>Accept H₀, general impressions</td>
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Table 8.2. Summary of Findings
In summary, based on Institution as independent variable, we found the following: the following factors, namely: ‘Instructions’, ‘Speed of website’, ‘Visual aids’, ‘Appearance of the website’, ‘Movement through the website’ and ‘General impressions’, seem not to affect the browsing experience of the user. ‘Reaction to the website’ seems to affect the browsing experience of the user. Considering the other independent variables, they also have a minimal effect on the browsing experience of users. Overall usability seems to have had a minimal effect on the browsing experience of users.

Our experiment and research process have revealed the following in the context of our research question:

- We have demonstrated that usability principles affect the attitudes of end-users when it comes to the browsing experience, but we could not conclusively explain how usability aspects affect them. This is, however, dependent on the variable(s) that were tested. Further research needs to be conducted to try to determine how the different variables affect usability principles. Making an interactive application usable may cause ‘other problems’. However, usability principles are by no means the ‘silver bullet’ for interactive application designs. The interactive browsing aspect of an electronic commerce application is complex and is affected by various factors besides usability. We cannot manipulate usability attributes in isolation and hope that they will improve effectiveness, efficiency and satisfaction.

- There are a myriad of factors that affect the success of a website. Usability is only one factor that designers need to consider when developing interactive software; other issues also play a role.

- We have criticised the development methodologies used to design interactive software. We demonstrated that usability was left for too late in the development process. We believe that usability advocates should be confident to suggest suitable usability guidelines that are related to the particular domain at the onset of the project. Later on in the project, thorough testing can be done [Norman, 2006]. Therefore, usability principles must be introduced very early in the design and development of an electronic commerce application, so that it is seamlessly integrated into the software product. For this to happen, an appropriate development methodology must be used to develop the electronic commerce application. We maintain that usability starts at the requirements gathering phase of the development of the electronic commerce application. Systems development methodologies do not adequately cater for usability aspects in the requirements and planning phases. It is, however, difficult to apply generic usability guidelines in the design of domain-specific electronic commerce websites. We have partially proved in this experiment that taking an existing application and trying to add usability to the application, does not work.
• We also discovered that statistical methods can be manipulated and misused. By using different statistical methods we can manipulate the data to reveal the required results. Seemingly unimportant factors can be made important, and vice versa.

• The methodological approach has affected the results of the experiment. We had an evaluation of Site A followed by Site B, and vice versa. In the process, we unintentionally educated the respondents in issues of usability, and many of them were much more critical during the second round of evaluation, as they knew which issues to look out for in advance.

In our experiment we investigated the browsing experience in general. These findings can therefore be applied to all kinds of applications, including electronic commerce applications.

In the context of this study, the usability principles of consistency, navigation and structured information seem to have had a minor affect on the browsing experience of the user. However, when it came to ‘Reaction to the website’, the first impressions was the lasting impressions. Regarding our theoretical conjecture, usability is one of many interrelated factors that must be considered in the development of interactive software products such as electronic commerce applications.

Our theoretical conjecture stated that: ‘Usability influences the design and development of the browsing experience in electronic commerce applications.’ We have demonstrated that usability is one of many factors that influence the browsing experience in electronic commerce applications. Usability cannot be seen in isolation.

A striking feature of this experiment is that because respondents were able to compare the two sites at the same sitting, they became much more critical of how they expected the second website to perform, even when they were given the ‘bad’ site first. They could see the difference that design according to HCI and usability principles made, and therefore ‘demanded’ more. The aphorism that ‘ignorance is bliss’ is therefore true – given the differently designed websites, the respondents aggressively commented on what they considered to be poor design.

6. Other General Issues Identified

It is, however, a naïve and simplistic view to believe that usability is the only factor that determines the success or failure of a project. When we consider the complexity that the Internet adds to the development of an interactive application, our research also revealed that the designers need to look further and should consider, for example, the following:

• How does culture affect our project?
• How do social aspects affect our project?
• Are we using the right ‘fit’ of technology?
• What are the change management issues involved?
• Do we have the right subject matter experts on the project? Such experts could be:
  o Computer networking experts: Can the country’s telephone infrastructure deal with the web page content and is the telephone infrastructure stable?
  o Computer security experts
  o Distributed database experts: A well-optimised database may improve response times of a web transaction.
  o Hardware experts: Does the appropriate, high quality hardware with the relevant support infrastructure exist?
  o Linguistic experts: Does the displayed web page convey an unambiguous massage to the users?
  o Legal experts: For example, in South Africa a user can log onto a banking website, fill in an application for a credit card, but s/he still has to go to the bank’s physical location and provide the relevant evidence that s/he is the applicant [Financial Intelligence Centre Act, 2001b].
  o Information technology auditors: Are there qualified, independent information technology auditors available to audit the electronic commerce application?

7. Conclusion

In our experiment we investigated the influence of usability principles on the browsing experience of a website. We discovered, though, that usability principles influence the attitudes of the users. However, usability principles are only one of many factors that need to be considered in the development of interactive software applications. This study has demonstrated that we need a much richer understanding of the human, social, cultural and technical world in which we design and develop interactive computer software products, so that the final user finds the interactive product useful, usable and stimulating. Systems requirements are dynamic and they evolve over time. Users’ needs are also constantly changing, based on time, place, circumstances and levels of empowerment, so it is difficult to have a universally accepted standard solution to designing engaging interactive computer software. The grass roots design process for interactive software requires a robust but flexible systems development methodology that combines all the domain specific issues with a user centered approach. In the next chapter we discuss our conclusions, recommendations and further research.
Chapter 9

Conclusions, Recommendations and Further Research

In this chapter we summarise the dissertation and outline the contributions of this dissertation. We further reflect on the knowledge acquisition process in this dissertation. We finally outline further research opportunities.

The machine itself makes no demands and holds out no promises: it is the human spirit that makes demands and keeps promises. In order to reconquer the machine and subdue it to human purposes, one must first understand it and assimilate it. So far we have embraced the machine without fully understanding it.

Lewis Mumford, Technics and Civilization, 1934.

1. Introduction

In a fair society, all individuals would have equal opportunity to participate in, or benefit from, the use of computer resources regardless of race, sex, religion, age, disability, national origin or other such similar factors.

-ACM Code of Ethics

This research was a multidisciplinary study, drawing from the fields of electronic commerce, usability and systems development. The primary objective of this research was to investigate *Do usability aspects affect the design and development of the browsing experience in electronic commerce applications?* This objective arose as a result of the different approaches that were being advocated by usability advocates and those advocated by systems development advocates. We designed an experimental website and a questionnaire to measure the perceived effects of usability on the respondents. The experiential results indicate that usability is one of many important factors that must be considered in the design of electronic commerce applications.

We begin this chapter by presenting a summary of the fields of study in this dissertation in Section 2. In Section 3 we have an overview of what can be learned from this research. We focus on the methodological reflection, substantive reflection, scientific reflection, and our personal reflection. In Section 4 we discuss further research opportunities, and we end with a final note.
2. Summary of this Dissertation

In Chapter 1 we introduced information systems, the various information systems development approaches and the context in which this research was conducted – online interactive systems, in this case the electronic commerce environment. In this study emphasis is placed on the HCI aspect of the development process. The problem statement of this research investigates how the browsing aspect of interactive systems affects users’ activities on the interactive system. The aims and objects of this research were identified. The delimitations, knowledge acquisition process and the contribution of this research were discussed.

We used Chapter 2 as the context for this study. This chapter investigated the electronic commerce realm. We looked at different definitions of electronic commerce. We then investigated the different classifications of electronic commerce – that is, according to the participants, according to the task, and we looked at classification by technology. Common to all these approaches is the single entry point that a user may use. The next issue that we looked at was the state of electronic commerce in South Africa.

In Chapter 3 we investigated the interaction design realm. In this chapter we considered various definitions of usability and the importance of the concept of usability in systems design. We looked at various usability techniques that are commonly used to test interactive systems and we also looked at electronic commerce usability.

In Chapter 4 we investigated the software engineering realm, the traditional approach, the object-oriented approach, agile developing methodologies and the HCI approaches to software engineering. We looked at the changing nature of the business environment and how this would affect systems development. We then compared the different methodologies, namely, structured systems development methods, object-oriented methods, human-computer interaction development methods and interactive systems design for the web and electronic commerce. The chapter ends by discussing usability as a key design component.

Chapter 5 contains a description of the research approach and the research instrument used in this dissertation. We looked at general research techniques and research techniques used in IS. We discussed how we went about acquiring the knowledge and our chosen research technique. We also discussed the concept of generational theory. We described the integration of Chapters 2, 3, 4 and 5. The various statistical techniques were briefly discussed and the questionnaire was explained.

In Chapter 6 we discussed the design of the experimental website. There were two websites designed. Site B was designed after taking into consideration usability factors, namely, consistency, navigation
and structured information. In Site A we did not consider the usability factors of consistency, navigation and structured information. Both website designs considered information systems design principles. Respective web users looked at these two websites and completed a questionnaire based on their perceptions of the websites.

In Chapter 7 we applied several statistical techniques to the data collected. We analysed the outcomes of the statistical analysis and provided an explanation for the results. We observed that usability cannot be the only determinant for making web applications usable.

In Chapter 8 we discussed our findings. We first looked at electronic commerce, then interaction design and design and development. Then we focused on our research question and answered the question. We demonstrated that we needed a much richer understanding of the human, social, cultural and technical world in which we design and develop interactive computer software products, to enable the final user to find the interactive product useful, usable and stimulating. Users’ needs are constantly changing as well, based on time, place, circumstances and levels of empowerment, so it is difficult to have a universally accepted standard solution to designing engaging interactive computer software. Systems requirements are dynamic and they evolve over time.

3. Reflections on the Knowledge Process

In this section I reflect on the approaches that were used to acquire the relevant data. These reflections are viewed from the following perspectives: methodological reflection, substantive reflection, and a scientific reflection.

3.1. Methodological Reflection

The methodological reflection refers to the extent to which the research approach influenced the results of this study. A researcher has to choose the approach that best suits the problem. This may include a combination of methods. The chosen method provides the framework by which a researcher will attempt to solve the research problem. There are various approaches/techniques that one could use, each with their own unique strengths and weakness.

It is worthy to note, though, that Introna and Whitley [2000] are of the opinion that experimental research in information systems context is fraught with some very serious problems. They believe that laboratory experiments are inaccurate, because the process deliberately introduces extra behaviour related to the research process. This is demonstrated by the following two phenomena:

- The Hawthorn effect [Adair, 1984]: This refers to changes in behaviour and performance of subjects resulting from their knowledge that they are being observed.
• The Order-effect [Barker, 2000; ciadvertising.org, 2004; Wang et al., 2000]: This refers to the phenomenon that the temporal order in which information is presented affects the final judgment of an event.

It is clear to us that these phenomena have affected the respondents in this particular study as well. The Hawthorn effect came into play because the respondents were in a controlled environment under the supervision of an experienced moderator, and the Order-effect came into play because of the manner in which the tests were designed and administered.

The results of this study will be hard to replicate by other researchers and as well as by me. This research in one sense was based on time, place and circumstances. This study does, however, give other researchers a framework by which they can approach their own research problems.

It is also worth mentioning that there are various tools that can be used to collect data. Each tool/technique has its strengths and weaknesses. With the tool that we used, a questionnaire with Likert scales, we noticed that the double negative manner in which some of the questions were asked affected the respondents’ answers.

Statistical methods are by no means a definitive method of explaining differences in data analysis. It is not as straightforward as comparing design A with design B, and vice versa. The types of statistical comparison used will affect the outcomes. For example [Jarrett, 2004]:

• Is treatment A better than treatment B?: This is a comparative evaluation. The challenge is that there may be parts of A that are better and parts of B that are better.

• Should the comparison be ‘between subject’ or ‘within subject’: The problem with ‘within subjects’ design is that nearly all systems have some learning effects. If participants are asked to try the same or similar tasks with both systems then they learn about the task with the first system and cannot unlearn that knowledge before they try the second system. If they try different tasks with each system, are they really comparing like with like? ‘Same size’ is an important consideration, because we have to vary the order of presentation of systems so that the one group of participants gets A then B and an equal group gets B then A. The problem with ‘between subjects’ design is that one cannot ask the participants which they preferred. And surely that is one of the main reasons why we are doing an evaluation anyway, to establish preference? So we end up in the deceptive world of inferential statistics: trying to figure out what the population as a whole might prefer, on the basis of the two samples from that population that tried these two interfaces. Then the issues of random sampling and statistical tests that require much larger sample sizes than we normally use in usability testing.
• Are the differences minimal or radically different?: The third problem with comparative evaluation is the ‘identical twins’ problem. The participants see both products as identical twins: both products look ‘pretty’ much the same. For example, we were looking at three different versions of a form that is much hated by the general public. The client could see all sorts of really major differences between then. The participants just saw the form they did not like.

It is clear to us that subject matter experts play a key role in the successful development of any interactive computer systems. Experts in content development, language grammar, technology, etc. must be consulted during the design process.

While conducting one of the experiments, the Unisa web server crashed. The test administrator called me up on my cellar phone, explained the problem and then waited. I in turn contacted the Unisa web administrator. The Unisa web administrator in turn found the responsible person for that server and attempted to solve the problem. This took about 12 minutes. In this time some of the respondents walked out from the test. They were under no obligation to stay, the same applies to a prospective customer. What also came out of this incident is that no matter how hard we try to control our environment, things will invariably go wrong, and we should have a backup plan to deal with these kinds of situations.

In our experiment the users were exposed to two different designs of the same website. In order for us to compare the results across different participants, the introductory material, question sequence and tasks were all the same. This approach confined our choice to the listed elements that we identified and tested. Other issues were ignored.

We concede that if we had used a different methodological approach to our research we would have derived different results.

3.2. Substantive Reflection

In this section the focus is on the substantive reflection where the goal is to compare the results of this research with other related research in the same area. The field of study, HCI, is in its early years in South African academia and in its infancy in the industrial sector. The result of this study can be compared with the results of other South African researchers (see, for example, Norton [2002] and de Wet et al. [2002] (these researchers conducted research on usability), and with some international researchers’ works (see, for example, Atterer & Schmidt [2005]; e-Commerce Usability [2004]; Fluckiger [2003]; Nielsen [1996]; Nielsen [2000a]; Schaffer & Sorflaten [1999]; Travis [2003b]; Rohn [1998]; Tilson et al. [1998]; Kubilus [2000]; Nielsen [2001] and Huang [2002], who all pointed out that usability is an important consideration in the design of electronic commerce software. It must be noted, though, that each researcher has their own unique approach and research agenda.
Research methodologies are analytical tools/lenses that researchers use to understand a given problem. The problem arises that these tools/lenses follow a defined series of steps to come to some type of conclusion. It is, for example, difficult to factor issues such as cultural sensitivity in these tools/lenses, that might affect the result.

3.3. Scientific Reflection

The scientific reflection focuses on what this research has contributed to the ‘scientific body of knowledge’, including what we have learned in this process. We first reflect on some overall issues.

We have learned that designing with usability in mind is not the ‘silver bullet’ for the design of successful electronic commerce websites. There are other factors that need to be considered and incorporated into design of the website. A holistic socio-technical approach should be adopted in the design of interactive products that interact with the wider society. We have learned that applying usability and designing electronic commerce applications is part science (which can be measured), part art (which cannot be measured), and part craft (which cannot be measured).

In the context of this study, over all when respondents looked at each website, they generally had a negative perception to the layout of both websites. I attribute this to other influence that I did not test, such as users are enticed but the media hype that promises all the clichéd ‘bells and whistles’. These are subjective emotional factors that were not tested. Non-interaction design experts cannot make an objective assessment of usability issues. Heuristic evaluations by usability experts seem to be a more reliable and object for of usability testing.

This study was a multidisciplinary study. In trying to understand the nature of the surveyed respondents, we looked at generational theory as a tool to classify the user type. One of the central observations of this study is that users are not a homogeneous group of social actors with convergent views on the outcomes of the development process. Rather, users tend to belong to various distinct social groupings or constituencies, each with their own particular organisational agenda, collective worldviews, and socially constructed sub-universes of institutional realities. Hence, the findings of this study indicate that not only do developers need to be sensitive to user/developers’ issues – they also have to be aware of the potential for conflict between the different stakeholders of the project.

However, it is clear that there is no easy way to determine the influence of complex social and organisational issues on participative development, without examining a variety of factors that directly and indirectly influence the development process.
We also found that there is a tendency by organisations to view the development process as a mechanism to resolve an economic/process/politically related problem that impacts on the operational needs of the organisation. They do not see the development process as an opportunity to better understand their users. It is clear that high levels of commitment are required by all key stakeholders in the development process. Users feel empowered when their views are considered during the development process. Although it is desirable and necessary for user participation in the development process, user participation is not always possible in practice.

However, there are many researchers in the computing discipline who believe that user participation is necessary for successful systems development [Butler & Fitzgerald, 1997]. Although user involvement poses a unique challenge in the development of electronic commerce applications, the situation has become even more difficult with the widespread use of the Internet as a communication tool. Better theoretical conceptualisation of the dynamic relationship between developers and users in systems development is needed to understand how this relationship shapes, and is shaped by, various constraints [Nandhakumar & Jones, 1997]. In practice, users’ involvement may be limited, or, in some cases, completely non-existent. The conventional wisdom within the computing community suggests that users’ participation is central to the successful development of electronic commerce systems [Butler & Fitzgerald, 1997]. Ives and Olson (as reported by Butler and Fitzgerald [1997]) report that ‘It is almost an axiom of the (M)IS literature that user involvement is a necessary condition for successful development of computer-based information systems. Butler and Fitzgerald [1997] report that Barki and Hartwick argue that the term user participation should be used to refer to development-related activities and behaviours of users and their representatives during the development process, and that ‘user involvement’ should be used to refer to the subjective psychological state that reflects the level of importance and personal relevance of the information system to users.

In our research we focused only on the effect that usability has on interactive software applications. Our findings indicate that usability is one aspect of the success of interactive software. Understanding the users is, however, an important aspect in developing functional and usable interactive software. In Figure 9.1 we propose a model of the different types of users to a system; we only concentrate on the user (see Chapter 1, Figure 1.3). The user is affected by many factors and the user can participate in many different roles. By understanding the users, we could design better interactive applications.
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Chapter 9

Figure 9.1. The Players in the Process

Figure 9.1 demonstrates that there is a minefield of ‘opportunities’ in attempting to understand the user.

In this dissertation we

- Classified e-services according to task.
- Analysed the electronic commerce activity using the Amazon.com website.
- Synthesised the classifications of electronic commerce activities.
- Classified electronic commerce by technology.
- Identified two distinct aspects of an electronic commerce application: The interactive browsing phase and the sequential transaction phase.

In the process we contributed to the scientific body of knowledge in the context of:

- A typical electronic commerce application has three basic components:
A common entry point (the web page): This could be an open entry into the electronic commerce application, or as secure login before the electronic commerce application is activated. This page should be designed for maximum information representation, so that the user knows upfront what to expect.

An interactive activity, called the browsing phase: The application is characterised by an iterative user pre-emptive browsing experience of trying to find the desired product(s). This activity was the primary focus of the research for this dissertation.

A transaction processing activity, called the checkout steps: Once the desired product(s) is found, the client proceeds to ‘Checkout Phase’. In this phase the client is locked into a sequential (linear) system pre-emptive set of actions to get the transaction completed in a controlled manner. Although we did not focus on this activity, we argue that most of our findings with regard to the browsing experience will also be applicable to this phase.

- Our research further revealed that the majority of electronic commerce tasks could be classified as either e-shopping or e-service. An original contribution of our research was to identify that e-service also has a generic task format, and we proposed the e-service task model to represent this (see Figure 2.4).

We overviewed usability and looked at examples of usability, and analysed various development methodologies.

We developed and refined a questionnaire to gather data on users’ attitudes to websites, and designed an experimental website to gather data on users’ attitudes to usability principles.

We found that there are different ways to compare data, that can affect the outcome of the statistical results.

Overall, we found that integrating varied philosophies towards systems development in a harmonious and scientific manner, is quite difficult. Changes in the particular field and changes in different fields have very different effects on the final outcomes, depending on the philosophical viewpoint of the designer.

3.4. Personal Reflection

During the course of this research, I have learnt many things, one being that we miscommunicate with each other. I will explain this by means of some examples. People have developed various methods for communication with each other. These methods range from oral communication languages to sign language for hearing-impaired individuals. To better facilitate these animate
exchanges of ideas/emotions/feelings, man went a step further and developed written communication
techniques (written languages, which follow a defines set of rules and signs – red means danger,
green arrow means proceed, morse code, sms, etc.) For example, if we look at the written English
language, we can find several ambiguities in the communication of an idea/emotion/feeling. This is
illustrated as follows:

- Pineapple: Is the pine in this apple?
- The teacher shouted, Tom. vs The teacher, shouted Tom. It is clear that these two sentences mean
two very different things; just by moving the comma, the meaning of the sentence has changed
[Richard, 2002].

To add to the miscommunication, man has developed different techniques to improve
communication. Some of these are:

- The use of eye movement, hand movement, sign languages.
- Use of particulars in specific contexts.
- Similarities.
- Metaphors.
- Colours.
- Body movements.

Most of these techniques are learned from childhood and honed by individuals as they mature. With
the world getting smaller, man has developed various other tools for communication. These
inanimate tools come in various shapes and sizes. Some of these tools are:

- Phones.
- Cellular phones.
- Facsimiles.
- Computer tools.
- Personal digital assistants.

These tools themselves introduce a whole series of challenges to improving communication,
miscommunication or discommunication. With various attempts to improve communication with
each other, we still find ourselves sometimes missing the point.

With the proliferation of interactive computer systems, a new dimension to the communication
puzzle has been added. Communication from computer devices to computer devices is not so
complicated; the machines seemingly understand each other. The challenge is the communication
between human and computer. This communication is fraught with different challenges, as illustrated
in Sections 3.4.5 of Chapter 3. We are of the opinion that these communication challenges will be very difficult to overcome. What the stakeholders (designers, developers, management, users, government, society at large, etc.) need is to develop sensible ways of designing interactive systems with a breadcrumb trial approach. We can still learn from the lessons pointed out in the fairy tale of Hansel and Gretel, in which two children are lost in a wood. They find their way home by following the breadcrumbs they dropped along their way. But the breadcrumbs didn’t work because the birds ate them all. Only the pebbles worked!

It is hard to satisfactorily evaluate human emotions to technology. There seem to be very few benchmarks by which to do these benchmarking tests. The current benchmark tests have built in assumptions that do not apply to all circumstances.

In the original writing of this dissertation I have consistently written myself out of the dissertation, constantly referring to the researcher. By trying to do this I was writing the humanware out of the process. I am now of the strong opinion that the humanware aspect is a pivotal pillar in the success/failure of any interactive computer systems. In my quest to understand how humans deal with technology. We noticed that there is no scientific means for a researcher to measure human emotions, which are affected by a number of related and unrelated factors.

What has been learned from this process is that the research process, like usability, is part science (I had to use established, well-grounded approaches to understand the given problems), part art (presenting ideas in a understandable non-technical, practical manner to prospective persons who may volunteer to help you), and part craft (once someone has volunteered to help you, you have to realise that help without wasting recourse). Research is a difficult, continuous and sometimes lonely process. Finally the best of intentions are fraught with disappointment.

4. Further Research

In this section I will consider some further research opportunities that have been identified in the course of our research for this dissertation. Some of these relate directly to the research we have been doing, while others arose from our literature studies:

- Communication: How do we effectively use our current technology to communicate our intentions in an unambiguous manner?

- Colour: Does the use of a particular colour affect the users of a website?

- Privacy: How do privacy issues affect electronic commerce and usability?

- Payment systems: How do payment systems or the lack of payment systems affect electronic commerce?
• Repudiation: When a transaction is conducted online, rather than in person, the customer may be provided with an opportunity to repudiate it more easily than with an in person transaction. How does this affect electronic commerce?

• Fraud: Can better usability reduce fraud? For example, fraud related to banking: an Internet banking user receives an e-mail stating that they must update their user name and password details by clicking on the e-mail link.

• Information requirements for product specification [Peffers, 2001]: Products that can be specified very precisely with little information, e.g. ‘Benq Joybee 130 MP3 player’, can satisfactorily be described over the Internet at reasonable cost. Other products require much more information. For example, a customer can only observe the quality of an apple if he can hold it in his hands, ascertaining its firmness and weight, turning it over to observe, at very high resolution, whether its surface shows any bruises, blemishes, mould, or rot, slicing it open to take in the aroma of its pulp; and biting into it to verify the nuances of its flavour, firmness and juiciness. Such information is more difficult to convey to the customer online than in person, and products with high information requirements for product specification place special burdens on electronic commerce transactions. Martins et al. [2001] point out that to an open-ended-write-in question in their research, one respondent had the following to say: “Nothing beats the experience of shops. I prefer to see and touch the goods that I purchase. There is a social experience in shopping. I prefer shopping, to ensure the quality of the goods purchased.” It is clear from this statement that traditional shopping is a social experience for most customers. How can usability be effectively used to create the experience that one is shopping a ‘real’ store?

• A further challenge to electronic commerce is to bridge the gap between what users know and what they need to know. Many users do not know how to begin, what to choose in a dialog box, how to handle system crashes, or what to do about viruses.

5. Final Note

No matter what the problem or what the approach; certain pitfalls lie in the path of the serious software developer. In most software development, many variables are at work. The task of software development has become a more complicated and costly affair. We have just looked at some issues that will affect the development process.
References


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References


Casaday, G. (2001). Whiteboard: online shopping: or, how I saved a trip to the store and receive my item in just 47 fun-filled days. Interactions, 8, 15-19.


References


References

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References


Appendix A: ICT Development

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Appendix B: Computer-generated Output

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Appendix C: Input Taxonomy

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Appendix D: Design Principles

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Appendix E: Questionnaire

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Appendix F: Test A

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Appendix H: Box plots

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Appendix I: Central Tendency Statistics

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Appendix J: Histograms

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Turnitin Originality Report

See attached CD