

**EXECUTIVE INFORMATION SYSTEMS USAGE:
THE IMPACT OF WEB-BASED TECHNOLOGIES**

by

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Submitted in fulfilment of the academic
requirements for the degree of
Master of Science (Information Technology)
in the School of Mathematics, Statistics and Information Technology,
University of Natal

Pietermaritzburg

December 2002

ABSTRACT

Executive Information Systems (EIS) grew out of the information needs of top executives. The recent literature reports that EIS usage has spread throughout organisations. Web-based technologies are causing a revisit of existing IT implementation models, including those for EIS. These technologies include: Intranet, Internet, Extranet, e-Commerce: Business-to-Business (B2B), e-Commerce: Business-to-Consumer (B2C), Wireless Application Protocol (WAP) and other mobile technologies.

The author conducts a field study of 31 well-established organisations in KwaZulu/Natal, South Africa, which have EIS experience. A validated survey instrument is administered to an EIS stakeholder in each organisation surveyed.

This dissertation reports on (1) an investigation into previous research on IT adoption; (2) that there is little evidence to support that the theoretical usage aspects of the Technology Acceptance Model (TAM) are echoed in EIS implementations in KwaZulu/Natal; and (3) identifies and ranks Web-based technologies in order of their perceived impact on EIS currently and in the future. There is a positive impact level trend for all Web-based technologies on future EIS implementations. The results from this field study could be useful in formulating a set of management perspectives for organisations in South Africa wishing to embark on EIS implementation programs.

PREFACE

The experimental work described in this dissertation was carried out in the School of Mathematics, Statistics and Information Technology, University of Natal, Pietermaritzburg, from January 2001 to December 2002 under the supervision of Professor D. I. Petkov of that School and co-supervision of Professor G. J. Erwin in the Faculty of Business Informatics, Cape Technikon, Cape Town and Dr W. H. Moolman in the School of Mathematical Sciences, University of Natal, Durban.

These studies represent original work by the author and have not otherwise been submitted in any form for any degree or diploma to any University. Where use has been made of the work of others it is duly acknowledged in the text.

Some of the material used in this dissertation has been locally and internationally reported as follows:

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LIST OF ABBREVIATIONS

| | |
|------------|---------------------------------------|
| A | Attitude Toward Using |
| ARPA | Advanced Research Project Agency |
| B2B | e-Commerce Business-to-Business |
| B2C | e-Commerce Business-to-Consumer |
| BI | Business Intelligence |
| BIU | Behavioural Intention of Use |
| C2B | Consumer-to-Business |
| C2C | Consumer-to-Consumer |
| CASE | Computer-aided Software Engineering |
| CEO | Chief Executive Officer |
| CSES | Computer Supported Executive System |
| CSFs | Critical Success Factors |
| DSS | Decision Support Systems |
| e-Commerce | Electronic Commerce |
| EDI | Electronic Data Interchange |
| EFT | Electronic Funds Transfer |
| EIS | Executive Information System |
| ERP | Enterprise Resource Planning |
| ES | Expert Systems |
| ESS | Executive Support Systems |
| EOU | Perceived Ease of Use |
| GVU | Graphic, Visualization, and Usability |
| HTML | HyperText Markup Language |
| IBM | International Business Machines |
| IOS | Interorganisational Systems |
| IS | Information Systems |
| IT | Information Technology |
| KPIs | Key Performance Indicators |
| MIS | Management Information Systems |

| | |
|--------|---|
| NSF | National Science Foundation |
| OLAP | Online Analytical Processing |
| OOP | Object-oriented Programming |
| PAS | People, Activities and Systems |
| PC | Personal Computer |
| PCAs | Personal Communications Assistants |
| PDAAs | Personal Digital Assistants |
| RAD | Rapid Application Development |
| SAA | South African Airways |
| SCM | Supply Change Management |
| SDLC | Systems Development Life Cycle |
| TAM | Technology Acceptance Model |
| TCP/IP | Transmission Control Protocol/Internet Protocol |
| TPS | Transaction Processing Systems |
| TRA | Theory of Reasoned Action |
| U | Perceived Usefulness |
| URL | Uniform Resource Locator |
| USA | United States of America |
| VANs | Value-added Networks |
| W3C | World Wide Web Consortium |
| WAP | Wireless Application Protocol |
| Web | World Wide Web |
| WIIS | Web integrated Information System |
| XHTML | eXtensible HyperText Markup Language |
| XML | eXtensible Markup Language |

ACKNOWLEDGEMENTS

I should like to thank my advisors, Professors Don Petkov and Geoff Erwin and Dr Henri Moolman, for affording me the opportunity to work with them, for their guidance and encouragement.

Thank you Papa, Walter Averweg, for being a source of inspiration and believing in me.

CHAPTER 1

INTRODUCTION

1.1 Information Technology (IT)

Information Systems (IS) are technology-based innovations that are created and used by individuals, organisations and societies (Allen, 2000). Technological advances have allowed organisations to utilise information technology (IT) applications in all aspects of organisational management (Khosrowpour, 1998). The information flow within an organisation, the decision-making process and the organisational practices are restructuring their processes to be able to survive and compete in a competitive global market.

As IT has evolved, so too has our understanding of the IS that employ them (Trauth, 2001). IS to support senior executives have been available for well over a decade (Poon and Wagner, 2001). Executive Information Systems (EIS) grew out of the development of IS to be used directly by executives and used to augment the supply of information by subordinates (Srivihok, 1998). EIS is the only known mature IS dedicated to business executives (Tao *et al.*, 2001). EIS is a technology that is continually emerging in response to managers' specific decision-making needs (Turban *et al.*, 1999).

The ubiquitous nature of the Internet is dramatically revolutionising the manner in which organisations and individuals access and share information (Anandarajan and Simmers, 2001). Many organisations hope to achieve general distributed computing across large networks or even across organisational boundaries (PriceWaterhouseCoopers, 2000). Globalisation is being realised via computing and communication networks. The adoption of networks in day-to-day and critical organisational operations has made them indispensable for co-operative work (Theoharakis and Serpanos, 2002). As global competition is increasing, rapid change has become a mode of operation. Today's new technologies, from the well-connected computer to the digital infrastructure, are dramatically changing the way we work, play and live (Chidambaran and Zigurs, 2001).

Developments in telecommunications and networking augur significant changes for people,

organisations, markets and society (Grant, 2001). Computer-based tools have become essential for executives learning to cope with the competitive market (Tao *et al.*, 2001). Web-based tools 'are very much suited' to executives' key activities of communicating and informing (Pijpers, 2001). Telecommunication technologies combined with Web-based technologies have created a new technology-based focus, Web-based learning and teaching (Aggarwal, 2000). This new area has changed the concept of education methods worldwide in the effective utilisation and management of Web-based learning and teaching technologies:

1.2 Background to the Research

During the past two decades, advances in computer technologies combined with telecommunication technologies have led to the development of the Internet and its most popular application, the World Wide Web ('the Web') (Khosrowpour, 2000). A new set of challenges has arisen as organisations integrate IT into all functions and activities of the modern organisation (Khosrowpour and Liebowitz, 1997).

Web-based Technologies

A Web-enabled technology 'is one that did not exist prior to the Web' (Looney, 2002) and utilises 'core Internet and Web technologies as the platform on which the solution operates' (Belanger, 2002). As the usage of IT increases, Web-enabled information technologies can provide the means for greater access to information from disparate computer applications and other information resources (Eder, 2000). Web-enabled IS present a particular challenge to interoperability because they are strongly heterogeneous in terms of their application domains (Dahanayake and Gerhardt, 2003).

'Web technologies are core to the functioning of the technology' (Belanger, 2002). Many global organisations are looking into emerging Web-based technologies to make their dispersed operations around the world more efficient (Khosrowpour and Herman, 2000). These technologies include: Intranet, Internet, Extranet, e-Commerce Business-to-Business (B2B), e-Commerce Business-to-Consumer (B2C) and Wireless Application Protocol (WAP) and other mobile technologies. There exists a high degree of similarity between the characteristics of a 'good EIS' and Web-based technologies (Tang *et al.*, 1997).

Adoption of Web-based Technologies

Recent studies have investigated factors affecting the use of the Internet or Web (see, for example, Atkinson and Kydd, 1997; Lederer *et al.*, 1998a, 2000; Teo *et al.*, 1999; Anandarajan *et al.*, 2000; Moon and Kim, 2001). The theoretical basis adopted in all these studies is the popular Technology Acceptance Model (TAM) (Davis 1989; Davis *et al.*, 1989) or its extensions. All the major features of the Web have been available for many years (Averweg and Erwin, 1999b). Averweg and Erwin (1999b) suggest that the packaging of these features in the Web should make data modelling a more seamless process for managers and thereby attract executives to Web use for EIS. This aspect of adoption is explored more in the next section.

1.3 Research on Information Technology adoption

Before the goals of this research are outlined, it is necessary to consider the broad issues regarding IT adoption. The foremost reason for adopting and using IT is perceived benefit. This reason is given by innovations theory (Rogers, 1995). It was found to be applicable in the case of IT where perceived benefits are often based upon beliefs about usefulness and ease of use (Davis, 1989; Davis *et al.*, 1989; Moore and Benbasat, 1991; Adams *et al.*, 1992).

The study of IT adoption has recently gained new attention after being popularly studied in the 1980s (Rose and Straub, 1998). Suradi (2001) attributes this to the fact that many organisations in the Western world started to use personal computers (PCs). The more sophisticated computer technology that includes the Internet is perceived to be part of modern organisations (Suradi, 2001). Web applications will become the predominant software (Rees, 2002). Little research on IT adoption has been conducted in less developed countries (Prescott and Conger, 1995). This is also relevant to a developing country as South Africa.

User acceptance of IT has been a primary focus in IT implementation research (Al-Gahtani, 2001b). Researchers in the field rely on the theories of innovations diffusion to study implementation problems. This model offers stages that deal with the problem of starting from scratch, *ie.* when there are not yet commitments or interest to introduce the new IT. Davis' (Davis, 1989; Davis *et al.*, 1989) TAM is based on the diffusion of innovations model. TAM is a well-respected model of IT adoption and use (Al-Gahtani, 2001b). It is often used to gain a better understanding of the adoption and use of IS (Chen, 2000). TAM forms the

basis of this research. TAM is one of the most influential research models in studies of the determinants of IS acceptance (Davis, 1989; Davis *et al.*, 1989; Mathieson, 1991).

Information Systems Usage

Computer or IS usage has been identified as the key indicator of the adoption of IT by organisations (Suradi, 2001). Igarria and Tan (1997) report that system usage is an important variable in IT acceptance since it appears to be a good surrogate measure for the effective deployment of IS resources in organisations. Davis *et al.* (1989) and Thompson and Rose (1994) argue that usage is a necessary condition for ensuring productivity payoffs from IS investment. Lu and Gustafson (1994) report that people use computers because they believe that computers will increase their problem solving performance (usefulness) and they are relatively effort free to use (ease of use). Lu and Gustafson (1994) suggest that the two belief variables, Perceived Usefulness and Perceived Ease of Use, are the most important factors determining usage of computers or IS. A person who believes that performing a certain behaviour will lead to mostly positive outcomes will have a favourable attitude towards performing that behaviour (du Plooy, 1998). A person who believes that performing that behaviour will lead to mostly negative outcomes, will have an unfavourable attitude.

Technology Acceptance Model (TAM)

TAM was developed by Davis (1989) and postulates that two particular beliefs, Perceived Usefulness and Perceived Ease of Use, are of primary relevance for computer acceptance behaviours (Davis *et al.*, 1989; Keil *et al.*, 1995; Igarria *et al.*, 1997). According to TAM, system use is determined by a person's attitude towards the system.

The basic TAM model consists of external variables which may affect beliefs. This model is derived from the general Theory of Reasoned Action (TRA) (Fishbein and Ajzen, 1975) in that TAM is intended to explain computer usage. In IT terms this means that the model attempts to explain the attitude towards *using* IT rather than the attitude towards IT *itself*. For this dissertation, Davis' (1989) Perceived Usefulness and Perceived Ease of Use constructs (see definitions in Section 4.5) are used in the author's survey instrument for measuring EIS usage levels in organisations in South Africa.

Perceived Usefulness and Perceived Ease of Use constructs

The most commonly investigated variables of TAM by researchers are Perceived Usefulness and Perceived Ease of Use (Davis, 1989; Davis *et al.*, 1989; Mathieson, 1991; Adams *et al.*, 1992; Igarria, 1993; Straub *et al.*, 1997; Garrity and Sanders, 1998; Hubona and Geitz, 1998; Rose and Straub, 1998). Straub *et al.* (1997) suggest that Perceived Usefulness of computers has a positive effect on the adoption of IT. Davis (1989) and Adams *et al.* (1992) report that perceived usefulness affects both attitudes and actual computer usage. From the available literature, there is little evidence to suggest that Perceived Usefulness and Perceived Ease of Use constructs have been investigated in South African organisations which have implemented EIS. As EIS adoption and usage coupled with the emergence of Web-based technologies present new challenges and impacts in an organisation, this creates a platform for conducting such research.

1.4 Goals of the Research

The main goal of the research is to use TAM to investigate and identify the areas of impact (if any) of Web-based technologies on EIS usage in organisations in KwaZulu/Natal, South Africa. The sub-goals of the research are to:

- investigate previous research on IT adoption;
- investigate whether the theoretical usage aspects of TAM are echoed in EIS implementations in KwaZulu/Natal; and
- identify and rank Web-based technologies in order of their perceived impact on EIS currently and in the future.

1.5 Scope and Limitations of the Research

The research on EIS is very broad. For example, some studies have looked at basic characteristics of the current status of EIS in organisations (Pervan, 1990; 1992), studies have focused on the development and implementation of EIS (Stevenson *et al.*, 1992; Watson *et al.*, 1991), the reasons for needing EIS (Leidner and Elam, 1994), the various organisational and technical issues associated with EIS in organisations (Rockart and DeLong, 1988; McFadden, 1996) and the attitude to IT within organisations with its resulting impact on EIS (Pervan and Meneely, 1995). Other studies have examined reasons (actual and perceived) for EIS failure (Watson and Glover, 1989; Glover *et al.*, 1992). Given this broad field, the focus of this research will be on EIS usage.

This study will explore some of the non-technical IS issues of organisations which have embarked on EIS programs. The scope of this research will be limited to existing EIS in organisations in the eThekweni Municipality region, KwaZulu/Natal. eThekweni Municipality is the most populous municipality in South Africa (SA2002-2003, 2002). KwaZulu/Natal is one of the nine provinces in South Africa. No attempt will be made to classify or report on the relative EIS implementation success (or failure) between these organisations. It is acknowledged that some organisations may have implemented more than one EIS and in those cases, for this study, only the latest EIS implementation will be used in the author's survey.

TAM enjoys a rich base of academic acceptance (Ruth, 2000). While some researchers have found it necessary to augment TAM (see, for example, Chen, 2000; Ruth, 2000) in an attempt to find greater nomological validity, this is not within the scope of this research. For this study, no technology specific constructs will be added to TAM.

1.6 Assumptions

Computer applications are part of waves of technology (Erwin and Blewett, 1998). For each wave, once it arrives there is often a reasonably predicted series of steps by which the technology associated with each wave becomes comfortable within the organisation. This series of steps constitutes the process of organisational assimilation of technology. The four stages of organisational assimilation of technology are: initiation, proliferation, control and maturity. For a discussion of each of these stages, see McNurlin and Sprague (1989). No attempt will be made in this research to position each organisation at one of the four stages of organisational assimilation of technology. The presence of these waves of technology (including Web-based technologies) is assumed as applying across the IS of each organisation, including their usage of EIS.

Almost all research in IS originates in Western countries, particularly the United States of America (USA), where conditions are very different from developing countries (Kirlidog, 1996). Conditions in developing countries are often greatly different from those of developed countries. For a discussion of the challenges to an IT-supported technology transfer to developing countries, see, for example, Nahar *et al.* (2000). This dissertation does not cover these differences in conditions, the maturity level of IT and the socio-cultural environment.

1.7 Research Methodology

A useful triad for the justification of research includes research aims, theoretical foundations and research methods (Robey, 1996). Research aims determine both the theoretical and the research methods, whereas theoretical foundations also determine the research methods. See Figure 1.1.

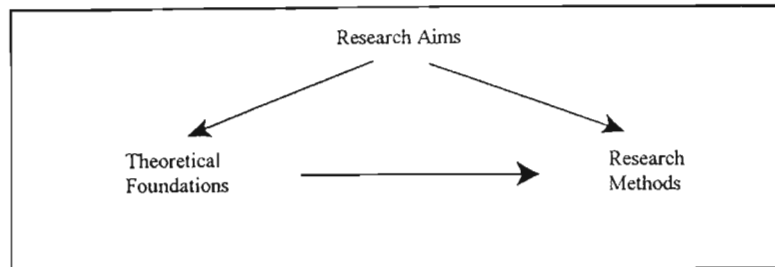


Figure 1.1 Triad for the Justification of Research
(Source: Adapted from Robey, 1996)

Jackson (1995) suggests that the theoretical foundation of research is what distinguishes it from the realm of theoretical unfounded management consultancy. The starting point in determining the appropriate research approaches are the aims of the research as outlined earlier.

The literature survey aims to examine

- the current research on EIS implementation; and
- TAM in general with specific focus on Perceived Usefulness and Perceived Ease of Use constructs applied to EIS.

This issue is an important aspect because this research focuses on two theoretical constructs, Perceived Usefulness and Perceived Ease of Use, which are theorised to be fundamental determinants of system use. The theoretical foundations of this research are formulated on the basis of the goals and the literature analysis. The investigation of the level of impact of Web-based technologies on EIS usage is addressed through the application of a survey instrument in organisations in South Africa which have implemented EIS. To the best knowledge of the author this research has not been previously undertaken in South Africa. The above considerations justify the empirical research methodology adopted in this dissertation. In line with the general guidelines articulated by Robey (1996) in Figure 1.1, the empirical methodology specifies further the methods to be used in the investigation - interviews and statistical analysis of the data.

1.8 Significance of the Research

The technology for EIS is evolving rapidly and future systems are likely to be different (Sprague and Watson, 1996). EIS is now clearly in a state of flux. As Turban (2001) notes, 'EIS is going through a major change'.

There is therefore both scope and need for research in the particular area of EIS being impacted by Web-based technologies as executives need systems that provide access to diverse types of information. The question is posed: Have Web-based technologies enabled EIS to be available to more management levels in an organisation? Emerging (Web-based) technologies can redefine the utility, desirability and economic viability of EIS technology (Volonino *et al.*, 1995). These technologies may need to be applied to resolve one of the most challenging and critical components of an EIS - data accessibility - which often incurs the greatest time, expense and delay in EIS implementation. This research will thus attempt to provide a richer understanding and furnish insights into current and future EIS usage levels in organisations in South Africa which have implemented EIS. The accessibility, navigation and management of data and information for improved executive decision-making is becoming *critical* in the new global business environment (Averweg and Erwin, 2000).

The rapid growth of the Internet has seen many organisations taking advantage of e-Commerce to change the way in which they do business and interact with their customers and partners. PriceWaterhouseCoopers (PriceWaterhouseCoopers, 2000) state that the shift to the Internet and to develop e-Commerce applications will dominate most companies' software efforts in the coming year. The resources of the Internet, Intranets and Extranets provide the basis for all e-Commerce transactions. These technologies will directly impact current EIS and future EIS implementations. Furthermore, Wireless technologies are also changing the face of e-Commerce (Erwee and du Preez, 2000) and a variety of mobile wireless devices have begun to access organisational sites using the Internet (PriceWaterhouseCoopers, 2000). As decision-making being facilitated from anywhere at any time, EIS implementation and usage will be impacted.

With the increasing amount of IT investment and substantial evidence of failures (Remenyi and Lubbe, 1998), many managers and researchers feel that IS justification and evaluation has become a key management issue. EIS has become a significant area of business computing and

there are increasing amounts of money invested by organisations in EIS development projects (Kaniçlides and Kimble, 1995) and the subsequent operation (use) of these systems (Millet *et al.*, 1991; Belcher and Watson, 1993). For example, in October 1997 the largest water utility in South Africa, Rand Water, took a decision to build an EIS (based on Oracle® products) and invested R4,5m in revamping its IT infrastructure to support that deployment (Harris, 2000).

In order to gauge the current applicability of TAM in the EIS context, the author approached three internationally respected TAM researchers and solicited their responses to the author's research topic. Roldán (2001) thinks that it 'was a good idea', Szajna (2001) indicates that it 'would work fine for EIS and am not aware of any research specifically targeting EIS and TAM' and Hubona (2001) notes that 'TAM is a robust model with strong theoretical underpinnings which make it suitable to gauge user acceptance in many contexts and with many different systems'. These three responses and the recent TAM/EIS research by Pijpers *et al.* (2001) create the platform for the author's research.

With the absence of any research efforts on the level of impact of Web-based technologies on EIS usage, this research begins to fill the gap with a field study in KwaZulu/Natal. The results from this field study could be useful in formulating a set of management perspectives for organisations in South Africa wishing to embark on EIS implementation programs.

1.9 Overview of the Structure of the Dissertation

This dissertation is structured in the following manner. This first chapter is an introductory chapter which articulates the goals of the research, its importance and justification and broadly looks at previous IS usage and TAM studies. The second chapter deals with current research issues in EIS. The third chapter is an investigation into the manner that Web-based technologies affect EIS implementation. The fourth chapter is a review of previous research of IT adoption and usage. The fifth chapter is the design, formulation and discussion of experimental work findings. Finally the sixth chapter concludes the research and looks at future research issues.

CHAPTER 2

CURRENT RESEARCH ISSUES IN EXECUTIVE INFORMATION SYSTEMS

2.1 Introduction

The purpose of this chapter is to review earlier studies of the EIS phenomenon, success factors associated with EIS and the measurements of EIS implementation success. The literature reviewed is used as a foundation for the framework for investigation of EIS adoption and usage which are more fully discussed in Chapter 4.

The chapter presents some findings on past research in IS, Management Information Systems (MIS) and Decision Support Systems (DSS). It then presents the basic concepts including the definitions and characteristics of EIS. The literature of IS, DSS, EIS development are reviewed. A framework which describes EIS development and use is discussed. From this framework the factors which affect EIS success are classified. This leads to a summary of critical success factors that contribute to successful EIS development and operation. Previous EIS research conducted in South Africa is then discussed. A review of current international research on EIS is then presented.

2.2 Information Systems (IS) Classification

An IS is a system whose purpose is to store, process and communicate information (Mallach, 1994). IS can be classified in several ways, by:

- organisational levels (*eg.* departmental, interorganisational, *etc.*);
- major functional areas (*eg.* financial, marketing, manufacturing, *etc.*);
- support provided (*eg.* MIS, DSS, EIS, *etc.*); and
- the IS architecture (Turban *et al.*, 1999).

Turban *et al.* (1999) report that regardless how IS are classified, the structure of these systems is the same: each contains hardware, software, data, procedures and people. All types of IS have some relationship to decision support (Mallach, 1994). In this dissertation IS are classified according to the type of support they provide regardless of the functional area. Some computerised systems used to support management decision-making are discussed in the next section.

2.3 Management Support Systems (MSS)

Management is a process whereby certain goals are achieved through the use of resources (people, money, energy, materials, space and time). These resources are considered to be inputs and the attainment of the goals is viewed as the output of the process (Turban *et al.*, 1999). The degree of a manager's success is often measured by the ratio between outputs and inputs for which the manager is responsible. This ratio is an indication of the organisation's productivity. Productivity (also known as efficiency) is a major concern for any organisation as it deeply influences the well-being of the organisation. Technology-based systems have changed the way employees, management and entire organisations behave and think (Absa, 2002).

To understand how computers support managers, it is necessary to describe what managers do. Managers do many things depending on their position in the organisation. There are several generic frameworks and management theories what managers do. In the classical studies by Mintzberg (1973), one category of a manager's role is decisional analysis. In this dissertation, focus is on the support that IT can provide to the decisional role.

In an organisation information comes from both internal and external environments. Internal information is generated from functional areas. External information comes from sources such as the Internet, online databases, newspapers, industry newsletters, government reports and personal contacts (Turban *et al.*, 1999). Clearly a large amount of information is available and it is necessary to scan the environment and data sources to find the *right* information. Collected information is then evaluated for relevancy and importance and whenever appropriate it is channelled to quantitative and qualitative analysis. A decision is then made by an executive on whether a problem or opportunity exists. If it is interpreted that there is a problem (or opportunity), alternatives must then be evaluated. A choice of one of the alternatives must be made for solving the problem (or opportunity). The purpose of various management support systems is to support these various tasks during this process (such as scanning and analysing) and to support the managerial role described earlier. In this dissertation two management support system technologies are looked at: Decision Support Systems (see Section 2.3.2) and Executive Information Systems (see Section 2.3.3).

Management Support Systems (MSS) are the application of technology, either as an independent tool or in some form of integration, for the solution of management problems (Turban, 1995). MSS are designed to provide comprehensive and integrated support for the decision-making process (Forgionne and Kohli, 2000). MSS can include MIS, DSS and EIS (Watson and Walls, 1993). These terms are related to the different purposes and characteristics of applications and need to be articulated. Other technologies can be used to support managers either by themselves or when integrated with other management support technologies (Turban *et al.*, 1999). Definitions of MIS, DSS and EIS are given in Sections 2.3.1-2.3.3 inclusive. One criterion to be used in this analysis can be structuredness of the decisions related to a particular system. Other criteria may be the amount and variety of input, degree of analytical capability, type of users or degree of interactiveness of the application.

2.3.1 Management Information Systems (MIS)

Turban (1993) defines the term Management Information Systems (MIS) as a 'formal, computer-based system, intended to retrieve, extract and integrate data from various sources in order to provide timely information necessary for managerial decision making'. Initially MIS had an historical orientation as they described events after they occurred (Turban *et al.*, 1999). Later they were also used to forecast trends and to support routine decisions. Sprague (1980) reports that MIS have been used in providing information for routine, structured and anticipated decisions aimed at middle managers. Nowadays, MIS reports may include summary reports from the periods of the scheduled reports (Turban *et al.*, 1999). MIS have been used to summarise information from operational databases (Srivihok, 1998). The databases are created by Transaction Processing Systems (TPS) which are built to support business functions. Millet and Mawhinney (1992) indicate that MIS are considered an upper layer of TPS.

TPS are generally inflexible, store large amounts of data and predominantly use internal data sources. The MIS use results from TPS supplying information about internal monitoring of past activities by pre-defined reports or simple queries (Millet and Mawhinney, 1992). As MIS usually have many applications and data, they require a large storage capacity (Elliot, 1989). TPS are usually developed to support only individual functions of the MIS and do not support the higher levels of management. MIS are primarily used by low-level managers during well structured decisions (Turban *et al.*, 1999). Consequently some MIS have been less successful

in serving the basic purposes and goals of an organisation (Gorry and Scott-Morton, 1989). With their limited capabilities in decision support, MIS have traditionally been difficult to use by managers (Turban, 1995). This scenario has catalysed the development of another computerised decision support aid and the Decision Support Systems concept was born (Turban *et al.*, 1999).

2.3.2 Decision Support Systems (DSS)

The concepts involved in Decision Support Systems (DSS) were first articulated by Scott-Morton (Scott-Morton, 1971). Scott-Morton (1971) defined such systems as 'interactive computer-based systems, which help decision makers utilize data and models to solve unstructured problems'.

The decision-making process is generally considered to consist of a set of phases or steps which are carried out in the course of making a decision (Sprague and Watson, 1996). Before defining the specific management support technology of DSS, it will be useful to present a classical framework for decision support. This framework will assist in discussing the relationship among the technologies and the evolution of computerised systems.

Turban *et al.* (1999) report that a framework for decision support was proposed by Gorry and Scott-Morton (1971) based on the combined work of Simon (1960) and Anthony (1965). The details of this framework are now discussed.

From Table 2.1, technology is used to support the decisions shown in the column at the far right and in the bottom row. The left hand side of this table is based on Simon's notion that decision-making processes fall along a continuum that ranges from highly structured (sometimes referred to as *programmed*) to highly unstructured (*non programmed*) decisions. **Structured** processes refer to routine and repetitive problems for which standard solutions already exist. **Unstructured** processes are 'fuzzy' for which no cut-and-dried solutions exist. Decisions where some (but not all) of the phases are structured are referred to as **semi-structured** by Gorry and Scott-Morton (1971). Simon (1997) suggests that decision-making is a principle of organisations.

Table 2.1 A Decision Support Framework
(Source: Adapted from Turban *et al.*, 1999)

| | Type of Control | | | |
|------------------------|--|---|---|---|
| Type of Decision | Operational Control | Managerial Control | Strategic Planning | Support Needed |
| Structured | ① Accounts receivable, order entry | ② Budget analysis, short-term forecasting, personnel reports, make-or-buy analysis | ③ Financial management (investment), warehouse location, distribution systems | MIS, operations research models, transaction processing |
| Semi-structured | ④ Production scheduling, inventory control | ⑤ Credit evaluation, budget preparation, plant layout, project scheduling, reward systems design | ⑥ Building of new plant, mergers and acquisitions, new product planning, quality assurance planning | DSS |
| Unstructured | ⑦ Selecting a cover for a magazine, buying software, approving loans | ⑧ Negotiating, recruiting an executive, buying hardware | ⑨ R&D planning, new technology development, social responsibility planning | DSS, ES, neural networks |
| Support Needed | MIS, management science | Management science, DSS, ES, EIS | EIS, ES, neural networks | |

The second half of this framework (upper half of Table 2.1) is based on Anthony's (1965) taxonomy which defines three broad categories that encompass all managerial activities:

- **Strategic Planning.** The long-range goals and the policies for resource allocation;
- **Management Control.** The acquisition and efficient utilisation of resources in the accomplishment of organisational goals; and
- **Operational Control.** The efficient and effective execution of specific tasks.

Anthony and Simon's taxonomies are combined in a nine-cell decision support framework in Table 2.1. The right-hand column and the bottom row indicate the technologies needed to support the various decisions. For example, Gorry and Scott-Morton (1971) suggest that for semi-structured and unstructured decisions, the conventional MIS and management science approaches are insufficient. Gorry and Scott-Morton (1971) propose the use of a supportive information system, which they label a DSS. Expert Systems (ES), which were only introduced several years later, are most suitable for tasks requiring expertise. In recent years, the field of DSS has become more sophisticated to encompass the ES paradigm (Bhatt and Zaveri, 2002).

The more structured and operational control-oriented tasks (cells 1, 2 and 4) are performed by low-level managers. The tasks in cells 6, 8 and 9 are the responsibility of top executives. This means that DSS, EIS, neural computing and ES are more often applicable for top executives and professionals tackling specialised, complex problems.

DSS is an IS application that provides its users with decision-oriented information whenever a decision-making situation arises. In particular DSS are usually designed to support **unstructured decisions** *ie.* those decision-making situations that cannot be predicted in advance (Whitten and Bentley, 1998). Sprague and Watson (1996) indicate that it is often unnecessary for a DSS to support the intelligence phase of Simon's model (Simon, 1960), especially for *ad hoc* DSS, where the DSS is created in response to the specific problem. In the case of institutional DSS which provide on-going decision support, a DSS may trigger an exception report which signals the need to address a problem.

Sprague (1980) defines DSS as a computer-based system that allows decision-makers to solve structured problems through direct interaction with the computer by using data and analysis models. The support may be indirect through staff assistant operation of the DSS or as a result of management using the DSS directly. DSS are usually designed and developed for a specific decision-making task or group of decision-makers (Sprague and Watson, 1996). DSS are used widely in South Africa. For a discussion of the implementation of DSS in South Africa, see Averweg (1998) and Averweg and Erwin (1999a).

DSS are helpful for analysis and decision-making but have limitations. Decision-making within an organisation is not always an easy task, particularly where the underlying problem is complex and ill-structured (Eierman *et al.*, 1995). Some executives with little computer experience or having time constraints, experience difficulties in using the system. Consequently Rockart and Treacy (1982) report that a new software paradigm was developed to serve the information needs of executives and named **Executive Information Systems**.

2.3.3 Executive Information System (EIS)

IS at strategic decision-making levels are commonly characterised as being 'executive'. The impact of such decisions, by definition, will be significant (Averweg and Erwin, 2000). IS for

executives therefore require careful planning both in their features and their applicability to organisational situations. EIS are designed to serve the needs of executive users in strategic planning and decision-making (Srivihok, 1998) and for making both strategic and tactical decisions (Salmeron *et al.*, 2001).

Executives deal mostly with ill-structured decision-making (Lee and Chen, 1997). Definitions of EIS are varied (see, for example, Rockart and DeLong, 1998; Carlsson and Widmeyer, 1990; Watson *et al.*, 1991; Westland and Walls, 1991; Whymark, 1991a; Millet and Mawhinney, 1992; Rainer *et al.*, 1992). All definitions identify the need for information that supports decisions about the business as the most important reason for the existence of EIS (Khan, 1996). An EIS is used by executives to extract, filter, compress and track critical data (Butler, 1992) and to allow executives seamless access to complex multi-dimensional models so that they can see their business at a glance (Harris, 2000). EIS applications support executive information needs and decision-making activities (Gillan and McPherson, 1993). An effective way to evaluate the success of an EIS is to obtain opinions from the executive users (Monash University, 1996). In this dissertation EIS is defined as ‘a computerized system that provides executives with easy access to internal and external information that is relevant to their critical success factors’ (Watson *et al.*, 1997). While a definition is useful, a richer understanding is provided by describing the capabilities and characteristics of EIS.

Earlier studies described EIS capabilities which are focused on providing information which serves executive needs. Srivihok (1998) reports that these capabilities are concerned with both the quality of the system (*eg.* user friendliness) and information quality (*eg.* relevance). Sprague and Watson (1996) identify the following capabilities or characteristics of EIS:

- tailored to individual executive users;
- extract, filter, compress and track critical data;
- provide online status access, trend analysis, exception reporting and ‘drill down’;
- access and integrate a broad range of internal and external data;
- user-friendly and require little or no training to use;
- used directly by executives without intermediaries; and
- present graphical, tabular and/or textual information (see Figure 3.1 (p.92)).

Other researchers, suggest additional capabilities and characteristics of EIS:

- flexible and adaptable (Carlsson and Widmeyer, 1990);
- should contain tactical or strategic information that executives do not currently receive (Burkan, 1991);
- facilitate executives' activities in management such as scanning (see, for example, Müller *et al.* (1997) for a discussion on environmental scanning), communication and delegating (Westland and Walls, 1991);
- make executive work more effective and efficient (Friend, 1992);
- assist upper management to make more effective decisions (Warmouth and Yen, 1992; Chi and Turban, 1995);
- incorporate an historical 'data cube' and 'soft' information (Mallach, 1994) ('data cube' is a structure in which data is organised at the core of a multi-dimensional online analytical processing (OLAP) system (Ross, 2001) and 'soft' information includes opinions, ideas, predictions, attitudes, plans, *etc* and will be further discussed in Sections 3.5.2 and 3.5.4);
- provide support for electronic communications (Rainer and Watson, 1995a); and
- enhanced relational and multi-dimensional analysis and presentation, friendly data access, user-friendly graphical interfaces, imaging, hypertext, Intranet access, Internet access and modelling (Turban *et al.*, 1999).

The terms 'Executive Information Systems' and 'Executive Support Systems (ESS)' are sometimes used interchangeably (Turban *et al.*, 1999). However, ESS usually refers to a system with a more extensive set of capabilities than an EIS (Mallach, 1994). Watson *et al.* (1991) and Rainer and Watson (1995a) report that these capabilities include the provision of data analysis capabilities (*eg.* spreadsheets, query languages and DSS) and the provision of organisation tools (*eg.* electronic calendars, personal information filing and management) (Beheshti, 1995). Expert practitioners state that ESS applications are high-risk, high-return projects (Heinrichs, 2001). Kuo (1998) proposes an ecological model of managerial intuition for the purpose of developing effective ESS. Turban *et al.* (1999) define ESS as 'a comprehensive support system that goes beyond EIS to include analysis support, communications, office automation, and intelligence'.

Other titles for EIS are 'Everyone's Information System' (Wheeler *et al.*, 1993), 'everyone information system' (Frolick and Robichaux, 1995), 'enterprise-wide' EIS (Frolick and Robichaux, 1995) and 'Enterprise Information Systems' (Cook, 1996; Post and Anderson, 1997; O'Brien, 1999). O'Brien (1999) states that (the evolution of various) names reflect the fact that more features, such as Web browsing, electronic mail and groupware tools, are being added to many systems to make them more useful to executive managers. Turban *et al.* (1999) report that sometimes where EIS applications embrace a range of products targeted to support professional decision-makers throughout the organisation, the term 'Everybody's Information System' is used. For the purposes of this dissertation the acronym EIS shall mean **Executive Information Systems**.

Some studies suggest that EIS should not only be accessed by executive users (see, for example, Hasan, 1995; Volonino *et al.*, 1995; Rai and Bajwa, 1997). These researchers suggest that EIS should be viewed as technology to be used to solve major business problems arising from global competitive and recessionary forces. Salmeron (2001) notes EIS as the technology for information delivery for all business end-users. Kennedy (1995) and Messina and Sanjay (1995) report that EIS have spread throughout organisations (see further discussion in Section 3.5.4). The non executive users or data providers include personnel from functional areas which include treasurers, accounting managers and controllers. It is evident that EIS requires continuous input from three different stakeholder groups (known as constituencies):

- EIS executives/users;
- EIS providers (*ie.* persons responsible for developing and maintaining the EIS);
and
- EIS vendors or consultants. These constituencies will be used in the author's data sampling (see Section 5.4.1).

This multiple constituency approach has been used to investigate other types of IS (see, for example, Hamilton and Chervany, 1981; Alavi, 1982; Hogue and Watson, 1985; Watson *et al.*, 1987). Rainer and Watson (1995b) suggest that these three EIS stakeholder groups may have different ideas on factors affecting successful EIS development and operation.

EIS flexibility should be considered in the development of an EIS in an organisation (Srivihok, 1998). Salmeron (2001) reports that if this were not so, EIS would soon become a useless tool which would only deal with outdated problems and would therefore not contribute to decision-making. EIS should be flexible to support different classes of business data (*eg.* external, internal, structured and unstructured) and different levels of users (*eg.* executives and non executive users). Turban *et al.* (1999) report that two types of EIS can be distinguished: (1) one designed especially to support top executives; and (2) EIS that is intended to serve a wider community of users.

Realising the benefits from EIS, these users become the driving force behind EIS development and implementation (Messina and Sanjay, 1995). Frolick (1994) suggests a trend for EIS toward MSS by combining the original EIS and analytical capabilities of office automation systems.

With the emergence of global IT, existing paradigms are being altered which are spawning new considerations for successful IT implementation (Averweg and Erwin, 2000). Web-based technologies are causing a revisit to existing IT implementation models, including EIS. The Web is 'a perfect medium' for deploying decision support and EIS capabilities on a global basis (Turban *et al.*, 1999). Web technologies allow integration of information via Web sites which can be linked to corporate databases to provide real-time access to information (Looney and Chatterjee, 2002).

Business Intelligence (BI) is a process for the collection of information on markets, new technologies, customers, competitors and broad social trends (Strydom, 1994). It is one of the more popular new types of data analysis software (Ross, 2001). BI from the Internet has proven a useful and timely source of industry news (Wreden, 1997a). Many organisations still experience trouble in extracting timely, business-critical information from their legacy systems (Bajgoric, 2000). BI applications (*eg.* enterprise-wide DSS, data warehousing, OLAP systems) may be of significant help in providing useful information to end-users. These tools extract and analyse data from a host of enterprise-wide systems and enterprise resource planning systems (ERP) (Glass, 1998) and then present the information to busy executives in a graphical, easy-to-understand format. Many tools are being developed to be Web-ready so that OLAP on

the data from the data warehouse can be directly tapped into via the corporate network (Turban and Aronson, 1998).

All major ERP vendors use BI to differentiate themselves offering features such as OLAP, sophisticated reporting and data warehousing (PriceWaterhouseCoopers, 2000). The browser-based access to BI systems (eg. DSS, EIS, data warehousing) is most important for decision-makers because of its ease of use eg. COGNOS Impromptu Web Reports® (see Internet Uniform Resource Locator (URL) <http://www.cognos.com>) delivers reporting facilities over the Web, providing end-users with quick and easy access to the latest company reports directly from their Web browser. Brio.Portal® from Brio Technology (see Internet URL <http://www.brio.com>) is another example of integrated BI software capable of retrieving, analysing and reporting information over the Internet. For a detailed discussion of the different features of four BI software packages (Brio.Enterprise 6.2.2®, Cognos Business Intelligence Platform®, Crystal Enterprise 8.0® and MicroStrategy 7®), see Ross (2001). For a discussion of Fingerhut BI® (for building statistical models to predict consumer behaviour), see Apte *et al.* (2001). Turban (2001) suggests that nowadays EIS capabilities are being 'embedded in BI'. As commercial EIS software improves, top executives must utilise this software technology for strategic decision-making and managing daily business activities in order to remain competitive (Nord and Nord, 1995). For example, Oracle Balanced Scorecard® is a BI application that allows executives and other business professionals to monitor the performance of strategic objectives of the organisation (Ashley and Desmond, 2002).

ERP systems are software solutions, typically provided by a vendor as a package, that provide seamless integration of all information flowing through an organisation: financial, accounting, human resources, supply chain and customer information (Davenport, 1998). Examples of commercial ERP systems include SAP®, BAAN®, PeopleSoft®, J.D. Edwards® and Oracle® (Baskerville *et al.*, 2000; PriceWaterhouseCoopers, 2000). COGNOS® claims to be the leading vendor of enterprise BI solutions (COGNOSuite, 1999). For example, the COGNOS Enterprise Business Intelligence® product allows an organisation to lever Extranet technology (see Section 3.4.1) to satisfy a 'customers heightened expectations' by 'tapping into departmental databases, vendor databases, Web servers' and legacy systems and 'transforming data into meaningful information that meets the unique access, analysis and reporting needs of people

across every area of the organisation (Cognos, 2000). BI is the ability of a computer-based IS to quickly provide answers to questions posed by managers about the current status of the business and economic trends (Turban and Aronson, 1998). BI and ERP software will be discussed in Section 4.2.

EIS are useful in identifying problems and opportunities. Such identification can be facilitated by an intelligent component (see discussion in Section 3.4). For example, using software agents, software vendor Comshare Inc is able to automate several tasks of an EIS. Comshare's software filters through databases or other electronic sources and gleans important, relevant information for executives. The information is delivered in a form that is actionable. There are many software vendors providing EIS/DSS integration tools (Turban *et al.*, 1999). Almost all vendors of EIS software are able to claim that they are OLAP compliant (Codd *et al.*, 1993).

In summary, four major IT have been successfully used to support managers. Collectively they are referred to as management support systems (Turban and Aronson, 1998). The four major technologies are as follows:

- DSS, which have been in use since the mid-1970s, provide support primarily to analytical, quantitative types of decisions;
- EIS is a technology developed in the mid-eighties, mainly to support the informational roles of executives. This technology is the focus of this dissertation;
- groupware (which refers to software products that support supports managers collaborating and working in groups). See discussion in Section 3.4; and
- intelligent systems (which refers to the various commercial applications of artificial intelligence).

These technologies can be used independently (or they can be combined) each providing a different capability (Turban *et al.*, 1999). As support for decision-making has evolved, decision-making support has become more comprehensive and integrated (Forgionne *et al.*, 2003). Since specific organisational environments and general technologies change over time, organisations need new systems (or major revisions) to existing systems to continue to meet their objectives. Hence systems development is an ongoing process in all organisations which use it.

2.4 Development of Decision Support System and Executive Information System

The Systems Development Life Cycle (SDLC) is a logical process by which systems analysts, software engineers, programmers and end-users build IS and computer applications to solve business problems and needs (Whitten and Bentley, 1998). According to Sommerville (1992) the SDLC approach includes:

- requirement analysis and definition;
- system software design;
- implementation and unit testing; and
- integration and system testing.

The SDLC is commonly used in traditional IS (eg. inventory and payroll TPS). However, it has been criticised in that the model is rigid and inflexible (Rockart and DeLong, 1988; Elliot, 1989; Turban, 1995). There are numerous factors involved in the development of these systems which include volumes of input and output, activity levels, file sizes, number of users who interact with the systems and the nature of tasks. A small change in the process involved in traditional systems may have wide repercussions (Sommerville, 1992; Turban, 1995). Traditional IS development sees frequent requirement changes as a major problem (Avison and Fitzgerald, 1988). As a result the majority of SDLC process are applied to systems which are neither flexible nor changeable (Srivihok, 1998). These characteristics are contrary to the characteristics of DSS and EIS which require systems to be flexible and adaptable (Carlsson and Widmeyer, 1990). System use is not normally considered as part of IS development. However, in DSS and EIS, *system use* is integral to the evolutionary process (Monash University, 1996). An EIS can be 'fairly regarded as a special kind of DSS' (Holsapple and Whinston, 1996).

The very nature of DSS requires a different design technique from that for conventional systems (Ahituv and Neumann, 1990). Ahituv and Neumann (1990) report that most traditional system analysis and design approaches are based on the assumption that the computerised system will have a well-defined process. However, by their very nature, DSS need to be independent of any imposed process because different decision-makers approach problem in different ways. One approach, known as the 'adaptive design' approach and advocated by Keen and Gambio (1983), assumes that a 'relatively' final system must evolve through usage and learning. This approach will be further discussed in the next section.

2.4.1 Decision Support System Development

An important key to the success of IT is its ability to provide users with the *right information* at the *right time* (Turban *et al.*, 1999). However, identifying the information needs of managers is not a simple task. Several approaches are available. One such approach, as developed by Wetherbe (1991) consists of a two-phase process. During Phase 1, a *structured interview* is conducted to determine managers' perceived information needs. During Phase 2, a *prototype* of the system is rapidly constructed. Prototyping is a development technique and evolutionary development is a philosophy (Monash University, 1996). This prototype system is shown to the managers who make suggestions for improvement. This iterative process continues until the detailed requirements are established. The *sources* of information are then identified and the system can be developed. If the EIS is well designed and developed with a high quality tool, the prototype can be converted to become a working EIS (Avison and Fitzgerald, 1988; Runge, 1989). The speed in developing a prototype is critical to EIS success (Bussen and Myers, 1997).

DSS development is different from the majority of traditional IS in the constraints of flexibility and changeability (Hurst *et al.*, 1983; Millet and Mawhinney, 1992; Turban, 1995). This makes the systems requirements definition of DSS very difficult. Traditional systems such as TPS, usually emphasise efficiency and developers avoid changing these systems as they process a large volume of transactions (Turban, 1995).

The commonly accepted DSS development principle is 'adaptive design'. It is summarised by Keen and Gambio (1983) as a 'development strategy applicable only to situations where the final system cannot be predefined. This has substantial implications for the choice of a design architecture and an implementation strategy. The DSS must evolve through the interactions of user, system and designer'.

The DSS development approach is a cyclical methodology where four traditional system development processes (requirements analysis, design, development and implementation) are combined in one single phase (Sprague, 1980). Ahituv and Neumann (1990) describe the adaptive design approach in developing a DSS involves the following:

- finding out quickly what is essential for users;
- providing a prototype which users can test;
- defining a clear architecture for a DSS;
- paying more attention to the user-DSS dialogue;
- emphasising system quality for user learning such as system evolution and DSS flexibility; and
- emphasising beginning rather than ending.

The development of DSS emphasises the effectiveness, flexibility and changeability of the system. The adaptive design framework for DSS describes the relationships between components of the development process (Keen and Gambino, 1993). This framework provides a background to the relationships between EIS components leading to their success, as discussed in Section 2.5.2.1.

2.4.2 Executive Information System Development

Decision-making is recognised as one of the most important roles of executives (Leidner and Elam, 1993). Executives are facing a business environment characterised by escalating complexity and turbulence.

Complexity generally refers to a large number of variables (many of which are perceived to be uncontrollable) making up a system. Complexity is defined as ‘the degree to which an innovation is perceived as relatively difficult to understand and use’ (Thompson *et al.*, 1991). Perceived complexity is the opposite of Perceived Ease of Use in Davis’ (Davis, 1989) TAM and on Internet usage specifically (Cheung *et al.*, 2000). The effect of complexity on the adoption of an innovation has been extensively investigated in adoption research in other areas based on Rogers’ (Rogers, 1995) model of adoption of innovations. In general, complexity is found to have a negative impact on the adoption of IT (Thompson *et al.*, 1991; Igarria *et al.*, 1995b; Teo *et al.*, 1999). Based on the above studies and for the purposes of this dissertation, the author contends that high complexity requires top managers (executives) to consider a large number of factors from various segments (*eg.* competitive, economic, political, global) to make decisions.

Turbulence implies complexity with a high degree of change or dynamism added. Ansoff and McDonnell (1990) suggest that four characteristics contribute to the turbulence of the environment: (1) complexity (the variety of factors that management must consider when making decisions); (2) novelty (the discontinuity of successive challenges that an organisation encounters in the environment); (3) rapidity of change (the ratio of the speed of evolution of changes to the speed of the organisation's change); and (4) visibility of the future (the predictability of information about the future, available at the decision time). The characteristics of information in a turbulent environment are complicated, novel, dynamic or ambiguous (Wang and Chan, 1995).

Forsdick (1995) found that the overwhelming consensus of executives surveyed was that complexity implied a lack of understanding of the factors impacting on their organisations and that complexity was increasing over time. Forsdick (1995) reports that approximately half the respondents saw turbulence as referring to the rate of change in uncontrollable external variables. Despite the availability of comprehensive reports and databases, executives take decisions based on their interactions with others who they think are knowledgeable about issues (Malhotra, 2001). Salmeron (2001) reports that 'it is surprising that external information is so seldom included in Spain' for tactical decision-making or strategic decisions. This can be possibly accounted for by the fact that most large Spanish organisations which have implemented EIS, are first-generation EIS (Salmeron, 2001). The external environment has been found to be an important predictor of EIS use (Watson *et al.*, 1991). Executives need information from outside the organisation 'about facts and things happening in their external environment' (Müller *et al.*, 1997).

This is the current business context in which organisations and those who manage them must operate. Clearly in this environment various needs exist for different methods of IS requirements analysis to support executive decision-making. However, executives often have little time articulating their information needs (Pervan and Phua, 1997) and there is the common problem of keeping abreast of executives' changing information requirements (Watson *et al.*, 1995b).

EIS development in organisations usually follows an evolving (or adaptive) approach instead of the traditional linear SDLC (Houdeshel and Watson, 1987; Fitzgerald, 1993; Watson *et al.*, 1995b; Monash University, 1996). It is a process often reported in DSS development (Srivihok, 1998). The initial application of the EIS should be small so that EIS developers can deliver a system quickly (Barrow, 1990; Watson *et al.*, 1992; Fitzgerald, 1993). A portion of the EIS is quickly constructed, then tested, improved and enlarged in steps (Watson *et al.*, 1995b). Watson *et al.* (1995b) indicate that what makes EIS development particularly interesting and challenging is the unique combination of considerations that affect the effort. They suggest three factors which are particularly relevant:

- an organisation's senior executives are seldom hands-on computer users as they 'probably are of an age to have missed the computer revolution' and may question the need for them now. The author suggests that executive personal variables (*eg.* values, intelligence, skills, knowledge, situational pressures and priorities) should also be included;
- executives perform highly unstructured work that is difficult for them to describe with sufficient precision to identify information requirements. Defining executives' information requirements is difficult (Zairi *et al.*, 1998); and
- an EIS is typically a new type of application for systems analysts and often requires learning and using new technology and understanding managerial work. It is suggested by the author that 'new technology' includes Web-based technologies.

It is evident that EIS development is a complex task. It requires a large investment of time and money (Beheshti, 1995). To ensure a minimal risk of failure, there should be an awareness of the various factors that could potentially affect the success of system (Kaniclides and Kimble, 1994). Kaniclides and Kimble (1994) suggest that the most effective way to gain such an awareness, is by having a structured approach to facilitate the study of these factors. This is undertaken by the construction of a suitable development framework for the classification of relevant issues. A development framework is helpful in organising a complex subjective issue, identifying the relationships between the parts and revealing the areas in which further developments will be required (Sprague, 1980).

There are a number of studies which have identified approaches towards EIS development (see, for example, Millet *et al.*, 1991; Watson *et al.*, 1991; Byun and Suh, 1994; Monash University, 1996). Kaniclides and Kimble (1994) undertook a comparison of some EIS development frameworks and identified the deficiencies and strengths of each. From their comparisons of the frameworks and analysis, they report 'the deficiencies of each framework with respect to the presentation of EISs (*sic*) development and EISs (*sic*) use'. Kaniclides and Kimble (1994) propose an alternative development and use framework which overcomes these shortcomings. Their framework is known as the PAS framework (PAS is an acronym for People, Activities and Systems). It will be used in this dissertation and the framework is discussed in Section 2.5.2.3. More understanding of EIS development frameworks is needed (Srivihok, 1998). Factors which influence the development and use of EIS should be identified.

Evaluating the success of a system is a complex responsibility (Garrity and Sanders, 1998). Garrity and Sanders (1998) note that a system may be successful on one or more dimensions and that the dimensions of success are interdependent. IS success measurement will now be discussed.

2.5 Information System Success Measurement

A number of possible indicators for a successful IS have been suggested in various implementation studies. See, for example, Laudon and Laudon (1998). One purpose of IS success measurement is to improve the performance and productivity of the system (Ives *et al.*, 1983; Ferguson and Zawacki, 1993). Improving the quality of IS in organisations can provide advantages over competitors, a valuable contribution to the business units of the organisation and services to meet the needs of the organisation (Ferguson and Zawacki, 1993).

The difficulties in measuring system success are noted by Zmud (1979). Zmud (1979) states that 'Evaluation of MIS success is a complex and perplexing issue. While it is easiest to simply examine actual usage, success ultimately depends on how well the MIS has, in fact, supported decision making'. The measurement of system success is complicated as it is a multi-dimensional construct (Srivihok, 1998). There is no single measure of IS success (DeLone and McLean, 1992). Laudon and Laudon (1998) suggest the following measures of IS success are considered the most important:

- **High levels of System Use.** This is measured by polling users or employing questionnaires. This measure will be used in this dissertation;
- **User Satisfaction with the System.** This is measured by interviews or questionnaires and may include users' opinions on the accuracy, timeliness and relevance of information. Especially critical are managers' attitudes on how well their information needs were satisfied (Ives *et al.*, 1983; Westcott, 1985) and users' opinions regarding how well the system enhanced their job performance (Davis, 1989);
- **Favourable Attitudes.** This relates to users regarding IS and IS staff;
- **Achieved Objectives.** This is the extent to which the system meets its specified goals as reflected by improved organisational performance and decision-making resulting from use of the system; and
- **Financial Payoff.** This is achieved by either reducing costs or by increasing sales or profits to the organisation. This measure is considered to be of 'limited value' as the benefits of an IS may not be totally quantifiable (Laudon and Laudon, 1998). IS researchers prefer to concentrate on the human and organisational measures of system success as information quality, system quality and the impact of systems on organisational performance (Lucas, 1981; DeLone and McLean, 1992).

There has been limited research reported on EIS implementation success measurements or their surrogates (see, for example, Belcher and Watson, 1993; Bergeron *et al.*, 1995; Watson *et al.*, 1995a). In this dissertation IS success and how the concept may be applied to EIS provide a background for the various surrogates measure for EIS implementation success. This will be discussed in the next section with the emphasis on the EIS usage measure.

2.5.1 Studies of Information System Success Measurements

IS success can be measured at multiple levels of analysis (Garrity and Sanders, 1998). At the organisational level, IS success is measured using metrics related to organisational performance (*eg.* how a system contributes to profitability and return on investment). Garrity and Sanders (1998) state that at the process or function level, systems success is measured in terms of the efficient use of resources and the reduction of process cycle times. The focus of IS success at the individual level of analysis is on the users' perception of utility and satisfaction.

Empirical research into the successful development of IS has been filled with difficulties. The many well-publicised IS failures and the paradox of high investment and low productivity returns has brought issues of success causes and success measurement to the fore (Ballantine *et al.*, 1998). Ballantine *et al.* (1998) report that predicated upon success not being a random variable, a number of models which attempt to delineate success and success causes have been proposed. One of the more complete and better known models was developed by DeLone and McLean (1992). It is the most cited model of IS success measurement (Srivihok, 1998) and will be discussed next.

The DeLone and McLean Model

DeLone and McLean’s model of IS success is based on the work of Shannon and Weaver (1949) and Mason (1978) in conjunction with a study of 180 published papers which address the issue of IS success. The DeLone and McLean model of IS system success (see Figure 2.1) proposes six main dimensions of IS success: system quality, information quality, **system use**, user satisfaction, individual impact and organisational impact (bold style added by author). The model has been used as a basis for empirical research and has been refined and extended by a number of researchers (Pitt *et al.*, 1995; Wilkin and Hewett, 1999; Roldán and Millán, 2000; McGill *et al.*, 2003) but this discussion is not within the scope of this dissertation. In Section 4.4, the model and its applicability to EIS will be reviewed.

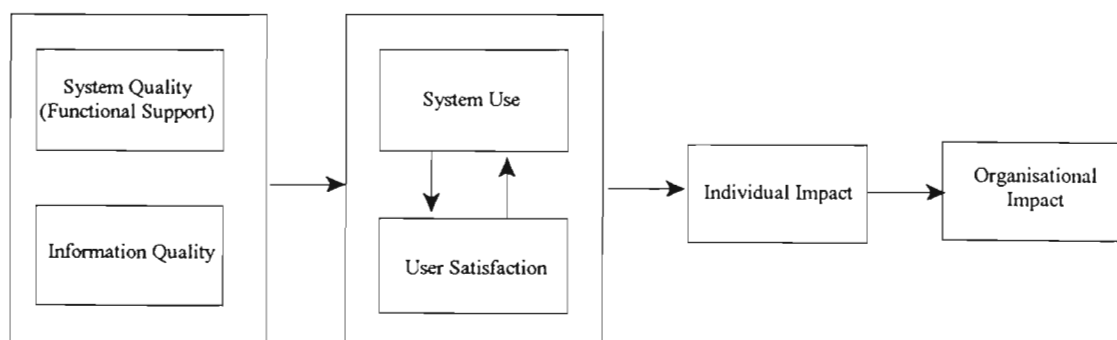


Figure 2.1 The DeLone and McLean Model of Information System Success
(Source: Adapted from DeLone and McLean, 1992)

Each of the six dimensions of IS success from the DeLone and McLean Model (Figure 2.1) will now be discussed.

The DeLone and McLean Model: System quality

System quality is the measure of the information processing system itself (DeLone and McLean, 1992; Myers *et al.*, 1998). This assessment is based on the performance and productivity of the system (Srivihok, 1998). The empirical studies of IS reflect the measures of system quality as flexibility of the system (Bailey and Pearson, 1983); ease of use and learning (Belardo *et al.*, 1982; Bailey and Pearson, 1983; Volonino and Robinson, 1991), response time (Belardo *et al.*, 1982; Bailey and Pearson, 1983; Srinivisan, 1985), simplicity (Barrow, 1990; Whymark, 1991b; Meneely and Pervan, 1994; Rainer and Watson, 1995b), timeliness (Bergeron *et al.*, 1995), system reliability (Belardo *et al.*, 1982; Srinivisan, 1985) and perceived usefulness (Franz and Robey, 1986). Rainer and Watson (1995a) also examined ease of use and the presence of specific functions of the system as measures of system quality in their study of EIS.

The DeLone and McLean Model: Information quality

Information quality is the measure of output from IS (DeLone and McLean, 1992). The information characteristics used in earlier empirical studies are accuracy (Bailey and Pearson, 1983; Srinivisan, 1985; Sääksjärvi and Talvinen, 1993; Rainer and Watson, 1995a), currency (Bailey and Pearson, 1983; King and Epstein, 1983), timeliness (Bailey and Pearson, 1983; King and Epstein, 1983; Srinivisan, 1985; Rainer and Watson, 1995a), reliability and relevance (Bailey and Pearson, 1983; King and Epstein, 1983; Rainer and Watson, 1995a; Srinivisan, 1985). Srivihok (1998) notes that information quality is commonly used in the measure of system success.

The DeLone and McLean Model: System Use

Use or system use refers to recipient consumption of an IS (DeLone and McLean, 1992). Earlier studies proposed system usage as a measurement of IS success (see, for example, Fuerst and Cheney, 1982; Srinivisan, 1985; Udo, 1992). It is the method of assessment most used (DeLone and McLean, 1992).

IS can improve the quality and productivity of individuals, groups and organisations only if they are actually used (Myers *et al.*, 1998). DeLone and McLean (1992) cite a lengthy list of IS use studies. Markus and Keil (1994) suggest that organisations should approach system development as business process engineering (BPR) and ensure that implementability (or use)

is built in (for a discussion of BPR, see, for example, Hammer and Champy, 1993; Larsen and Myers, 1997). Rather than develop an IS to solve organisational problems and mandate its use, Markus and Kiel (1994) argue that system use is inevitable when the interests of developers and users are aligned and good system design concepts which are jointly developed by users and developers are used. User involvement in the design of EIS brings about realistic expectations of system capabilities and decreases the risk of failure (Salmeron, 2001).

Conceptually, system usage is easy to measure (Ishman, 1998). However, in terms of actual measurement, some important issues should be considered. For example, whether direct usage or usage through others (chauffeured usage) is being measured, whether one uses a self-reporting or actual usage approach and whether the measurement should be based on the frequency of use or the actual amount of time spent using the system (DeLone and McLean, 1992; Szajna, 1993). For the purposes of this dissertation the following measures will be used: direct usage, self reporting and frequency of use. System usage is objective and convenient to measure and assess (Srivihok, 1998). In this research usage is used as *the* measure of EIS implementation success.

The DeLone and McLean Model: User satisfaction

User satisfaction is defined as the users' response to the use of the output of an IS (DeLone and McLean, 1992). User satisfaction is the psychological state after the use of an IS (Srivihok, 1998). Satisfaction is due to the successful interaction between the IS and the user(s). Ishman (1998) notes that user satisfaction refers to the positive affective orientation that an individual has toward an IS. While user satisfaction has been widely used as a single measure of success (see, for example, Bailey and Pearson, 1983; Ives *et al.*, 1983; Baroudi and Orlikowski, 1988), Myers *et al.* (1998) suggest that 'the reliable measurement of user satisfaction requires further study'. Conrath and Mignen (1990) found that even though the literature extols the measurement of user satisfaction, very few are actually using it. Ballantine *et al.* (1998) note that it is difficult in practice to truly obtain an 'objective measure of user satisfaction reflecting success, as user satisfaction itself is intrinsically dependent on; for example, information quality and system quality, which in turn, is dependent on user participation and identification of user needs'. For these reasons, user satisfaction is not used as a measure of EIS implementation success in this research. For a critical review of research in end-user satisfaction, see, for example, Au *et al.* (2002).

The DeLone and McLean Model: Individual impact

Individual impact is the effect the information has on the behaviour of the users including improving personal or departmental performance (DeLone and McLean, 1992). This impact occurs when the information is received and understood by the users and applied to their jobs (Srivihok, 1998). It results in decisions being made (Mason, 1978).

Studies have measured the impact of IS on decision effectiveness or improving decision-making productivity of the users (see, for example, Fuerst and Cheney, 1982; Sanders and Courtney, 1985; Bergeron, 1986; Forgionne and Kohli, 2000). While this measurement of IS success is commonly used in laboratory experiments, it has seldom been used in field studies (Srivihok, 1998). Furthermore it has been claimed that 'impact' may be one of the most difficult surrogate measures to define in an unambiguous way (DeLone and McLean, 1992). The disadvantages of this measurement make it unsuitable as a surrogate of EIS implementation success measurement.

The DeLone and McLean Model: Organisational impact

Organisational impact refers to the effect of information on organisational performance (DeLone and McLean, 1992). Some researchers tend to avoid organisation performance measurements (Srivihok, 1998). Srivihok (1998) suggests that this is due to the complexities in separating the effect of the IS from other effects which influence organisational performance.

Studies of the effect of IS on organisational performance mostly include revenue and cost issues and especially cost/benefit analyses (Srivihok, 1998). Barua *et al.* (1995) report that the most significant contributions of IT investments occur at low organisational levels where they are implemented. Barua *et al.* (1995) also confirm that the intermediate level contributions positively affect performance measures such as return on assets and market share. However, cost/benefit analyses are often found to be lacking due to the difficulty of quantifying the EIS project in monetary value (Srivihok, 1998). It is not easy to place a monetary value on the ability to make better decisions (Strydom, 1994). There may be some tangible and intangible benefits that may not lend themselves to identification and calculation of analyses (Ives and Olson, 1984). Consequently, due to the difficulties in quantifying cost/benefit of an EIS in an organisation, this measure is not used in this research.

Other models of IS success have been proposed. See, for example, IS success models by Garrity and Sanders (Garrity and Sanders, 1998) and Davis (1989) which are widely cited in the literature. These models will be discussed in Section 4.4.

This literature review in Section 2.5.1 is valuable for an understanding of IS success. However, some limitations should be noted. For example, research by Zmud (1979) and Ives and Olson (1984) concentrates on investigating independent variables (individual difference (Zmud) and user involvement (Ives and Olson)) rather than on investigating the dependent variable (IS success). As IS success is a theme in this dissertation, EIS implementation success measures will be discussed in the next section.

User perceptions of IS success play a significant role in the user developed application domain (McGill *et al.*, 2003). It is evident that EIS success depends on how well the implementation process is managed in terms of technology and the users. When an EIS fails the cause is probably its inability to meet user expectations (Szajna and Scamell, 1993). As has been evidenced in the literature factors during the development process and especially during the use of the system can affect its eventual success. To study these factors an examination of EIS use separately from the rest of the development cycle needs to be undertaken (Kaniclides and Kimble, 1994). Kaniclides and Kimble (1994) indicate that to achieve this effectively a structured framework is needed which classifies the various components involved and highlights the relations between them. A discussion of the PAS framework will be made in Section 2.5.2.3.

2.5.2 Studies of Executive Information System Implementation Success Measures
Successful project implementation is complex and difficult (Schutte, 2000). Many researchers have identified key variables purported to affect EIS success (Rainer and Watson, 1995a). Some South African research on success factors for EIS implementation has been conducted (see, for example, Chilwane, 1995; Steer, 1995). However, no comprehensive single listing of key variables has appeared in the literature (Rainer and Watson, 1995a). Despite this shortcoming Table 2.2 reflects twenty-three EIS success factors which have been reported in the international literature which contribute to successful EIS implementation.

Table 2.2 EIS Success Factors and Source(s) of Studies
(Source: Adapted from Srivihok, 1998)

| EIS Success Factor | Source(s) of Studies |
|---|--|
| Appropriate hardware technology | Rockart and DeLong (1988); Guiden and Ewers (1989); Cottrell and Rapley (1991); Pervan (1992); Rainer and Watson (1995a, 1995b); Pervan and Phua (1997); Poon and Wagner (2001) |
| Appropriate software technology | Rockart and DeLong (1988); Guiden and Ewers (1989); Cottrell and Rapley (1991); Pervan (1992); Rainer and Watson (1995a, 1995b); Bussen and Myers (1997); Poon and Wagner (2001) |
| Business and Communications Skills of EIS Staff | DeLong and Rockart (1986a); Guiden and Ewers (1989); Armstrong (1990); Barrow (1990); Houdeshel (1990); Glover <i>et al.</i> (1992); Nandhakumar (1996b); Overton <i>et al.</i> (1996); Whymark (1991a); Allison (1996) |
| Deliver first version quickly | Rainer and Watson (1995a); Young and Watson (1995); Poon and Wagner (2001) |
| Evolutionary development approach | Fitzgerald (1993); Houdeshel and Watson (1987); Watson <i>et al.</i> (1995b); Pervan and Phua (1997); Poon and Wagner (2001) |
| EIS quality | Barrow (1990); Whymark (1991a); Bergeron and Raymond (1992); Glover <i>et al.</i> (1992); Meneely and Pervan (1994); Pervan and Meneely (1995); Rainer and Watson (1995b) |
| EIS support team | Bergeron <i>et al.</i> (1995); Pervan and Meneely (1995); Rainer and Watson (1995b) |
| EIS usage | Watson and Glover (1989); Glover <i>et al.</i> (1992); Leidner and Elam (1993); Elam and Leidner (1995); Thodenius (1995); Pervan and Phua (1997); Walstrom and Wilson (1997); Poon and Wagner (2001) |
| Executive participation on information analysis | Meneely and Pervan (1994); Pervan and Meneely (1995); Whymark (1991a) |
| Executive sponsorship | Houdeshel and Watson (1987); Rockart and DeLong (1988); Barrow (1990); Fitzgerald (1993); Pervan and Meneely (1995); Rainer and Watson (1995a); Bussen and Myers (1997); Poon and Wagner (2001); Salmeron (2001) |
| Existing operating sponsor | DeLong and Rockart (1986a); Thierauf (1991); Watson <i>et al.</i> (1991); Overton <i>et al.</i> (1996); Poon and Wagner (2001) |
| Identifying information requirements | Houdeshel and Watson (1987); Evans <i>et al.</i> (1989); Houdeshel (1990); Volonino and Watson (1991); Emery (1991); Volonino and Robinson (1991); Whymark (1991b); Armstrong (1990); Watson and Frolick (1992); Frolick (1994); Meneely and Pervan (1994); Bussen and Myers (1997); Pervan and Phua (1997); Poon and Wagner (2001); Salmeron (2001) |
| Initiation by executive sponsor | Barrow (1990); Watson <i>et al.</i> (1991); Meneely and Pervan (1994) |
| IS department management support | Fitzgerald (1993); Bajwa and Rai (1994); Fitzgerald and Murphy (1994); Poon and Wagner (2001) |
| Linking to business objectives | Houdeshel and Watson (1987); Rockart and DeLong (1988); Tang (1991); Fitzgerald (1993); Pervan and Meneely (1995); Rainer and Watson (1995b); Nandhakumar (1996b); Bussen and Myers (1997); Poon and Wagner (2001) |
| Managing data | Rockart and DeLong (1986a); Pervan and Meneely (1995); Rainer and Watson (1995b); Thodenius (1995); Poon and Wagner (2001) |
| Managing user expectations | Rainer and Watson (1995b) |
| Managing political resistance | DeLong and Rockart (1986a); Whymark (1991b); Rainer and Watson (1995b); Poon and Wagner (2001) |
| Planning for system development and spread | DeLong and Rockart (1986a); Houdeshel and Watson (1987); Barrow (1990); Volonino and Watson (1991); Rainer and Watson (1995b) |
| Prototyping approach | Evans <i>et al.</i> (1989); Armstrong (1990); Barrow (1990); Volonino and Watson (1991); Emery (1991); Holland (1991); Thierauf (1991); Volonino and Robinson (1991); Whymark (1991a); Jordan (1993); Nandhakumar (1996b); Salmeron (2001) |
| Top management support | Barrow (1990); Bajwa and Rai (1994); Rainer and Watson (1995b); Bajwa <i>et al.</i> (1998) |
| User computer experience | Abdul-Gader (1992); Alavi and Joachimsthaler (1992); Igharia and Iivari (1995); Thong and Yap (1995) |
| Using consultants | Rainer and Watson (1995b); Bajwa <i>et al.</i> (1998); Salmeron (2001) |

The studies reflected in Table 2.2 are valuable despite some weaknesses. Some are merely 'ideas' generated without firm evidence from empirical research (Armstrong, 1990; Watson, 1990). The research methodology applied in these studies has not been systematic. Sometimes studies have relied on a single organisation's experiences (Houdeshel, 1990; Emery, 1991; Evans *et al.*, 1989; Volonino and Robinson, 1991; Nandhakumar, 1996b; Bussen and Myers, 1997). Some studies have used multiple organisations but the data has not been collected systematically enough to facilitate comparisons across organisations (Hasan, 1995). Few researchers in this area applied empirical methods to their studies (Watson *et al.*, 1991; Glover *et al.*, 1992; Bajwa and Rai, 1994; Rainer and Watson, 1995b).

Several studies of EIS consider success factors as independent variables relating to EIS development without recognising their interactions (Srivihok, 1998). Since EIS have not been widely researched empirically, the majority of empirical studies of EIS are only exploratory in nature (Watson *et al.*, 1991; Glover *et al.*, 1992; Rainer *et al.*, 1992; Rainer and Watson, 1995b; Salmeron, 2001) rather than explanatory (Bajwa and Rai, 1994; Bergeron *et al.*, 1995). However, for the purposes of this dissertation, this exploratory-explanatory distinction will not be investigated.

One explanatory study by Bergeron *et al.* (1995) suggests a behaviour model of EIS use. It identifies the relationships of various factors to EIS usage. Srivihok (1998) suggests that the study may have some limitations (*eg.* small sample size, focus groups on only one type of EIS). Notwithstanding these apparent limitations, this model of EIS usage will be further discussed in Chapter 4.

2.5.2.1 The Classification Framework of Executive Information System Success Factors

The factors which affect EIS success may be divided in two categories each associated with one of two phases in the life of an EIS (Rockart and DeLong, 1988; Rainer and Watson, 1995b). The first category comprises factors relating to the development of an EIS *ie.* this phase encompasses the period between the initial request for the development of an EIS and the point when the initial version of the system is delivered to its users. The second category comprises factors relating to the operation of the EIS *ie.* this phase incorporates aspects of the use, maintenance and further expansion of EIS.

Kaniclides and Kimble (1997) indicate that there are three classes of entity during EIS development and operation. Attributes of the elements in each class constitute factors that have an impact on EIS success. These classes are:

- **People.** Many researchers agree that different attributes of the various stakeholder constituencies make up crucial facts which initially determine the success of the implementation process and later the level of success of EIS operation (Canning-McNurlin, 1987; Barrow, 1990; Armstrong, 1992);
- **Activities.** Individuals in the above constituencies are involved in activities which first aim to build a working IS and later to operate, maintain and expand it. Meiklejohn (1989) reports that the manner in which these activities are carried out is affected by organisational contingencies such as structure and culture; and
- **Systems.** System-related issues are important from the user's perspective and have an impact on the success of EIS development: they play a decisive role in the successful operation of an EIS (Watson *et al.*, 1991). The relation of EIS to other systems in the organisation is also important.

The relation of these classes to each phase in the life of an EIS is shown in Table 2.3. This structure provides the conceptual framework on which the classification and ordering of the factors that affect EIS were used in the survey undertaken by Kaniclides and Kimble (1997).

2.5.2.2 Factors Affecting Executive Information System Success: Survey undertaken by Kaniclides and Kimble

The objective of the Kaniclides and Kimble (1997) survey was to investigate the relative importance of factors affecting EIS success in organisations (in the United Kingdom). In particular, Kaniclides and Kimble (1997) aimed to determine the most important factors during EIS implementation and EIS operation in each of the following classes: People, Activities, Systems, Organisational/Cultural factors, Politics and Technical factors. The concept of Critical Success Factors (CSFs) was used by Kaniclides and Kimble (1997) to refer to the most highly rated factors in each category. CSFs are the indispensable business, technology and human factors that help to achieve the desired level of organisational goals (Turban *et al.*, 2000). The use of the CSF term in the context of this dissertation denotes factors which are vital to the success of EIS development and EIS operation. CSFs will be further discussed in Section 2.6.

Kaniclides and Kimble used a Likert-type scale instrument during their survey. In this dissertation, this type of survey instrument will also be used by the author. Table 2.3 shows the CSFs for EIS Development and Operation.

Table 2.3 CSFs for EIS Development and Operation
(Source: Adapted from Kaniclides and Kimble, 1997)

| | EIS Development | EIS Operation |
|-------------------------|---|---|
| People | Executive Sponsor Senior Management Data Providers Executive users Prospective EIS users EIS team | Executive users Executive Sponsor |
| Activities | Manage users' expectations Methodology used/Evolutionary approach Define Information Requirements Training Define Scope of the System | System Maintenance |
| Systems | Prototype development time Balance between foundation laying and flexibility | System Usability <i>Simplicity/Ease of Use</i> <i>System Speed</i> Quality of information System Reliability Satisfaction of user needs System Capabilities Flexibility for Expansion |
| Organisational/Cultural | Support from Top Management Executive Sponsor Support Executive Resistance Executive Culture | Support from Top Management Management of user expectations Executive Resistance Executive Sponsor Support |
| Political | Executive Sponsor Support Support from Top Management | Senior Management Support Executive Sponsor Support |
| Technical | Satisfaction of user needs | System Capabilities |

From this survey, the three most critical factors that affect EIS success in the operational phase were actual attributes of the system. The first was *system usability*, then *system reliability* followed by *quality of information* provided. Kaniclides and Kimble (1997) note that in this phase, the emphasis is upon system **usage** and the characteristics of the system. Kaniclides and Kimble (1997) state '**System use is the most crucial aspect of EIS operation**' (bold style added by author).

2.5.2.3 The People, Activities and Systems (PAS) framework

From the literature, Kaniclides and Kimble (1994) identify frameworks which describe EIS development and use. These frameworks include:

- A structural EIS framework. This framework was developed by Watson *et al.* (1991);

- A path framework for EIS. This framework was developed by Millet *et al.* (1991); and
- A structurational framework. This framework was developed by Orlikowski and Robey (1991).

Kaniclides and Kimble (1994) note that each framework has some deficiencies with respect to describing EIS development and use. For the purposes of this dissertation, these deficiencies are not discussed here. Kaniclides and Kimble (1994) developed an alternative framework (the PAS framework) which overcomes these shortcomings. The PAS framework is an attempt to integrate the advantages in each of the identified frameworks and provide a tool for a coherent classification of the elements involved in developing and using an EIS.

The structural EIS framework (Watson *et al.*, 1991) and path framework for EIS (Millet *et al.*, 1991) are widely cited in the literature. As the PAS framework integrates the advantages in each of the identified frameworks, focuses on EIS use and provides a coherent classification of the elements involved in using an EIS, this forms the justification for using it in this dissertation. The elements of the PAS framework can be summarised in three words: People, Activities and Systems (PAS). These elements comprise the main components of the framework. They are the elements within an organisation which have an effect on and describe EIS development and usage. The relation between the three components is reflected in Figure 2.2.

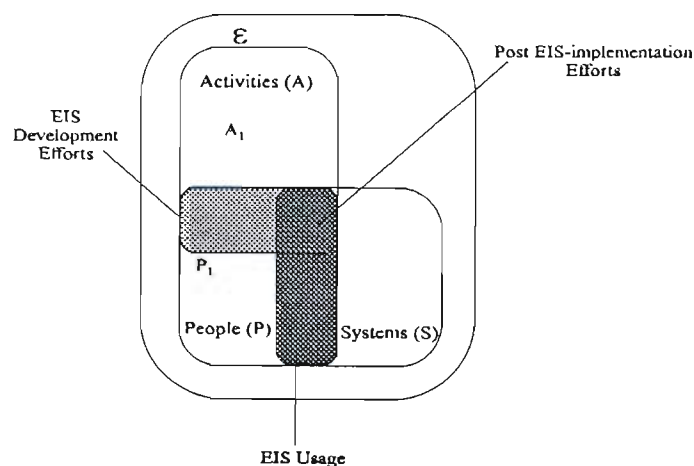


Figure 2.2 The People, Activities and Systems (PAS) framework for EIS development and use
(Source: Adapted from Kaniclides and Kimble, 1994)

People, Activities and System framework: Framework Components

The framework was formulated using set theory but this mathematics will not be discussed in this dissertation. Each of the three main components of the PAS framework are considered to be sets containing elements present in an organisation during systems development. These three sets are:

P = Set of People in an organisation

A = Set of Activities taking place in the organisation

S = Set of Systems present in the organisation.

The universal set is the environment the organisation has to operate in:

ε = Organisational Environment

Each of these three sets is now briefly discussed.

Framework Component 1: People element

The most important component is *People* (Kaniclides and Kimble, 1994). Kaniclides and Kimble (1994) state that during an EIS development project and during its subsequent usage, *People* is the main element that determines the success of the system. Paller and Lasker (1990) note that success does not only depend on people who are involved directly with the system. Other people who are not involved in the system may also be stakeholders in the system's success. It can therefore be assumed that factors such as organisational politics can play an important role in the success of EIS. Nandhakumar (1996a) reports that power relations 'heavily' influence the development of an EIS.

Framework Component 2: Activities element

IS development can be viewed as a project (Kaniclides and Kimble, 1994). Kaniclides and Kimble (1994) note that in order for a project to be completed a set of activities need to be undertaken. The second part of the framework includes *activities* or procedures that typically take place in an organisation. Using the same rationale as for People involved with EIS, there are activities that might be directed specifically towards EIS development and others which occur in the organisation but affect EIS development indirectly. Nandhakumar (1996b) supports this viewpoint by stating that the development and evaluation of EIS was found to be

embedded in ongoing organisational practices *ie.* the 'developed practices were fitted into, and interwoven with, the streams of other activities'.

Framework Component 3: Systems element

The third main element of the framework is *Systems*. Kaniclides and Kimble (1994) note that this comprises any IS that the organisation employs to carry out its operation. As noted by Millet *et al.* (1991), this element of EIS is important since the installation of EIS is usually a transition from other forms of MIS. The existing infrastructure may place limitations and constraints on EIS and influence the success by which these systems are employed.

Features of the PAS framework

Factors which could potentially affect EIS success to the development and usage of EIS can be classified to the three components of the PAS framework. Each area of interest is illustrated by a shaded region in Figure 2.2 (p.38).

Executive Information System Development Effort

EIS development can be viewed as a project. This implies that a set of activities are undertaken by people using resources to reach the goal of the project, which in this case is the development of an EIS. The intersection between People and Activities (illustrated by the shaded area), represents development efforts. People actively involved in EIS development are within this shaded area. Other people may not be involved in development but may influence the successful development of the EIS are reflected in the area labelled P_1 in Figure 2.2 (p.38) of the model. Similarly, activities directed towards EIS development are within the shaded area. Other activities which could affect the success of the system are found in the area labelled A_1 . People, activities and other factors which could also affect the development process (and therefore the success of the system) are not restricted within the organisation. These could originate in the environment in which the organisation has to operate (Kaniclides and Kimble, 1994).

Executive Information System Usage

The context for the various issues relating to the use of an EIS is reflected by the shaded area represented by the intersection between People and Systems. It is assumed that this can only take place after an IS has been developed in the organisation. Kaniclides and Kimble (1994)

note that while the time dimension is not shown on the diagram of the framework, it is assumed to be present. Successful EIS usage could therefore be influenced by people that are not users of the system and various attributes of other systems that the EIS may rely on for input of data. Cottrell and Rapley (1991) note that a measure of success for an EIS is not the amount of hands-on it receives but whether the important information in the EIS is being communicated to key executives and being used by them to influence business decisions. The construction of the framework implies that the use of the EIS could also be affected by other factors external to the organisation (Kaniclides and Kimble, 1994). One such factor could be the emergence of Web-based technologies.

Post Implementation Effort

The intersection between People, Activities and Systems reflects development efforts directed towards the expansion and enhancement of EIS applications already built. This is represented by the intersection of the two shaded areas in the diagram. The people involved in these post-implementation efforts are both developers and users of the system. The assumption about an implicit time dimension is again made here. The various external factors that affect both the development process and use of EIS inherently can affect post-implementation efforts (Kaniclides and Kimble, 1994).

Automated activities

From Figure 2.2 (p.38) it is noted that there is no intersection between Systems and Activities. The reason for this is simple. The intersection of Systems and Activities would represent automated activities which would not require the invention of people. These could be triggered by time. For example, a TPS updating a database at month end. This kind of interaction was not included in the PAS framework as they are characteristic of other systems and not directly relevant to either EIS development or use (Kaniclides and Kimble, 1994).

2.5.2.4 A Critique of The People, Activities and Systems (PAS) framework

The structural EIS framework (Watson *et al.*, 1991) and path EIS framework (Millet *et al.*, 1991) are cornerstones of the PAS framework. Both the structural EIS framework and the path EIS framework are widely cited in the literature. Kaniclides and Kimble (1994) state that the PAS framework 'provides a coherent, structured context to

represent and classify elements included in these areas'. The PAS framework represents a positive step in addressing the previously identified shortcomings of classifying the elements which can influence and determine success (or failure) of EIS implementation.

One of the criticisms of the research by Kaniclides and Kimble (1994), was that the survey sample (25 respondents) was not large enough to draw statistically valid generalisations for each CSF. While this limitation is acknowledged by Kaniclides and Kimble (1994), it does not impact the author's work which is not focused on CSFs for EIS implementation. Another criticism is that the PAS framework has not been tested (to the author's knowledge) in a developing country. In some countries, although the purposes of EIS are similar, they have emerged 'very differently' (Kosaka and Fitzgerald, 1997).

A significant result of the Kaniclides and Kimble (1994) research is that **system use is the most crucial aspect of EIS operation** (bold style added by author). They deduce that the system attributes from the user's perspectives (while not particularly important in the development process), play a critical role in the operation phase of the system. This suggests that it is important to measure user's perspectives only once an EIS has been implemented in order to gauge systems usage. In this dissertation, this is the rationale for the author's EIS implementation survey of users. Another result is that technical problems were consistently regarded to be the **least important** concern influencing EIS success (bold style added by author). As stated in Section 1.5, it is therefore appropriate that the author's work explores some of the non-technical IS issues of organisations which have implemented EIS.

Given that the focus of this dissertation is on EIS usage and as the PAS framework provides an easy-to-use usage classification, the author considers it appropriate that it be used in this dissertation. At this juncture the CSF concept will be discussed. Thereafter previous EIS research undertaken in South Africa will be reviewed.

2.6 Critical Success Factors (CSFs)

John Rockart's (Rockart, 1979) Critical Success Factors (CSFs) concepts were developed from ideas stated much earlier by Daniel (1961). Rockart (1979) defines 'critical success factors' as 'those key areas of activity in which favorable results are absolutely necessary for a particular

manager to reach his or her goals'. This was later refined by Bullen and Rockart (1981) who state the following CSF definition:

'CSFs are the limited number of areas in which satisfactory results will ensure successful competitive performance for the individual, department, or organisation. CSFs are the few key areas where 'things must go right' for the business to flourish and for the manager's goals to be attained'.

The use of the CSF concept as an IS methodology was first introduced by John Rockart as a mechanism for defining a CEO's information needs (Rockart, 1979). For any organisation, CSFs are the limited number of areas in which results, if they are satisfactory, will ensure successful competitive performance for an organisation (Thierauf, 1982). Thierauf (1982) states that they are the few key areas where things must go right if the organisation is to flourish. This is underscored by Fidler and Rogerson (1996) who explain that CSFs are 'those small number of critical areas where things must go right for the organisation to prosper'. Turban *et al.* (1999) note that if 'these functions are well, the organization will do well'. Should the results in these areas be not adequate the organisation's efforts for the period will be less than desired. Consequently CSFs are areas of activity that should receive constant and careful attention from management. Executives must continually receive information about the current level of performance in each of the critical areas as a basis for decision-making (Holsapple and Whinston, 1996). For EIS the CSF method is the most frequently mentioned approach of the methods that determine information requirements based on the characteristics of the object system (Sprague and Watson, 1996). However, not all users of the CSF methodology report success (see, for example, Burkan, 1988).

CSFs can be strategic, managerial or operational (Turban *et al.*, 1999). They are defined primarily from three sources: (1) organisational factors; (2) industry factors; and (3) environmental factors.

Once CSFs are identified they can be monitored, measured and compared to standards. Once CSFs have been identified, measures to monitor them are devised - these are KPIs (Holohan, 1992). For example, in South Africa, Eskom is to implement an automated KPI reporting solution based on SAS Institute's Strategic Vision® product which will make use of

data accessed from Eskom's SAP® systems (Carroll, 2002a). With 'a central information repository fine-tuned for decision-making' executives will receive reliable reports on how the organisation (Eskom) is performing.

One or several KPIs (an illustrative sample is given in Table 2.4), can measure each CSF. This capability is common to most EIS (Turban *et al.*, 1999) and use of this approach results in systems that provide executives the information needed to manage the organisation from the top (Olson and Courtney, 1992).

Table 2.4 Illustrative Key Performance Indicators for Typical CSFs
(Source: Adapted from Turban *et al.*, 1999)

| Critical Success Factor (CSF) | Key Performance Indicator (KPI) |
|-------------------------------|---|
| Profitability | Profitability measures for each department, product, region, <i>etc</i> Comparisons between departments and product comparisons with competitors |
| Financial | Financial ratios, balance sheet analysis, cash reserve position, rate of return on investment |
| Marketing | Market share, advertisement analysis, product pricing, weekly (daily) sales results, customer potential |
| Human Resources | Turnover rates, skills analysis, absenteeism rate |
| Planning | Corporate partnership ventures, growth/share analysis |
| Economic Analysis | Market trends, foreign exchange values, industry trends, labour cost trends |
| Consumer Trend | Consumer confidence level, purchasing habits, demographical data |

Turban *et al.* (2000) suggest that many CSFs may be relevant to electronic commerce (e-Commerce) projects as technology and IS issues should not be underestimated as CSFs. Turban *et al.* (2000) note that integrating new Web applications with existing legacy systems for seamless database operation, queries and transaction processing may be highly desirable but challenging considering the many different hardware platforms and software applications. One CSF of e-Commerce is therefore 'Integration with the corporate legacy systems' (Turban *et al.*, 2000). According to Mougayar (1998) this integration issue represents one of the major challenges facing e-Commerce systems. e-Commerce will be discussed in the next chapter.

2.7 Executive Information System research in South Africa

A review of previously conducted EIS research in South Africa was undertaken by the author. From this collection, the CSFs were extracted and are discussed. South African databases were

searched for research literature (essays, technical reports, thesis, dissertations, *etc*) with the keywords ‘Executive Information Systems’ in the title. Eight successful ‘hits’ were found. Those research articles are reflected in chronological publication sequence in Table 2.5.

Table 2.5 Research literature (essays, thesis or dissertations) with the keywords ‘Executive Information Systems’

| No | Researcher(s) | Publication Date | Research title | Report Type | Qualification and Institution |
|----|--|------------------|---|------------------|---|
| 1 | DeWitt, P. | May 1992 | Design and Implementation of Executive Information Systems (EISs) | Technical Report | B Com (Honours) - University of Cape Town |
| 2 | Twemlow, S., Hoffmann, U. and Erlank, S. | October 1992 | An Assessment of the Penetration of Executive Information Systems in South Africa | Technical Report | B Com (Honours) - University of Cape Town |
| 3 | Strydom, I. | April 1994 | Executive Information Systems: A Fundamental Approach | Thesis | Doctor Commercii (Informatics) - University of Pretoria |
| 4 | Steer, I. J. | January 1995 | The Critical Success Factors for the Implementation of Executive Information Systems in the South African environment | Dissertation | M Com - University of Witwatersrand |
| 5 | Faure, S. | June 1995 | The Impact of Executive Information Systems on the User | Essay | B Com (Honours) - University of Cape Town |
| 6 | Chilwane, L. | November 1995 | Critical Success Factors for the Management of Executive Information Systems in Manufacturing | Research report | M Com - University of Witwatersrand |
| 7 | Khan, S. J. | February 1996 | The Benefits and Capabilities of Executive Information Systems | Research report | MBA - University of Witwatersrand |
| 8 | Baillache, S. | April 1997 | The Experiences Gained by Users of Executive Information Systems | Dissertation | MBA - University of Witwatersrand |

None of the researchers in Table 2.5 report on EIS usage in South Africa. The extent to which researchers investigated CSFs for the implementation of EIS in South Africa is now reviewed.

2.7.1 Design and Implementation of Executive Information System

DeWitt (1992) discusses CSFs for EIS development and states that the type of EIS for an organisation will depend on the information requirements of the organisation. It should be driven by the CSFs that are unique to a particular business (Schutte, 1990; Volonino and Watson, 1991). From previous studies, DeWitt (1992) identifies nine CSFs for an EIS (see Table 2.6) and notes that there ‘are differences of opinion in the literature regarding the selection of the right technology’ as a CSF.

Table 2.6 DeWitt’s (1992) nine CSFs for an EIS

| |
|--|
| A committed and informed executive sponsor |
| An EIS driver |
| A clear link to business objectives |
| Carefully defined system requirements |
| Ensure feasibility of data availability |
| An active team approach to ensure spread to additional users |
| An evolutionary development approach |
| Quick response and user friendliness |
| Managing organisational resistance |

This study was undertaken with sixteen large Cape Town companies from various industry sectors. The findings from Watson's international survey (Watson *et al.*, 1991) were compared against the local survey findings. The following findings emerged: (1) congruences between the literature search and the survey findings; (2) major conflicting results between the local survey, the international survey and the literature search; and (3) major problems encountered in developing EIS.

2.7.2 Assessment of the Penetration of Executive Information System

Twemlow *et al.* (1992) carried out an exploratory study that would show the extent of EIS penetration in South Africa. The sample (61 companies) was selected from the 1992 Financial Mail survey of the top companies in South Africa. The research instrument was designed to evaluate EIS as a significant business trend, the extent of penetration of this trend in the organisation and perceived impact on the business. From these researchers' findings the problems experienced by companies during the implementation and use of their EIS is reflected in Table 2.7.

Twemlow *et al.* (1992) note that even though studies have been performed to determine the nature of executive work and their information requirements, there is still uncertainty in this area (El Sawy, 1985). Twemlow *et al.* (1992) note that 'it is not surprising' that the first two out of the top four problems associated with EIS implementation were concerned with the complex and changing executive information needs.

Table 2.7 Problems with Implementation and Use of EIS
(Source: Adapted from Twemlow *et al.*, 1992)

| |
|--|
| Complex information needs of EIS users |
| Changing needs of EIS users |
| Insufficient management support |
| Lack of clarity of EIS purpose |
| Data availability |
| Failure to incorporate EIS into management processes |
| Hardware compatibility |
| Software compatibility |
| Unexpected increase in costs |
| Failure to meet the user's expectations |

2.7.3 A Fundamental Approach to Executive Information System

Strydom's (1994) research investigates the problems concerning EIS 'from a fundamental research perspective'. Based on the results of the research an augmented EIS is proposed and referred to as a Computer Supported Executive System (CSES). Strydom (1994) discusses the role of training in successful implementation of IS and focuses on computer supported learning for EIS. Little discussion on the CSFs for EIS implementation is reflected in Strydom's research.

2.7.4 Critical Success Factors for Executive Information System Implementation

Steer's (1995) study used the findings of research undertaken by Harris (1993) and others. The basis of Steer's research 'was to identify the critical success factors for the successful implementation of an Executive Information System where an EIS had been implemented' in South Africa. Seventeen well-established organisations in Gauteng that have EIS experience were targeted and surveyed. The analysis of Steer's findings revealed twenty-one major concepts that were raised by interviewed respondents in relation to the CSFs for implementing EIS. The top ten CSFs (in descending order) that were identified in the study for the successful implementation of EIS are reflected in Table 2.8.

Table 2.8 The Top ten CSFs for the Successful Implementation of EIS
(Source: Adapted from Steer, 1995)

| CONCEPT |
|---|
| An EIS needs a project champion |
| An EIS must support the cross-functional integration of information |
| An EIS has to link to the organisation's business strategy |
| An EIS should be implemented using a phased approach |
| An EIS project champion should be a steering committee rather than one person |
| Resistance from the information users must be managed |
| An EIS must have the capability to access external information |
| Resistance from the information providers must be managed |
| The project champion should change during the project |
| An EIS must support 'drill down' facilities |

Steer indicates that although 'the remaining 11 concepts of the 21 discussed during the research are not the most important critical success factors of implementing an EIS, *they are still important*, and should therefore *be considered* when implementing an EIS' (italics added by author). Steer (1995) labels these CSFs as 'secondary' CSFs for the successful implementation of EIS. The CSFs are reflected in Table 2.9.

Table 2.9 Secondary CSFs for the Successful Implementation of EIS
(Source: Adapted from Steer, 1995)

| CONCEPT |
|---|
| An EIS should be made available to everyone |
| An EIS must have 'what if' and simulation facilities |
| Resistance from IT people must be managed |
| An EIS must support trend analysis |
| The user must be able to interact with and manipulate the information |
| An EIS must support exception reporting |
| It must be possible to track actuals against plans |
| An organisation must develop a formalised business strategy before it embarks on an EIS project |
| An EIS must have a good graphical user interface |
| An EIS should be for executives only |
| An EIS must be able to access financial information |

2.7.5 The Impact of Executive Information System on the User

The focus of Faure's (1995) research is to highlight 'the key features of an EIS, the benefits that can be achieved from implementing an EIS and the development methodologies that can be adopted to achieve success in the implementation of an EIS'. For the CSFs for EIS development, Faure (1995) refers to research by DeLong and Rockart (1986b); McNurlin and Sprague (1993); Mohan *et al.* (1990). In the conclusion of Faure's (1995) research there is no reference to CSFs for EIS implementation.

2.7.6 Critical Success Factors for the Management of Executive Information System

The aim of Chilwane's (1995) research is 'to identify those critical issues, which when managed properly, will ensure that the system remains providing and meeting the needs of the executives. Ten interviews were conducted from business organisations in order (*sic*) identify these factors'. Table 2.10 reflects the CSFs for managing an operating EIS 'as seen by respondents who organisations have implemented EIS' (Chilwane, 1995). Chilwane (1995) states that ensuring 'that these factors are monitored will contribute to sustaining the investment an organisation has made in this technology'.

Table 2.10 CSFs for the management of an operating EIS
(Source: Adapted from Chilwane, 1995)

| |
|--|
| Executives or users should provide regular feedback on the EIS either formally or informally |
| Continued alignment of EIS ensures that the system remains useful to the users |
| Continued executive involvement ensures success of the system |
| An EIS should be flexible to accommodate the dynamic business environment |
| As EIS spreads new requirements should be reflected in the system |
| ISD should provide somebody who knows the business to look after the users |
| An EIS should help individual managers to monitor their individual CSFs |
| EIS data should always be consistent with the operational data it summarises |
| There should be prompt attention to user queries and requirements |
| An EIS should be portable <i>ie.</i> loaded on a notebook and accessed offline |

2.7.7 The Benefits and Capabilities of Executive Information System

The objective of Khan's (1996) research is to identify and evaluate the organisational benefits derived from EIS and to establish which of its capabilities contribute to the realisation of the benefits. Khan (1996) notes that a major problem when implementing an EIS is determining the information requirements for the system (Watson and Frolick, 1993). For them a major developmental problem is determining the information to include in the system.

Khan (1996) notes that practitioners find it difficult to get executives to specify what they want and to keep abreast of executives' changing information desires and needs. A crucial element in the success of an EIS is pinpointing key business success factors and performance indicators. Khan's (1996) findings identify six major benefits of EIS and five major capabilities of EIS. No significant correlation is found between the benefits and the capabilities of EIS.

As an area of further research, Khan (1996) suggests that a qualitative study be made 'of a selection of successful and unsuccessful implementation of EIS to compare what makes some systems successful and others not successful'. Research on this topic may reveal those factors causing some EIS applications to be successful and those factors which are causing others to be unsuccessful.

2.7.8 Experiences Gained from Executive Information System

Baillache's (1997) research investigates the experiences gained by South African users of EIS. The results are seen as important in identifying problem areas that negatively affected the evolution of EIS in South Africa. Approximately thirty companies participated in the survey. Four users from each company were requested to complete a questionnaire.

The results and findings indicate that some important capabilities had been omitted in systems, users expectations of benefits were far greater than benefits delivered, *key CSFs did not occur during the implementation of the project* and the growth of the system by new users was not strongly correlated to the CSFs (italics added by author). Baillache's (1997) 'summary of results of CSFs implemented' are reflected in Table 2.11.

Table 2.11 Summary of Results of CSFs Implemented

| | CSFs Implemented |
|---|---|
| CSFs supported by the research | Having an executive sponsor on the project System reliability was ensured Quality data The skills of the system designers |
| CSFs not supported by the research | Having an operating sponsor on the project Local representation of software companies for support |
| New CSFs which emerged from the research | There was a clear link between the EIS and business objectives Appropriate resources were used from the information systems function Appropriate technology was used Users specified their own information requirements The first deliverable by the ITD was information that was highly valuable The EIS contained information of much value to me The EIS was implemented as quickly as possible The hardware used was reliable Pilot sites were used in the implementation |

2.7.9 Discussion of previous Executive Information System research undertaken in South Africa

From Table 2.5 (p.45), only four of the EIS researchers (Nos 1, 4, 6 and 8) dealt with CSFs for EIS implementation. A synopsis of the results and findings indicates that there is no consistent ‘shopping basket’ of CSFs for EIS implementation for use by South African practitioners. While there has been a lack of research specifically on EIS usage in South Africa, Khan (1996) reports that there has been an increasing focus on EIS in South Africa. This focus may be as a result of data warehouses.

High capacity fast storage media have made the deployment of massive data warehouses possible. Users of data warehouses frequently like to visualise data as a multi-dimensional ‘data cube’ (Gray *et al.*, 1997) to facilitate OLAP. For example, WebFOCUS for J.D. Edwards®, gives executives a powerful and intuitive application for analysing their operational data from different perspectives. A variety of financial or sales reports shows trends, comparisons and analyses from different data views. WebFOCUS for J.D. Edwards® can be customised to offer *ad hoc* reporting, OLAP analysis, ‘drill down’ to production systems, Web access and high performance data warehousing. This tool may have potential relevance to the eThekwin Municipality for its common financial system (J.D. Edwards®). Data warehouses and related OLAP continue to receive strong interest from the research community and industry (Fu and Hammer, 2000).

A data warehouse is a subject-oriented, integrated, time-variant, non-volatile collection of data in support of management's decision-making process to make timely, accurate decisions (Cobb, 1996). As distinct from an operational database, a data warehouse is managed data situated after and outside operational systems (Gupta, 1997). A data warehouse contains historical data to supply a time-related view (eg trend analysis) and is mainly intended for analytical applications such as DSS and EIS (Gallagher, 1995).

Like other systems, EIS are constantly changing. The result has been the emergence of second generation EIS (Carnelly, 1995). Donkin (1994) notes the future EIS tools will be smart systems that incorporate intelligent agents to assume responsibility for collecting, analysing and distributing information to the relevant people. Khan (1996) suggests an investigation into new technologies being employed in the IT area and 'to what extent advances in technology have influenced ... EIS'. As networked computing is becoming the dominant architecture of most organisations (Turban *et al.*, 1999), DeLong (1999) notes that there is now a need to 'differentiate between executives in traditional organisations and those in internet-centred businesses'. Khan's (1996) EIS research 'identified the employment of new technologies as **the most important future trend of EIS**' (bold style added by author).

The Web serves as the foundation for new kinds of IS (Laudon and Laudon, 1998). As the Web grows in direct usage by executives, existing CSFs for EIS implemented models may need to be revisited. This is a fertile area for future research. Srivihok (1998) states that 'a cohesive theory that accounts for the success factors and successful EIS implementation needs to be developed'. For example, the growth of Internet and Intranet technologies has added Web browsing to the list of EIS capabilities (O'Brien, 1999) but this is *not* reflected in the studies of Researcher No 7. The technology which is driving the Internet economy is having a profound effect on the way which all organisations conduct business (Robinson, 2000). Robinson (2000) states that the management of all relationships will be *critical* and can only be achieved by the collaboration of internal processes and *systems*. It is contended that in South Africa *not* all previously identified CSFs for the successful implementation of EIS are 'critical'. The existence of the other success factors is, however, recognised. A contingency approach is suggested by labelling some of the identified CSFs for EIS implementation as 'of secondary importance but not essential for success'.

While there is no single listing of key variables for EIS success factors (Rainer and Watson, 1995a), strong human factors are nevertheless associated with EIS research. These are influenced by cultural, political and other 'soft' human factors. It is therefore neither possible nor valid to generalise experiences on other continents to South Africa's conditions. This makes relevant local studies of EIS implementation and usage which are the basis for this research project.

2.8 International Research on Executive Information Systems usage and Implementation

The successful implementation of any IS (including EIS) depends on many social, environmental, behavioural, economic, technical and organisational factors (Averweg, 1998). Much international research on EIS has previously been conducted (see Table 2.2 (p.34)) and EIS research continues to be undertaken (see, for example, Poon and Wagner, 2001). International EIS research has not only undertaken in US and Europe but also on other continents. For example, a wide survey of the state of EIS in large Australian organisations was conducted (see Pervan and Phua, 1997). Pervan and Phua (1997) report on EIS usage in the surveyed Australian organisations.

Environmental, organisational and technological factors are creating a highly competitive business environment in which customers are the focal point (Turban *et al.*, 1999). These factors can change quickly, sometimes in an unpredictable manner (Knoke, 1996) in a dynamically changing business environment (Malhotra, 2001). Therefore organisations need to react frequently and quickly to both the problems and the opportunities resulting from this new business environment (Drucker, 1995). Boyett and Boyett (1995) emphasize this dramatic change and describe it with a set of business pressures or drivers.

Most response activities can be greatly facilitated by IT (Turban *et al.*, 1999). Larson (1996) and Callon (1996) report that in some cases IT is the only solution to these business pressures. IT has been both an enabler in and driver of globalisation activity (Palvia *et al.*, 1996). The business drivers create pressure on organisations. Organisations respond with activities supported by IT. IT projects that combine wide internal access with low risk and a clearly visible return are especially popular (KPMG Consulting, 2002). The core of today's IT is networked computing (Turban *et al.*, 1999) which embraces Web-based technologies.

The steadily growing phenomenon of organisations engaging in global business and the vast changes in world markets have made a tremendous impact on the use of IT and the information needs of these organisations (Palvia *et al.*, 1996). Nowadays there is a strong move toward market economy by many countries (including South Africa). This has created the foundation necessary for a global economy (Naisbitt, 1994). This move to globalisation is facilitated by advanced telecommunication networks and especially by the Internet (Kanter, 1995; Negroponte, 1995; Clinton and Gore, 1997). South Africa is extremely vulnerable to global and economic business cycles but is supported by highly developed systems of telecommunications (SA2002-2003, 2002). The Internet and other telecommunication networks increase the amount of information available to organisations and individuals (Turban *et al.*, 1999). Thus the accessibility, navigation, management of data, information and knowledge which are necessary for managerial decision-making become critical.

An increasing number of organisations are implementing EIS, the interest in such systems is surging (Palvia *et al.*, 1996) and the use of EIS is growing rapidly (O'Brien, 1999). Palvia *et al.* (1996) report that descriptions of current EIS systems typically have no reference to environmental data/information that is international in scope. It is implicit in these systems that they capture information which is predominantly domestic (*ie.* about a single country, *eg.* USA or South Africa). However, as business becomes global, its senior executives need not only monitor domestic information within their own country of operation but also access information which is global in nature and relates to other countries. Deans and Kane (1992) describe the growth of global online databases in the 1990s which will be vital to the development of EIS that are global in scope.

Palvia *et al.* (1996) argue that 'businesses now need to incorporate a global dimension in the design of their executive information systems'. Such EIS will incorporate important international information that will be critical to executives of multinational corporations and global businesses in order for them to conduct business and compete globally. They report that future EIS research should take the following direction: 'researchers should attempt to find the **impact of global and country variables on the development, implementation, and use of global EISs**' (bold style added by author). This impact by global (Web-based technologies) variables on the use of Executive Information Systems constitutes the research justification for this dissertation.

In summary the implications of this literature survey in this chapter shows that much research has been undertaken with success factors associated with IS implementation and the measures of EIS implementation success. As noted in Section 2.5.1 system usage is a method of IS success measurement most commonly used. The current role of Web-based technologies affecting EIS implementation will be addressed in the next chapter.

2.9 Conclusion

This chapter has reviewed previous studies of EIS and introduced the basic concepts, success measurements, the PAS development and use framework, and success factors as they relate to the development of EIS. The use factor as a surrogate measure of EIS implementation success was introduced. Previous EIS research conducted in South Africa and the relevance of this local EIS study were discussed. With the global emergence of IT these concepts and measures provide a backdrop for introducing the concept of Web-based technologies in the next chapter.

Chapter 3 will be an investigation into the manner in which Web-based technologies affect EIS implementation. Given the current shifting IT and EIS implementation environments, a literature analysis of IT adoption and usage will then be made in Chapter 4.

CHAPTER 3

WEB-BASED TECHNOLOGIES AFFECTING EXECUTIVE INFORMATION SYSTEMS IMPLEMENTATION

3.1 Introduction

The purpose of this chapter is to trace the evolution of the World Wide Web and review the current status of Web-based technologies. Thereafter the manner in which the Web supports decision-making is presented. The relevancy of the Web to EIS and research in that area are then discussed. These topics serve as a backdrop for discussing some theoretical models of IS success (with specific focus on the Technology Acceptance Model) in Chapter 5.

IT has become the major facilitator of business activities in the world today (see, for example, Tapscott and Caston, 1993; Gill, 1996). It is also a catalyst of fundamental changes in the structure, operations and management of organisations (Dertouzos, 1997). Wreden (1997b) reports that IT capabilities support five business objectives: improving productivity (in 51 *per cent* of organisations), reducing cost (39 *per cent*), **improving decision-making** (36 *per cent*), enhancing customer relationships (33 *per cent*) and developing new strategic applications (33 *per cent*). Elliott (1992) notes that EIS use enables executives more analysis in decision-making, faster problem identification and faster decision-making. Executives who use EIS most frequently should notice the greatest increase in their decision-making speed (Leidner and Elam, 1993). Leidner and Elam (1993) report that frequency of EIS use and length of time of use are both significantly associated with an executive's decision-making process.

With the evolution of distributed computer technology, paved by the rapid adoption of Web technology, there is a growing need for improved decision-making at any time, anywhere and with any participants. Digital communication requires a new business paradigm: being able to join and use any type of business system anytime, anywhere (Worthington-Smith, 2000). This is a real business problem and is especially relevant to EIS. Palvia *et al.* (1996) argue that organisations need to incorporate a global dimension in the design of their EIS. Palvia *et al.* (1996) suggest that such global EIS will incorporate international information that

will be critical to executives of multinational and global organisations in order for them to conduct business and compete globally. The Internet has starkly increased the growth of transnational relations (Kaiser, 2001) and offers almost unlimited access to information (Deutschland, 2001). Given this scenario, this chapter investigates the manner in which Web-based technologies affect EIS implementation.

3.2 Historical evolution of the World Wide Web ('the Web')

During the past two decades, advances in computer technologies combined with telecommunication technologies have led to the development of the Internet and its most popular application, the World Wide Web (Khosrowpour and Herman, 2000). The world has witnessed a technological evolution that has provided a totally new medium of communications entirely new to mankind. Through the use of networks, information in all forms has been disseminated throughout the world. The Internet and technology has dramatically changed the world we live and work in and in the way nations and organisations operate (Shaw, 2001). IT and telecommunication networks are now unquestionably considered fundamental for the running of all contemporary organisations (Avgerou, 2000).

The Web grew out of a project that began with a different intent (ARPAnet). In 1969 the ARPAnet was designed and developed by Bolt, Beranek and Newman under a contract for the Advanced Research Project Agency (ARPA) of the USA Department of Defense. Turban *et al.* (1999) report that the purpose was to test the feasibility of a wide area computer network over which researchers, educators, military personnel and government agencies could share data, exchange messages and transfer files. The ARPAnet Project was eventually handed over to the National Science Foundation (NSF) and ultimately became known as Internet. Vinton G Cerf, widely known as a 'Father of the Internet', co-designed with Robert E Kahn the TCP/IP protocols and architecture of the Internet. The major growth occurred after commercial organisations were allowed to join ARPAnet (renamed the Internet) in 1993 (Turban *et al.*, 1993). For an account of the Internet's historical evolution, see, for example, Naughton (2000).

In the beginning, several resources (*eg.* electronic mail, news, Telnet, file transfer protocol) were offered through Internet to its users (Misic, 1994). Nowadays, additional important

Internet capabilities for business also include Usenet newsgroups, LISTSERVs, chatting, gophers and the World Wide Web (Laudon and Laudon, 2000). The Internet is international (Deutschland, 2001). The design philosophy of the Internet was not to reduce transaction costs or support electronic markets but to provide a robust heterogeneous distributed computing environment for applications that may not yet be developed (Clark, 1988).

A significant step for the increase of the role of the Internet was the World Wide Web ('the Web') which emerged in the early nineties. The Web is one of the software tools that through the use of hypertext allows computers to link information in new ways different from a sequential reading approach; to make it easy to retrieve and add information from different computer sources through the use of communication links (Berners-Lee *et al.*, 1992). In the short time since the Internet's inception it has revolutionised business in that it redefines the methods used in traditional business practices (Foo and Lim, 1997) and stoked a business revolution by creating an efficient communications channel for organisations to manage inventory, supplies and proprietary data (Cohen, 2001). The Internet is the turbocharger of globalisation (Kaiser, 2001). Giesecke (2001) suggests that is time to develop new visions for globally networked humanity. The Net is the backbone for the new digital economy that is radically changing business models around the globe (Hoque, 2000). For example, the Internet can do much legwork for Enterprise-wide Resource Planning (ERP) systems (see Section 4.2) making them work more effectively.

The Web can serve as the foundation for new kinds of IS (Laudon and Laudon, 2000) and has led to a vast array of options for developers to create applications and deliver them expediently to users (Basu *et al.*, 2000). There is a growing body of research on Web usage (Sellen *et al.*, 2002). There exists a high degree of similarity between the characteristics of a 'good EIS' and Web technologies (Tang *et al.*, 1997). A Web-based solution can quickly overcome some of the drawbacks of traditional EIS especially with regard to cost, **ease of use** (bold style added by author), development cycle, architecture and added features (*eg.* intelligent agents) (see, for example, Gopal and Tung, 1999; Rahwan *et al.*, 2002). For example, systems that use software agent technologies are proving to be effective in helping users make better decisions when buying or selling over the Internet (Bailey and Bakos, 1997). The current status of Web-based technologies will now be discussed.

3.3 The Current Status of Web-based Technologies

During the early days of the Internet the technology was primarily utilised as a medium for communication (*eg.* electronic mail) purposes. Soon thereafter many organisations from both the private and public sectors began to discover that in addition to use of the Internet and its popular Web, they could utilise this technology in support of information dissemination purposes (Khosrowpour and Herman, 2000). This resulted in organisations realising that the greatest payback in investing in the technologies of the Web would be in sharing information about the organisation's products and services to the organisation's stakeholders (Gardner, 1997). As a consequence, successful organisations of all types and sizes have been adopting different applications/technologies of the Web in discovering emerging ways of doing business that even a decade ago could not be imagined (Prawitt *et al.*, 1997).

In recent years the Web has become the glittering place of information and electronic trading that some visionary pundits promised it would become (Jacobs, 1998). The Web has, for example, seen many improvements in the marketing business sector (*eg.* identification of sales prospects), immediate access to information (*ie.* product/service specifications and pricing) and allowing customers to obtain goods regardless of their geographical location in the world (Hacker, 1996; Presti, 1996). The Web remains a fairly inexpensive form of communication with potential customers (Bird, 1996). The global connectivity of the Internet provides a relatively economical medium of marketing services and products over vast distances (Looney and Chatterjee, 2002).

Business organisations are currently faced with more dramatic changes in their business environments than ever before (Rockart *et al.*, 1996). Web technologies are helping organisations realise their goal of mass customisation (Looney and Chatterjee, 2002). Many organisations are increasingly turning to emerging IT as a means of coping with this change (Huber, 1984) but such technologies are often unknown and difficult to manage (Bhattacharjee, 1998). Recently there have been many emerging Web-based technologies and some of the more popular applications/technologies are reflected in Table 3.1. Each of these applications/technologies will be discussed in Section 3.4.

Table 3.1 A Summary of some Web-based Applications/Technologies

| |
|-------------------------------------|
| Organisational Intranets/Extranets |
| Electronic Commerce (e-Commerce) |
| Wireless Application Protocol (WAP) |

Web-based technologies are not free of associated risks and controversies (Khosrowpour and Herman, 2000). Khosrowpour and Herman (2000) indicate that like many other emerging technologies, this technology has its share of associated problems and limitations. In order to clearly understand the total potentials of these technologies and their applicability to EIS, one must also assess the limitations, stipulations and provisions of these technologies in modern organisations. This topic will now be discussed. At the end of this section a summary of the critical issues of Web-based technologies will be presented.

Among many issues, some of the cited problems and limitations of Web-based technologies are as follows:

The issue of Bandwidth Restrictions and Latency

According to Berghel (1996); Pitkow and Kehoe (1996) a large percentage of Web users run low-speed modems (56K) which in reality cause considerable delays in obtaining Web-based materials when the corresponding downloads incorporate images, animation and audio. Bandwidth is the current bottleneck (Worthington-Smith, 2000). With the success of the Web sound graphics and full-motion video are now important aspects of network computing (Laudon and Laudon, 2000). A study by a popular server reveals that about one in five users were connecting with graphics turned off to eliminate the annoying latency of loading web pages (Fox and Brewar, 1996). Latency issues are also being experienced with some of the more popular Web documents (Khosrowpour and Herman, 2000). In this case slowness relates to the number of requests an individual Web server can handle at once (Roush, 1995).

Cyberloafing

Surfing the Internet, wasting time and accessing inappropriate materials are the primary concerns and which are labeled cyberloafing (Prawitt *et al.*, 1997). A study shows that once users become more familiar with the Web the cyberloafing practice becomes a common

phenomenon (Frook, 1997). Cyberloafing can also take place in a different form where users receive unsolicited messages about all kinds of decent and indecent offers (Khosrowpour and Herman, 2000). In this case the user is not searching sites to explore but in the act of reading the unsolicited message, the user may be tempted to explore inappropriate materials.

Equity

Meeks (1997) argues that the Web will bring forth a better democracy within the USA by returning power to the people. This may not come to pass if the issues of equity and demographic trends are poorly addressed (Khosrowpour and Herman, 2000). Khosrowpour and Herman (2000) report that the Web technology is not equally utilised by all classes of society in the USA as well as other countries.

Exposure Points

As more organisations utilising Web-based technologies incorporate the ability for remote access to their computer systems by their employees, there is a higher risk of information exposure (Prawitt *et al.*, 1997). These emerging exposure points are inroads which can lead to sloppy data entry into systems. Furthermore savvy hackers may break into the system where inadequate control measures may not be applied at every exposure point.

Web flooding with content for content's sake

With the ease of access to the Internet and the availability to use Web development tools, there is an abundance of costly and slick Web pages on the Internet (Khosrowpour and Herman, 2000). Many of these Web pages include information which is not helpful to their viewers. They are merely on the Internet so that individuals or organisations that own the site can claim that they have a Web site. Nowadays many organisations are beginning to view content for content's sake as a wasteful exercise and instead are beginning to understand that the role of the Web site is to facilitate business processes (Gardner, 1997).

Inadequate search facilities on the Web

One of the important issues of the Internet is that of adequate search facilities with the lack of a high level query language for locating, filtering, and presenting Web information (Foo and Lim, 1997). Some search engines search document headers, some look for the document

themselves and others look for directories. As a result, Khosrowpour and Herman (2000) conclude that much of the information on the Web is presented in a dynamic and somewhat chaotic fashion. Thus, the real challenge is in managing information on a regular basis with updated content and links (Balasubramanian and Bashian, 1998).

Maintaining and integrity of data

The task of keeping up with commercial Web pages by maintaining the latest information, is considered to be a costly issue faced by many organisations. As an organisation's Web site becomes more complex and elaborate, the task of maintaining and validating information included in their Web sites becomes much more costly too (Khosrowpour and Herman, 2000). It will reach a point where maintaining and ensuring the accuracy of information becomes difficult (Foo and Lim, 1997). Developing and maintaining an EIS is not a trouble-free endeavour (Watson *et al.*, 1995b). Watson *et al.* (1995b) report that the 'top ranked problem is getting accurate data' and combining data from multiple sources. Inaccurate and out-of-date information included in a Web site can contribute (in part) to decisions made by the user of the information based on data that is either outdated or inaccurate. This can potentially harm an organisation's business processes.

Security

The issue of Web security is considered to be one of the most important challenges to many organisations. Many security experts believe that the existing layers of security are considered to be inadequate and in some cases fragile (Hodges, 1997). Khosrowpour and Herman (2000) note that it is important to note that security is a broad term. In some instances the term security is related to privacy. In other contexts the term refers to the integrity of data (Grimshaw, 1997). Some examples of security threats are as follows: electronic mail risks (see, for example, Berghel, 1997; Prawitt *et al.*, 1997), false store fronts (see, for example, Bhimani, 1996; Prawitt *et al.*, 1997), industrial espionage (see, for example, Roush, 1995; Bhimani, 1996; Higgins, 1997), information vandalism (see, for example, Bhimani, 1996; Prawitt *et al.*, 1997), Internet Service Providers alterations (see, for example, Prawitt *et al.*, 1997), viruses (see, for example, Prawitt *et al.*, 1997) and Webware (see, for example, Felton, 1997).

With the advent of e-Commerce and the overwhelming interest in the utilisation of this technology for modern commerce, there are many challenges presented by security issues and risks (Khosrowpour and Herman, 2000). e-Commerce will be more fully discussed in Section 3.4.2. Although there are perceived issues with security (especially related to e-Commerce), there is still substantial interest in utilising the Web technology for e-Commerce (Liu *et al.*, 1997).

System incompatibilities

During the past several years, the issue of system incompatibilities has been a major issue. In many cases, cross-platform compatibility is not always available in all emerging technologies being developed. This can result in difficulty when trying to make them function in unison (Prawitt *et al.*, 1997).

Unauthorised use of computer resources

Emerging interconnectivity technologies have presented opportunities for computer misuse which were previously not possible (Prawitt *et al.*, 1997). For example, the Boeing corporation has reviewed the issue of URL filtering of objectionable material (Frook, 1997). Frook (1997) reports that Boeing decided that 'restricting site access is a cumbersome management process, but unrestricted access to public Web sites could open the company up to legal issues'. eThekweni Municipality has installed Websense® software on its WAN. This software is an Internet filtering solution that manages, monitors and reports on employee use of the Internet. See Internet URL <http://www.websense.com> for further Websense® software details.

User ignorance and perceptions

The lack of adequate understanding of the Internet, its usage and risks have been contributing actors in maintaining secure systems (Khosrowpour and Herman, 2000). Nowadays IS are comprised of many different components of distributed hardware, software and data maintained on different locations by different systems. While it is becoming increasingly critical for users to exercise sound control practices, most are not adequately trained to do so (Prawitt *et al.*, 1997).

Web Performance Tracking

With the exponential growth of Web applications, services, traffic volumes and contents, a management void has been created (Khosrowpour and Herman, 2000). If the availability and performance of the Web services are not managed and information cannot be accessed quickly, it is likely the user will jump to a competitor's Web site which results in a loss of business (McConnell, 1997). McConnell (1997) notes that 'to achieve peak performance, the IT department must harmonize many critical elements, including the transport network and its Featured Site service levels, if any, Web server hardware and software and information content'.

Low overhead electronic payment facilities

Low overhead electronic payment facilities, micropayments are needed as a service on the Web so that advertising is no longer necessary to cover the cost of running servers (Khosrowpour and Herman, 2000). The content providers will then be able to sell information in the same fashion as the purchase of newspapers or a single song (Machlis, 1998). The process typically works whereby an account is opened with a micropayment system and the software required is downloaded to work with the user's browser. Digital Equipment Corporation has developed such a system.

Failure to adhere to standards

The failure of primary organisations and their products to adhere to the existing standards (eg. HyperText Markup Language (HTML) and JavaScript) is an important issue as many organisations which have monopolistic power (eg. Microsoft Corporation) do not abide by those standards which exist in the industry. Their lack of following industry standards is viewed as an attempt in creating a new 'standard' with their products (Khosrowpour and Herman, 2000). While an amount of HTML created does not conform to HTML's rules it is not seen as a problem in today's browsers. However, problems are envisaged with HTML in the newer user agents such as personal digital assistants (PDAs) and cellphones (Holzschlag, 2001).

Unsolicited electronic mail (spamming)

Spamming occurs when an endless stream of electronic mail and electronic messages are received which can overflow a user's mailbox and potentially choke the user's system. Worldwide users receive unsolicited electronic mail promoting products or services (Khosrowpour and Herman, 2000). Laudon and Laudon (2000) report that the spamming practice is growing.

Use of Metadata

The Web has a large amount of data with practically no classification information and this makes it extremely difficult to handle data/information effectively (Marchiori, 1998). Many systems can support knowledge management by establishing metadata (information about information) standard so that users of data can obtain the raw materials which enables them to capture, store and share knowledge that is gathered from different sources (Phillips, 1995). This task can be accomplished by adding to the Web objects a metadata classification which will assist search engines and Web-based digital libraries by properly classifying and structuring information on the Web (Baer, 1996; Marchiori, 1998).

Ensure a continued global body

Many users of the Web are concerned that the body of knowledge created on the Internet consists of some kind of global understanding that users from all over the world can relate to (Khosrowpour and Herman, 2000). This task has been assigned to the World Wide Web Consortium (W3C). The W3C is a global body that was founded to lead the Web to its full potential by developing common protocols that promote its evolution and ensure its operability. The primary services offered by W3C to developers and users consists of: (1) acting as a depository of information about the Web; (2) providing reference code implementations to embody and promote standards; and (3) providing various prototype and sample applications to demonstrate use of new technology. The W3C's strength is the broad technical knowledge base of its 380 members who are active in industry and research (Machill, 2001).

On 31 May 2001, W3C released XHTML (eXtensible HyperText Markup Language) 1.1 as a recommendation in order to reformulate HTML into a truly eXtensible Markup Language (XML) application (Holzschlag, 2001).

Privacy and confidentially agreements

The privacy and confidentially agreements issue entails an aspect of the security issue in that it is a violation of users' privacy (Khosrowpour and Herman, 2000). Many users believe that more information about their lives is now shared with others through the use of the Internet.

Global laws for Net crimes

There is a global perception that crimes and criminals should be punished but there is confusion regarding what is a criminal act on one society in comparison to another (Khosrowpour and Herman, 2000). The issue of global laws for Internet crimes is considered to be a complex issue. Based on the current dilemma of establishing national laws regarding Internet activities, it is anticipated to remain unsolved for a long period of time (see, for example, Rose, 1996; Weston, 1996; Charlesworth, 1997). The Internet's dynamics seem to preclude it being regulated by conventional supernational organisations such as the United Nations (Machill, 2001).

Required labeling sites

There is a concern about how to differentiate Web sites from each other regarding their contents (Khosrowpour and Herman, 2000). By labeling sites, search engines can provide more effective and efficient search processes. Labeling will also assist the enforcement of any global laws related to Internet crimes. This issue becomes valid once global laws are in place to deal with Internet crimes.

System Utilisation

System utilisation deals with the overall question of what functionality or information sharing is best served on the Web (Khosrowpour and Herman, 2000). Many users have seen the transformation of this technology into a business tool where organisations all over the world can conduct their commerce through this medium. This e-Commerce concept will be fully discussed in Section 3.4.2. Many users question what should be the future overall functionality of the Internet as this medium becomes more acceptable as a common medium for communication purposes.

Expressability of HyperText Markup Language (HTML)

The expressability of the HTML issue is primarily concerned with the ability of the user to create documents that contain complex layouts (Khosrowpour and Herman, 2000). Khosrowpour and Herman (2000) suggest that this is most important to the functionality of the Web because of its usefulness in presenting information with all its characteristics and potentials. As more users rely on the use of this technology to share information with other users, the role of HTML (or other tools) will become more recognised. These tools should allow users at all levels to create documents which consist of the full picture and one should not be limited by the tool that is used. Rein *et al.* (1997) call for integrating document management functionality into the Web infrastructure.

HTML is a page description language for creating hypermedia documents (*eg.* Web pages) and focuses on the structure of a document (Holzschlag, 2001). XML is a new specification designed to improve delivery of Web documents (Laudon and Laudon, 2000). See XML discussion in Appendix 1 and Internet URL <http://www.w3.org/markup/> for more information.

Lack of Standardised Vector Graphics

This issue deals with the lack of incorporating vector graphics in Web designs. Khosrowpour and Herman (2000) note that the adoption of graphics in Web design will enable programmers to present better user interfaces to Web applications. Walsh (1998) reports that 'Vector graphics scale easier, download faster and print better than their bit-mapped graphics counterparts GIF and JPEG'.

Hype

Web sites are effective if used intelligently and imaginatively (Khosrowpour and Herman, 2000). Many organisations boast their Web sites to be showcases for the organisation's goods and services. However, Khosrowpour and Herman (2000) note that few are very effective at serving the purpose of the organisation's betterment. Despite this reality there is much hype among organisations (and their Web designers) that their Web sites should consist of more bells and whistles in order to compete with their competitors and also to attract more customers.

From the above discussion and according to existing literature a summary of the twenty-four critical issues of Web technologies is now presented in Table 3.2.

Table 3.2 Summary of critical issues of Web technologies according to existing literature

| Issue | Brief Explanation |
|--|--|
| Bandwidth Restrictions and Latency | Low-speed data transition caused by slow communication device such as a modem |
| Cyberloafing | Surfing the Internet, waiting time and accessing inappropriate materials |
| Equity | Not equally utilised by all classes of society |
| Exposure Points | Sloppy data entry and breaking into the system due to lack of adequate control measures applied at every remote control |
| Web flooding with content for content's sake | Web sites that do not offer effective and useful information |
| Inadequate search facilities on the Web | Inadequate search facilities with lack of a high level query language for locating, filtering and presenting Web information |
| Maintaining and integrity of data | Keeping up with the task of maintaining and validating information included in Web sites |
| Security | Treat risks and misuse of the system |
| System incompatibilities | Lack of available cross-platform compatible communication networks |
| Unauthorised use of computer resources | Use of the Internet resources for personal use |
| User ignorance and perceptions | Lack of user understanding of security risks and control |
| Web Performance Tracking | Keeping track of systems performance and effectiveness |
| Lower overhead electronic payment facilities | Content providers are able to sell information |
| Failure to adhere to standards | Monopolistic organisations do not abide by industry standards |
| Unsolicited electronic mail (spamming) | Users' mailboxes overflow and choke users' systems |
| Use of Metadata | Large amount of data with little classification information |
| Ensure a continued global body | World Wide Web Consortium (W3C) to lead the Web to its full potential by developing common protocols |
| Privacy and confidentially agreements | Violation of users' privacy |
| Global laws for Net crimes | Establishing of national laws regarding Internet activity |
| Required labeling sites | How to differentiate Web sites from each other regarding their contents |
| System Utilisation | The functionality or information sharing best served on the Web |
| Expressability of HyperText Markup Language | Ability of the user to create documents that contain complex layouts |
| Lack of Standardised Vector Graphics | Incorporation of vector graphics in Web designs |
| Hype | Web sites should consist of mor bells and whistles to compete with their competition |

From Table 3.2, the most prominent critical issues are those which impact e-Commerce (Khosrowpour and Herman, 2000). Khosrowpour and Herman (2000) note that these issues are bandwidth restrictions, security and inadequate search facilities (see three shaded areas in

Table 3.2). They state ‘these three are the primary ones impacting the further development, acceptance and utilization of electronic commerce capabilities’. For example, e-Commerce organisations are currently devoting more time and money on security matters than they did in preparing for 2001 (Bartels, 2001). e-Commerce is the key to doing business in the new global economy that is based on knowledge and information. Even with an anticipated economic downturn, a survey of 1,000 global executives by AMR research reports that 87% of the interviewed executives plan to sustain or increase electronic business investments, especially in B2B (see, Put Your Eggs in the E-business Basket, 2001 and Section 3.4.2).

The success of business is becoming more dependent on the successful applications of IT (Rahman and Bignall, 2001). Basu *et al.* (2000) report that many of the technology uses lean towards collaborative rather than decision supportive types of functions for executives. Rein *et al.* (1997) state that Web technologies must support existing work processes just as work practices need to adapt to emerging Web technologies. Furthermore, developments in network computing, the Internet and corporate Intranets have fueled the development and deployment of EIS (Turban and Aronson, 1998). This suggests that those IS (*eg.* EIS) which support executive decision-making are being impacted by Web-based technologies.

The emergence of the Internet and e-Commerce are seen as key factors in business (Malhotra, 2001). Internet-based technology must integrate processes and relationships within and between organisations (Anderson, 2002). It is readily apparent that advancing information technologies have forever changed the management landscape (Hitt, 2000). Hitt (2000) notes that organisations will operate in a state of continual transformation, leaving executives to struggle in a changing environment of ambiguity and uncertainty. Clearly, nowadays an executive’s decision-making processes will be impacted by the existence (if any) of Web-based technologies in the executive’s organisation. Web-based systems deliver the technology but they do not ensure successfully meeting the information requirements of executives (Basu *et al.*, 2000). While information by computer systems is not a very rich carrier of human interpretation for potential action, knowledge resides in the user’s (executive) subjective context of action based on that information (Malhotra, 2001). The theory of reasoned action will be discussed in the next chapter.

In contemporary conditions, it is not reasonable to expect decision-makers to spend their time in specialised training in order to be able to use any software. As Bajgoric (2000) suggests, from the perspective of ease of use, it is Web technology that can help in that sense. The use of the Web has far-reaching impact for collaborative computing in the form of EIS (Turban and Aronson, 1998). It is apparent that Web-based technologies have significant potential for impacting existing and future EIS usage but the extent thereof has not been gauged. The information requirements of executives and how the Web supports decision-making will be discussed in the next section.

3.4 How the World Wide Web supports Decision-Making

The Internet, Intranets and e-Commerce are changing the manner in which business is done, especially when facilitated by appropriate support systems (Turban and Aronson, 1998). Turban and Aronson (1998) note that the decision support of groups whose members are at different locations has become an increasingly important topic because of the increased emphasis on workgroups and teams. The computing environment is rapidly changing to a global network and the Internet (World Wide Web) is the enabling link of accessing information anywhere and at anytime.

There is an increasing use of teams and teamwork in organisations (see, for example, Navarro, 1992; Roberts, 1995). The major feature of networked decision support is the use of several computers and databases connected by networks (Turban and Aronson, 1998). When people are working in teams (especially when the members are in different locations and may be working at different times), they need to communicate, collaborate and access a diverse set of information sources in multiple forms (*eg.* text, video, graphics and voice). Turban and Aronson (1998) indicate that the major information architecture that supports this distributed decision support environment consists of the Internet and Intranets. The Internet is used to support interorganisational decision-making and provides access to information outside the organisation. Intraorganisational networked decision support is achieved by the use of an Intranet which allows people within an organisation to work with Internet tools and procedures. Many software and hardware computing tools can be used to provide networked decision support. These software tools are often known as *groupware*. In the commercial world, several tools offer groupware capabilities (Fraternali, 1999). For the purposes of this dissertation these tools are not discussed any further. For a discussion of the role and

opportunities offered by groupware related to decision support, see, for example, Migliarese and Paolucci (1995). A comprehensive survey of Web-enabled workflow systems is contained in Miller *et al.* (1997).

Networked computing allows organisations to conduct business electronically among business partners. e-Commerce is the execution of business via computer networks. e-Commerce means more than just another way to reach the market since it also gives businesses the ability to share and manage knowledge, the most valuable business commodity (Emery, 2001).

Turban and Aronson (1998) report that decision-makers often need to access data and retrieve information (including graphs, software or animation). Intranets and their basic browsers and search engines are extremely useful for data access and retrieval. With the ever-increasing amount of information stored in databases, the search for information specifically required for a decision may be lengthy and cumbersome even with a good search engine. Intelligent search agents (commonly referred to as intelligent software agents) provide a solution. They can help decrease the search time and perform a more complete search. Intelligent software agents are particularly useful for executives.

Communication is a critical element for decision support (Turban and Aronson, 1998). Individual decision-makers need to communicate with experts, government agencies, business partners, customers and vendors. They must access data and information stored in different databases in several locations. Groups of decision-makers must collaborate, communicate and negotiate to make decisions. IT provides fast, inexpensive and very capable means of providing such communication. Networked computer systems (such as those on the Internet) are the major enabling architectures. Some specific technologies include electronic Mail, chat programs, newsgroups, mailing lists and electronic boards. For the purposes of this dissertation, these technologies are not discussed further. The three previously classified Web-based technologies (see Table 3.1 (p.59)) and how they support decision-making, will now be reviewed. The first Web-based technology is organisational Intranets/Extranets.

3.4.1 Organisational Intranets/Extranets and their influence on decision-making

A distinction is made between the technologies of organisational Intranets and organisational Extranets as follows:

Organisational Intranet

An Intranet (or internal Web) is a network architecture designed to serve the internal information needs of an organisation using Web (Internet) concepts and tools (see, for example, Cortese, 1996). Organisations can use Internet networking standards and Web technology to create Intranets (Laudon and Laudon, 2000). It provides similar capabilities, namely inexpensive and easy browsing, communication and collaboration (Turban and Aronson, 1998) and are used solely for intraorganisational communication activities and information flow (Abraham and Seal, 2001).

Intranets can create networked applications that can run on many different kinds of computers throughout an organisation (Laudon and Laudon, 2000). Typical Intranet applications include:

- publishing corporate documents;
- providing access to searchable directories (*eg.* telephone and address lists);
- publishing corporate, departmental and individual pages;
- providing access to groupware applications;
- distributing software;
- providing electronic mail; and
- providing a consistent user interface.

Turban and Aronson (1998) note that an Intranet changes **decision-making processes** (bold style added by author), organisational structure and procedures and helps re-engineer organisations. Strom (1996) reports that much information on Intranets is available directly on the Web. The use of Intranets is increasing rapidly not only as an internal communication system, but also as a facilitator of e-Commerce (Turban *et al.*, 1999). Robinson (1996) suggests that Intranets can be applied to enhanced knowledge sharing and group decision and business processes. Information that is most frequently included in Intranets *inter alia* includes data warehouse and decision support access (Chabrow, 1998). Many organisations have benefitted from use of the Intranet Web-based technology and have made their organisations more efficient (Sprout, 1995). KPMG Consulting (2002) reports that organisations are focusing strongly on internal communications projects (such as Intranets).

Managerial tasks in organisations typically require more collaborative work than day-to-day operational tasks (Abraham and Seal, 2001). Abraham and Seal (2001) report that an Intranet facilitates the communication behaviour between individuals who have to accomplish a task together. Giesecke (2001) foresees that creating information will become a team process. Communication is facilitated because the Intranet provides the platform to integrate communication tools (eg. electronic mail) as well as information sharing mechanisms (eg. data bases and file servers). It makes it easier for people in managerial roles to make use of IT to carry out their work. Clearly the use of the Intranet becomes integral to the success of the managerial functions in the organisation.

Intranets are being used as the platform for developing and deploying critical business applications to support business operations and managerial decision-making across the internetworked enterprise (O'Brien, 2000). Many applications are designed to interface with and access existing organisation databases and legacy systems so that employees (within the organisation) can access and run such applications using Web browsers from anywhere on the network whenever needed. O'Brien (2000) reports that some Intranet-using organisations are in the process of Web-enabling operational and managerial support applications including **executive information and decision support** (bold style added by author).

Organisational Extranet

An Intranet's infrastructure is confined to an organisation's boundaries while the Internet is an infrastructure that is used to connect organisations (Turban *et al.*, 1999). The combination of corporate Intranets and the Internet is known as an Extranet (Turban and Aronson, 1998). Laudon and Laudon (2000) note that private Intranets that are extended to authorised users outside an organisation are known as Extranets. Extranets are especially useful for linking organisations with customers or business partners (Laudon and Laudon, 2000; Schneider and Perry, 2000). An Extranet can be any of the following types: a public network, a secure (private) network or a virtual private network (Schneider and Perry, 2000). Each has the same capability of sharing information between organisations.

Organisations are using Extranets to allow external parties to access their data warehouses (Gray and Watson, 1998). An example of an Extranet is South African Airways' (SAA) website

at Internet URL <http://www.flysaa.com>. Via a Web browser, a SAA Voyager member can access SAA's Intranet and view the number of accumulated Voyager miles reflected against his SAA Voyager account number.

Extranets enable innovative applications of e-Commerce (Turban *et al.*, 1999). This topic (which is also the next classified Web-based technology reflected in Table 3.1 (p.59) will be discussed in the following section.

3.4.2 Electronic Commerce (e-Commerce) and its influence on decision-making

The Internet, Intranets and Extranets are becoming the principal platforms for e-Commerce and electronic business because this technology provides so many benefits (Laudon and Laudon, 2000). Laudon and Laudon (2000) note that the Internet's global connectivity, ease of use, low cost and multimedia capabilities can be used to create interactive applications, products and services.

e-Commerce could become a significant global economic element during this century (Clinton and Gore, 1997). The infrastructure for e-Commerce is *networked computing* which is emerging as the standard computing environment in business, government and home (Turban *et al.*, 2000). Networked computing connects several computers and other electronic devices by telecommunications networks. This facilitates users accessing information stored in several places and to communicate and collaborate with others. This new breed of computing is helping many organisations (private and public) not only to excel but also frequently to survive. Since the technologies required for networked computing are often immature, organisations are only beginning to develop systems that are big steps toward achieving an ideal that can probably only be approximated (PriceWaterhouseCoopers, 2000). Clearly this new networked computing environment has impacted existing IS and in turn impacts an organisation's EIS.

Definitions of e-Commerce

e-Commerce is an emerging concept that describes the process of buying and selling or exchanging of products, services and information via computer networks (including the Internet) (Turban *et al.*, 2000). Kalakota and Whinston (1997) define e-Commerce from the following perspectives:

- **Communications perspective.** e-Commerce is the delivery of information, products/services or payments over telephone lines, computer networks or any other electronic means;
- **Business process perspective.** e-Commerce is the application of technology toward the automation of business transactions and work flow. For example, during 2002, Absa 'implemented a tactical CRM plan to maximise current investments for short-term benefits and upgraded the data warehouse environment to a two-tier architecture to position Absa for more rapid development and leveraging of information' (Absa, 2002);
- **Service perspective.** e-Commerce is a tool that addresses the desire of organisations, consumers and management to cut service costs while improving the quality of goods and increasing the speed of service delivery. Effective service delivery enjoys a high priority with the emphasis on technology (Absa, 2002); and
- **Online perspective.** e-Commerce provides the capability of buying and selling products and information on the Internet and other online services. Absa serves 36% of the South African online banking population. During the year [ending 31 March 2002], the online population almost doubled to nearly 300,000 with the monthly business value of transactions growing by 83% to R8,75 billion to March 2002 (Absa, 2002).

Turban *et al.* (2000) indicate that the term *commerce* is viewed by some as transactions conducted between business partners. Hence the term *electronic commerce* appears to be narrow to some people. Thus, many use the term *electronic business (e-business)*. e-Business refers to a broader definition of e-Commerce (not just buying and selling) but also serving customers and collaborating with business partners and conducting electronic transactions within an organisation. E-Business is about improving processes, not technology-enabling existing systems (KPMG Consulting, 2002). IBM's CEO, Lou Gerstner, states 'E-Business is all about cycle time, speed, globalisation, enhanced productivity, reaching new customers and sharing knowledge across institutions for competitive advantage'. Competitive advantage depends on the nature and sophistication not only of application software but also of the rest of an organisation's information infrastructure - its data sources, databases, operating systems

and hardware (Pralhalad and Krishnan, 1999). The accountability for automating business processes through the implementation of Internet technologies has moved up the corporate hierarchy and into the mainstream (KPMG Consulting, 2002). e-Commerce is the most visible business use of the Web (Chen *et al.*, 2002). For the purposes of this dissertation, the term *electronic commerce* is used in its broadest scope. Essentially this is equivalent to e-business.

The Framework for e-Commerce

There is a popular misconception that e-Commerce is merely having a Web site. However, this is not the case. There are many e-Commerce applications (*eg.* banking, shopping in online stores, malls, finding a job, conducting an auction, collaborating electronically on research and development projects) and in order to execute these applications, it is necessary to have supporting information, organisational infrastructure and systems. There are several e-Commerce frameworks. One e-Commerce framework was proposed by Kalakota and Whinston (1997). Based on this framework a modified e-Commerce framework was proposed by Turban *et al.* (1999). For a discussion of understanding the relationships among e-Commerce components, see, for example, Zwass (1996). For a recent literature review and classification scheme for e-Commerce research, see, for example, Ngai and Wat (2002).

Applications of e-Commerce may be divided into three categories: (1) buying and selling goods and services. These are commonly referred to as electronic markets; (2) facilitating inter- and intraorganisation flow of information, communication and collaboration. These are sometimes referred to as interorganisational systems (IOS); and (3) providing customer service. For the purposes of this dissertation attention is now focused on IOS.

Interorganisational Systems (IOS)

An IOS involves information flow between two or more organisations (Turban *et al.*, 2000). Its major objective is efficient transaction processing (*eg.* transmitting orders, invoices and payments) using electronic data interchange (EDI) or Extranets (Senn, 1996). EDI is the interorganisational computer-to-computer exchange of structured information in a standard, machine-processable format as defined by the e-Commerce World Institute Resource Centre (see Internet URL <http://www.ecworld.org>) (Tiernan, 2000). An IOS is a unified system encompassing several business partners. A typical IOS will include an organisation and its suppliers and/or customers. The most prominent types of IOS are:

- electronic data interchange (EDI) which provides secured B2B connection over value-added networks (VANs). Before the introduction of the Internet, e-Commerce took the form of EDI over private networks (Mougayar, 1998). The origins of B2B lie in EDI (Kauffman and Walden, 2000);
- Extranets which provide secured B2B connection over the Internet;
- electronic funds transfer (EFT);
- integrated messaging - delivery of e-mail and telefax documents through a single electronic transmission system that can combine EDI, electronic mail and electronic forms;
- shared databases - information stored in repositories is shared between trading partners and is accessible to all parties. The sharing is primarily done over Extranets; and
- supply chain management (SCM) - co-operation between an organisation and its suppliers and/or customers regarding demand forecasting, inventory management and orders fulfilment can reduce inventories, speed shipments and enable just-in-time manufacturing.

Better information leads to better decisions and information from outside the organisation should be included in EIS (Chiusolo and Kleiner, 1995). Chiusolo and Kleiner (1995) note the need for current and accurate information about the organisation and the world in general is common among all executives.

Classification of e-Commerce by the nature of transactions

A common e-Commerce classification is by the nature of transactions. Turban *et al.* (2000) distinguish the following types:

- **Business-to-Business (B2B)**. Today most e-Commerce are of this type. It includes IOS transactions described in Section 3.4.2 and electronic market transactions between organisations. B2B is causing a fundamental transformation of trade (Cassidy, 1995) and will transform the conduct and structure of business (Leebaert, 1998; Kalakota, 1999);
- **Business-to-Consumer (B2C)**. These are retailing transactions with individual shoppers. The typical shopper at Internet URL <http://www.kalahari.net> is a consumer;

- **Consumer-to-Consumer (C2C)**. In this category a consumer sells directly to consumers. Consumers can post their own products online through some agent websites for other consumers to bid (BigNews, 2002). An example is the selling of residential property at Internet URL <http://www.ecr.co.za>;
- **Consumer-to-Business (C2B)**. This category includes individuals who sell products or services to organisations. It also includes individuals who seek sellers, interact with them and conclude a transaction;
- **Nonbusiness e-Commerce**. There are a number of non business organisations (eg. academic institutions, incorporated not for gain organisations, religious organisations and social organisations) which are using various types of e-Commerce to reduce their financial overheads or to improve their operations and customer service; and
- **Organisational e-Commerce**. This category includes all internal organisational activities usually performed on Intranets which involve exchange of goods, services or information.

The global nature of e-Commerce technology, its interactive nature, resourcefulness and rapid growth of supporting infrastructures (especially the Web) result in many potential benefits (eg. expanding the market place, reducing inventories, *etc*) to organisations (Turban *et al.*, 2000). There are, however, limitations of e-Commerce. These can be grouped into technical and non-technical categories. Some of the technical limitations of e-Commerce are:

- there is insufficient telecommunication bandwidth (see first shaded area in Table 3.1 (p.59));
- there are limiting search facilities for filtering Web information (see second shaded area in Table 3.1 (p.59));
- there is a lack of system security, reliability, standards and some communication protocols (see third shaded area in Table 3.1 (p.59));
- **the software development tools are still evolving and changing rapidly** (bold style added by author);
- **it is difficult to integrate the Internet and e-Commerce software with some existing applications and databases** (bold style added by author);

- in addition to the network servers, vendors may require special Web servers and other infrastructures; and
- some e-Commerce software may not fit some hardware or be incompatible with some operating systems or other components.

Turban *et al.* (2000) predict that these limitations will lessen or be overcome. Appropriate planning can minimise their impact. Rapid progress in e-Commerce is taking place (Turban *et al.*, 2000). As technology improves and experience accumulates the ratio of e-Commerce benefits to costs will increase resulting in a greater rate of e-Commerce adoption. For a discussion of e-Commerce in the South African environment, see, for example, Worthington-Smith (2001). Clearly, the Internet offers a wealth of new opportunities for e-Commerce but also presents executives with a series of new challenges (Laudon and Laudon, 2000). These challenges stem from the fact that Internet technology and its business functions are relatively new. While data quality problems have been around for a long while, in the world of e-Commerce, it is getting worse (Simon and Shaffer, 2002). At this juncture the third classified Web-based technology, Wireless Application Protocol (see Table 3.1 (p.59)), will now be discussed.

3.4.3 Wireless Application Protocol (WAP) and its influence on decision-making

The Wireless Application Protocol (WAP) is a standard designed to deliver Internet content and other interactive real-time services (*eg.* mobile banking) to hand-held digital wireless devices. The protocol is designed to optimise Web content for delivery over wireless networks with limited bandwidth and to smaller screens on devices such as mobile phones, pagers, two-way radios and smart phones. WAP enabled devices give users access to such services as e-Commerce applications, news, message modification, call management and unified messaging (PriceWaterhouseCoopers, 2000). For a technical discussion of some wireless technologies, see Appendix 1.

An increasing amount of information is being disseminated to decision-makers via Web interfaces (Albers and Kim, 2000). Advances in wireless networking technologies and portable information appliances have engendered a new paradigm of computing: mobile computing (Jing *et al.*, 1999). In this environment users carry portable devices to information services

through a shared infrastructure regardless of their physical location or movement behaviour. Jing *et al.* (1999) note that with advances in wireless data telecommunications and portable computers, nomadic users will soon enjoy virtually unlimited access to information and services any time and anywhere. The growth in mobile computing devices (*eg.* laptops, notebooks, PDAs, personal communications assistants (PCAs) and the emergence of wide area wireless technologies paves the way for rapid growth in mobile wireless communications (Housel *et al.*, 1998). With an increase in the use of PDAs future websites must accommodate hand-held access (Albers and Kim, 2000). Housel *et al.* (1998) note that mobile computing has brought about a new paradigm of distributed computing in which communications may be achieved through wireless networks and users can compute even when they relocate from one support environment to another.

Recent advances in wireless networking, mobile technologies and applications have led to the emergence of mobile commerce (m-Commerce). For a discussion of m-Commerce applications that run on hand-held devices using wireless and mobile networks, see, for example, Cousins and Varshney (2001).

Access to corporate information nowadays is determined *first* by a device that is used by end-users (Bajgoric, 2000). From that viewpoint the types of information access are: (1) terminal-based access; (2) PC-based access; and (3) portable devices-based access. Given that standard hand-held devices (or hand-held PCs), palm-held devices or PDAs, cellular telephone-based devices (wireless information devices), information agility in contemporary business can be considerably improved by easing the information access. This facilitates decision-making from anywhere at any time.

Mobile computing is extremely important. One key point for mobile computing's wide acceptance is the user's efficient access to applications (Imielinski and Badrinath, 1994). This includes access to legacy and existing systems with minimum effort and cost. It is also cost effective and has reliable support for new applications. Clearly using this Web technology and gaining access to these systems effortlessly enables users to make more informed and timely decisions in response to changing conditions in the marketplace. Such new technologies combined with advanced software development tools (*eg.* computer-aided software

engineering (CASE), rapid application development (RAD) and object-oriented programming (OOP)) have facilitated the development of the specialised applications required to support executives (Volonino *et al.*, 1995). Volonino *et al.* (1995) note that these advanced tools also incorporate a high level of customisation and dynamism which are vital for acceptance and sustained usage. Some organisations in highly competitive industries (*eg.* banking and consumer goods) which tend to be early adopters have successfully and widely deployed EIS using these technologies (Volonino *et al.*, 1995).

There are challenges facing the deployment of the next generation networks that are so necessary to breach the digital divide between the developed countries and Africa. Africa has to prove to the world that it is capable of using the latest technologies to provide world-class solutions for electronic business and to start competing in the new global economy (de Villiers and du Preez, 2001). Africa possesses less than 1,0% of the world's Internet connections (Kaiser, 2001). The South African Web market comprises approximately 0,5 to 1,0% of the world market (Worthington-Smith, 2001). Relative to South Africa's population the user base is predictably low and this indicates the challenge South Africa faces in bridging the digital divide. The aggressive investments into third generation networks by cellular providers all contribute to the fact that existing and emerging wireless technologies are the key to enabling developing countries (like South Africa) to join and compete in the global market through electronic business (Edgar, 2001). In addition to globalisation South Africa is increasingly being exposed to the continuing technology explosion and more highly developed communications systems (Geldenhuys, 2001). Decision-making 'has to be undertaken at lightning speed' (Gower, 2001).

Technology has the power to allow South Africa to leapfrog to the top of the technological heap as intermediate stages in the evolution of the country can be skipped (Kok, 2001). For example, South Africa can go straight to a rural cellular network without having first to go through a fixed line network stage. Whether existing, emerging next generation wireless technologies and/or other mobile technologies impact EIS usage in organisations in South Africa, is uncertain. Hence this situation will be surveyed by the author. Using various components of EIS, integrated with an organisation's Intranet, the Internet, an organisation's Extranet, B2B and B2C applications, WAP and other mobile technologies, an executive can

transform data to play out various alternatives and business scenarios to determine what effects of certain decisions will be (Beheshti, 1995). Beheshti (1995) notes this is particularly useful for confidential decision-making.

Globalisation of trade, the emergence of information economies and the growth of the Internet and other global communications networks have recast the role of IS in business and management (Laudon and Laudon, 2000). In this environment traditional EIS are making a transition 'to the new Web-based information systems that cater to the demands of a highly diversified audience' (Basu *et al.*, 2000). Given this scenario the relevance of the Web to EIS and research in that area will now be discussed.

3.5 The Relevance of the World Wide Web to EIS usage and Research in that Area

It is commonly argued that IT does affect the organisation structure and strategy and has a profound effect on management (Drucker, 1988; Leavitt and Whistler, 1988). It alters the nature of work in the workplace (Igarria *et al.*, 1994). IT impacts are best addressed at the level of the individual organisation (Brynjolfsson and Hitt, 1998). The Internet has fundamentally changed the ways in which much of the world communicates and does business (Hardaker, 2001). EIS can help managers keep information of relevance to the organisation's success within easy access (Beheshti, 1995). For organisations to succeed in the current business environment, it is important to develop policies to create an environment conducive to technological innovation (Basu *et al.*, 2000). This entails the need to prioritise available resources to facilitate the development of implementation of new ideas and technologies (Lai *et al.*, 1993). The continued challenge remains in terms of ensuring adaptability and flexibility of information interfaces - both internally and **externally** (bold style added by author) - required for coping with dynamically changing business and competitive environments (Malhotra, 2001). As Mintzberg (1973) reports, a manager performs several roles in which the exchange and access to information is a critical aspect.

Executives (as most people) nowadays have an increased computing literacy and can confidently locate online information due to extensive personal use of the Web - a knowledge which is transferred to their business setting (Basu *et al.*, 2000). The Web has become a vast information resource in recent years (Meng *et al.*, 2002). Meng *et al.* (2002) report that most

data on the Web is in the form of text or image. A 1999 survey reports that 92% of CEOs, Chief Financial Officers and Chief Information Officers have Internet access, 81% go online at least weekly and 50% feel comfortable using the Web (Andersen Consulting News, 1999). Despite user friendliness as a prerequisite in EIS, in earlier EIS environments training was found to be an essential. Organisations who participated in this 1999 survey report that limited or no training was needed with new Web-based systems because the software is intuitive and works the same regardless of computer configuration. Organisations capitalised on the self-training users undertook outside their work environments (Basu *et al.*, 2000). While traditional EIS had limited diffusion within the organisation from the late 1980s to early or mid-1990s the emergence of new Web-based systems were catalysing change to existing EIS paradigms.

3.5.1 Catalysts of change for Executive Information Systems

In earlier traditional EIS, Basu *et al.* (2000) report that in some instances, only a few executives actually used the system. In other instances, more users were logged but only on a small percentage of the system's functions. The primary reasons cited were that the system was too hard to use or had little added value for the executive. Actual benefits were not aligned with high development costs. Basu *et al.* (2000) report that these experiences parallel general trends. Two surveys conducted during 1995 indicate executive discontent in:

- a Price Waterhouse survey, 87% of 200 executives did not have the needed information (Wagner, 1995); and
- an Ernst and Young survey 71% of 400 executives stated they were dissatisfied with legacy systems (Blumenthal, 1995).

During this period, globalisation was increasing the expanse of business along with the need for more collaboration and communication. Concurrent with these conditions Internet technologies began to emerge. Once the infrastructure for Internet access existed, it was a small step to apply the technology to internal applications. Articles in journals (*eg. Management Accounting and Business Week*) explained the benefits of Intranets and their software suppliers in clear terms to executives: 'Internet/Intranet?' (Castelluccio, 1996), 'Here comes the Intranet' (Cortese, 1996) and 'Intranets: The second wave' (Gulati, 1997). As stated earlier in Section 3.5 nowadays executives can confidently locate online information due to extensive

personal use of the Web. Furthermore vendors of decision support software see a larger market for products that provide OLAP spreadsheet-type capabilities and Web-based solutions (Gray and Watson, 1998).

With the demise of early EIS, in the early to mid-1990s some organisations surveyed (Basu *et al.*, 2000) consciously discontinued these systems after conducting some level of value-based analysis. Other organisations gradually migrated to Intranet applications such as groupware, database querying, electronic calendars and scheduling. All organisations have browser-based Intranets. The Web browser has become ‘an almost universal interface’ for end-user access (Gray and Watson, 1998). In summary the catalysts of change away from traditional EIS implementations were as follows:

- systems difficult to use;
- high costs compared to value added;
- lack of needed information;
- dissatisfied executives;
- globalisation; and
- better technological alternatives were becoming universally known.

It is important to recognise the role of the Web in decision support (Gray and Watson, 1998). Like all computing Web-based technologies affect how all applications are developed and used. Gray and Watson (1998) note that many organisations are building decision support applications that have a multi-tier architecture consisting of a browser, Web server and data base. Recognising this shift vendors of decision support software (*eg.* EIS) are making their products Web enabled. Applications can now be accessed by browsers but still provide the capabilities long associated with decision support software (Gray and Watson, 1998).

Nowadays there is an urgent need for organisations to adapt to constantly changing business conditions. IT can enable the fast adaptation necessary to accommodate these constant and rapid changes in the business environment (Keen, 1991). For example, in a January to March 2002 KPMG survey (KPMG Consulting, 2002), 63% of respondents surveyed believe that new technology will increase the number of customers that their organisation serves. It is argued by the author that EIS, particularly those that incorporate emerging Web-based

technologies, can increase an organisation's ability to react to changing circumstances, quickly and flexibly. Organisations must control ever more sophisticated types of information (Yager, 1999). For example, Astral Datatech Solutions announced the local availability of Monarch|ES®, a Web-enabled software suite that provides live multi-dimensional data analysis (Carroll, 2002b). The data within the selected reports are rendered as HTML ready to provide users with the BI which they need to pro-actively manage the enterprise. Every Monarch|ES® system starts with the ES Report portal base module. Tools such as enterprise portals provide fast, powerful insights into the business (Anderson, 2002).

Organisations are evolving into virtual enterprises using integrated computer and communications technologies and linking hundreds, thousands, even tens of thousands of people together (Bleecker, 1994). Executives are now able to process queries which provide up to minute information in situations where timeliness and completeness are of equal value (Volonino *et al.*, 1995). Clearly the 1990s 'face' of EIS has changed and the next generation of EIS has arrived.

3.5.2 The next generation of Executive Information Systems

Executives place substantial requirements on EIS (Turban and Aronson, 1998). Firstly they often ask questions which require complex, real-time analysis for their answers. Hence many EIS are being linked to data warehouses and are built using real time OLAP in separate multi-dimensional databases along with organisational DSS. There are also efforts to use data warehouse and OLAP engines to perform data mining (Han, 1998). Giuffrida (2002) reports that efficient and effective data mining can be achieved on top of standard database management systems. Secondly executives require systems that are easy to use, easy to learn and easy to navigate. Turban and Aronson (1998) report that current EIS generally possess these qualities. Thirdly executives tend to have highly individual work styles. While the functionality of the current generation of EIS can be moulded to the needs of an executive, it is more difficult to alter the general look and feel or method of interaction with a system. Fourthly any IS is essentially a social system. Turban and Aronson (1998) note that one of the key elements of EIS is the electronic mail capabilities it provides for members of the executive team. Nowadays, the electronic mailing of multimedia documents is becoming critical. Given this scenario EIS of the future will look significantly different from today's systems.

Nord and Nord (1995) report that developers of decision support technology for executives must be alert to the needs of top executives and EIS evolution. Like most other IS EIS have migrated to the networked world of the technical workstation and Intranets. The advent of Web services now allows interaction between software and systems that would previously only have been possible with extensive systems development (Anderson, 2002). Furthermore Volonino *et al.* (1995) report that the impact from CASE, RAD and OOP will affect the structure, development and deployment of EIS. Turban and Aronson (1998) describe some of the features that are emerging or likely to appear in the next generation of EIS:

- **A toolbox for building customised systems.** To quickly configure a system for an executive, the builder of the system requires a toolbox of graphic and analytical objects that can be easily linked to produce the system. Commander EIS LAN®, Forest and Trees® and Pilot Decision Support Suite® are examples of such tools;
- **Multimedia support.** The requirement that an EIS can be configurable also requires support of multiple modes of output and input. The current generation provides text and graphic output with keyboard, mouse or touch screen input. The rapid proliferation of databases supporting image data, voice and video will no doubt mean that future EIS will be multimedia in nature. Audio and video news feeds ('soft' information) via the Internet through LANs are currently a reality;
- **Virtual reality and 3-D image displays.** The development of virtual reality standards, the ability to examine megabytes of data on a landscape or in a map form via 3-D visualisation, and higher resolution monitors are beginning to affect EIS. As these tools are deployed for general use executives will adopt them to assist in their data visualisation for information evaluation and decision-making;
- **Merging of analytical systems with desktop publishing.** Many reports prepared for executives contain text, graphs and tables. To support the preparation of these reports, some software companies have merged desktop publishing capabilities with various analytical capabilities. In keeping with multimedia features, EIS have the capability to cut and paste data and graphs from various windows and to ship that document (via electronic mail) to other executives or post it to a Web site;

- **Client/server architecture.** This approach is extremely important for EIS as the server provides data to client software running on the executives' workstation. The original architecture of EIS was the client/server environment and it has now been adopted for many IS applications including data warehousing and Web technology. For a technical discussion of Web client/server communication, see, for example, Schneider and Perry (2000);
- **Web-enabled architecture.** Web browser software is the cheapest and simplest client software for an EIS. This is leading toward Web-enabled EIS. The current generation of software supports information delivery via the corporate Intranet and is evolving into the norm rather than the exception. Some examples are: Comshare provides Commander DecisionWeb®, Pilot Decision Support Suite® contains an Internet publishing module and the SAS Institute provides Internet support for its flagship enterprise software suite;
- **Automated support and intelligence assistance.** Expert systems and other artificial intelligence systems are currently embedded or integrated with existing DBMS or DSS. Clearly this adds more automated support and assistance to the analytical engines underlying EIS. The researchers indicate that one is also likely to see other forms of intelligent or automated assistance. One such form is the intelligent software agent (see previous discussion in Section 3.4). An agent can learn how the executive uses an EIS and adopts the appropriate screens in the executive's preferred order. Other agents are actively used in Web search engines and can be deployed in Web-enabled EIS;
- **Integration of EIS and group support systems.** Much of the technology developed for group support systems (*ie.* groupware) can be used effectively by executives for a number of managerial tasks. For example, Haley and Watson (1996) document ten cases where Lotus Notes® was specifically chosen for EIS development; and
- **Global EIS.** As organisations become more global in nature, providing information about international locations around the world is becoming critical to organisations' success. The accuracy and timeliness of information for decision-making become critical. The challenge has become to find ways to integrate information across the enterprise (Ba *et al.*, 1997). The transparency

of the integration of the information process is what makes Web technology so effective. Palvia *et al.* (1996) investigated the types of data that executives require in two scenarios: (1) introducing a new service or product into other countries; and (2) distribution channel expansion into other countries. Most of the executive information requirements include demographic and marketing data from public sources and 'soft' information from personal contacts. Palvia *et al.* (1996) indicate that EIS can be used to provide the 'soft' information. Soft information that is provided in EIS can be classified in groups according to their softness (Watson *et al.*, 1996). This classification helps the user judge them (Müller *et al.*, 1997).

The following current trends in EIS are suggested by Watson *et al.* (1997):

- EIS are becoming more enterprise-wide with greater decision support capabilities;
- **EIS are becoming used or integrated with software not specifically designed for it, eg. the World Wide Web technology** (bold style added by author); and
- EIS are gaining in intelligence through the use of intelligent software agents.

Given these EIS trends and a recent survey, the composition of emerging Web-based EIS will now be discussed.

3.5.3 Composition of emerging Web-based Executive Information Systems

In an EIS survey, Basu *et al.* (2000) note 'that the usage, adoption of an EIS in an organization present (*sic*) new challenges and impacts'. Basu *et al.* (2000) conducted eleven case studies and report that 'the case studies have provided some unique insights on the subject of EIS'. The findings from their research under the paragraph headings *Impetus for EIS*, *Rationale for EIS*, *Benefits and usage of EIS* and *Diffusion of EIS* are now briefly discussed.

Impetus for EIS

Most EIS were designed internally by IS departments. Basu *et al.* (2000) did not encounter a single case where the EIS was purchased commercially. They suggest that information sought

by top executives is very specific to the industry and must tie directly into existing feeder systems within the organisation. In this age of technology executives may feel it appropriate to use an EIS, however, the initiative seems to evolve more as an extension of other systems in the organisation as opposed to specific demands by the executives. As is commonly held the impetus may not always be top-down. The case studies indicate that these systems are usually a product of smaller systems that could be implemented and integrated on a pre-existing IT infrastructure.

Rationale for EIS

The most important reason for using an EIS comes from its value added to the decision-making process. As it is costly to develop and based upon fluid sources of data an EIS is only considered viable when an executive perceives that there is clear value gained from its use (bold style added by author). This is a common fact among all levels of IS but is more pronounced at the EIS level since the outputs of the system are not driven by reporting regulations, operational logistics or transactional recordings. For example, a financial system may be tolerated even if evaluated as less than desirable because it is an essential reporting system. An EIS may be dropped if it does not meet the critical bottom line of 'significant added value'. Basu *et al.* (2000) report that in most cases there were no formal cost-benefit analyses prior to EIS development and little after implementation.

Benefits and usage of EIS

Most executives interviewed in these case studies seemed to learn quickly how to use an EIS. This was evidenced by short training times. This infers that the desired 'ease of use' system design requirement is being successfully met (The 'ease of use' concept introduced in Section 1.3 will be fully discussed in Chapter 4).

How executives use an EIS differs from expectations. Executives appear to use an EIS to identify initial symptoms and then use conventional methods (*eg.* telephonic contact with relevant parties) to figure out the details of the problem. This implies that an EIS trademark, the ability to 'drill down' to the heart of the problem, may not be critical to executives.

Most of the early systems were a type of hybrid system. While in many cases, fixed data was presented to executives, the user could display the information in data or graphical form. These users were allowed some level of flexibility regarding the types of variables they wished to look at.

Diffusion of EIS

Basu *et al.* (2000) suggest that in this area, a contradiction in terms may exist. By definition, EIS are designed with upper echelon executives in mind thus restricting the diffusion curve *ie.* the number of users in this category is quite small and a plateau should quickly be reached. For a discussion of diffusion see Lewin's change model (Lewin, 1952); the stages of diffusion (Cooper and Zmud, 1990) and explanation of the diffusion characteristic in epidemic models (Holland and Leinhardt, 1977; Kinderman and Snell, 1980). Given the fact that EIS have highly political stigma (Watson *et al.*, 1991) and are implemented at the highest level in organisations, it is expected that some inconsistencies from traditional diffusion models may be observed (Basu *et al.*, 2000). These inconsistencies are not explored in this dissertation.

In terms of numbers of users, diffusion down the organisational hierarchy is the only growth direction. However, if this occurs one may then question whether the basic definition and adjective 'Executive' IS is still accurate. If EIS usage diffuses to the mid-management level (or lower), is it still an 'EIS'? Case studies indicate that usage does migrate from executives to lower management levels within organisations (see, for example, Salmeron, 2001). Basu *et al.* (2000) observe a varying degree of diffusion trends among the surveyed organisations. Diffusion patterns varied from the traditional S-shaped curve to growth spurts more consistent with epidemic models. In each case, the diffusion of the EIS was directly affected by the payback of the system. The impact on productivity, decision-making, competitiveness and market share were small to moderate. The largest impact was in the area of customer satisfaction and the feeling of comfort with computers. These impacts lay the foundation for future EIS (Basu *et al.*, 2000). These areas (customer satisfaction and feeling of comfort) fall within the Ease of Use domain. The Ease of Use construct, specifically in the Technology Acceptance Model, will be reported on in the next chapter. At this stage Web integrated IS for executives will now be discussed.

3.5.4 Web integrated Information Systems for Executives

Basu *et al.* (2000) note that the term 'EIS' is no longer used consistently or directly as the current environment is much broader, serves a wider base of users and it is not self-contained. As indicated in Section 2.3.3, there is still some debate as to whether an EIS is an IS for executives or for everyone (Guiden and Ewers, 1989). Traditional EIS supports a few top executives but the emerging view is that EIS can spread horizontally across and vertically down to other organisational managers. Salmeron (2001) suggests that 'the current trend is to view EIS as technology for the information delivery for all business end users'. Volonino *et al.* (1995) propose that EIS be viewed as technology for information delivery to all business end-users, one subset of which is the executive user; where the support provided is customised to the needs and nature of the class of user. Basu *et al.* (2000) suggest that EIS is rather a conglomerate of Web-based tools forming a Web integrated Information System (WIIS).

The evolution of an EIS is a complex process (Monash University, 1996). A WIIS serves as the electronic interface for an organisation by pulling together needed internal and external information and storing it for quick access by users. Internet data may be downloaded to intranets on corporate Web pages to present relevant sites for executive access. Executives may search their own Web sites in addition to that which is provided. Browser plug-in software permits most type of applications to be launched via a Web link. Literature in the IT field suggests that characteristics of EIS parallel those of the Internet/Intranet and any differences that do exist are in favour of a WIIS (Tang *et al.*, 1997; Gopal and Tung, 1999). As stated in Section 1.2, all major features of the Web have been available for years outside the Web (Averweg and Erwin, 2001). Furthermore it has been shown that executives obtain information by scanning, general browsing and focused searches that seek to answer a specific question (Vandenbosch and Huff, 1997). A direct match with WIIS leads to user perceptions of effective and efficient use of information. As introduced in Section 1.3, two belief variables (Perceived Usefulness and Perceived Ease of Use) are the most important factors determining use of computers or IS. These variables will be discussed in the next chapter.

With more and more information becoming available in electronic form, organisations have increasingly carried out environmental scanning using EIS linked to online databases (Vandenbosch and Huff, 1997). This trend is likely to grow as the borderless nature of the

Internet suggests that organisations may be able to scan a greater variety of information sources that cover a wider range of environmental sectors (Tan *et al.*, 1998). Environmental scanning often initiates a chain of actions that lead to organisational adaptation to environmental changes (Hambrick, 1981). The viability of an organisation depends on its ability to stay ahead of environmental challenges and thus environmental scanning can be considered a vital organisational task (Boyd and Fulk, 1996) and this 'soft' information is needed for successful competition and survival (Turban and Aronson, 1998). Some scanning of news stories, internal reports and Web information is performed by intelligent agents (see Sections 2.7.9 and 3.2) (Turban and Aronson, 1998). The ease of access to information on the Internet and as a borderless information resource which transcends traditional boundaries and notions for information acquisition and use, may change the way executives conduct environmental scanning (using EIS) in the future (Tan *et al.*, 1998). The Internet abolishes geographical distance - the latter is no longer a hindrance to communication (Kaiser, 2001).

The research by Basu *et al.* (2000) reports that many of the technology uses lean towards collaborative rather than decision supportive type of functions for executives and managers. Basu *et al.* (2000) suggest that adoption by an organisation is more likely for collaborative aids because of lower development and IS resource demands. Adoption within an organisation seems more diffuse than with the EIS predecessor because the technology can provide all levels of users with needed information and user training costs are minimal. This may be an area for future research. The findings of a shift to collaborative aids for executives is supported by empirical research (Rai and Bajwa, 1997). The following specific functions are identified as common to WIIS:

- collaboration, communication and exchange of documents and information;
- generation of basic reports in text, three dimensional graphics and interactive forms with database queries;
- 'drill down' to more detailed information via links on Web pages;
- modeling capabilities for forecasting and manipulation of data and information. This is partially achieved with downloadable spreadsheets or databases that users obtain from Web pages;
- monitoring and comparative analysis, OLAP (see Section 2.3.3) which can extract and present multi-dimensional data from different perspectives;

- access to external and environmental information with links to consultative, professional and financial services, or news/trend-related Web sites; and
- Extranets which permit data input and sharing with external corporate partners, customers and suppliers.

From the above discussion, the shift to WIIS is depicted in Figure 3.1.

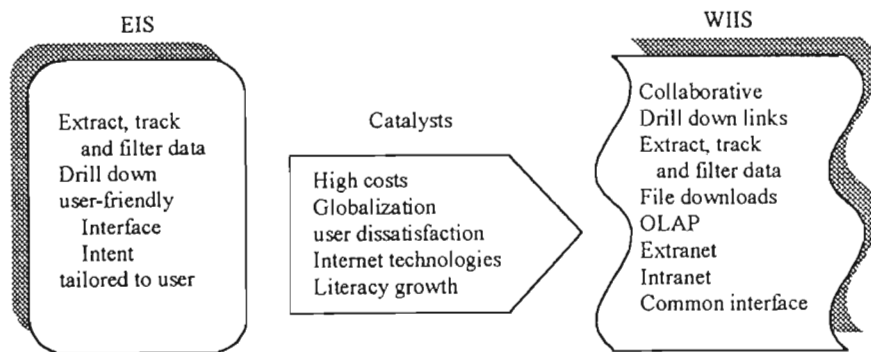


Figure 3.1
The shift to Web Integrated Information Systems (WIIS)
 (Source: Basu *et al.*, 2000)

In order to increase WIIS functionality, powerful Web-based tools such as WebFOCUS® for J.D. Edwards® (see Section 2.7.9) and COGNOS POWERPLAY® are being successfully used by planning and research staff in organisations without a need for significant technology support. In some other cases, IS staff are employing SAP® and Oracle® Web developer products to provide browser access to mainframe databases. See previous discussion (in Section 1.8) on the use of Oracle® products in the South African EIS environment. This approach of using powerful Web-based tools may have potential relevance to the eThekweni Municipality for its common financial system J.D. Edwards® in supporting the City Treasurer’s decision-making processes. See, for example, Averweg (2002a).

The enhanced portability of delivered applications, has facilitated the acceptance of IT into the executive workplace. Portability continues to be further advanced by wireless technologies (see discussion in Section 3.4.3) that fit in with the itinerant nature of executive life. Volonino *et al.* (1995) report that portability promotes managing in near-real time and at anytime which can lead to tangible improvements in productivity by enabling executives to determine when to be

productive. Nowadays executives and business end-users are able to tap into information resources that were previously not accessible because of economic and/or operational barriers.

Basu *et al.* (2000) note that traditional EIS are 'a thing of the past' and most organisations have moved to other types of systems, such as WIIS. However, Salmeron (2001) reports 'a trend towards direct use of EIS by Spanish executives'. Lederer *et al.* (1998b) report that organisations adopting WIIS indicate that the most important benefit of being on the Web is to 'enhance competitiveness or create strategic advantage'. Given the Web's ease of use in multiple environments and positive user perceptions Basu *et al.* (2000) suggest that WIIS will be more widely adopted and diffused among organisations. They caution, however, that whether WIIS actually meet the information requirements of executives will be determined over the next five years as more organisations implement and experience these systems. Users will continue to pull and receive pushed information from the Web (Kendall and Kendall, 1999). The research by Basu *et al.* (2000) clearly shows that the advent of the Internet Age and resultant Web-based technologies have significantly impacted traditional EIS in organisations in the USA. Whether such a similar EIS situation exists in organisations in South Africa (and in particular in the province of KwaZulu/Natal) is the focus of this research; namely to identify and rank Web-based technologies in order of their perceived impact on EIS in organisations currently and in the future. This investigation and survey will be fully discussed in Chapter 5.

The purpose of this chapter was to review the current status of Web-based technologies affecting EIS implementation. This has been undertaken.

3.6 Conclusion

This chapter discussed the concept of IT being the major facilitator of business activities for improved decision-making. Advances in computer technologies have led to the development of the Internet and its most popular application the Web. An overview of the current state of Web-based technologies was then presented. How the Web supports decision-making in organisational Intranets and Extranets, e-Commerce and WAP environments was then discussed. The relevancy of the Web to EIS the next generation of EIS and some current research in this area was then presented. With the changing use of EIS in the Web environment this provides the backdrop for introducing the concept of IT adoption and usage in the next chapter.

In this next chapter a literature analysis of previous research on IS success, IT adoption and usage (with specific focus on EIS) is made. The framework used is the Technology Acceptance Model (TAM). In Chapter 5 the conceptual framework justifying the survey undertaken in South Africa is then discussed. This chapter also looks at the design, formulation and discussion of the experimental work (field survey) of this dissertation.

CHAPTER 4

REVIEW OF PREVIOUS RESEARCH ON INFORMATION TECHNOLOGY ADOPTION AND USAGE

4.1 Introduction

The purpose of this chapter is to review existing research regarding successful IS implementation with specific focus on the usefulness and use of IT as conceptualised by the Technology Acceptance Model (TAM). TAM proposes that levels of usefulness and ease of use predict applications usage (Davis, 1989; Davis *et al.*, 1989).

The goal of TAM is provide an explanation of the determinants of computer acceptance that is general, capable of explaining user behaviour across a wide range of end-user computing technologies and user population. A key purpose of TAM is to provide a basis for tracing the *impact* of external factors on internal beliefs, attitudes and intentions (Davis *et al.*, 1989). TAM posits that two particular beliefs, perceived usefulness and perceived ease of use, are of primary relevance for technology acceptance behaviours.

In this chapter TAM's theoretical underpinnings (based on Ajzen and Fishbein's Theory of Reasoned Action), research findings, limitations thereof and research implications are discussed (TAM in predicting user acceptance of corporate technologies (*eg.* Web technologies) and research on some general extensions to TAM are then reviewed). Some recent research on TAM and the Web and TAM's applicability to EIS are then discussed. This discussion is then used as the foundation for the design and formulation of the experimental work of this dissertation contained in Chapter 5.

4.2 Successful Information System Implementation

The Internet and Web-related technologies, with their numerous capabilities, have emerged as the new agents of change (Looney and Chatterjee, 2002). Their wide-ranging capabilities include global information dissemination, interactive communication, mass communication, collaboration, transactional support and integration (Cronin, 1996; Chatterjee and Sambamutthy, 1999). An increasingly attractive means of improving these processes lies in the

wide variety of IT (see Child, 1987; Drucker, 1988). For example, ERP software is considered as a system that aims to serve as an information backbone for the whole organisation (Bajgoric, 2000). Bajgoric (2000) notes that the crucial point is in efficient integration of all business processes with an emphasis placed on reporting and BI (see previous discussion in Section 2.3.3) capabilities important for management. ERP is a collection of modules that produce a wide range of manufacturing management decision support information (Schubert, 2000). Turning organisations into 'ERP-enabled enterprises' is a dominant theme of modern business (Laing, 1999) and many organisations have initiated ERP projects (Sumner, 1999). As Bajgoric (2000) notes, the successful deployment of an ERP system results in an organisation which has integrated information flow between different business functions and even different business locations. After the successful implementation of ERP software, organisations are adding BI tools to their ERP systems to enhance access to data and improve organisational decision-making. ERP vendors such as SAP®, Oracle® and J.D. Edwards® provide such BI products. With the existence of Web-based technologies coupled with their many different business applications, this strong move to make processes more efficient is especially relevant nowadays. Executives more than ever need more effective ways to understand their markets, their competition and guide their operations and people (Guiden and Ewers, 1990). EIS can be key to the effective executive. However, significant difficulties often plague IT implementation (McFarlan, 1981; Kwon and Zmud, 1987; Tait and Vessey, 1989). Hence there is the need to investigate what makes IT implementation successful.

Implementation refers to all organisational activities working toward the adoption, management and routinisation of an innovation (Laudon and Laudon, 2000). Much research has been undertaken to develop a better understanding of both IT implementation problems and how these can be resolved. For example, Kwon and Zmud (1987) categorised this research as follows:

- **Factors research.** Factors research focuses upon a variety of individual, organisational and technological forces which are important to IT implementation effectiveness. Factors found to have a significant impact include top management support of the implementation effort, good IT design and appropriate user-designer interaction and understanding (see Fuerst and Cheney, 1982; Ives and Olson, 1984; Sanders and Courtney, 1985).

Davis (1989) notes that in designing or implementing successful systems, perceived usefulness (see Section 4.5) is a strong correlate of user acceptance;

- **Process research.** Process research examines social change activities and suggests that implementation success occurs when commitment to change and the implementation effort exists, extensive project definition and planning occurs and management of the process is guided by the organisational change theories (see Ginzberg, 1981; DeSanctis and Courtney, 1983); and
- **Political research.** Political research recognises that the diverse vested interest of IT stakeholders affect implementation efforts and that successful implementation depends upon recognising and managing this diversity (Markus, 1983). As information is the basis of corporate power EIS can challenge traditional lines of communication (Beheshti, 1995).

From a technological diffusion perspective, IT implementation is defined as an organisational effort directed toward diffusing appropriate IT within a user community (Kwon and Zmud, 1987). Kwon and Zmud (1987) developed an IT implementation research model which is based on the organisational change, innovation and technological diffusion literature. It is based on Lewin's (1952) change model. A variation of their stage model, which incorporates some of the post-adoption behaviours developed by Zmud and Apple (1992), is now discussed.

4.3 Zmud and Apple Stage Model of Information Technology Implementation

Zmud and Apple's (1992) stage model of IT implementation activities is as follows:

Initiation

- **Process:** Active and/or passive scanning of organisational problems/opportunities as IT solutions are undertaken. Pressure to change evolves from either organisational need (pull), technological innovation (push) or both. Chau and Tam (2000) report that the concepts of need-pull and technology-push were introduced by Schon (1967) as the underlying motivations and driving forces behind the innovation of a new technology (Chidamber and Kon, 1994). For a discussion of current Web pull and push technologies, see, for example, Kendall and Kendall (1999).
- **Product:** A match is found between an IT solution and its application in the organisation.

Adoption

- Process: Rational and political negotiations ensue to obtain organisational backing for implementation of the IT application.
- Product: A decision is reached to invest resources necessary to accommodate the implementation effort.

Adaptation

- Process: The IT application is developed, installed and maintained. Organisational procedures are revised and developed. Organisational members are trained both in the new procedures and in the IT application.
- Product: The IT application is available for use in the organisation.

Acceptance

- Process: Organisational members are induced to commit to IT application usage.
- Product: The IT application is employed in organisational work.

Routinisation

- Process: Usage of the IT application is encouraged as a normal activity.
- Product: The organisation's governance systems are adjusted to account for the IT application. The IT application is no longer perceived as something 'out of the ordinary'.

Infusion

- Process: Increased organisational effectiveness is obtained by using the IT application in a more comprehensive and integrated manner to support higher levels of organisational work.
- Product: The IT application is used within the organisation to its fullest potential. See Sullivan (1985).

One of the difficult and long standing problems faced by academics and practitioners is the assessment of the relative success of an IS (see previous discussion in Section 2.5). This is an

important problem because researchers must depend on precise quality construct measurement in order to provide sound guidance to practitioners. Without a well-defined dependent measure researchers cannot be confident in their results and much of their research may be purely speculative. Consequently the author selected three respected streams of IS success research for discussion in the next section.

4.4 On some Streams of Information System Success Research

The following three streams of IS success models are well-cited in the literature:

- DeLone and McLean Model;
- Garrity and Sanders Model; and
- Davis Technology Acceptance Model.

Each of the first two models will be briefly reviewed in this section. The justification for selecting the third model (Davis Technology Acceptance Model) for the purposes of this dissertation will then be given in Section 4.5.

4.4.1 DeLone and McLean Model of Information System Success

The first stream of IS success research is the DeLone and McLean model of IS (see previous discussion in Section 2.5.1 and Figure 2.1 (p.29)). It is one of the most widely cited models of IS success. This model is useful because it identifies the major areas that researchers have chosen to focus on when considering IS success measurement (Sherman *et al.*, 2001).

Rainer and Watson (1995a) report that their findings regarding successful EIS confirms the research undertaken by DeLone and McLean (1992); namely the six dimensions of IS success: system quality, information quality, use, user satisfaction, individual impact and organizational impact (see Section 2.5.1). Rainer and Watson (1995a) state that the ‘most important variables affecting successful operation of the EIS are those that affect the executives and their work’ and suggest that ‘future research should examine actual executive usage of ... their EIS’.

4.4.2 Garrity and Sanders Model of Information System Success

In the second stream of IS success, Garrity and Sanders (1998) expand on the DeLone and McLean (1992) model by identifying four major factors they assert are the basic underlying

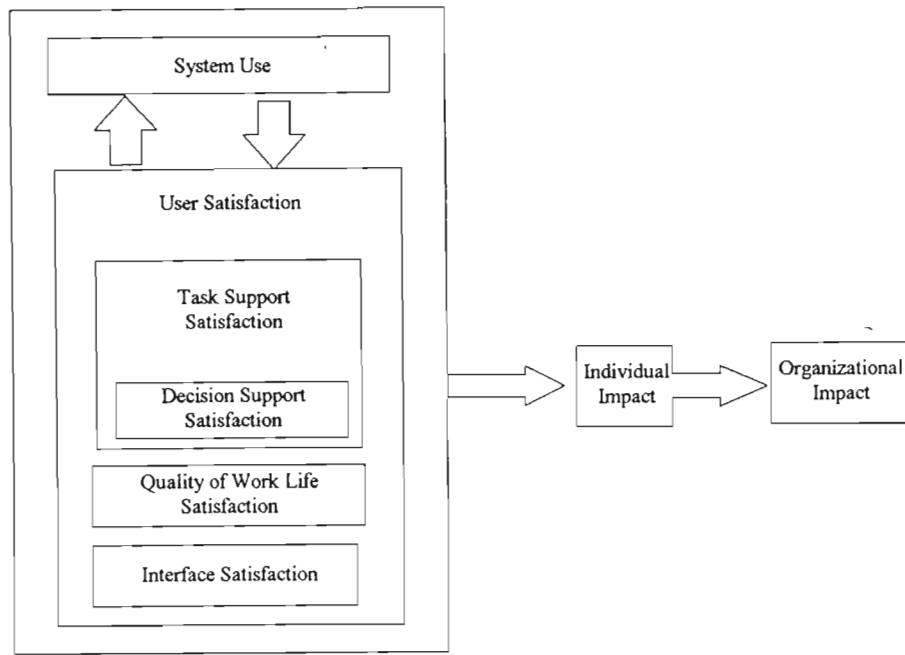


Figure 4.1 Garrity and Sanders Model of Information System Success
(Source: Adapted from Garrity and Sanders, 1998)

constructs which make up existing success measures in the IS field. See Figure 4.1. Garrity and Sanders (1998) identify a four-factor model based on three major viewpoints which influence the conceptualisation of IS in organisations:

- **Organisational System Viewpoint.** This perspective examines systems from a functional, input-process-output model or viewpoint. The organisational system treats IS from an engineering or mechanistic perspective. This perspective underlies Task Support Satisfaction and Decision Support Satisfaction. Both Task Support Satisfaction and Decision Support Satisfaction attempt to assess the effectiveness of an IS;
- **Socio-Technical Viewpoint.** In this case, IS are understood from a broader perspective which recognises the human component of systems and relationships beyond the documented methods and procedures (Sachs, 1995). Sherman *et al.* (2001) note that this is a very important perspective which is often overlooked. This viewpoint of systems forces developers to confront the reality that humans often have their own set of goals and objectives. These different, personal objectives can often cause problems when systems are designed from a 'closed-world' organisational perspective; and

- **Human-Machine Viewpoint.** This is a strategy which is adopted by many researchers when assessing systems success. Sherman *et al.* (2001) report that this viewpoint has the advantage of providing the closest, most detailed vantage point of the fit between the human and technical component of the system. The perspective of IS success is ascertained through the Interface Satisfaction dimension. Interface Satisfaction measures the quality of the interface in terms of format, presentation and processing efficiency. The quality of the interface is related to both Task Support Satisfaction and Decision Support Satisfaction. An improperly designed interface may cause users difficulty with task completion or may impair their ability to make decisions. Clearly from this human-machine viewpoint, improperly designed EIS interfaces may affect executives in their decision-making processes.

4.4.3 Summary evaluation and critique of the above models

Seddon (1997) and Ballantine *et al.* (1998) note that the DeLone and McLean (1992) model of IS makes several important contributions to our understanding of IS. The contributions of the model are: (1) consolidates previous research; (2) provides a scheme for classifying into six dimensions the different measures of IS success proposed in the literature; (3) suggests a model for temporal and causal interdependencies between the identified categories; (4) makes the first moves to identify different stakeholder groups in the process; (5) has been considered an appropriate base for further empirical and theoretical research; and (6) has met general acceptance in the IS community.

Notwithstanding, this model has received critical analyses from different points of view (Seddon, 1997; Ballantine *et al.*, 1998) and modifications (Pitt *et al.*, 1995; Wilkin and Hewett, 1999; Roldán and Millán, 2000). For example, in research by Roldán and Millán (2000), the DeLone and McLean (1992) model was adapted to the EIS field in Spain. Roldán and Millán (2000) report that several relationships among IS success dimensions were demonstrated but there was an inadequate predictive power of the use variable.

Garrity and Sanders (1998) note that it is important to expand our horizons and consider multiple viewpoints or perspectives on what it means to produce a 'successful' IS. For

example, Garrity and Sanders (1998) report that when the socio-technical perspective is ignored, there is a greater risk of introducing a system that does not support the worker in the accomplishment of the worker's total job needs. Furthermore a focus on the technical quality of a system does not guarantee that the system will be successful for the organisation. Garrity and Sanders (1998) concede that 'the success measure by Davis (1989) for measuring Perceived Usefulness and Ease of Use is, in our judgment, the best instrument at this point in time'. As the Garrity and Sanders (1998) model does not focus on the Systems Use variable and for the purposes of this dissertation, the author feels that a 'better' model should be identified where measurement scales for predicting user acceptance of IS have been formulated and tested.

Both the DeLone and McLean (1992) Model and Garrity and Sanders (1998) Model of IS success reflect the System Use variable. However, neither of these models postulate that technology usage is determined by the behavioural intention to use the technology. It is argued by the author that this is a significant limitation of both these models as the behavioural intention for EIS usage is not mandated. As Kaniclidis and Kimble (1995) note, the most important phase in the development cycle of an EIS is the use of the system. Consequently a model that has been studied in a number of contexts using different IS and valid in predicting the individual's acceptance of IT was sought. A model that satisfies this requirement was identified as the Davis Technology Acceptance Model of Information System Success (Davis, 1989; Davis *et al.*, 1989).

4.5 Davis Technology Acceptance Model of Information System Success

In the third stream of IS success research is focused on the use of IT as conceptualised by the Technology Acceptance Model (TAM) (see Davis, 1989; Davis *et al.*, 1989).

Davis' model specifically postulates that technology usage is determined by behavioural intention to use the technology; which is itself determined by both perceived ease of use and perceived usefulness. Additionally behavioural intention to use the technology is also affected by perceived usefulness directly. Behavioural intention to use the technology is then positively associated with actual system use. See Figure 4.2.

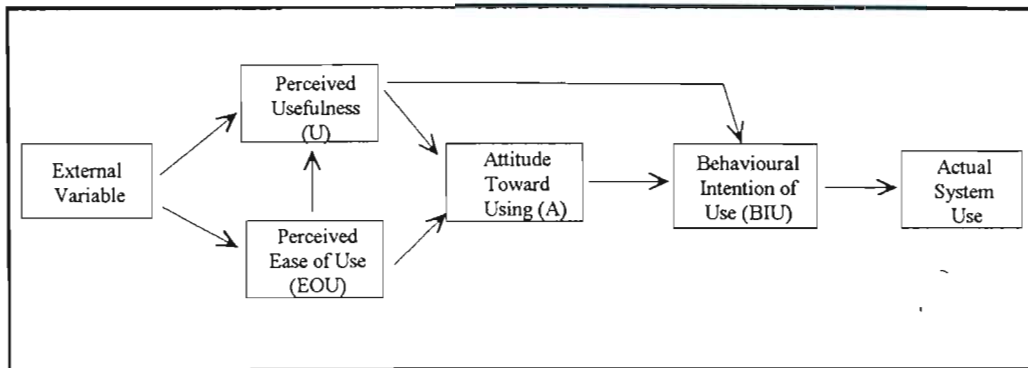


Figure 4.2 The Technology Acceptance Model (TAM)
(Source: Adapted from Davis *et al.*, 1989)

The TAM model of IS success relies on Fishbein and Ajzen's (1975) and Ajzen and Fishbein's (1980) TRA to assert that two factors are primary determinants of system use:

- **Perceived Usefulness.** Perceived Usefulness (U) is defined as the user's subjective probability that using a specific technology will increase his or her job performance within an organisational setting (Davis *et al.*, 1989); and
- **Perceived Ease of Use.** Perceived Ease of Use (EOU) is the user's assessment that the system will be easy to use and requires little effort.

These factors will be further discussed in Section 4.5.1. Davis' model specifically postulates that computer usage is determined by behavioural intention of use (BIU). See Figure 4.2. BIU is viewed as being jointly determined by the person's attitude toward using the system (A) and perceived usefulness (U) with relative weights estimated by regression:

$$BIU = A + U \quad (4.5.1)$$

According to TAM, A is jointly determined by U and EOU with relative weights statistically estimated by linear regression:

$$A = U + EOU \quad (4.5.2)$$

The environment which facilitated the development of measurement scales for predicting user acceptance of IS is now introduced.

Poor theory development (see Keen, 1980) and the inadequate or inconsistent measurement of constructs related to user perceptions of IT have been extensively reported in the literature. Many authors (see, for example, Ives and Olson, 1984; Jarvenpaa *et al.*, 1985; Benbasat, 1990) have noted the problems of using inconsistent instruments. Many IS have focused on instrument development for IS research (see, for example, Bailey and Pearson, 1983; Ives *et al.*, 1983; Doll and Torkzadeh, 1988; DeLone and McLean, 1992) and a significantly large number have specifically investigated the perceived usefulness and perceived ease of use constructs (see, for example, Davis, 1989; Davis *et al.*, 1989; Mathieson, 1991; Adams *et al.*, 1992; Davis and Bostrom, 1993; Hendrickson, *et al.* 1993; Hubona, 1995; Subramanian, 1995; Hubona and Kennick, 1996; Lederer *et al.*, 2000). As Hubona and Geitz (1997) report perceived usefulness and perceived ease of use have sound theoretical foundations and are widely accepted as valid, predictive measures of future IS usage levels. These two theoretical foundations will be discussed in Section 4.5.2.

One of the haunting problems in managing IS activities is the difficulty in measuring the quality of delivered systems (Davis, 1989). This problem is relevant to EIS as they are high-risk/high-return systems (Rainer and Watson, 1995a) as shown by the large number of EIS failures (Rath, 1989; Watson and Glover, 1989). Researchers have generally found relatively weak correlation between user's acceptance of an IS and the intensity of its use. Davis (1989) notes that the inability to measure user attitudes as an indicator of payoff is a serious limitation for the IS manager (or software vendor) trying to develop effective applications and products.

Davis' (1989) research was aimed at developing improved measures for assessing systems quality. The research focused on two characteristics: perceived usefulness and perceived ease of use. Usefulness depends on the extent to which an application (*eg.* EIS) contributes to the enhancement of the user's performance (taking less time to accomplish a required task, producing higher quality work products, *etc.*). Ease of use relates to the effort required by the user (*eg.* executive) to take advantage of the application. Both Perceived Usefulness and Perceived Ease of Use constructs will be fully discussed in the next section and the theoretical foundations for the importance of these two constructs will be outlined in Section 4.6.3.

Davis (1989) suggests that a practitioner is likely to find his research of value as it ‘provides two validated questionnaires, one for measuring usefulness and the other for measuring ease of use. With only minor modifications to the questionnaires ... the questionnaires could be adapted to both internally developed systems and software products being considered for acquisition’. In this dissertation Davis’ questionnaire has been adapted for the purposes of this research (see Section 3 of Appendix 3) and the ‘internally developed systems’ will refer to existing EIS in organisations.

4.5.1 Perceived Usefulness and Perceived Ease of Use constructs

The question is posed ‘What causes people to accept or reject information technology?’ Among the numerous variables that may influence system use, previous research suggests two determinants that are especially important (Davis, 1989). First, people tend to use (or not use) an application to the extent they believe it will help them perform their job better and this variable is labelled *perceived usefulness*. Second, even if potential users believe that a given application is useful, they may simultaneously believe that the system is too difficult to use and that the performance benefits of usage are outweighed by the effort of using the application *ie.* in addition to usefulness, usage is influenced by *perceived ease of use*.

Perceived usefulness was defined in Section 4.5. Davis (1989) notes that this follows from the definition of the word *useful*: ‘capable of being used advantageously’. Within an organisational context employees are generally reinforced for good performances by salary increases, bonuses, promotions and other rewards. Davis (1989) suggests that a system high in *perceived usefulness*, in turn, is one for which a user believes in the existence of a positive use-performance relationship.

Perceived ease of use was defined in Section 4.5. Davis (1989) notes that this follows from the definition of the word *ease*: ‘freedom from difficulty or great effort’. Effort is a finite resource that a person may allocate to the various activities for which he is responsible. Davis (1989) suggests that an application perceived to be easier to use than another is more likely to be accepted by users.

The theoretical importance of Perceived Usefulness and Perceived Ease of Use constructs will now be presented.

4.5.2 Theoretical Importance of Perceived Usefulness and Perceived Ease of Use constructs

The theoretical importance of perceived usefulness and perceived ease of use as determinants of user behaviour is reflected by several diverse lines of research. Some theoretical perspectives and lines of research embrace the following: (1) system utilisation; (2) self-efficacy theory; (3) cost-benefit research; (4) adoption of innovations; (5) evaluation of information reports; (6) channel disposition model; and (7) user perceptions and subjective ease of use. Each of these perspectives and their relevance to either perceived usefulness and/or ease of use construct(s) will now be discussed. At the end of this sub-section a convergence of these perspectives and associated research studies will then be given.

System Utilisation

The impact of perceived usefulness on system utilisation was suggested by the research of Schultz and Slevin (1975); Robey (1979). As quoted by Davis (1989), Schultz and Slevin (1975) conducted an exploratory factor analysis of 67 questionnaire items. This yielded seven dimensions. From these dimensions, Schultz and Slevin (1975) interpreted the 'performance' dimension as the perceived 'effect of the model on the manager's job performance' most highly correlated with self-predicted use of a decision model. Using the Schultz and Slevin questionnaire, Robey (1979) found that the performance dimension to be most correlated with two objective measures of system usage and theorised that a 'system that does not help people perform their jobs is not likely to be received favorably in spite of careful implementation efforts'.

According to Davis (1989), an alternative expectancy-theoretical model derived from Vroom (1964) was formulated and tested by DeSanctis (1983). Davis (1989) notes that the use-performance expectancy was not analysed separately from performance-reward instrumentalities and reward valences. Davis (1989) reports that instead a matrix-oriented measurement procedure was used to produce an over-all index of 'motivational force' that combined these three constructs. 'Force' had small but significant correlations with usage of

a DSS within a business simulation experiment. The contrast between DeSanctis' (1983) correlations and those obtained by Robey (1979) clearly underscore the importance of measurement in predicting and explaining use. The importance of measurement scales for predicting user acceptance of IS was previously discussed in Section 4.4.3.

Self-efficacy Theory

As quoted by Davis (1989) the importance of perceived ease of use is supported by Bandura's (1982) research on self-efficacy. Self-efficacy is defined as 'judgments of how well one can execute courses of action required to deal with prospective situations'. Davis (1989) notes that self-efficacy is similar to perceived ease of use as defined in Section 4.5. Davis (1989) reports that self-efficacy beliefs are theorised to function as proximal determinants of behaviour. Bandura's (1982) theory distinguishes self-efficacy judgments from outcome judgments - the latter being concerned with the extent to which a behaviour (once successfully executed), is believed to be linked to valued outcomes. Bandura's 'outcome judgment' variable is similar to perceived usefulness. Bandura suggests that self-efficacy and outcome beliefs have differing antecedents and in 'any given instance, behavior would be best predicted by considering both self-efficacy and outcome beliefs'.

Cost-benefit research

From behavioural decision theory (see, for example, Johnson and Payne, 1985) the cost-benefit paradigm is also relevant to perceived usefulness and ease of use. This research explains people's choice among various decision-making strategies (eg. linear compensatory, conjunctive, disjunctive and elimination-by-aspects) in terms of a cognitive trade-off between the effort required to employ the strategy and the quality (accuracy) of the resulting decision. Davis (1989) notes that this approach has been effective for explaining why decision-makers alter their choice strategies in response to changes in task complexity. Although the cost-benefit approach has mainly concerned itself with unaided decision-making, research has applied the same form of analysis to the effectiveness of information display formats (Jarvenpaa, 1989).

Cost-benefit research has primarily used objective measures of accuracy and effort in research studies. The distinction between objective and subjective accuracy has been downplayed (Davis, 1989). However, Davis (1989) suggests that increased emphasis on subjective

constructs is warranted since (1) a decision-maker's choice of strategy is theorised to be based on subjective as opposed to objective accuracy and effort (Beach and Mitchell, 1978); and (2) other research suggests that subjective measures are often not in agreement with their objective counterparts (Abelson and Levi, 1985). By introducing measures of the decision-maker's own perceived costs and benefits (independent of the decision actually made) has been suggested as a way of mitigating criticisms that the cost-benefit framework is tautological (Abelson and Levi, 1985). Davis (1989) suggests that the distinction made between perceived usefulness and perceived ease of use is similar to the distinction between subjective decision-making performance and effort.

Adoption of innovations

Diffusion of Innovation Theory is concerned with how the use of innovation spreads through social systems (Van Slyke *et al.*, 2002). Research on the adoption of innovations suggests a prominent role for perceived ease of use (Davis, 1989). According to Davis (1989), Tornatzky and Klein's (1982) meta-analysis of the relationship between the characteristics of an innovation and its adoption found that compatibility, relative advantage and complexity have the most consistent significant relationships across a broad range of innovation types. Van Slyke *et al.* (2002) define *complexity* as the degree 'to which an innovation is seen by the potential adopter as being relatively difficult to use and understand' and it parallels perceived ease of use quite closely (Davis, 1989). Tornatzky and Klein (1982) note, however, that compatibility and relative advantage have both been dealt with very broadly and inconsistently in the literature and are difficult to interpret.

Evaluation of information reports

Previous IS research on the evaluation of information reports echoes the distinction between usefulness and ease of use made herein (Davis, 1989). Larcker and Lessig (1980) factor analysed six items used to rate four information reports. Three items augur on each of two distinct factors: (1) Perceived Importance. Larcker and Lessig (1980) define this factor as 'the quality that causes a particular information set to acquire relevance to a decision maker' and the extent to which the information elements are 'a necessary input for task accomplishment'; and (2) Perceived Usableness. This factor is defined as the degree to which 'the information format is unambiguous, clear or readable'. These two constructs are similar

to perceived usefulness and perceived ease of use (as defined in Section 4.5) although Larcker and Lessig (1980) refer to the two constructs collectively as ‘perceived usefulness’.

Channel disposition model

Swanson (1982, 1987) formulated and tested a model of ‘channel disposition’ for explaining the choice and use of information reports. The concept of channel disposition is defined as having two constructs: attributed information quality and attributed access quality. Potential users select and use information reports based on an implicit psychological trade-off between information quality and associated costs of access.

Swanson (1987) undertook an exploratory factor analysis in order to measure information quality and access quality. A five-factor solution was obtained: one factor corresponded to information quality (Factor No 3, ‘value’) and one to access quality (Factor No 2, ‘accessibility’). Davis (1989) inspected the items which augured these factors and suggested a close correspondence to perceived usefulness and ease of use. Items such as ‘important’, ‘relevant’, ‘useful’ and ‘valuable’ augur strongly on the value construct. Hence value parallels perceived usefulness. Several of Swanson’s (1987) ‘accessibility’ items (eg. ‘convenient’, ‘controllable’, ‘easy’ and ‘unburdensome’) correspond to perceived ease of use (as defined in Section 4.5).

User perceptions and subjective Ease of Use

External to the IS domain, a marketing study by Hauser and Simmie (1981) regarding user perceptions of alternative communications technologies similarly derived two underlying constructs: ease of use and effectiveness. The latter construct is similar to the perceived usefulness construct defined in Section 4.5. Davis (1989) reports that both ease of use and effectiveness were influential in the formation of preferences regarding a set of alternative communication technologies.

Davis (1989) notes, that most of the human-computer interaction studies have focused on objective measures of ease of use (eg. task completion and error rates). Although objective ease of use is relevant to user performance (given the system is used), subjective ease of use is more relevant to the users’ decision whether or not to use the system and may not agree with the objective measures.

Convergence of Findings

There appears to be a 'striking' convergence among the wide range of theoretical perspectives and research studies discussed above: all are supportive of the conceptual and empirical distinction between usefulness and ease of use. The accumulated pool of knowledge regarding self-efficacy, contingent decision behaviour and adoption of innovations provides theoretical support for perceived usefulness and ease of use as key determinants of behaviour (see Davis, 1989). This discussion is the theoretical underpinning for this dissertation. A synopsis of Davis' TAM research findings, limitations thereof and research implications will now be given.

4.5.3 A Synopsis of Davis' Technology Acceptance Model: Research findings, limitations thereof and research implications

The purpose of Davis' (1989) research was to investigate, develop and validate new measurement scales for perceived usefulness and perceived ease of use - two distinct determinants of computer usage. This effort was successful in several respects:

- the new scales have strong psychometric properties and exhibit significant empirical relationships with self-reported measures of usage behaviour;
- new insights were generated about the perceived usefulness and ease of use and their roles as determinants of user acceptance;
- both perceived usefulness and ease of use constructs were significantly correlated with self-reported indicators of system use;
- the relative strength of the usefulness-usage relationship compared to the ease of use-usage relationship;
- from a causal perspective ease of use may be an antecedent to usefulness, rather than a parallel, direct determinant of usage; and
- a major conclusion is that perceived usefulness is a strong correlate of user acceptance and should not be ignored by those attempting to implement successful systems (Davis, 1989). With an ever-increasing diffusion of the Internet and associated Web-based technologies in organisations, coupled with the decision-making usefulness of accessing information anywhere and at any time, it is argued by the author that this environment will facilitate the implementation of successful IS. This scenario is particularly relevant to those users of Web-based EIS.

Davis (1989) reports that some limitations of his research were:

- the generality of the findings ‘remains to be shown by future work’ (with the widespread acceptance of Davis’ research by the IS community and extensions to TAM (see Sections 4.5.5-4.5.6) this limitation is no longer valid); and
- the usage measures employed were self-reported as opposed to objectively measured (Gefen and Straub (2000) report findings from previous studies indicating that perceived usefulness appears to have a stronger effect on actual usage). For the purposes of the author’s survey usage measures will be self-reported by interviewees.

The usefulness of conducting experiments on possible adoption of IT among students (Davis *et al.*, 1989; Mathieson, 1991) can be questioned. The difference between using IT in a classroom situation and for purposes of study, and using IT in an organisational context where other considerations (*eg.* political) are important, is vast. It is therefore not surprising that Davis *et al.* (1989) report insignificant effects from the subjective norm (refer to TRA model) on behaviour in their research. It is argued by the author that there is a potential danger in extrapolating from students and their perceptions to real-life situations in organisations. Consequently to overcome this danger the author’s survey does not include any students.

With regards to future research implications, Davis (1989) suggests that research is needed to address how other variables relate to usefulness, ease of use and acceptance. In the next section some research in this field will be discussed. In essence these surveys are extensions to Davis’ (1989) original TAM. Davis (1989) also notes that more research is needed to understand how previously discussed measures ‘perform in ... evaluation settings’. The literature on design principles (see, for example, Shneiderman, 1987) calls for the use of subjective measures at various points throughout the development and implementation process to post-implementation assessment. Davis recommends that ‘research on how usefulness and ease of use can be influenced by various externally controlled factors ... is important’. In today’s environmental uncertainty for organisations it is argued by the author that one of these ‘externally controlled factors’ may be Web-based technologies.

As Pijpers *et al.* (2001) report, a number of studies using TAM identified numerous external

variables, no consistent groups of variables have been found. Given the scenario of post-implementation assessment, Web-based technologies, usage constructs of perceived usefulness and perceived ease of use, this creates the climate to conduct specific EIS research within this domain. In the next section, TAM and its applicability in predicting user acceptance of corporate technologies (eg. EIS and the Web) will be discussed.

4.5.4 Technology Acceptance Model in predicting user acceptance of corporate technologies

TAM has been widely studied in a number of contexts using different IS and accepted as valid in predicting the individual's acceptance of various corporate technologies (see, for example, Mathieson, 1991; Adams *et al.*, 1992; Chin and Todd, 1995; Segars and Grover, 1993; Doll *et al.*, 1998). TAM has enjoyed widespread support across IT adoption studies (Venkatesh and Davis, 2000) including a recent study in an EIS context (see Pijpers *et al.*, 2001 and discussion in the next section).

TAM has also been applied to examine the use of Web information systems (see, for example, Morris and Dillon, 1997; Teo *et al.*, 1999; Gefen and Straub, 2000; Lederer *et al.*, 2000; Chen *et al.*, 2002). A discussion of research dealing with TAM and specifically the Web will be presented in Section 4.5.6. Some subsequent research has used and extended TAM for various situations both when introducing new IT as well as for explaining the use of IT that has already been implemented. A discussion of some of this research and extensions to TAM will now be given.

4.5.5 Research on some general extensions to the Technology Acceptance Model

In this section, some applications which were tested using TAM will be presented. Thereafter research on some general extensions to TAM will be discussed. One of the focus areas of this dissertation is Web-based technologies. As this is an important focus of the author's work specific recent TAM research with the Web as the application will be presented thereafter.

Some applications which were tested using TAM

Various researchers and practitioners have empirically tested TAM using different methodologies, subjects and IT resources. For a list of some sample applications which were tested using TAM see Table 4.1.

Table 4.1 A List of some sample applications which were tested using TAM
(Source: Adapted from Lederer *et al.*, 2000)

| Authors | Constructs | Applications | Methodology | Findings |
|--------------------------------|---|--|--------------------|---|
| Davis (1989) | U, EOU, Usage | PROFS, XEDIT, Chart-Master, Pendraw | Survey, experiment | U → Usage, EOU → Usage |
| Davis <i>et al.</i> (1989) | U, EOU, A, BIU, Usage | WriteOne | Experiment | EOU → U, U → A, EOU → A, A → BIU, U → BIU, BIU → Usage |
| Haynes and Thies (1991) | U, EOU, Usage | Automated teller, self-service gas | Survey | U → Usage, EOU → Usage |
| Mathieson (1991) | EV, U, EOU, A, BIU, Usage | Spreadsheet, calculator | Experiment | U → Usage, EOU → Usage |
| Adams <i>et al.</i> (1992) | U, EOU, Usage | Electronic mail, Voice mail, WordPerfect, Lotus1-2-3, Harvard Graphics | Survey | EOU → Usage, U → Usage, EOU ↔ U |
| Bagozzi <i>et al.</i> (1992) | U, EOU, BIU (two time intervals), Usage | WriteOne | Experiment | U → BIU, EOU → BIU, BIU → Usage |
| Taylor and Todd (1995) | U, EOU, A, Subjective norm, Perceived behavioural control, BIU, Behaviour | Computing resource centre | Survey | EOU → U, U → A, EOU → A, A → BIU, SN → BIU, PBC → BIU, BIU → B, PBC → B |
| Straub <i>et al.</i> (1995) | U, EOU, Usage, Social presence/information richness (SPIR) | Voice mail | Survey | U → Usage, EOU → Usage, SPIR → U |
| Igbaria <i>et al.</i> (1995a) | EV, EOU, U, Usage | Micro-computer | Survey | EV → EOU, EV → U, EOU → U, EOU → Usage, U → Usage |
| Szajna (1996) | U, EOU, BIU, Usage | Electronic Mail | Experiment | EOU → U, U → BIU, BIU → Usage |
| Hendrickson and Collins (1996) | U, EOU, Usage | Lotus1-2-3, WordPerfect | Experiment | EOU → U, EOU → Usage, U → Usage |
| Chau (1996) | EOU, Near-term U, Long-term U, BIU | Word, Excel | Word, Excel | EOU → Near-term U, EOU → BIU, Near-term U → Long-term U, Near-term U → BIU, Long-term U → BIU |
| Morris and Dillon (1997) | EOU, U, A, BIU, Usage | Netscape | Survey | EOU → U, U → A, EOU → A, U → BIU, A → BIU, BIU → Usage |
| Gefen and Straub (1997) | Gender, U, EOU, Usage | Electronic Mail | Survey | Gender → SPIR, Gender → U, Gender → EOU, SPIR → U, U → Usage |
| Thompson (1998) | U, EOU, A, BIU | Access, Web page development software | Survey | EOU → U, EOU → A, U → A, U → BIU, A → BIU, Motivation → BIU, Social factors → A |
| Teo <i>et al.</i> (1999) | U, EOU, Usage, Perceived enjoyment (PE) | Internet | Web-based survey | EOU → U, EOU → Usage, EOU → PE, U → Usage, PE → Usage |

Legend: A: attitude; BIU behavioural intention; EOU: ease of use; U: usefulness

To date, TAM has accumulated fairly satisfactory empirical support (Pijpers *et al.*, 2001). Many studies use the original TAM whereas others have adapted TAM to gain new insights. Some examples from both these study streams will now be given.

TAM research applied to the usage of electronic and voice mail

When Davis (1989) developed the original TAM constructs, he validated the model in a field study assessing the self-reported usage of PROFS® electronic mail and XEDIT file editor applications and a laboratory study of the intended usage of Chart-Master® and Pendraw® graphic systems (see Table 4.1). Adams *et al.* (1992) replicated Davis' original work in two field studies on the usage of electronic and voice mail and WordPerfect®, Lotus 1-2-3® and Harvard Graphics® applications (see Table 4.1).

In one of the studies of electronic and voice mail usage, Adams *et al.* (1992) applied Davis' (Davis, 1989) original six item usefulness scale. However, Adams *et al.* (1992) eliminated two of Davis' original items from the ease of use scale. Furthermore, no measure of attitude was assessed (Hubona and Geitz, 1997). Instead, Adams' model (Adams *et al.*, 1992) looked at the impact of usefulness and ease of use on two separate measures of usage as mediated by an additional latent usage construct. The usage measures consisted of user's self-reports of 'the number of messages they had sent and received on the previous working day, as well as the number they sent and received on a typical day'. In this dissertation, for the purposes of data collection of usage measures, user self-reports will be used. Most TAM studies show that the two salient beliefs, perceived usefulness and perceived ease of use, predict actual system usage (Pijpers *et al.*, 2001).

TAM research in the Arab world

TAM has been successfully tested by several previous studies in North America across a wide variety of applications. However, only a few studies have been carried out to test the applicability of TAM outside this region. Some of these studies by country as follows: in Japan and Switzerland (Straub *et al.*, 1997), New Zealand (Igbaria *et al.*, 1997), Hong Kong (Chua, 1996), Singapore (Teo *et al.*, 1999), Malaysia (Suradi, 2001), Arab world (Rose and Straub, 1998; Al-Gahtani, 2001b) and United Kingdom (Al-Gahtani, 2001a). It is striking to observe that from the available literature, no single TAM study has taken place in South Africa. This may be an avenue for future research.

Straub *et al.* (1995) note that system usage has a notable practical value for managers interested in evaluating the impact of IT. While TAM has been widely applied and tested in North America, there have been rare attempts to extend this work to other regions of the world (Al-Gahtani, 2001b). It has been argued that TAM may not hold equally well across cultures (Straub *et al.*, 1997). Straub *et al.* (1995) elaborated that given the rapid globalisation of businesses and systems, there exists a pressing need to understand whether TAM applies in other cultures. Research was conducted by Al-Gahtani (2001b) to establish whether TAM, as an IT diffusion model which originated and tested in the developed Western world, would apply to developing countries. Lacking a strong *a priori* basis for the applicability of TAM in the Arab world (specifically in Saudi Arabia), the following question was posited by Al-Gahtani (2001b) in his study 'why TAM would not apply to Saudi Arabia as a developing country of different culture?' *ie.* the study specifically focused on whether TAM would be applicable to test IT adoption and diffusion in Saudi Arabia (which is an important part of the Arab world). At the end of this survey Al-Gahtani (2001b) reports that the study 'findings ... confirm that TAM constructs are both valid and reliable', 'was successful as TAM effectively predicts computer technology adoption and use in the Saudi culture' and 'supports the applicability of TAM to the Arab culture'. As Saudi Arabia is an important developing country in the Arab world, South Africa is an equally important developing country in Africa. It is argued by the author that TAM will thus be equally applicable to South Africa. For a discussion of the term 'developing country' see Averweg and Erwin (1999a).

TAM research in the Malaysian environment

The research by Suradi (2001) is similar in concept to Al-Gahtani (2001b) - the objective was to test TAM in a non-Western environment. Suradi (2001) also acknowledges that even though culture has been identified to play a role in the acceptance of certain models developed different from the local culture of a given country (*eg.* USA), TAM was tested to be a workable model in the Malaysian environment. The results were similar to the findings of Davis (1989), Davis *et al.* (1992); Igbaria (1993). Suradi (2001) reports that TAM can be applied in the Malaysian environment for organisations which intend adopting new IT applications. This research also underscores the author's previously stated viewpoint that TAM can be equally applied in the South African environment.

TAM research on external variables in influencing beliefs, attitude and usage

TAM was originally developed by Davis (1989) to predict computer-usage behaviour and explain future user behaviour based on simple measures taken after a very brief period of interaction with a system. The goal of TAM is to provide an explanation of general determinants of computer acceptance that would help explain user behaviour across a broad range of end-user computing technologies and user populations (Davis *et al.*, 1989).

In Davis' (1989) work the external factors in his TAM model were not fully investigated (Pijpers *et al.*, 2001). du Plooy (1998) reports that TAM disregards 'the external factors that govern an individual's behaviour within an organization'. Pijpers *et al.* (2001) note that very little research has looked at these external variables for their influence on usage behaviour as mediated by the belief and attitude constructs. Although recent studies found a number of variables (see, for example, Venkatesh and Davis, 1996, 2000), if usage is to improve, actually influencing the formation of beliefs and technology acceptance must be identified. As Agarwal and Prasad (1998) report external variables are the only channels for influencing behaviour as the intermediate and dependent variables in TAM are hypothesised to be an internal psychological process. In TAM actual system usage is determined by behavioural intention to use. In turn this behaviour is related to attitude towards using the system (Pijpers *et al.*, 2001). Pijpers *et al.* (2001) note that the constituent TAM model elements have evolved over time most notably by excluding the behavioural intention to use construct when actual or self-reported usage measures are available. Some researchers (see, for example, Thompson *et al.*, 1991; Adams *et al.*, 1992; Al-Gahtani and King, 1999) also dropped behavioural intention to use because they were interested in actual behaviour (system usage) and not intentions. Pijpers *et al.* (2001) argue that the attitude towards the use construct is essential because TAM asserts that the principal influence of the belief constructs is on attitudes that subsequently influence usage, rather than on usage directly.

Pijpers *et al.* (2001) results provide support for the core TAM 'as an adequate and parsimonious conceptualization of acceptance behavior and the salience of usefulness and ease of use beliefs'. They note, however, where TAM assumes that the influence of external variables on use is channeled through the two beliefs, their research study also found variables that directly influence attitude and use. Their most significant finding is the key role perceived

fun/enjoyment plays as an external variable in influencing beliefs, attitude and usage. They suggest that an investigation of the fun component of TAM appears to be a very promising line of research. The author supports this notion as nowadays most IS (and specifically EIS) aimed at executives are built around the Internet technology and its appearance. By emphasizing the entertainment value of managerial IT tools (eg. EIS) the computer anxiety of executives may be diminished and at the same time their computer self-efficacy improved.

TAM research when usage is mandated

In the prediction of IS usage behaviour, studies have tended to include *frequency and/or duration of use* (see, for example, Igarria *et al.*, 1996; Al-Gahtani and King, 1999; Brosnan, 1999) as dependent variables often without maintaining consistency of action, context, target and time across the measures (Rawstorne *et al.*, 2000). Rawstorne *et al.* (2000) note that there are related problems with these dependent outcome measures that would be more readily solved if consistency measured were adhered to. While this is not within the scope of this dissertation, they ask whether 'greater use and frequency indicate more acceptance, or inefficient usage, or something else?'. They argue that it seems important for the IS community to assess whether models (such as TAM) are suitably equipped to predict and explain behaviour when usage is mandated. As du Plooy (1998) notes '... will perceived usefulness be of importance when a person is *ordered* to use information technology?'

While the findings by Rawstorne *et al.* (2000) are based on a small (60) sample they report some doubt on the utility of TAM to predict and explain multiple types of usage. Rawstorne *et al.* (2000) indicate that a necessary assumption in expecting to predict and explain mandated usage is that there is variance in such behaviour and their findings provide support for this position. Rawstorne *et al.* (2000) report that when IS use is mandated it is likely that behaviour will vary as a function of three aspects of use. These are: (1) the extent to which an individual wishes to comply with the mandate; (2) the extent to which the organisation enforces its mandate; and (3) individual differences in using the technology. Given that variation in behaviour is likely to be present in most situations of mandated use, Rawstorne *et al.* (2000) believe that TAM can be used to predict and explain such variation. Clearly it is not very informative to know that perceived ease of use is a determinant of IT adoption and use if such use is usually not voluntary but mandatory. In this dissertation it is assumed that use of the

surveyed IS is not mandated (*ie.* voluntary use of the organisation's EIS) and consequently the findings of Rawstorne *et al.* (2000) cannot be compared with the author's survey.

Another important issue arising from the research of Rawstorne *et al.* (2000) is the issue whether determinants of intentions and the underlying beliefs of such determinants are associated with future usage and if so, for how much time into the future does the association last? There is growing evidence that beliefs and determinants of current use are somewhat different to ongoing usage (Karahanna *et al.*, 1999) and possibly even further usage. The results from the Rawstorne *et al.* (2000) study indicate 'that usage behaviour can be predicted to a reasonable degree between two and four months after the commence of use'. It is contended by the author that this is a significant result. Despite the rapidly changing 'traditional' EIS environment (proliferation of Web-based technologies), future successful usage of EIS can still be reasonably predicted. The applicability of TAM to the Web will now be discussed.

4.5.6 The Technology Acceptance Model and the World Wide Web

Researchers have recommended the investigation of Web user behaviour (see, for example, Shaw *et al.*, 1997; Chen *et al.*, 2002). For example, by applying TAM and innovation diffusion theory, Chen *et al.* (2002) research took an extended perspective to examine consumer behaviour in the virtual store context. This research provides both theoretical and empirical analyses to explain consumers' use of a virtual store and its antecedents.

TAM proposes ease of use and usefulness predict applications usage (Lederer *et al.*, 2000). Some studies investigated TAM for work-related tasks using the Web as the application. Morris and Dillon (1997) found that ease of use predicted usage. Teo *et al.* (1999) found usefulness and ease of use predicted usage but that usefulness had a stronger effect. By supporting TAM, the Morris and Dillon (1997) and Teo *et al.* (1999) studies suggest the importance of antecedents to usefulness and ease of use. A question is thus posed 'What makes the Web useful and easy to use?'. In addition to employing previous measures of usefulness and ease of use, antecedents specific to the Web were sought by Lederer *et al.* (2000).

Researchers have investigated features potentially predictive of the perceived ease of use of the Web. For example, The Graphic, Visualization, and Usability Center (GVU) at the

Georgia Institute of Technology has since 1994 conducted user surveys every six months (Pitkow and Kehoe, 1996). Results from recent surveys indicate some key ease of use problems: slow speed of downloading (or viewing) Web pages, finding a page that users knew existed and organising the pages and information they had gathered. A qualitative study by Lightner *et al.* (1996) raised similar problems: difficulty in searching for specific information, incomplete category searches, time delays due to images and information clutter.

A study by Levi and Conrad (1996) identified eight usability principles: (1) speaking the users' language (use words, phrases, concepts familiar to the user); (2) consistency (similar concepts, terminology, layout, graphics, *etc*); (3) minimisation of the user's memory load (do not force users to recall information across documents); (4) flexibility and efficiency of use (accommodate a range of user sophistication and diverse goals); (5) aesthetic and minimalist design (visually pleasing displays with no distracting or irrelevant information); (6) chunking (short documents with one topic ideally on a single page); (7) progressive levels of detail (organise information hierarchically with general information before specific detail); and (8) navigational feedback (allow users to determine document positions). A study by Boling (1997) suggests similar issues.

Lederer *et al.* (2000) assert that much less research has considered potential predictors of perceived usefulness on the Web. The GVU survey listed the most common uses of the Web as browsing (79%), entertainment (64%), work (52%) and shopping (11%) (see Pitkow and Kehoe, 1996). Lightner *et al.* (1996) report that the amount of information on the Web was the issue most liked by respondents. Information related to functional support within an organisation might provide usefulness aspects to a Web site. Such functions may typically include marketing, finance, production, human resources and research and development (Griffin, 1990). The author contends that this Web information may be particularly important for (executive) decision-making. For a technical discussion of information retrieval on the Web see, for example, Kobayashi and Takeda (2000). The following four factors that differentiate between good and bad information may also provide a basis for usefulness of the Web: accuracy, timeliness, relevance and completeness. As discussed in Section 2.3.2 and reflected in Table 2.1 (p.14), there are three types of managerial decision-making: operational, managerial and strategic decision-making. Presumably information to support those decision types can potentially make a Web site useful (Lederer *et al.*, 2000).

The research by Lederer *et al.* (2000) investigates TAM for work-related tasks with the Web. These researchers' survey instrument measures the extent to which a Web site meets usefulness and ease of use characteristics. The instrument constructs for these characteristics were drawn from Davis (1989) and the literature sources reflected in the previous two paragraphs. The results provide support for TAM: usefulness has a stronger effect than ease of use. This research confirms that use of Web sites is dependent on the usefulness and ease of use of the site. The antecedents predict usefulness but only information quality had a significant effect. The antecedents predict ease of use with ease of understanding having a stronger effect than ease of finding.

In the research by Lederer *et al.* (2000), the highest predictive power belongs to information quality (for usefulness) and ease of understanding (for ease of use). This helps researchers understand the predictors of usefulness and ease of use for the Web. Both information quality and ease of understanding are reported in the literature (see discussion in Section 2.3.3) as important attributes for the capabilities and characteristics of EIS. As Lederer *et al.* (2000) suggest, future researchers may empirically investigate why these factors had the highest predictive power for their respective constructs (in their TAM/Web research), the author contends that similar initiatives may also be applied to future TAM/EIS research.

From the discussion in the previous sub-section it emerged that TAM is applicable to EIS. Given the discussion in this sub-section, it is evident that TAM is also applicable to the Web. In view of this overlap some international EIS researchers' comments were solicited regarding the author's research topic. These were discussed in Section 1.8.

The purpose of this section was to discuss Davis' TAM of IS success. This has been undertaken. Furthermore the first sub-goal of this dissertation (see Section 1.4) is to investigate previous research on IT adoption. This sub-goal has now been achieved.

4.6 Conclusion on Information Technology adoption

This chapter reviewed the literature regarding successful IS implementation with specific focus on the use of IT as conceptualised by TAM. As indicated this model proposes that ease of use and usefulness predict applications usage. TAM, its theoretical underpinnings, some extensions

to TAM and its applicability to EIS were then discussed. Recent research on TAM and the World Wide Web were reviewed. This provides the backdrop for the author's experimental work in the next chapter.

In the next chapter the conceptual framework justifying the survey undertaken in South Africa will now be discussed. This chapter also looks at the design, formulation and discussion of the experimental work (field survey) of this dissertation. Chapter Six concludes the research and also looks at future research issues.

CHAPTER 5

DESIGN, FORMULATION AND DISCUSSION OF THE EXPERIMENTAL WORK

5.1 Introduction

The purpose of this chapter is to discuss the design and formulation of the author's research instrument for conducting the experimental work of this dissertation. The survey conducted is used for investigating whether the theoretical usage aspects of TAM are echoed in EIS implementations in KwaZulu/Natal and identifying and ranking Web-based technologies in order of their perceived impact on EIS currently and in the future.

In this chapter the relevant methods for field studies applicable to the goals of this research are described. The chapter then presents the design of the author's survey. The development and the testing of the survey instrument is then discussed. The approach taken during the data collection process is described. The data analysis procedures, processing and interpretation of the results are then given. Further considerations on the applicability of the survey results are discussed.

5.2 Research Methods that are relevant to the problem of this Investigation

Kraemer (1991) suggests that there are five major methods used in the field of IS research. These are: (1) qualitative research; (2) experimental research; (3) survey research; (4) mathematical models; (5) and software systems demonstrations.

Since MSS (see Section 2.3) deal with organisations and individuals using computers to improve decision-making Benbasat (1985) states that it is not surprising to find all methodologies being used to study the wide range of research issues in the field. This researcher attempts to identify the research methodologies appropriate for conducting research in MSS by surveying the studies directly or indirectly related to the field. From previous research, Benbasat (1985) recommends methodologies to be used for particular research areas and issues. For implementation research areas these are summarised in Table 5.1.

Table 5.1 Research Areas and Recommended Research Strategies
(Source: Adapted from Benbasat, 1985)

| Research Area | Research Focus | Case Studies | Field Studies | Laboratory Experiments |
|----------------|---|--------------|--------------------|------------------------|
| Implementation | Dynamics of Change Process | Recommended | Highly Recommended | Recommended |
| | Organisation; Various Phases of Project Life; Multiple Participants | Recommended | Recommended | |
| | Single User; Individual Differences | | | Recommended |

Although Table 5.1 does not include qualitative research methods whose application is growing in the last decade, this table is indicative of the importance of various quantitative techniques. It was felt that due to the quantitative nature of previous research on TAM, the author's project needs a quantitative approach as well.

Benbasat (1985) 'highly recommends' *field studies* for the change process dynamics in the implementation research area. This researcher reports that field studies are useful for two purposes:

- to test the value of different interface features by tracking actual use and collecting statistics on efficiency measures; and
- to test the power of organisational change models to explain the implementation process and predict its success.

Trauth (2001) reports that *field studies* have been used in a variety of settings to uncover subtleties of process and **impact** related to the **use** of IT (bold style added by author). Since the level of impact by Web-based technologies on successful EIS implementation usage is the focus of this dissertation it seems appropriate that a field study be conducted by the author. The merits of this approach will now be discussed.

Following the work by Van Horn (1973), Van Schaik (1988) distinguishes four approaches:

- **Case Study.** This is an investigation of a single organisation with respect to a number of variables. The case study approach seeks to understand the problem being investigated in a natural setting. It provides the opportunity for researchers to ask questions and to capture organisational behaviour.

A case study of a failed EIS in a large New Zealand organisation was conducted by Bussen and Myers (1997). The results of this study were compared with the success factors found in the literature. The case study approach was also adopted by Srivihok (1998) for a cross-case analysis of five organisations. Srivihok (1998) notes that the multiple cases studies were used to obtain supplementary information in order to study EIS success factors in the natural setting. The identified EIS success factors were an outcome of this case study approach. Earlier EIS literature was mainly based on case studies (Roldán and Leal, 2003a). However, some of the weaknesses of case studies are as follows: (1) the conclusions may be specific to the organisation studies and may thus not be generalised (Lee, 1991; Srivihok, 1998); (2) an inability to control independent variables (Kerlinger, 1986); (3) the risk of inappropriate interpretation and the lack of power to provide random sampling (Kerlinger, 1986); and (4) a lack of controllability, deductibility, repeatability and generalisability (Lee, 1991). For these reasons the case study approach was not adopted by the author;

- **Field Study.** An investigation of several organisations with respect to one or more variables with an experimental design but without experimental control is made. For example, Watson *et al.* (1995b) conducted a field study of 43 organisations to explore how the initial version of EIS are developed. These researchers developed a 'field survey questionnaire' and in their findings report that the major problems in developing an EIS are getting accurate data and identifying executives' information requirements. Other examples of field studies are by Sanders and Courtney (1985); McLeod and Jones (1986);
- **Field Test.** An investigation of one or more organisations with respect to one or more variables with a specific experimental design and with experimental control is made. Sprague (1971) describes this approach; and
- **Laboratory study.** An investigation is made of aspects of IS within a simulated environment. Research following this approach is described by Dickson *et al.* (1977); Orlikowski and Baroudi (1991). Most laboratory experiments in IS research have neither internal nor external validity and should

be actively discouraged (Introna and Whitley, 2000). Field studies conducted in an organisation produce superior results to a laboratory study (Pijpers *et al.*, 2001).

After an in depth analysis of many empirical research projects which used these four methods, Van Schaik (1988) reports that Van Horn (1973) drew the following conclusions:

- **Case studies.** They provide little insight into the key research issues of IS. This may be partially attributed to the complexity of the research problems and to the lack of careful chronology and detail. Furthermore McLean (1973) levels the criticism of who knows whether the research outcome can extend beyond a single organisation which has been studied;
- **Field studies.** These attempts by researchers to gather data in ongoing uncontrolled situations, are inefficient primarily due to the large amounts of data that have to be collected. This stance is not supported in more recent literature by Bergeron *et al.* (1995) who report that (EIS) field data obtained from 38 executives in nine organisations allowed these researchers to test and confirm the appropriateness of a behavioural model through correlation and regression analysis. Another problem which is cited is the lack of experimental control to isolate the key independent variables. From a recent literature survey no supporting evidence can be found;
- **Field tests.** These attempt to introduce change and measure some aspect of the system which are plagued by the subordinate role a controlled study is forced to play to the necessary operations and survival of the organisation. According to Van Horn (1973) field tests described in the literature are extremely rare and 'the ones that are published are sad stories'. This researcher indicates that the competing demands of careful experimental control and the pressing concerns of the organisation inevitably yield to the latter and that almost all field tests end up as case or field studies; and
- **Laboratory studies.** These attempt to control and measure phenomena through the creation of a model of the system and offer the only viable approach for many aspects of research into IS.

The author recognises that the laboratory approach may have advantages when it is applicable (eg. for the measurement and control of variables). However, field (and TAM) studies are widely reported in the literature. For example, in the research by Al-Gahtani (2001b), a field study of 1,190 users across Saudi Arabia was conducted. In the EIS domain field studies are often reported (see, for example, Bergeron *et al.*, 1995; Elam and Leidner, 1995; Rainer and Watson, 1995a; Watson *et al.* 1995b; Vandenbosch and Huff, 1997). The reason is simply because executives use IT often in unique ways which cannot be replicated in a laboratory experiment. Field studies employ systematic means for obtaining and recording the variables of interest and (as in this one), field study data is obtained through questionnaires and interviews (Vandenbosch and Huff, 1997). A similar approach was adopted by Roldán and Leal (2003b) in their EIS survey in Spain. Field studies tend to intrude less upon the system being studied than case studies, where the risk that data collection will modify the system under study is greatly increased (Webb and Weick, 1979). Since there are no documented field studies of the impact of Web-based technologies on EIS usage in the South African environment the field study approach has been adopted by the author. Survey is the most widely used data collection technique in social science as well as in business research (Emery and Cooper, 1991; Neuman, 1994). It is the strongest technique when used as a measuring tool to investigate respondents' attitudes (or opinions) towards variables of interest. The author's survey instrument will be discussed next.

5.3 The Survey Instrument

Kothari (1993) states that in social science studies, when measuring attitudes of people, researchers generally follow the technique of preparing a questionnaire using attitude scales. Cooper and Emory (1995) indicate that the measuring instrument should be easy and efficient to use. The important criteria for instruments are validity (see Section 5.3.1), reliability (see Section 5.6.3) and practicality (see Section 5.4). Different scales for measuring attitudes of people are given by Kothari (1993) (see Table 5.2).

From Table 5.2 and in reviewing the literature on EIS research, only references to Likert-type scales were found. See, for example, Roldán and Leal (2003b).

Table 5.2 Different Scales for Measuring Attitudes of People
(Source: Adapted from Kothari, 1993)

| | Name of the Scale Construction Approach | Name of the Scale Developed |
|---|---|---|
| 1 | Arbitrary Approach | Arbitrary Scales |
| 2 | Consensus Scale Approach | Differential Scales (such as Thurstone Differential Scale) |
| 3 | Item Analysis Approach | Summated Scales (such as Likert Scale) |
| 4 | Cumulative Scale Approach | Cumulative Scales (such as Guttman's Scalogram) |
| 5 | Factor Analysis Approach | Factor Scales (such as Osgood's Semantic Differential, Multi-dimensional Scaling) |

Even though there are some limitations with all scales, Likert-type scales are regarded as the most popular in social studies relating to measuring of attitudes (Kothari, 1993). For example, Likert-type scales are relatively easy to construct in comparison to Thurstone-type scales because Likert-type scales can be performed without a panel of judges. Furthermore it is considered more reliable because respondents answer each statement included in the instrument and as such it also provides more information and data than the Thurstone-scale.

Kothari (1993) notes that there are several limitations of the Likert-type scale. For example, one important limitation is that whilst one can simply examine whether respondents are more or less favourable to a topic, one cannot tell how much more or less they are. Barnette (2001) notes the issue of error or bias associated with attitude assessment. For example, in responding to Likert-type items, Hopkins *et al.* (1990), present four basic types of problems in measuring attitudes: fakability, self-deception, semantic problems and criterion inadequacy. Barnette (2001) reports that from practical measurement issues associated with data from Likert scales, these problems relate to biasing results 'in a minimal way'. Even with these recognised limitations there is wide usage of Likert-type scales (see, for example, Sanders, 1984; Franz and Robey, 1986; Doll and Torkzadeh, 1988; Davis, 1989; Davis *et al.*, 1989; Joshi, 1989; Goodhue, 1990; Nord and Nord, 1995; Rainer and Watson, 1995a; Lai, 1996; Liang and Hung 1997; Roldán and Leal, 2003b).

Once the area of research had been identified by the author it would be necessary to administer the measuring instrument. However, during the construction of the questionnaire it became apparent that due to the 'soft' nature of the research topic, it would be difficult to extract the true feelings and opinions from respondents through a structured, self completion post-back

questionnaire. Steer (1995) cites similar difficulties. Since some of the research findings would be based on the subjective opinions of the respondents it was decided that instead of performing a questionnaire survey, semi-structured interviews (see Section 5.4) will be undertaken.

5.3.1 Developing the Survey Instrument

The questionnaire was validated using expert opinion and also the fact that it was based on previous instruments used in published research papers. Particular attention was given to Straub's (1989) guideline involving the use of a pretest for the technical validation of the research instrument (the pre-test will be discussed in Section 5.3.2). This validation included the use of 'previously validated instruments wherever possible' (Straub, 1989) which has been used by the author in Sections 1-4 of the survey instrument (see Appendix 3).

Watson and Frolick (1993) note that numerical information comes from the questionnaire. The findings of the author's survey (see Section 5.6) will be based on the survey instrument.

As a preamble to the interview the classification of the various types of IS and the distinguishing characteristics of EIS was discussed with each interviewee. A working definition of EIS (as used in this dissertation in Section 2.3.3) was also given. See Appendix 2. This preamble to the actual interview meant that the interviewee was properly focused on the EIS IS in the organisation. The survey instrument (see Appendix 3) consists of six parts:

- Section 1 deals with an organisation's demographics. Questions 1.1- 1.5 were extracted from the Roldán (2000) EIS questionnaire (see Appendix 4), translated from Spanish to English and adapted for the author's survey. Questions 1.6-1.8 were formulated by the author. The measurement of demographic variables of interest is consistent with prior research in sociology and organisational behaviour (Venkatesh and Morris, 2000);
- Section 2 deals with the attributes of the organisation's EIS. Questions 2.1-2.10 were extracted from the Roldán (2000) EIS questionnaire (see Appendix 4), translated from Spanish to English and adapted for the author's survey.

Straub *et al.* (1995) note that 'system usage has a notable practical value for managers interested in evaluating the impact of IT'. Based thereon

Al-Gahtani (2001b) suggests a construct using the following five indicators of IT usage: (1) the actual time spent using IT applications per day; (2) frequency of use of IT applications; (3) number of different IT software applications; (4) variety of IT application tasks; and (5) expectation of continuous IT usage in the future.

Substituting the phrase *IT* with *EIS* in each of the above indicators, the author adapted each of these five usage indicators in his survey instrument as follows: (1) *Usage amount* is measured as the average duration of a 'session' (in minutes and hours) the interviewee reports using the EIS in the organisation. See question 2.13; (2) *Usage frequency* is measured as how often (number of times per interval) the interviewee reports using the EIS in the organisation. See question 2.12. This question is an adaptation of the Davis *et al.* (1989) 'check the box' format wherein these researchers use seven different categories for current system use. Davis (1989) reports that these 'are typical of the kinds of self-reported measures often used to operationalise system usage, particularly in cases where objective usage metrics are not available'. The author has adopted this approach of using seven categories for current system usage; (3) see question 2.11; (4) already embraced in question 2.3; and (5) see questions 3.13 and 3.14 in Section 3.

Open-ended questions 2.14-2.16 were formulated by the author to glean some insights regarding the perceived success (or failure) of the EIS implementation of the interviewee's organisation;

- Section 3 deals with the Perceived Usefulness, Ease of Use and System Usage of the EIS in the interviewee's organisation. For the perceived usefulness and ease of use constructs the six-item instruments of the seven-point Likert scale statements for each construct were specifically drawn from the established Davis (1989) questionnaire. Appropriate modifications were made to make them specifically relevant to the author's study (an identical approach was adopted by Al-Gahtani, 2001b). This serves to facilitate validation of the author's instrument.

Perceived Usefulness: This construct was measured from statements 3.1- 3.6. Interviewees were asked to indicate the extent of agreement or disagreement with six statements each concerning how useful they perceived EIS usefulness in their organisation on a scale anchored with *extremely likely* and *extremely unlikely*.

Perceived Ease of Use: This construct is measured from statements 3.7- 3.12. Interviewees were asked to indicate the extent of agreement or disagreement with six statements each concerning how useful they perceived EIS ease of use in their organisation on a scale anchored with *extremely likely* and *extremely unlikely*.

System Usage: Davis (1989) reports using a seven-point Likert-type scale statement for the System Usage construct. Statement 3.13 is an adaptation of Davis' question but using this researcher's identical anchors: *extremely frequently* and *extremely infrequently*. Statement 3.14 is an adaptation by the author of Statement 3.13 for predicting future continuous (regular) usage of the EIS in interviewee's organisation. Interviewees were asked to indicate the extent of agreement or disagreement with each of these two statements;

- Section 4 deals with the perceived impact of Web-based technologies on EIS implementation in the interviewee's organisation (the respective Web-based technologies stated in statements 4.1-4.6 are fully discussed in Chapter 3). Interviewees were asked to indicate the extent of agreement or disagreement with statements 4.1-4.7 (each on a seven-point Likert scale anchored with (1) Not at all and (7) Extensively) concerning how they perceive specific Web-based technologies impacted their organisation's EIS implementation. Pooling data across different technologies is consistent with prior research in user acceptance (see, for example, Davis, 1989; Davis *et al.*, 1989; Compeau and Higgins, 1995; Venkatesh and Davis, 1996; Venkatesh and Morris, 2000);
- Section 5 deals with the perceived impact of Web-based technologies on future EIS implementation in the interviewee's organisation (the respective Web-based

technologies stated in statements 5.1-5.6 are fully discussed in Chapter 3). Interviewees were asked to indicate the extent of agreement or disagreement with statements 5.1-5.7 (each on a seven-point Likert scale anchored with (1) Not at all and (7) Extensively) concerning how they perceive specific Web-based technologies will impact their organisation's **future** EIS implementation; and

- Section 6 contains an open-ended question allowing the interviewee to furnish general comments which are regarded as significant to the EIS implementation in the interviewee's organisation.

The use of Likert scales is common in DSS and EIS research (see previous discussion in Section 5.3). For example, Davis (1989) in his DSS research used Likert scales to measure perceived usefulness and attributes of perceived ease of use. Rainer and Watson (1995a) used Likert scales in their questionnaire to assess the contribution of each factor to the successful development or operation of an EIS in the interviewee's organisation. Following Davis' (1989) use of a seven-point Likert scale, this scale was used by the author for all attitudinal questions in his survey instrument. For Likert scales Ghiselli *et al.* (1981) note that 'of special importance is item analysis'. Item analysis was noted (shaded area) in Table 5.2 (p.127) and will be described in Section 5.6.4.

5.3.2 Pre-testing the Survey Instrument

Pre-testing a survey instrument is common practice. For example, in the EIS survey conducted by Watson *et al.* (1995b), the pre-test resulted in a few minor wording changes of their survey instrument. Nonetheless the instrument's content was judged to be valid. Roldán and Leal (2003b) report that their 'instrument was pre-tested with consultants and business and IS professors'. A similar process was undertaken and experienced by the author who solicited expert opinion for 'additions, modifications and/or deletions to the survey' instrument (Rainer and Watson, 1995b).

A pilot study was conducted to ensure that the interview schedule was clear, intelligible and unambiguous. In order to evaluate the initial questionnaire design, an executive who uses EIS and four academics participated in separate field tests. One Spanish academic with EIS research interests commented 'Very interesting'. Their comments led to a refinement of the

questionnaire instrument. Their contributions are gratefully acknowledged. The survey instrument was submitted to three EIS software vendors (Cognos®, J.D. Edwards® and ProClarity®) in South Africa. A senior employee (*eg.* managing director) from each vendor independently furnished some suggestions regarding the survey instrument. Some appropriate suggestions were adopted by the author and incorporated in the survey instrument. A keen interest was expressed by all three EIS software vendor employees in the author's research. Such a piloting process helps establish content validity (Straub, 1989). Bias in response from misinterpretation of the survey instrument should therefore be reduced (Leidner and Elam, 1993).

5.4 Data Collection

A formal extensive interview schedule was compiled and used for the semi-structured interviews. No questionnaires were sent in advance to respondents. Thirty-one interviews were conducted by the author during the period 15 May to 5 June 2002. See Appendix 5. Twenty-six (83,9% of survey sample) interviews were conducted at the interviewee's organisation. Five (16,1%) interviews were conducted at either an EIS software vendors' premises, local hotel or airport. These five off-site interviews were for practical reasons (*eg.* one organisation is situated in a potentially 'unsafe' area).

In order to ensure that the interviewee replied specifically relating to EIS the author identified EIS as having the following characteristics:

- applications which support top management decision-making and environmental scanning;
- focus on tracking, control and 'drill down';
- access to external, corporate and enterprise wide databases;
- decision capabilities combined with a DSS;
- manipulation of numerical data (some symbolic) is feasible;
- information supports status access, exception reporting and key indicators;
- senior executives to business end-users are served; and
- focus is on timeliness.

The average duration of interviews was approximately 25 minutes. The duration range was between 18 minutes and one hour and five minutes.

5.4.1 Data Sampling of organisations with actual EIS experience

It is often not practical or possible to study an entire population (Melville and Goddard, 1996). Remenyi and Williams (1995) concur by stating that it is 'nearly always impossible' to test the theory against all members of the target population. It is necessary to select a sample which is both representative and unbiased of the overall population on which to conduct the test. The research hypothesis is the prediction derived from the theory under test (Siegal and Castellan, 1988). Siegal and Castellan (1988) note that confirmation of that prediction lends support to the theory from which it was derived.

The sample selected was planned to include organisations with actual EIS experience, including representatives of the following three constituencies:

- EIS executives/users whose organisation's utilise EIS;
- EIS providers (*ie.* persons responsible for developing and maintaining the EIS in the organisation); and
- EIS vendors or consultants in the EIS arena.

These three constituencies were identified and used in EIS research by Rainer and Watson (1995a). However, while these researchers only targeted *executives* in the first constituency, the author has broadened this constituency to *executives/business end-users* as nowadays EIS often spread throughout organisations (see previous discussion in Section 2.3.3). While EIS were originally intended only for senior managers, Beheshti (1995) reports that 'middle managers are using them more and more frequently', Nord and Nord (1995) note that 'other levels participate substantially', Liang and Hung (1997) observe that 'middle- and lower-level managers were major ... EIS users' and O'Brien (1999) suggests that 'EIS have spread into the ranks of middle management'. A further rationale for selecting these three constituencies is that they have a common interest in the success (usage) of EIS with potentially different perspectives. The use of multiple perspectives is frequently suggested in IS research (see, for example, Hamilton and Chervany, 1981; Alavi, 1982; Hogue and Watson, 1985; Watson *et al.*, 1987). For these reasons the above three constituencies were chosen by the author.

The sample was selected using the unbiased 'snowball' sampling technique. See, for example, Biernacki and Waldorf (1981). Cooper and Emory (1995) state that this technique has found a niche in recent years in applications where respondents are difficult to identify and are best located through referral networks. During the initial stage of snowballing individuals are 'discovered' and may or may not be selected through probability methods. This group is then used to locate others who possess similar characteristics and who, in turn, identify others. In this way a researcher collects evidence from a group of qualified respondents (Remenyi and Williams, 1995). Steer (1995) indicates that the snowball sampling technique is a widely accepted business approach in business research. The snowball sampling technique was also adopted by Roldán and Leal (2003b) in their EIS study of organisations in Spain.

Organisations considered for interview were chosen over a spread of industries (*eg.* banking, manufacturing, metropolitan municipality, retail). Using the snowball sampling technique the author targeted 31 sizeable and well-established organisations in the eThekweni Municipality region, KwaZulu/Natal which have EIS experience. eThekweni Municipality is the most populous municipality in South Africa (SA2002-2003, 2002). Its geographic area size is 2,300 km² with a population of 3,026,974 (eThekweni Municipal Area Development Profile, 2002). The author's survey of organisations in KwaZulu/Natal which have implemented EIS is confined to the eThekweni Municipality region.

Fifty-three local landline telephone and three cellphone calls were made by the author in arranging the 31 interviews. Where an organisation had implemented more than one EIS, the most recent EIS implementation was selected for survey purposes. All interviewees were computer proficient and were able to provide a meaningful business perspective on their organisation's EIS implementation. As Roldán and Leal (2003b) note this is 'to enable the answering of questions asked'. The EIS survey conducted by Steer (1995) in South Africa consisted of 24 completed questionnaires. The author's sample consists of 31 completed questionnaires which complies with the minimum recommended size that is needed for statistical inference purposes (Siegel and Castellan, 1988).

5.5 Data Analysis Procedures

The discipline of statistical analysis has traditionally been divided into two major subfields: descriptive statistics and inferential statistics (Jaccard and Becker, 1990; Howell, 1999).

Jaccard and Becker (1990) indicate that the two are highly related to one another and in some respects the distinction is arbitrary. Descriptive statistics involves the use of numerical indices to describe either a population or a sample (as in the author's research). Descriptive statistics 'is merely to *describe* a set of data' (Howell, 1999). The goal is to describe a group of scores in a clear and precise manner. In contrast, inferential statistics involves taking measurements on a sample and then from the observations, making inferences about a population - 'we must draw a *sample* from a *population*' (Howell, 1999). For the purposes of this dissertation descriptive and inferential statistics are used.

Descriptive statistics is a technique for sorting, arranging, collating and presenting the gathered information in a form which makes it intelligible (Allan, 1982). It describes the information. Allan (1982) notes that it makes users' numbers to be explicit.

From the 31 interviews conducted using the author's survey instrument (see Appendix 3) 31 completed questionnaires were analysed. A tally of the responses to questions 1.1-1.5 (Section 1) and questions 2.1, 2.3 and 2.5-2.13 (Section 2) was made. Where there was a null (or blank) response recorded, this null (or blank) response was excluded from the respective tally. Frequency tables were constructed for each tally. For the responses to questions 2.2 and 2.4, the data was arranged, sorted and frequency tables constructed. Such approaches are common in EIS research (see, for example, Meneely and Pervan, 1994; Kaniclidis and Kimble, 1997; Salmeron *et al.*, 2001; Roldán and Leal, 2003b). As Meneely and Pervan (1994) report the questionnaire data was analysed using basic statistical methods including frequencies. The author adopted a similar process.

For questions 3.1-3.12 (Section 3) of the author's survey instrument, Likert scale item responses were assigned numerical values in the range *extremely likely* = 3 to *extremely unlikely* = -3. A similar process was adopted for questions 3.13-3.14 (Section 3) anchored by *extremely frequent* = 3 to *extremely infrequent* = -3. For each questionnaire total scores for responses to questions 3.1-3.6 (Perceived Usefulness construct) and 3.7-3.12 (Perceived Ease of Use construct) was calculated. See Appendix 9. From the assigned numerical values and respective totals, Cronbach coefficients of reliability for the Perceived Usefulness and Perceived Ease of Use constructs were calculated.

For ordinal data the measure of association for ranked-ordered data is calculated by using the Spearman rank-order correlation coefficient r (Siegal and Castellan, 1988). Spearman rank-order correlation coefficients were calculated using total scores for Perceived Usefulness and Perceived Ease of Use constructs and numerical values assigned to questions 3.13 and 3.14 respectively. For the Davis *et al.* (1989) 'check the box' process (see Section 5.3.1) a Spearman rank-order correlation coefficient is calculated using interviewee's responses to question 2.12 (Section 2) and question 3.13 (Section 3). For question 2.12 responses were assigned numerical values in the range *Very rarely or not at all* = 1 to *Frequently (several times per day)* = 7. Interviewees 2 and 4 each gave one than one response (see Table 8). For these respondents a mean scale value of their assigned numerical values is calculated.

Siegal and Castellan (1988) note that when a correlation between two sets of attributes in a sample are observed, one may wish to determine whether it is plausible to conclude that they are associated in the population that is represented by the sample. If a group of subjects constitutes a random sample from a population it may be determined whether the association that exists between two sets of scores from that sample indicates that an association exists in the population by testing the association for 'significance' (Siegal and Castellan, 1988).

The item analysis procedure evaluates an item based on how well the item discriminates between those respondents whose total score is high and those whose total score is low (Cooper and Emory, 1995). The most popular type using this approach is summated scales. See Table 5.2 (p.127). Summated scales consist of statements that express either a favourable or unfavourable attitude toward an object of interest. The respondent is asked to agree (or disagree) with each statement. Item analysis permits the researcher to shorten a test while at the same time increasing the test's validity and reliability (Ghiselli *et al.*, 1981). Ghiselli *et al.* (1981) report that selective discrimination of noncontributing items (removing items that are equivalent to those that remain) can increase the validity and reliability of item properties. In the author's item analysis process noncontributing items (zero number of Web-based technologies) are not included.

In this research questions 4.1-4.7 deal with the impact of current Web-based technologies on EIS implementation in the interviewee's organisation. Each question is on a 7-point Likert scale

anchored by *Not at all* and *Extensively*. Each response is given a scale value (range -3 to 3) to reflect the respondent's degree of attitude. The scale values are used to produce a total score for each respondent's attitude. See Appendix 10. Excluding a scale value = -3 a tally of the number of scale values is made. This tally represents the total number of Web-based technologies which impact EIS implementations in organisations surveyed. See right most column in Appendix 10.

Questions 5.1-5.7 deal with the impact of Web-based technologies on future EIS implementation in the interviewee's organisation. Each question is on a 7-point Likert scale anchored by *Extremely likely* and *Extremely unlikely*. Each response is given a scale value (range 3 to -3) to reflect the respondent's degree of attitude. The scale values are used to produce a total score for each respondent's attitude. See Appendix 11. Excluding a scale value = 3 a tally of the number of scale values is made. This tally represents the total number of Web-based technologies which interviewees predict will impact future EIS implementations in organisations surveyed. See right most column in Appendix 11.

Cooper and Emory (1995) indicate that each interviewee's response must first be added to secure a total score. The next step is to array these total scores in descending sequence (see Table 5.6 (p.155) and Table 5.10 (p.162)) and select the respondents at each end with the highest and lowest *total scores* (eg. the top 25% and the bottom 25%). Where the number of Web-based technologies which impact EIS implementations in organisations surveyed equals zero (*ie.* noncontributing items) these organisations were excluded from further item analysis.

Scores or observations dealt with in research are frequently from individuals in whom researchers are interested (Siegal and Castellan, 1988). These individuals constitute a random sample from a population. Random sampling is the only method of sampling in which one can be confident that the selection method is free from bias (Harper, 1989). Any test to see if a difference is statistically significant (or not) is termed a significance test (Harper, 1989). In testing the significance of a measure of association the null hypothesis is being tested that there is no correlation in the population sample. An *appropriate* statistical test is used to determine whether the observed value of that statistic can reasonably be thought to have arisen under H_0 , referring to some predetermined level of significance (Siegal and Castellan, 1988). The

processing and interpretation of the results from the author's survey of 31 organisations situated in the eThekweni Municipality region is now presented.

5.6 Processing and Interpretation of the Results

The processing and interpretation of the results follows closely the sequence of sections in the author's survey instrument (see Appendix 3).

5.6.1 Demographics of organisations participating in Study

From a tally of interviewees' responses to question 1.1, the organisations participating in the study belongs primarily to the manufacturing (22,6%) and financial services (19,5%) sectors. See Table 1 of Appendix 6. The prominence of these two sectors is reported in the Spanish EIS survey by Roldán and Leal (2003b). The corresponding Spanish activity sector percentages are manufacturing (37,1%) and banking/financial services (24,3%).

From a tally of interviewees' responses to question 1.2, the gross annual turnover in South African Rands of organisations surveyed is given in Table 2 of Appendix 6. One respondent was unsure of his organisation's turnover and was not able to give a response to question 1.2. This null response was not included in Table 2 of Appendix 6. From Table 2 27 (90%) of the organisations surveyed were large enterprises in the eThekweni Municipality region. One organisation surveyed had an annual 'sales for the year exceeding R12 bn' (Butcher, 2002).

From a tally of interviewees' responses to question 1.3, the number of permanent employees in organisations surveyed is given in Table 3 of Appendix 6. From Table 3 it can be seen that 20 (64,5%) of these organisations had more than 500 employees. This percentage compares favourably with the Spanish EIS survey percentage of 71% (Roldán and Leal, 2003b).

From a tally of interviewees' responses to question 1.4, the number of years of existence of organisations surveyed is given in Table 4 of Appendix 6. From Table 4, 28 (90,3%) of organisations surveyed have existed for more than a decade. This suggests that these organisations are well-established in the eThekweni Municipality region. The surveyed organisation which existed for less than five years was from the Information Technology Services sector (see Table 1 of Appendix 6).

From a tally of interviewees' responses to question 1.5 the classification of organisations surveyed is given in Table 5 of Appendix 6. Table 5 suggests that the existence of EIS in organisations is not limited to a single organisational classification. As EIS differ considerably in scope and purpose 'the primary purpose of the system will change from one organization to another' (Roldán and Leal, 2003b). In the case of the Foreign enterprise classification both organisations were locally based (South African) but wholly owned by their respective overseas (based in Germany and Switzerland) parent organisations.

Interviewee names and their corresponding organisation names were recorded against question 1.6. These are reflected in Appendix 5. From the recorded responses to question 1.7, an alphabetic inventory of interviewee's job titles is given in Table 6 of Appendix 6. Some interviewees had identical job titles (Director, Managing Director, Regional Manager and Systems Analyst). Twelve (38,7%) interviewees held IT positions in organisations surveyed.

From Table 6 and an interviewee's response to question 1.8, the author objectively classified respondents into one of three stakeholder groups: EIS executive/business end-users, EIS providers and EIS vendors or consultants. Such classification for data sampling was discussed in Section 5.4.1. The three EIS constituencies and number of surveyed respondents and associated percentages per constituency are given in Table 5.3. Most research of IT acceptance and use does not distinguish senior executives as a separate group (Pijpers *et al.*, 2001).

Table 5.3 Stakeholder groups (constituencies) participating in Study

| Stakeholder groups (constituencies) | Number of respondents surveyed and associated percentage of total sample surveyed (N=31) |
|-------------------------------------|--|
| EIS executives/business end-users | 20 (64,5%) |
| EIS providers | 7 (22,6%) |
| EIS vendors or consultants | 4 (12,9%) |
| TOTAL | 31 (100,0%) |

From an analysis of interviewee's responses to question 1.8, 29 respondents indicated that they were EIS users in their organisations. Two respondents reported that they were EIS implementors. This concludes the analysis and findings of the interviewee's responses to Section 1 of the author's survey instrument (Appendix 3). Interviewees' responses to the

questions in Section 2 of the survey instrument (see Appendix 3) will now be analysed and discussed.

5.6.2 EIS in Respondent's organisation participating in Study

Roldán and Leal (2003b) surveyed organisations whose EIS were 'operative or in an implementation stage sufficiently advanced'. From a tally of interviewees' responses to question 2.1, the current (*ie.* during the interview period) EIS situation in the respondent's organisation is given in Table 1 of Appendix 7. From Table 1 one EIS implementation failure was reported by a respondent. This failure was ascribed to the most *recent* EIS implementation. In the Pervan and Phau (1997) EIS survey of organisations in Australia a similar experience was reported - 'only one of the organisations had experienced complete failure, in which the system had fallen into disuse'.

From the 27 operational EIS and in use by executives/business end-users (see Table 1 of Appendix 7) in organisations surveyed, a tally of interviewees' responses to question 2.2 is given in Table 2 of Appendix 7. Two respondents were not able to report the time taken before the EIS was in use by executives/business end-users. They stated 'EIS in use before I joined the company'. Their null responses are not included in Table 2.

From Table 2 the average time taken before the EIS was in use by executives and business end-users is 9,01 months. This compares favourably with the Roldán and Leal (2003b) average time of 8,53 months. Salmeron *et al.* (2001) report that the development of an EIS (in Spain) usually takes 6-12 months. These average times should be considered long term when compared with previous studies (Watson *et al.*, 1991; Watson *et al.*, 1992; Park *et al.*, 1997) which could negatively affect the users' acceptance of the system (Young and Watson, 1995).

From a tally of interviewees' responses to questions 2.3 (more than one answer could be given), the applications for which the EIS is used in organisations surveyed is given in Table 3 of Appendix 7.

Research has found that the accessibility of information is more important than its quality in predicting use (O'Reilly, 1982). Access to updated online information is a basic characteristic

of EIS (Houdeshel and Watson, 1987; Martin *et al.*, 1999). Pervan and Phua (1997) report that the ability to access current status information, such as performance reports, is the main feature most highly used by executives in obtaining the day-to-day information needed for their decision-making. From Table 3 the two highest scoring (see shaded areas) EIS applications used in respondents' organisations confirms the Australian EIS survey findings. Jones (2002) notes 'Executives need to be able to draw upon corporate knowledge and make decisions based on hard facts, not assumptions'.

From the 27 operational EIS and in use by executives/business end-users (see Table 5.3 (p.139)) in organisations surveyed, the EIS user statistics of interviewees' responses to question 2.4 is given in Table 4 of Appendix 7.

The EIS user statistics for **all** interviewee's responses (31 organisations surveyed) to question 2.4 is given in Table 5 of Appendix 7. The mean number of EIS users per organisation in both samples (see shaded areas in Tables 4 and 5) are similar.

Roldán and Leal (2003b) report that 'the average number of users in all organisations studied is 75.93 persons'. This figure is significantly higher than the author's means of 54 (N=27) and 50 (N=31) in Tables 4 and 5 of Appendix 7 respectively. A possible explanation for this is that in the Spanish survey, three organisations surveyed each had more than 400 users. One of these three organisations had a total of 1,800 EIS users. In the author's research the largest number of reported EIS users in one organisation was 700.

Roldán and Leal (2003b) suggest that it would therefore be more appropriate to take into account the mode values. They report 'the number of 20 users as a measure of the central trend'. This mode corresponds exactly to the author's survey results given in Tables 4 and 5.

From a tally of interviewees' responses (more than one answer could be given) to question 2.5, the hierarchical employee levels where EIS is used in organisations surveyed is given in Table 6 of Appendix 7.

Liang and Hung (1997) report that in their survey of organisations in Taiwan, middle-level

managers are primary EIS users (78,94%) 'but lower-level managers (24,58%) are also popular'. From Table 6 middle managers show significant higher EIS use levels (77,4%) than top managers (Managing Director/Chief Executive Officer (45,2%) and Director (58,1%)). This middle manager use level (77,4%) corresponds with the Liang and Hung (1997) survey but is higher than the Roldán and Leal (2003b) middle manager survey result of 68,6%. While Roldán and Leal (2003b) report a 'close similarity' between EIS use by middle managers (68,6%) and EIS use by managing directors (70,0%), this similarity is not evidenced by the author's findings in Table 6. There is a significant use difference between these two hierarchical levels. Furthermore Roldán and Leal (2003b) report that '21.4% of organizations declare that they have other users' below the line manager hierarchical level'.

From Table 6 there are twelve (38,7%) business end-users and one (3,2%) financial consultant below the line manager hierarchical level. The total percentage (41,9%) of these EIS users is significantly higher than the Roldán and Leal (2003b) survey. This tends to suggest that the degree of EIS diffusion to lower organisational hierarchical levels and use by these levels in organisations surveyed in South Africa, is on par with organisations surveyed in Taiwan but is significantly higher than experienced by organisations in Spain. As Liang and Hung (1997) note a 'reason for this may be the extension of EIS to everybody information systems'. EIS are becoming less strictly defined to support professional decision-makers throughout the organisation (Turban and Aronson, 1998). Turban and Aronson (1998) state that 'there is now increasing number of tools designed to help functional managers (finance, marketing); these tools are integrated with EIS'.

From a tally of interviewees' responses to questions 2.6 (more than one answer could be given), the functional areas where EIS are used in organisations is given in Table 7 of Appendix 7. The highest scoring functional areas are Finance (64,5%) and Marketing (64,5%). The lowest scoring functional area is Personnel (16,1%). Table 7 shows that the functional areas where EIS are used in organisations surveyed is quite broad. Similar broad findings are reported by Liang and Hung (1997) in organisations surveyed in Taiwan. One must ensure that the cost of the technology is able to justify its usage (Agarwal *et al.*, 1991).

From a tally of interviewees' responses to questions 2.7 (more than one answer could be

given), the different types of information held by an EIS in an organisation is given in Table 8 of Appendix 7. From Table 8 Financial information (90,3%) appears as the most important item followed by Business/Sales (74,2%) and then Strategic Planning (35,5%). In the Roldán and Leal (2003b) survey, the three highest ranking types of information held by an EIS in an organisation were Commercial and Sales information (89,2%), Financial information (65,7%) and Production information (55,7%). While previous research studies agree in presenting these three types of information (sales, financial and production) as the most relevant ones (Thodenius, 1995; Allison, 1996; Kirlidog, 1997) the author's findings partially support these findings with Business/Sales (74,2%) and Finance (90,3%) types of information. Holding strategic planning information in EIS in organisations in South Africa appears to have a higher importance than holding production information.

Watson *et al.* (1996) recognise that executives require 'soft' information (often provided informally) for decision-making. Soft information is 'fuzzy, unofficial, intuitive, subjective, nebulous, implied, and vague'. Watson *et al.* (1996) found that soft information was used in most EIS but the author's findings (12.9%) does not support this. One possible explanation is that it is often policy not to allow unsubstantiated rumours into IS without a reference to a source and tagged by the individual entering the information (Turban and Aronson, 1998).

From Table 8 of Appendix 7 it can be observed that the information that appears predominantly in EIS has an internal characteristic (Preedy, 1990). External information obtains low response levels: Trade/Industry (12,9%), External news services (3,2%), Competitors (9,7%) and Stock Exchange prices (3,2%). Roldán and Leal (2003b) report similar low response levels. Salmeron *et al.* (2001) note that 'it is surprising that external information is so seldom included in Spain'.

From a tally of interviewees' responses to question 2.8 (more than one answer could be given), how information is held by EIS in an organisation is given in Table 9 of Appendix 7. From Table 9 information is generally presented by products (71,0%), operational areas (64,5%) and geographical areas (58,1%). Roldán and Leal (2003b) report similar findings for operational/ functional areas (62,9%), products (61,4%) and geographic areas (52,9%).

Roldán and Leal (2003b) note that 'information according to processes ranks quite low, existing in only 20% of participating entities'. From Table 9 there is a striking commonality with the author's finding of 19,4%. This situation was highlighted by Wetherbe (1991) as one of the traditional IS problems for top managers *ie.* these systems are considered as functional systems rather than being considered as systems crossing functions.

From a tally of interviewees' responses to questions 2.9 (more than one answer could be given), the different types of sources of information that support an EIS in an organisation are given in Table 10 of Appendix 7. One of the capabilities or characteristics of EIS is the filtering, organisation and consolidation of multiple data sources (see Section 2.3.3). This quantitative data stems from corporate databases (80,6%) and operational databases (64,5%). Data aggregation is to integrate data from various sources to provide critical information requested by decision-makers (Liang and Hung, 1997).

As previously discussed Table 8 of Appendix 7 reflects that the information that appears predominantly in EIS has an internal characteristic. Table 10 of Appendix 7 reflects that a significant majority of the information came from internal sources. External sources have a low presence: external databases (25,8%) and Internet, Intranet or Extranet (16,1%). This trend towards internal sources supports the results obtained in previous research studies (Watson *et al.*, 1991; Watson *et al.*, 1992; Kirlidog, 1997; Basu *et al.*, 2000; Roldán and Leal, 2003b). In the opinion of Salmeron *et al.* (2001) 'the extent to which information coming from the environment is included in the EIS of Spanish big businesses should reach higher figures, due to the fact that all elements that currently form economy are interrelated'. Given the presence of Web-based technologies and from Table 10 it is therefore somewhat surprising that the Internet, Intranet and Extranet rank as the lowest source of information which support an EIS in the organisations surveyed in the eThekwini Municipality region. One of the contributions of the Web has been streamlining and co-ordinating the internal communication structure of organisations by using the Web as a standard (Abraham and Seal, 2001).

From a tally of interviewees' responses to questions 2.10, the approach taken for EIS development is given in Table 11 of Appendix 7. In-house development with assistance from the vendor (38.7%) was the most common approach taken. A 'piece meal' strategy where

in-house EIS development with critical features was conducted initially then operational features added over time using existing or purchased software tools was most preferred (33%) by organisations surveyed in Australia (Pervan and Phua, 1997). From Table 11 a similar pattern (29,0%) was evidenced in organisations surveyed in South Africa.

Roldán and Leal (2003b) report a ‘low number of cases in which the systems have been developed with software produced by the organization itself (5,7%)’. In the author’s survey in-house development using existing software tools is somewhat higher (19,4%). A possible explanation is that some organisations surveyed may not yet have migrated from their first (in-house developed) EIS.

Pervan and Phua (1997) report that for organisations surveyed in Australia, only 17% of EIS were developed in-house with assistance from a vendor/consultant. Roldán and Leal (2003b) report in-house development with assistance from the vendor (47,1%) as the most common approach taken in organisations surveyed in Spain. From Table 11 it can be seen that while this approach is taken by organisations surveyed in South Africa the occurrence is slightly less.

From a tally of interviewees’ responses to questions 2.11 (more than one answer could be given), the distribution of the market amongst vendors of EIS tools used in organisations surveyed is reflected in Table 12 of Appendix 7.

One respondent indicated that his organisation *only* used in-house developed software. This response was therefore not included in Table 12. From Table 12 Cognos® is the most frequently (60,0%) reported commercially packaged EIS software tool (see shaded area). Cognos® has 2,5 million users at 18,000 customers in 120 countries and its BI solutions are available from more than 3,000 worldwide partners and resellers. See Internet URL <http://www.cognos.com>

Pervan and Phua (1997) report that ‘Pilot was the most popular choice with 26%, followed by Powerplay with 16%’ in organisations surveyed in Australia. Roldán and Leal (2003b) found that ‘Commander from Comshare (39,1%), DSS Agents from MicroStrategy (21,9%), Forest & Trees from Platinum Technology (15,6%) and Focus/EIS from Information Builders

(10,9%)' were the popular EIS software tools in organisations surveyed in Spain. From Table 12 of Appendix 7 and the Australian and Spanish survey findings it appears that little use is made of ERP software with EIS features. EIS products 'tend to be included in larger software systems, becoming a module integrated in quite a few ERP systems such as SAP' (Roldán and Leal, 2003b). However, the author's findings suggest that there is a strong *usage* preference for commercially purchased EIS software tools (as opposed to ERP software with EIS features) by organisations surveyed in South Africa. Usage of ERP software with EIS features appears to be minimal in organisations surveyed in South Africa.

From a tally of interviewees' responses to questions 2.12 (more than one answer could be given), the frequency of EIS use in organisations surveyed is given in Table 13 of Appendix 7. As stated in Section 4.5.3 this EIS use measure was self-reported by respondents. Although previous research suggests that self-reported frequency measures are appropriate as relative measures (Blair and Burton, 1987), they should not be regarded as precise measures of actual use frequency (Davis *et al.*, 1989). From Table 13 frequent (several times per day) and regular use of the EIS were reported by a total of 25 (80,6%) respondents (see shaded area in Table 13). In the survey of EIS applications in Taiwan, Liang and Hung (1997) state that 'over half of the respondents reported using their systems every day. Twenty-two percent used the system very often'. Liang and Hung (1997) report that organisations with EIS 'rely heavily on their systems for support decision making'. In the author's survey some respondents reported different EIS use frequencies during the month (*eg.* higher EIS use during month end). One respondent stated 'First week of month is a lot busier. Towards end of the month not more than an hour'. An EIS has the effect of multiplying the frequency of use (Palvia *et al.*, 1996).

The low EIS use frequencies can be ascribed to the fact that three EIS implementations in organisations are currently under development and implementation (see Table 1 of Appendix 7). Despite this Davis (1989) notes that users are often willing to cope with some difficulty of use in a system that provides critically needed functionality. System use is the most crucial aspect of EIS operation (see Section 2.5.2.4).

From the responses to question 2.14 a smorgasbord of some interviewee's comments is now given. Twenty-nine interviewees expressed a positive personal expectation to the success of the

EIS implementation in their organisations. Some interviewee comments recorded (by the author) were: 'Positive', 'Very optimistic', 'We knew it would be a success from our previous history', 'I thought the guys would really go for it', 'Had a very high expectation of success', 'We had nothing. We believed it would sort out all our problems', 'I knew it would be successful because we had done a lot of research' and 'I knew it would work as we were reliant on the mainframe'.

One interviewee's response was neutral with a reply 'Can't comment. Before my time'. Another interviewee 'thought it would fail ... had old style managers who were not into new kinds of things ... things have now changed'. Perlman (1986) notes that overcoming inherent human conservatism associated with any change is crucial. The right determination is seen as a key to EIS success (Salmeron, 2001).

From a synthesis of interviewees' responses to question 2.15, the author identified that 27 interviewees reported the most recent EIS implementation in their organisation as successful, three interviewees reported partially success and one interviewee reported failure with his organisation's most recent EIS implementation.

For the 27 successful organisations some interviewee comments recorded were: 'Yes, definitely growing now', 'Yes, it was successful due to the ease of implementing the Cognos product. It is very scalable. We staged the implementation', 'Absolutely, yes!', 'Oh, yes. Without a doubt', 'To a large degree it achieved what we had originally set out to achieved', 'Successfully implemented but is not widely used' and 'Yes, once up and running'.

For the partially successful EIS implementations some interviewee comments recorded were: 'It has not yet been completed ... serious mindset to get rid of' and 'thought it would be successful but needed executive team buy-in'. Support from senior management is considered to be the most critical issue affecting EIS operation (Kaniclides and Kimble, 1997).

For the not successful (*ie.* failure) EIS implementation in response to question 2.16, the interviewee stated for the latest EIS implementation his organisation had 'tried to pilot a project ... but there were some political reasons for its failure'. Politically motivated resistance from

executives is a highly rated factor affecting the success of EIS development (Kaniclides and Kimble, 1997). Kaniclides and Kimble (1997) note that politically driven tactics can originate from both executives designated as initial users of the system and those regarded as potential future users of the system. This scenario appears to be present in the organisation which the interviewee reported that the latest EIS implementation had not been successful. Furthermore there seemed to exist an interest in letting the EIS system fail rather than a lack of interest in system success. A similar finding was reported by Poon and Wagner (2001) in organisations surveyed in Hong Kong.

There is little information available to assist practitioners regarding the question of how to minimise the risk of EIS failure (Watson *et al.*, 1991). Watson and Glover (1989) carried out a study of 21 EIS failures. From their findings they identified the following factors that contribute to the EIS failure: inadequate or appropriate technology, failure of the system to meet user needs, lack of executive commitment and executive resistance to technology. In the Pervan and Phua (1997) study of EIS failures in organisations surveyed in Australia, inadequate or appropriate technology was reported as being the major EIS failure factor. During the author's interview of the respondent who reported his most recent EIS implementation as not successful, the interviewee cited that 'there were some political reasons for its failure'. At first glance this finding appears to be inconsistent with the Watson and Glover (1989) and the more recent Pervan and Phua (1997) studies.

A further investigation reveals that in the Pervan and Phua (1997) study 'with only 16% of organisations having EIS that are in full operation, this may be the reason for political problems being rated the least important'. Pervan and Phua (1997) note that 'this issue may increase in significance as more organisations progress from the evaluation stage to the operational stage in the near future'. During the author's survey the respondent who reported his most recent EIS implementation as not successful **had** progressed from an EIS evaluation stage to the operational stage. Consequently the author's findings do not appear to be inconsistent with the Pervan and Phua (1997) study.

From the responses to question 2.15 for successful and partially successful EIS implementations in organisations surveyed, some interviewee's comments are now given. 'Software had to be

user friendly ... the way that we had done our reporting did not display well ... our MD wants to look at something more visual', 'a very clear understanding of user requirements is necessary because they don't know what they want', 'the ease of extracting the data ... must be very easy and flexible', '... the buy-in was already there', 'that we can use our data for analysis', 'management support', 'the immediate access to data, drill down, KPIs to customers and products', 'presents answers in a presentable way ... user-friendly', 'reliable, timeliness and flexibility', 'accurate, timeous, relevant to what's happening in business at moment ... also ease of use', 'needed to be backed by management to be successful', 'needed an executive sponsor', 'stable technology' and 'data integrity'.

Rockart and Delong (1988) observed several factors in organisations which appear to be the most important for effective EIS implementation. Some factors which Rockart and Delong (1988) report as critical to a successful EIS implementation are a committed and informed executive sponsor, an operating sponsor, appropriate IS staff, appropriate technology, management of data, clear link to business objectives, management of organisational resistance and management of system evolution spread. Pervan and Phua (1997) report that these factors will be refined by other researchers as the EIS field evolves. While there is no consensus on the 'ingredients for EIS success' (Paller and Laska, 1990) there appears to be a strong degree of commonality between the identified factors and interviewee's comments. See previous discussion in Section 2.5.2.2. As stated in Section 2.5.2.4 factors for successful EIS implementation are not the focus of this dissertation. This concludes the analysis and findings of the interviewee's responses to Section 2 of the author's survey instrument (Appendix 3). Interviewees' responses to the statements in Section 3 of the survey instrument (see Appendix 3) will now be analysed and discussed.

5.6.3 Perceived EIS Usefulness, Ease of Use and System Usage in Respondent's organisation

A knowledge of individual attitude determinants can be useful in any diagnosis of potential problems with the changes that accompany the implementation of a new IS (Hodgson and Aiken, 1998). The reliability of measurement refers to the extent of variation in an individual's scores over a series of parallel tests (Ghiselli *et al.*, 1981). Ghiselli *et al.* (1981) note that the reliability coefficient gives a description of the degree of reliability. The Cronbach alpha is a

commonly used coefficient of reliability. See, for example, Doll and Torkzadeh (1988), Whyte (1995), Lai (1996) and Lederer *et al.* (2000). Nunnally (1978) suggests an alpha score above 0.7 for reliability.

For the Perceived Usefulness and Perceived Ease of Use constructs, Davis (1989) calculated the Cronbach alphas. The magnitude of coefficient alpha is a function of the ratio of the sum of the inter item covariances to the variance of the total score (Ghiselli *et al.*, 1981). Ghiselli *et al.* (1981) state that the sum of the covariances in turn is largely a function of the intercorrelations among the parts. According to UCLA Academic Technology Services (see Internet URL <http://www.ats.ucla.edu/stat/spss/faq/alpha.htm>), the Cronbach alpha can be written as a function of test items and the average intercorrelation among the items:

$$\alpha = \frac{N \cdot \bar{r}}{1 + (N - 1) \cdot \bar{r}} \quad \text{(Equation 5.6.3.1)}$$

In equation 5.6.3.1, N is equal to the number of items ($N = 31$ in author's survey) and \bar{r} is the mean inter item correlation among the items. From Appendix 7, intercorrelations between the scale values to questions 3.1-3.6 (Perceived Usefulness) and intercorrelations between the scale values to questions 3.7-3.12 (Perceived Ease of Use) constructs were calculated. The results are given in Tables 5.4 and 5.5 respectively.

Table 5.4 Intercorrelations between scale values to questions 3.1-3.6 (Perceived Usefulness)

| Question No | 3.1 | 3.2 | 3.3 | 3.4 | 3.5 | 3.6 |
|-------------|----------|----------|----------|----------|----------|-----|
| 3.1 | 1 | | | | | |
| 3.2 | 0.581381 | 1 | | | | |
| 3.3 | 0.625311 | 0.451258 | 1 | | | |
| 3.4 | 0.324384 | 0.334883 | 0.439406 | 1 | | |
| 3.5 | 0.407905 | 0.293303 | 0.379525 | 0.589805 | 1 | |
| 3.6 | 0.343011 | 0.343651 | 0.320175 | 0.136704 | 0.379525 | 1 |

From Table 5.4, the mean intercorrelation was 0.3966818. Substituting $\bar{r} = 0.3966818$ and $N = 6$ in Equation 5.6.3.1, the Cronbach coefficient alpha for Perceived Usefulness construct = 0.80.

Table 5.5 Intercorrelations between scale values to questions 3.7-3.12 (Perceived Ease of Use)

| Question No | 3.7 | 3.8 | 3.9 | 3.10 | 3.11 | 3.12 |
|-------------|----------|-----------|----------|----------|----------|------|
| 3.7 | 1 | | | | | |
| 3.8 | 0.122943 | 1 | | | | |
| 3.9 | 0.555738 | 0.065362 | 1 | | | |
| 3.10 | 0.320175 | -0.108040 | 0.423216 | 1 | | |
| 3.11 | 0.517940 | 0.026549 | 0.361211 | 0.517940 | 1 | |
| 3.12 | 0.406961 | 0.125034 | 0.561226 | 0.541171 | 0.630256 | 1 |

From Table 5.5, the mean intercorrelation was 0.3378450. Substituting $= 0.3378450$ and $N = 6$ in Equation 5.6.3.1, the Cronbach coefficient alpha for Perceived Ease of Use construct = 0.75.

The Cronbach alpha measures how well a set of items (variables) measures a single one dimensional latent construct *ie.* the reliability of measurement. In the Davis (1989) study 'Cronbach alpha was 0.98 for perceived usefulness and 0.94 for perceived ease of use'. Subsequent studies have reported reliability scores ranging from 0.82 (Igbaria *et al.*, 1995a) to 0.95 (Davis *et al.*, 1989) for perceived usefulness and 0.85 (Igbaria *et al.*, 1995a) to 0.91 (Davis *et al.*, 1989) for perceived ease of use. While the author's Cronbach alpha of 0.80 for perceived usefulness may be regarded as 'just acceptable', the Cronbach alpha of 0.75 for perceived ease of use is relatively low. This casts some doubt on the reliability of measurement as a relatively low alpha indicates that the data could be multi-dimensional. Factor analysis can be performed on the data. For the purposes of this dissertation the multi-dimensionality aspect is not explored further.

Some studies have investigated TAM using the Web as the application. Teo *et al.* (1999) found that usefulness and ease of use predicted usage but that usefulness had a stronger effect. Another study (Morris and Dillon, 1997) found that ease of use predicted usage. Perceived ease of use is the degree to which a person believes that using a particular system would be free from effort (Davis, 1989). By supporting TAM both studies suggest the importance of the antecedents to usefulness and ease of use (Lederer *et al.*, 2000).

Statistical tests that do not rely on parameter estimation or precise distributional assumptions are referred to as nonparametric (or distribution-free) tests (Howell, 1999). Howell (1999) notes that because many distribution tests rank raw scores and operate on those ranks they offer a test of differences in central tendency which is unaffected by one or a few very extreme scores. As described in Section 5.5, from Appendix 9 the Spearman rank-order correlation coefficients r were calculated for perceived usefulness and intended usage; and perceived ease of use and intended usage. Allowing for tied observations (see Siegel and Castellan, 1988), $r = 0.144$ for Perceived Usefulness and $r = 0.373$ for Perceived Ease of Use. These correlation values are considerably lower than expected. For example, Davis (1989) reports 'Perceived usefulness was correlated .63 with self-reported current use in Study 1 and .85 with

self-predicted use in Study 2. Perceived ease of use was correlated .45 with use in Study 1 and .69 in Study 2'. The author's correlation for usefulness-usage ($r = 0.144$) is *lower* than for use-usage ($r = 0.373$) and is therefore not consistent with Davis' findings. Furthermore because of the author's low correlation values Perceived Usefulness is **not** 'significantly more strongly linked to usage than was ease of use' (Davis, 1989). Davis (1989) emphasises that 'perceived usefulness and ease of use are people's subjective appraisal of performance and effort, respectively, and do not necessarily reflect objective reality'.

The author's results are not in support of the basic tenets of TAM. TAM has emphasised the importance of perceived usefulness (over perceived ease of use) as the key determinant of acceptance. Empirical evidence has constantly borne out this claim leading to perceived ease of use being treated as somewhat of a 'step-child' (Venkatesh, 1999). However, results of Venkatesh's research indicates that perceived ease of use **can** be a strong catalyst fostering acceptance. The author's results partially supports this finding *ie.* perceived ease of use can be a stronger catalyst (over perceived usefulness) fostering IT acceptance. In summary the author's finding is that ease of use on intended usage is greater than the effect of perceived usefulness on intended usage.

In order to investigate the author's low correlation values, an inspection was made of the raw data (interviewee's responses to questions 3.13 and 3.14) in Appendix 8. For question 3.13, 19 (61,3%) respondents reported that they currently use EIS extremely frequently in their job. Nine (29,0%) respondents reported that they currently use EIS quite frequently in their job and 3 (9,7%) respondents reported that they currently use EIS slightly frequently in their jobs. It is evident that there is little variation in these responses: only 3 (out of 7 possible) different Likert scale categories. Moolman (2002b) notes that when 'a correlation coefficient is based on values from a 3 point scale there is the potential for a problem'. For question 3.14, 27 (87,1%) respondents predict that in the future they will use the EIS in their organisation extremely frequently and 4 (12,9%) respondents predict that in the future they will use the EIS in their organisation quite frequently. Moolman (2002b) notes, that this 'low correlation value will not be changed by using an alternative formula. To get a higher correlation you will need more variation among the intended useage responses' (*sic*). While these low correlation results may appear to be disappointing, given the very small statistical variation in interviewee's

responses, this accounts for the fact that the author's results are not consistent with previous findings where significantly higher correlations are reported (see, for example, Davis, 1989; Al-Gahtani, 2001b; Suradi, 2001). It is therefore concluded that in this study there is little evidence to support that the theoretical usage aspects of TAM are echoed in EIS implementations in KwaZulu/Natal.

As stated in Section 5.3.1, question 2.12 (more than one answer could be given) in Section 2 of the survey instrument (see Appendix 3) is an adaptation of Davis *et al.* (1989) 'check the box' concept wherein Davis *et al.* (1989) used seven different categories for current system use. From Appendix 8 (interviewees responses to question 2.12 (Section 2) and 3.13 (Section 3)) the Spearman rank-order correlation coefficient ($r = -0.241$) between frequency of EIS use and current EIS use in the respondent's job was calculated. This (corrected) r includes tied observations. This negative correlation indicates that when there is an increase in frequency of EIS use, there was a greater or lesser extent of association with a decrease in current EIS use in the respondent's job. This low correlation may also be ascribed to the very small variation in interviewee's responses.

Siegel and Castellan (1988) note that if 'the proportion of tied observations is not large, their effect on r_s is negligible'. In the author's survey for the interviewee's responses to question 2.12, there were four groupings of different tied rankings (one grouping had 12 tied rankings). For the interviewee's responses to question 3.13 there were no individual rankings (one grouping had 12 and the other 19 tied rankings). With the small variation in interviewee responses, these tied rankings inflated the value of the (uncorrected) correlation r . It is therefore concluded that in this survey there is little evidence to support the Davis *et al.* (1989) 'check the box' concept.

This concludes the statistical analysis and findings for the interviewee's responses to Section 3 of the author's survey instrument (Appendix 3). Furthermore the second sub-goal of this dissertation (see Section 1.4) is to investigate whether the theoretical usage aspects of TAM are echoed in EIS implementations in KwaZulu/Natal. This sub-goal has now been achieved. For Section 4 statistical analysis of the current impact level (if any) of Web-based technologies on EIS implementation will be undertaken in the next section.

5.6.4 Level of impact of Web-based Technologies on EIS implementation

As discussed in Section 5.5 the item analysis procedure evaluates an item based on how well the item discriminates between those respondents whose total score is high and those whose total score is low (Cooper and Emory, 1995). The most popular type using this approach is summated scales.

Summated scales consist of statements that express either a favourable or unfavourable attitude toward an object of interest. The respondent is asked to agree (or disagree) with each statement. Each response is given a scale value to reflect the respondent's degree of attitude.

In this research the 7-point Likert scale had anchor scale values -3 ('Not at all') and 3 ('Extensively'). The scale values were used to produce a total score for each respondent's attitude. Where a scale value did **not** equal -3, this indicated that a Web-based technology had (to some perceived degree) impacted the EIS implementation in the organisation surveyed. A tally of the other scale values (3, 2, 1, -1, and -2) was made to calculate the number (if any) of Web-based technologies. This number of Web-based technologies which impacted EIS implementations in organisations surveyed is given in the right most table column of Appendix 10.

Cooper and Emory (1995) indicate that each interviewee's response must first be added to secure a total score. The next step is to select group high score and low score respondents (eg. the top 25% and the bottom 25%). Downie and Heath (1970) suggest for item analysis of small samples (less than 100) estimates 'as to whether or not an item is discriminating can be made by an inspection of the number of individuals in the high and low groups for each item. Those items with no discrimination ... can be spotted at once'. A standard must be adopted (by the researcher) so that there is a difference between the high and low groups. Downie and Heath (1970) caution that while 'this technique is crude, it is better than nothing'.

As suggested by (Moolman, 2002a), where the number of Web-based technologies which impacted EIS implementations in organisations equals zero, the associated total scores (all total scores equal -21) should be excluded from further item analysis processing. The 'adjusted' author's sample size reduced from 31 to 17 organisations. From these 17 organisations (see

scale values in Appendix 8), the highest four (top 25%) and lowest seven (bottom 25%) total scores are highlighted (see shaded areas) in Table 5.6. These two extreme groups (highest four total scoring and lowest four total scoring) represent the most favourable and least favourable attitudes toward the topic being studied (Cooper and Emory, 1995).

Table 5.6 Organisation number, organisation total score and associated number of Web-based technologies

| | Organisation's total score | Number of Web-based technologies which impacted EIS implementations in organisations surveyed |
|----|----------------------------|---|
| 6 | 12 | 6 |
| 10 | -1 | 4 |
| 7 | -3 | 4 |
| 24 | -3 | 6 |
| 27 | -4 | 3 |
| 17 | -5 | 4 |
| 20 | -11 | 2 |
| 23 | -11 | 2 |
| 1 | -13 | 2 |
| 18 | -15 | 3 |
| 25 | -16 | 1 |
| 30 | -16 | 1 |
| 11 | -17 | 1 |
| 14 | -17 | 4 |
| 26 | -17 | 1 |
| 8 | -19 | 1 |
| 19 | -19 | 1 |

From the number of Web-based technologies which impacted EIS implementations in organisations surveyed (see Table 5.6), the associated range, mean and standard deviation for each of the two extreme groups (highest four total scoring and lowest four total scoring) is given in Table 5.7.

In order to determine whether a linear relationship exists between an organisation's total score and the associated number of Web-based technologies which impacted the organisation's (most recent) EIS implementation, a hypothesis was made. The hypothesis was that this was a

one-tailed lower-tail test with H_0 : No relationship between the current number of Web-based technologies and the total points scored and H_1 : Negative linear relationship between the current number of Web-based technologies and the total points scored.

Table 5.7 Associated Range, Mean and Standard Deviation for each Group (current Web-based technologies)

| Statistical Calculation | Highest Four Total Scoring Group | Lowest Four Total Scoring Group |
|-------------------------|----------------------------------|---------------------------------|
| Range | 12 to -3 | -17 to -19 |
| Mean | 1.3 | -1.8 |
| Standard Deviation | 7.2 | 1.2 |

From Table 5.6 (shaded areas), Pearson's product-moment coefficient of linear correlation $r = 0,832$ was calculated. The number of degrees of freedom was 6. The table values (critical values of the coefficient of linear correlation), see Melville and Goddard (1996), are 0,707 (5% level) and 0,834 (1% level). It can therefore be concluded that the null hypothesis (H_0) is rejected and H_1 can be accepted at the 5% level. This tends to suggest that there is some negative linear relationship between the current number of Web-based technologies and the total points scored in organisations surveyed in the eThekwini Municipality region.

From Section 4 of Appendix 8 a tally and associated percentage of the degree to which specific Web-based technologies impacted respondent's EIS implementation is given in Table 5.8.

Table 5.8 Tally and associated percentage of the degree to which specific Web-based technologies impacted respondent's EIS implementation

| Web-based technology | The degree to which Web-based technologies impacted respondent's EIS implementation (N=31) | | | | | | |
|-----------------------------------|--|-------------|-----------------|-----------|---------------|-----------|-------------|
| | Not at all | Very little | Somewhat little | Uncertain | Somewhat much | Very much | Extensively |
| Intranet | 17 (54,8%) | 2 (6,5%) | 2 (6,5%) | 0 (0,0%) | 3 (9,7%) | 4 (12,9%) | 3 (9,6%) |
| Internet | 21 (67,7%) | 1 (3,2%) | 1 (3,2%) | 0 (0,0%) | 2 (6,5%) | 3 (9,7%) | 3 (9,7%) |
| Extranet | 24 (77,4%) | 1 (3,2%) | 2 (6,5%) | 1 (3,2%) | 1 (3,2%) | 2 (6,5%) | 0 (0,0%) |
| e-Commerce: (B2B) | 28 (90,4%) | 1 (3,2%) | 0 (0,0%) | 0 (0,0%) | 0 (0,0%) | 1 (3,2%) | 1 (3,2%) |
| e-Commerce: (B2C) | 26 (83,9%) | 1 (3,2%) | 1 (3,2%) | 0 (0,0%) | 2 (6,5%) | 0 (0,0%) | 1 (3,2%) |
| WAP and other mobile technologies | 29 (93,6%) | 1 (3,2%) | 0 (0,0%) | 0 (0,0%) | 0 (0,0%) | 0 (0,0%) | 1 (3,2%) |
| Portal | 26 (83,8%) | 0 (0,0%) | 0 (0,0%) | 0 (0,0%) | 2 (6,5%) | 2 (6,5%) | 1 (3,2%) |

The shaded area in Table 5.8 suggests that there is little (if any) perceived impact by Web-based technologies on EIS implementations in organisations in KwaZulu/Natal. These results are similar to earlier findings by Averweg (2002b).

When the experimental data consists of frequencies in discrete categories (such as Table 5.8), the chi-square test may be used to assess the significance of differences among k independent groups (Siegal and Castellan, 1988). Siegal and Castellan (1988) note, however, the application of this test requires that the expected frequencies in each cell are not too small. Cochran (1954) recommends that in chi-square tests for which the degrees of freedom are greater than 1, no more than 20% of the cells should have an expected frequency of less than 5 and no cell should have an expected frequency of less than 1. From Table 5.8, the expected frequencies of each cell are given in Table 1 of Appendix 12. From Table 1, 42 cells (85,7%) of expected frequencies have a value less than 5 and 14 (28,6%) cells have an expected frequency less than 1, the application of a chi-square test requirements will be 'violated' and 'the results of the test cannot be interpreted' (Siegal and Castellan, 1988). For these reasons the chi-square test is not applied to the tallies in Table 5.8.

Table 5.8 shows that only seven (22,5%) of organisations surveyed reported that the Intranet significantly impacted their EIS implementation. The level of impact by the Internet on EIS implementation is slightly lower with six (19,4%) of organisations surveyed reporting that the Internet had significantly impacted their EIS implementation. While 24 (77,4%) of organisations surveyed reported that the Extranet had no impact on their organisation's EIS implementation, the balance of the data sample (22,6%) reported different degrees of impact. This may be an avenue for further investigation. The exact definition of an Extranet is still evolving (Turban *et al.*, 1999).

The results show that the vast majority (90,4%) of respondents reported that e-Commerce: (B2B) had not impacted EIS implementation in organisation surveyed. A slightly lower result (83,9%) was reported for e-Commerce: (B2C). One possible explanation for the e-Commerce (B2B) and (B2C) low impact levels is that the software development tools are still evolving and changing rapidly. Another possible reason is that it is difficult to integrate the Internet and e-Commerce software with some existing applications and databases. See previous discussion in Section 3.4.2.

WAP and other mobile technologies have no (93,6%) or very little (3,2%) impact on EIS implementations. Of the seven Web-based technologies given in Table 5.8, WAP and other mobile technologies have the *least* impact (combining ‘Somewhat much’, ‘Very much’ and ‘Extensively’) on EIS implementation in organisations surveyed. Only one respondent (3,2%) reported that WAP and other technologies had extensively impacted the EIS implementation in her organisation. A possible explanation for this result is that the EIS consultant was technically proficient in WAP technologies.

From Table 5.8, three interviewees reported that their organisation’s EIS implementations were significantly impacted (‘Very much’ and ‘Extensively’) by portal technologies. This is noteworthy as the portal technology impact on EIS implementations (9,7%) is higher than the Extranet (6,5%), e-Commerce: (B2B) (6,4%), e-Commerce: (B2C) (6,4%) and WAP and other technologies (3,2%) impacts. This means that after the Intranet and Internet, portal Web-based technologies have the third highest impact on EIS implementations in organisations surveyed. Portal technologies will be discussed shortly. Combining the results (‘Somewhat much’, ‘Very much’ and ‘Extensively’) for each of the seven Web-based technologies, Table 5.9 gives a descending ranking order of the levels of impact on EIS implementations. This information is particularly useful for IT practitioners in the planning of future EIS implementations.

Table 5.9 Descending rank order of impact levels of Web-based technologies on EIS implementation

| Rank | Web-based technology | Tally and level of impact on EIS implementations |
|------|-----------------------------------|--|
| 1 | Intranet | 10 (32,2%) |
| 2 | Internet | 8 (25,9%) |
| 3 | Portal | 5 (16,2%) |
| 4 | Extranet | 3 (9,7%) |
| 4 | e-Commerce: (B2C) | 3 (9,7%) |
| 6 | e-Commerce: (B2B) | 2 (6,4%) |
| 7 | WAP and other mobile technologies | 1 (3,2%) |

Enterprise portal is a new approach in Intranet-based applications. It is often referred to as next-generation Intranet (Bajgoric, 2000). Bajgoric (2000) notes that it goes a step further in

the 'webification' of applications and integration of corporate data. Several 'portal-based' products particularly from the BI area exist. The Hummingbird Enterprise Information portal® (see Internet URL <http://www.hummingbird.com>) is an example of an integrated enterprise-wide portal solution. It provides organisations with a Web-based interface to unstructured and structured data sources and applications.

BI portal is a new software product based on the Web concept of a portal site that lets organisations deliver information from a variety of sources to end-users (Bajgoric, 2000). Bajgoric (2000) reports that enterprise information portal describes a system that can be used to combine an organisation's internal data with external information which provides a powerful decision support capability. WebIntelligence® from Business Objects (see Internet URL <http://www.businessobjects.com>) includes a BI portal that gives users a single Web entry point for both WebIntelligence® and BusinessObjects®, the organisation's client-server reporting and OLAP (see Section 2.6.9) system. As indicated in Section 2.3.3, Brio.Portal® from Brio Technology is another example of integrated BI software capable of retrieving, analysing and reporting information over the Internet. For a discussion of some BI trends and BI popularity in South Africa see Appendix 13.

The findings of this survey show, however, that while EIS have a significant role in organisations within the eThekweni Municipality region their technological base is not affected considerably by the latest innovations in the form of Web-based technologies. This requires further investigation as to whether it is a signal for the fact that IT in South Africa is not transforming fast enough to adopt new Web-based technologies.

IT - the convergence of computing, telecommunications and imaging technologies - has had a radical impact on IT users, their work and their working environments (Chan, 2000). IT has been one of the fastest growing industrial sectors in developed countries during the last forty years. Through declining hardware costs and increasing benefits IT has achieved varying intensities of diffusion to less developed countries (Kirlidog, 1996). For organisations to succeed in the current business environment it is important to develop policies to an environment conducive to technological innovation (Basu *et al.*, 2000).

A United Nations (UN) study recognised the existence of four levels of computer usage in developing countries (Perelet, 1977; Paker, 1981). These levels are identified as initial, basic, operational and advanced. Kirlidog (1996) notes, however, that much has changed since this UN study was conducted and such a 'classification can give only a superficial idea of relative levels of computer usage' in less developed countries. Palvia *et al.* (1992) report that the UN's *basic* level classification corresponds to underdeveloped nations and the *operational* level corresponds to developing nations (like South Africa).

In many developing countries, the computer is mainly used as a simple record machine to register organisational transactions (Kirlidog, 1996). Kirlidog (1996) note that although this is a necessary initial step which must be covered, it is usually of little help with organisational effectiveness. It is argued by the author that the full power of information technologies (such as Web-based technologies) can be attained only through the computer's advanced reporting and analysis capabilities (such as EIS type of applications). In other words the input processes must be followed by advanced output processes to nourish knowledge to people who need it most. The operational level implications are clear: for their EIS applications, managerial practices in South Africa still have a long way to go to reap the benefits offered by Web-based technologies. As noted by Basu *et al.* (2000) it 'is not enough to have the most current (Web-based) technologies in place if users do not adopt this new technology'. In some cases a technology is simply made available for use by those in the organisation but there is no requirement that it be used (Hodgson and Aiken, 1998). Hodgson and Aiken (1998) state that the success of any IS technology is dependent on getting the user to accept the technology.

This concludes the statistical analysis and findings for the interviewee's responses to Section 4 of the author's survey instrument (Appendix 3). For Section 5 statistical analysis of the perceived future level of impact (if any) of Web-based technologies on EIS implementation will be undertaken in the next section.

5.6.5 Level of Impact of Web-based Technologies on future EIS implementations

The item analysis process described in Section 5.6.4 is followed for the processing of the results for the impact of Web-based technologies on future EIS implementations. The Likert 7-point scale values were 3 ('Extremely likely') and -3 ('Extremely unlikely'). The scale values were

used to produce a total score for each respondent's attitude. Where a scale value equaled -3 this indicated that a Web-based technology will **not** impact future EIS implementations in the organisations surveyed. A tally of the other scale values (3, 2, 1, -1 and -2) was made to calculate the total number of Web-based technologies (if any). The number of Web-based technologies which may impact an organisation's future EIS implementation is given in the right most table column of Appendix 11.

From these 31 organisations (see scale values of Appendix 9) the highest eight (top 25%) and lowest eight (bottom 25%) total scores are highlighted (see shaded areas) in Table 5.10. These two extreme groups (highest eight total scoring and lowest eight total scoring) represent the most favourable and least favourable attitudes towards Web-based technologies which may impact future EIS implementations in organisations surveyed.

From the number of Web-based technologies which may impact future EIS implementations in organisations surveyed in Table 5.10, the associated range, mean and standard deviation for each of these two groups is given in Table 5.11 (p.163).

In order to determine whether a linear relationship exists between an organisation's total score and the associated number of Web-based technologies which may impact an organisation's **future** EIS implementation, a hypothesis was made. The hypothesis was that this was a one-tailed lower-tail test with H_0 : No relationship between the future number of Web-based technologies and the total points scored and H_1 : Negative linear relationship between the future number of Web-based technologies and the total points scored.

From Table 5.10 (shaded areas), Pearson's product-moment coefficient of linear correlation $r = 0,897$ was calculated. The number of degrees of freedom was 14. The table values (critical values of the coefficient of linear correlation), see Melville and Goddard (1996), are 0,497 (5% level) and 0,623 (1% level). It can therefore be concluded that the null hypothesis (H_0) is rejected and H_1 can be accepted at the 1% level. This tends to suggest that there is some negative linear relationship between the future number of Web-based technologies and the total points scored in organisations surveyed in the eThekwin Municipality region.

Table 5.10 Organisation number, organisation total score and associated number of Web-based technologies

| | Organisation's total score | Number of Web-based technologies which may impact future EIS implementations in organisations surveyed |
|----|----------------------------|--|
| 24 | 17 | 7 |
| 27 | 12 | 6 |
| 11 | 11 | 6 |
| 17 | 11 | 6 |
| 21 | 11 | 6 |
| 26 | 11 | 7 |
| 8 | 10 | 7 |
| 7 | 9 | 6 |
| 5 | 8 | 6 |
| 12 | 8 | 6 |
| 14 | 8 | 6 |
| 10 | 7 | 7 |
| 2 | 6 | 7 |
| 23 | 5 | 5 |
| 15 | 4 | 6 |
| 3 | 2 | 6 |
| 1 | 0 | 6 |
| 18 | 0 | 6 |
| 20 | 0 | 6 |
| 22 | 0 | 6 |
| 28 | -2 | 6 |
| 16 | -3 | 5 |
| 30 | -3 | 3 |
| 9 | -4 | 5 |
| 25 | -4 | 3 |
| 19 | -6 | 6 |
| 29 | -9 | 2 |
| 4 | -12 | 2 |
| 31 | -13 | 2 |
| 6 | -16 | 3 |
| 13 | -21 | 0 |

Table 5.11 Associated Range, Mean and Standard Deviation for each Group (future Web-based technologies)

| Statistical Calculation | Highest Eight Total Scoring Group | Lowest Eight Total Scoring Group |
|-------------------------|-----------------------------------|----------------------------------|
| Range | 9 to 17 | -4 to -21 |
| Mean | 11.5 | -10.6 |
| Standard Deviation | 2.4 | 6.0 |

From Section 5 of Appendix 8, a tally and associated percentage of the perceived degree to which specific Web-based technologies will impact a respondent’s future EIS implementation is given in Table 5.12. The shaded area in Table 5.12 suggests that there will be some degree by which future EIS implementations will be impacted by Web-based technologies in organisations in KwaZulu/Natal.

Table 5.12 Tally and associated percentage of the expected degree to which specific Web-based technologies will impact respondent’s future EIS implementations

| Web-based technology | The expected degree to which Web-based technologies will impact respondent’s future EIS implementations (N=31) | | | | | | |
|-----------------------------------|--|--------------|-----------------|-----------|-------------------|----------------|--------------------|
| | Extremely likely | Quite likely | Slightly likely | Uncertain | Slightly unlikely | Quite unlikely | Extremely unlikely |
| Intranet | 17 (54,8%) | 7 (22,6%) | 3 (9,7%) | 2 (6,5%) | 0 (0,0%) | 1 (3,2%) | 1 (3,2%) |
| Internet | 12 (38,8%) | 6 (19,3%) | 5 (16,1%) | 3 (9,7%) | 1 (3,2%) | 1 (3,2%) | 3 (9,7%) |
| Extranet | 6 (19,3%) | 7 (22,6%) | 3 (9,7%) | 8 (25,8%) | 0 (0,0%) | 1 (3,2%) | 6 (19,4%) |
| e-Commerce: (B2B) | 3 (9,7%) | 9 (29,0%) | 4 (12,9%) | 3 (9,7%) | 2 (6,5%) | 4 (12,9%) | 6 (19,3%) |
| e-Commerce: (B2C) | 2 (6,5%) | 9 (29,0%) | 4 (12,9%) | 1 (3,2%) | 2 (6,5%) | 4 (12,9%) | 9 (29,0%) |
| WAP and other mobile technologies | 1 (3,2%) | 8 (25,8%) | 5 (16,1%) | 4 (12,9%) | 0 (0,0%) | 3 (9,7%) | 10 (32,3%) |
| Other (eg. portal) | 3 (9,7%) | 2 (6,5%) | 1 (3,2%) | 1 (3,2%) | 1 (3,2%) | 2 (6,5%) | 21 (67,7%) |

From Table 5.12, the expected frequencies of each cell are given in Table 2 of Appendix 12. From Table 2, 28 cells (57,1%) of expected frequencies have a value less than 5 and 14 (14,26%) cells have an expected frequency less than 1. As discussed in Section 5.6.4 the application of a chi-square test requirements will be ‘violated’. For these reasons the chi-square test is not applied to the tallies in Table 5.12

Table 5.12 shows that only two (6,4%) of organisations surveyed reported that it is unlikely that the Intranet will impact future EIS implementations. The unlikeliness of impact by the

Internet on future EIS implementations is somewhat higher (16,1%): While seven (22,6%) respondents indicated that is unlikely that the Extranet will impact their future EIS implementations, eight (25,8%) respondents were unsure of future impact levels by the Extranet. Twelve (38,7%) respondents indicated that it is unlikely that e-Commerce: (B2B) will impact future EIS implementations. Almost half (48,4%) of organisations surveyed reported that it is unlikely that e-Commerce: (B2C) will impact future EIS implementations. WAP and other mobile technologies have similar (42,0%) unlikely future levels of impact. It is striking to note that 21 (67,7%) of respondents indicated that it is *extremely unlikely* that other technologies (such as portal) will impact future EIS implementations. This result (when combined with the ‘Slightly unlikely’ and ‘Quite unlikely’ degrees) rises to 24 (75,2%) of organisations surveyed. This finding is somewhat surprising considering that portal technologies *currently* have the third highest level of impact on EIS implementations in organisations surveyed. An explanation for this finding is that possibly some respondents are not aware of the existence of such technology. Roldán and Leal (2003b) report that with the availability of Web-based technologies ‘together with the need to build something similar to an EIS but focused on all members of the organization has led to the development of the enterprise information portal (EIP) concept, which, to some extent represents the latest incarnation of EIS’. According to Trowbridge (2000) two elements characterise these systems according to the respondents: EIP ‘acts as a single point of access to internal and external information’ and ‘gives users access to disparate enterprise information systems’. Internal and external information must be easy to access - hence the growth of the information portals market (Hunter, 2002).

Table 5.13 Descending rank order of impact levels of Web-based technologies on future EIS implementation

| Rank | Web-based technology | Tally and level of impact on future EIS implementations |
|------|-----------------------------------|---|
| 1 | Intranet | 27 (87,1%) |
| 2 | Internet | 23 (74,2%) |
| 3 | Portal | 16 (51,6%) |
| 3 | Extranet | 16 (51,6%) |
| 5 | e-Commerce: (B2C) | 15 (48,4%) |
| 6 | e-Commerce: (B2B) | 14 (45,1%) |
| 7 | WAP and other mobile technologies | 6 (19,4%) |

From Table 5.12 (p.163), combining the positive attitude results ('Extremely likely', 'Quite likely' and 'Slightly likely') for each of the seven Web-based technologies, Table 5.13 gives a descending ranking order of the expected degree to which Web-based technologies will impact respondent's future EIS implementations.

From Table 5.13, there are three significant trends. Firstly this rank order of impact levels of Web-based technologies on *future* EIS implementation matches the current rank order levels of Web-based technologies on EIS implementations. Whereas in Table 5.9 (p.158) there is a tie for rank order 4 (Extranet and e-Commerce: (B2C)) in Table 5.13 there is a tie for rank order 3 (Portal and Extranet). Secondly while nearly three quarters (75,2%) of respondents surveyed report that it is unlikely that portal technologies will impact future EIS implementations (see Table 5.12 (p.163)), seen in the context of the other six Web-based technologies, it still appears in the top three ranks. This is an important consideration for IS practitioners when planning future EIS implementations. As Hodgson and Aiken (1998) report there continues to be implementation problems associated with changes in IS technology. Thirdly when comparing current impact levels of Web-based technologies (see Table 5.8 (p.156)) and future impact levels of Web-based technologies, there is a positive impact trend for **all** Web-based technologies. The largest trend increase is the Intranet rising from 32,2% to 87,1%. As Basu *et al.* (2000) report the use of Web-based technologies in the distribution of information is becoming widespread. These technologies will impact future EIS implementations. For example, the enterprise portal provides a single point of access to all sources of information, data, people and business applications (Sawhney and Zabin, 2001). Sawhney and Zabin (2001) note that the enterprise portal may offer links to internal websites, interfaces to internal applications, information on competitors and to industry associations. During 2003 Microsoft will be releasing the next version of Sharepoint Portal Server, which draws together a wide range of portal and document management technologies (Nair, 2002). Nair (2002) notes that the 'new version will include a lot more enterprise portal functionality'.

This concludes the statistical analysis and findings for the interviewee's responses to Section 5 of the author's survey instrument (Appendix 3).

From the discussion in Sections 5.6.3-5.6.5 a summary of the author's research findings is given in Table 5.14.

Table 5.14 Summary of author's research findings

| Specific Research Area | Associated Study Results |
|---|--|
| TAM usage aspects | Cronbach coefficient alphas for Perceived Usefulness and Perceived Ease of Use constructs not within generally accepted limits Low correlation coefficients for Perceived Usefulness and Intended Usage, and Perceived Ease of Use and Intended Usage constructs Usefulness-usage correlation <i>lower</i> than use-usage correlation Little evidence that theoretical usage aspects of TAM are echoed in EIS implementations |
| Perceived impact of Web-based technologies on current EIS implementations | Intranet significantly impacted EIS implementations Descending rank order of current impact levels is Intranet, Internet, Portal, Extranet, e-Commerce (B2C), e-Commerce (B2B) and WAP and other mobile technologies |
| Perceived impact of Web-based technologies on future EIS implementations | Descending rank order of future impact levels is Intranet, Internet, Portal, Extranet, e-Commerce (B2C), e-Commerce (B2B) and WAP and other mobile technologies Positive impact level trend for all Web-based technologies on future EIS implementations Largest trend increase reported for the Intranet |

The third sub-goal of this dissertation (see Section 1.4) is to identify and rank Web-based technologies in order of their perceived impact on EIS currently and in the future. This sub-goal has now been achieved. For Section 6 respondent's general comments will be discussed next.

5.6.6 Some general comments made by respondents

From the responses to question 6.1 of Appendix 3, comments which some interviewee's regard as significant to the EIS implementation in their organisations are now given: 'If you drop the ball on training, your EIS is very likely to be a failure', 'you have to know what you want to achieve ... and need to know the end result', 'the flexibility and satisfaction of creating you own business solution', 'business training ... how they create the report', 'bugged with the mindset of the people ... not prepared to learn the product', 'a very significant issue is that it must be extremely user friendly for executives without any knowledge of computer technology', 'reliability of data is very important', 'if you don't have clean data, don't bother setting up an EIS', 'staff resources who use it is important', 'it is an exercise in change management', 'accuracy of data', 'training is a significant factor', 'getting the culture into them', 'getting managers to change their mindset', 'training and sometimes forced motivation', 'buy-in and sponsorship', 'no user buy-in' and 'need to drag them to the altar and then become dedicated to it'.

A vast body of literature exists on IS success. See previous discussion in Section 2.5. As discussed in Section 2.5.1 the DeLone and McLean (1992) proposes six dimensions of IS systems success: system quality, information quality, system use, user satisfaction, individual impact and organisational impact. It is important to understand the keys to successful EIS development and ongoing operation (Rainer and Watson, 1995a).

An EIS is best viewed as an ‘ongoing journey rather than as a destination’ (Watson and Frolick, 1993). Important insights for developing an EIS are included in the descriptions of successful EIS (Houdeshel and Watson, 1987; Rockart and DeLong, 1988). Rainer and Watson (1995a) report ‘Our findings regarding successful ongoing EIS operation confirm their [DeLone and McLean] conclusions’.

A synthesis of interviewee’s comments in organisations surveyed in the eThekweni Municipality region was made by the author. A subjective assessment of these comments (and insights) was made to gauge whether some evidence could be found for the existence of **all** six DeLone and McLean (1992) success dimensions. A corresponding ‘match’ for each IS success dimension was found. The results are given in Table 5.15.

Table 5.15 Dimensions of IS success and corresponding interviewee’s comments

| IS success dimension | Interviewee’s comments |
|-----------------------|--|
| System quality | ‘reliability of data is very important’ |
| Information quality | ‘if you don’t have clean data, don’t bother setting up an EIS’ |
| Use | ‘staff resources who use it is important’ |
| User satisfaction | ‘the flexibility and satisfaction of creating you own business solution’ |
| Individual impact | ‘getting managers to change their mindset’ |
| Organizational Impact | ‘it is an exercise in change management’ |

From Table 5.15, **all** six dimensions of IS success were evidenced by the author’s research. This research lends support to the work of DeLone and McLean (1992). This concludes the findings for the interviewee’s responses to Section 6 of the author’s survey instrument (Appendix 3). Further considerations on the applicability of the author’s results are now presented.

5.7 Further considerations on the Applicability of the Results

This research has considerations on the applicability of these results which should be pointed out. Firstly generality of the findings remains to be shown by future EIS research. Further work is needed to provide evidence for other regions of South Africa and other countries.

Secondly another consideration is that the usage measures employed were self-reported as opposed to objectively measured. Davis (1989) indicated similar limitations in his research. Not enough is currently known about how accurately self-reports reflect actual behaviour. Furthermore since usage was reported on the same questionnaire used to measure usefulness and ease of use, the possibility of the halo effect should not be overlooked. As noted by Davis (1989) user 'reactions to computers are complex and multi-faceted'.

Thirdly it should be noted that perceived usefulness and ease of use are a person's subjective appraisal of performance and effort respectively. They do not necessarily reflect objective reality (Davis, 1989). For example, even if an application (such as EIS) would objectively improve performance, if users do not perceive it as useful they are unlikely to use it (Alavi and Henderson, 1981). Some studies have observed discrepancies between perceived and actual performance. See, for example, Gallupe *et al.* (1988) and Sharda *et al.* (1988).

The second and third considerations need to be seen in context of a changing world. Since the Davis studies (Davis, 1989; Davis *et al.*, 1989) research has progressed to recognise that subjectivity cannot be avoided in social sciences including IS. As Wheatley (1992) points out 'We inhabit a world that is always subjective and shaped by our interactions with it'. Therefore it must be added that the nature of EIS does not allow an objective observation and hence the author's chosen approach is widely recognised in the IS literature.

Fourthly while the author's study was limited to existing EIS in organisations in the eThekweni Municipality region, it can be stated that due to the similarities between the economy in KwaZulu/Natal and the rest of South Africa the author's results can be considered as approximately indicative for the South African economy. However, this statement is not categorical.

Notwithstanding these limitations the author's findings represent a promising step towards the establishment of improved measures for two important variables specifically for EIS usage in South Africa. Future EIS research is needed to address how other variables (*eg.* attitude towards using computers, perceived involvement, *etc*) relate to usefulness, ease of use and IT acceptance.

5.8 Conclusion on Experimental work

This chapter discussed the research methods that are relevant to the problem of the author's investigation. A field study (using a validated survey instrument) of 31 well-established organisations in KwaZulu/Natal which have EIS experience was undertaken. The approach taken during the data collection process was described. The data analysis procedures, processing and interpretation of the results were given. Considerations on the applicability of the survey results were discussed.

In the concluding chapter a summary of the study results is given. Directions for future research are suggested. Some concluding remarks are then made.

CHAPTER 6

CONCLUSION

EIS and its derivatives have always been high-risk systems, usually offering only once chance to successfully implement them in an organisation. EIS have been successfully implemented in many organisations (Chi and Turban, 1995). However, many failures of EIS implementation have been cited (see, for example, Burkan, 1991; Bussen and Myers, 1997; McBride, 1997). Understanding system success and failure is becoming more important (Averweg, 2001). One of the key developments of *new* IT has been the widening use of EIS by top-level managers. These managers' decisions must be made in an increasingly competitive and uncertain environments. If an EIS intends to satisfy the manager's needs of information, their right determination of information needs is seen as the main element for success (Salmeron *et al.*, 2001). The current explosion of the Web has led to a vast array of options for developers to create applications and deliver them expediently to users (Basu *et al.*, 2000).

It is evident that EIS requires a different approach in the way it is developed and made available to its executives and business end-users. Different executives have different work styles in accessing information (Srivihok, 1998). Salmeron (2001) reports that the number of executives that directly use EIS has increased. This led to the main premise of this research - that EIS adoption and usage coupled with the emergence of Web-based technologies present new challenges and impacts in an organisation. A summary of the research undertaken by the author is now presented.

6.1 Summary of Research undertaken

To conduct the author's study within an appropriate context of the existing body of knowledge in IT, literature surveys were undertaken of the current research on EIS implementation and TAM in general with specific focus on Perceived Usefulness and Perceived Ease of Use constructs applied to EIS. This was done specifically to:

- present an overview of the state of EIS and TAM in a changing world that is being impacted by the emergence of Web-based technologies;
- investigate the theoretical usage aspects of TAM;
- investigate the theoretical aspects of an EIS development and use framework;
- and

- identify and rank Web-based technologies in order of their perceived impact on EIS currently and in the future in organisations in KwaZulu/Natal.

Summary of the Essence of the Underlying Theories for EIS

Any advance in the field of EIS can advance the understanding of all MSS (Benbasat and Nault, 1990). Kaniclides and Kimble (1994) developed an alternative EIS framework which overcame the shortcomings of previous EIS frameworks (*eg.* structural EIS framework developed by Watson *et al.* (1991) and path framework developed by Millet *et al.* (1991)). The three main components of the Kaniclides and Kimble framework are **People, Activities and Systems (PAS)**. System use is the most crucial aspect of EIS operation. Kaniclides and Kimble (1994) suggest that as the system attributes from the user's perspectives play a critical role in the operation of the EIS, it is important to measure user's perspectives only once an EIS has been implemented in order to gauge system usage. Thus by testing the applicability of the PAS taxonomy, this should add value to EIS theory. As the PAS framework provides an easy-to-use usage classification it was used by the author as the theoretical backdrop in this study. A summary of the author's study results is now given.

Author's Study Results

The main goal of the research was to use TAM to investigate and identify the areas of impact (if any) of Web-based technologies on EIS usage in organisations in KwaZulu/Natal. This was achieved by addressing the following sub-goals:

- **Investigate previous research on IT adoption.** Implementation refers to all organisational activities working toward the adoption and management of an innovation. The accumulated pool of knowledge regarding adoption of innovations provided the theoretical support for perceived usefulness and ease of use as key determinants of behaviour. Existing research regarding successful IS implementation with specific focus on the usefulness and use of IT as conceptualised by the TAM was given. TAM proposes that levels of usefulness and ease of use predict applications usage. TAM provides an explanation of the determinants of computer acceptance that is general and capable of explaining user behaviour across a wide range of end-user computing technologies. The author's study was limited to Web-based technologies as they have emerged as the new agents of change.

Some extensions to TAM and its applicability to EIS were discussed. Current research on TAM and the Web were reviewed. EIS, TAM and Web-based technologies thus provided the backdrop for the author's study.

- **Investigate whether the theoretical usage aspects of TAM are echoed in EIS implementations in KwaZulu/Natal.** In the author's study, Cronbach's coefficient alphas (degree of reliability) for Perceived Usefulness and Perceived Ease of Use constructs were not within generally accepted limits. Low correlation coefficients were calculated for Perceived Usefulness and Intended Usage, and Perceived Ease of Use and Intended Usage constructs. The correlation for usefulness-usage was *lower* than for use-usage and therefore not consistent with Davis' findings. However, the author's results *partially* support Venkatesh's (1999) findings that perceived ease of use can be a stronger catalyst (over perceived usefulness) in fostering IT acceptance. While the author's results are not in support of the basic tenets of TAM which emphasise the importance of perceived usefulness (over perceived ease of use) as the key determinant of acceptance, this may be a sign of other cultural issues affecting the usage of EIS due to the geographic factor or to the fact that the world has changed as a whole since 1986-1989 when TAM was published. Those issues may require further research. It was therefore concluded that in the author's study there is little evidence to support that the theoretical usage aspects of TAM are echoed in EIS implementations in KwaZulu/Natal.
- **Identify and rank Web-based technologies in order of their perceived impact on EIS currently and in the future.** Approximately a fifth of organisations surveyed reported that the Intranet significantly impacted their EIS implementations. The level of impact by the Internet on EIS implementation was slightly lower while the balance of respondents reported different degrees of impact. Of the seven Web-based technologies given in Table 5.8 (p.156), WAP and other mobile technologies had the *least* impact level. Some EIS implementations were significantly impacted by portal technologies. In summary the rank order (highest to lowest) of Web-based technologies impacting EIS **currently** is: Intranet (32,2%), Internet (25,9%), Portal (16,2%), Extranet (9,7%), e-Commerce: (B2C) (9,7%), e-Commerce: (B2B) (6,4%) and WAP and other mobile technologies (3,2%).

Only 6,4% of organisations surveyed reported that it is unlikely that the Intranet will impact future EIS implementations. Almost half of organisations surveyed reported that it is unlikely that e-Commerce: (B2C) will impact future EIS implementations. WAP and other mobile technologies have similar unlikely future impact levels. It is striking to note that 67,7% of respondents indicated that it is *extremely unlikely* that other technologies (such as portal) will impact future EIS implementations. The rank order of levels of impact of Web-based technologies on **future** EIS implementations, matches the current rank order levels. However, when these two sets of rank orders are compared, there is a positive impact level trend for **all** Web-based technologies on future EIS implementations. The largest trend increase is the Intranet rising from 32,2% to 87,1%. This should occur as the use of Web-based technologies in the distribution of information becomes more widespread.

This information is particularly useful for IT practitioners in the planning of future EIS implementations. An understanding of Web-based technology taxonomies is important to EIS researchers and practitioners. System development practitioners need the descriptive relevance that a taxonomy can provide (Thomas and Tymon, 1982) in order to provide guidance in assisting successful EIS implementation.

Characteristics of the Main Outcome of this Research

While TAM has been validated in a field setting (*eg.* Adams *et al.*, 1992) it has typically been tested using students (see, for example, Davis *et al.*, 1989; Taylor and Todd, 1995). One basic strength of the author's research is that it was conducted among business professionals. This lends a high degree of external validity to research findings (Venkatesh, 1999).

There is a significant degree of EIS diffusion to lower organisational hierarchical levels and use by these levels in organisations surveyed. This result is in keeping with international trends where EIS are being diffused in organisations as EIS is becoming less strictly defined to support professional decision-makers throughout the organisation. As Prakken (2000) notes the real users must not be sought among executive managers but outside this circle such as middle management and other staff.

All organisations in the author's study have browser-based Intranets. This research shows that Web-based technologies have enabled EIS to become available to more management levels in the organisation. The Web browser has become the common interface to end-user access. While applications can now be accessed by browsers, the capabilities long associated with decision support software are still found. Vendors of decision support software are making their products Web-enabled.

The summary of these study results and characteristics of the main outcome of this research could be useful as a set of management perspectives for organisations in South Africa wishing to embark on EIS implementation programs. Some directions for future research are now discussed.

6.2 Directions for future Research

While the results of this study show that EIS has a significant role in organisations within the eThekweni Municipality region, their technological base is not affected considerably by the latest innovations in the form of Web-based technologies. This requires further investigation as to whether it is a signal for the fact that IT in South Africa is not transforming fast enough to adopt new Web-based technologies.

Every major business or organisation in the world is now experimenting with Web-based technologies in one form or another (Jordan, 2002). The international transfer of technology to a developing country is a very complex, time consuming and expensive endeavour due to the complexity, sophistication and dynamism of the technology, and inferior technological capacity as well as a low technology absorption capacity of a developing country technology recipient and other factors (Al-Obaidi, 1999; Nahar *et al.*, 1999a). In many countries (including South Africa), organisations experience difficulty and even failure in transferring IT into practice (Hill *et al.*, 1998). Organisations face several barriers in their technology transfer efforts such as cultural barriers, different infrastructure and different economic situations (Nahar, 1998; Nahar *et al.*, 1999b). The high growth of the Internet and the advent of several more powerful easier to use information technologies are increasing the opportunities to tackle such barriers. There is no escape from digital change (Leer, 2000). South Africa's problem is not technical illiteracy but rather weak market penetration of Web technologies into certain

market sectors of South Africa particularly the low and middle-income black market (Eedes, 2000). This may be an avenue for future research.

An organisation's investment in IT to support planning and decision-making is often very large and risky (Leong, 2001). It is not the IT investments that are important but how IT is used by every employee from the top to the bottom of an organisation. An understanding of end-user requirements to meet demand in system usage in order to foster the adoption and effective usage of new systems is needed.

6.3 Concluding Remarks

The rapid advance of information and communication technology is generating so many changes that the thinking of yesterday is likely to be irrelevant today (Small, 2000). Although the Internet is one of many Web-based technologies, it undoubtedly has been the driver behind the change in attitudes by many executives to the opportunities IT offers. EIS is being catalysed through a major change as technical barriers disappear. Web-technologies are often not just a single technical solution, rather a host of an industry specific with inter-connective capabilities that pull together people, processes and technology infrastructure. This all requires a strategic vision of where an organisation would like to position itself in the future. Organisations must 'start simple, grow fast' (McKenna Group, 1999) using these technologies that will enable it to build on what it has, link in to legacy systems, rather than throwing away what has been achieved and developed through each new enhancement iteration. EIS will be impacted by these change catalysts as EIS become integrated with Web-based technologies not specifically designed for EIS usage. This study is an attempt in the direction of providing better understanding of EIS and its role in the Web-based software environment.

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Technical discussion of some Wireless technologies

The key to effective B2B is interaction between business partners with knowledge flowing quickly and efficiently between them. The need for organisations to have digital nervous systems in place to compete effectively in the new global economy, has led to an insatiable demand for broadband data access (de Villiers and du Preez, 2001). Some emerging wireless technologies are as follows:

Third Generation (3G) Networks

Third Generation (3G) Networks bring together two powerful forces: wideband radio communications and IP-based services. Ericsson (2001b) notes that together these lay the groundwork for advanced Mobile Internet services; including personalised portals, infotainment, mobile commerce and unified messaging which encompasses high-speed data, superior quality voice, video and location-based services. In order for 3G to become a reality depends on technology developments in different areas, such as amendments to the radio interface to support wideband communications and in the core network.

The Migration to Third Generation Networks

Currently cellular networks are known as Second Generation (2G) networks. These networks were designed for voice but with the recent addition of data, this has resulted in slow transmission speeds. Wireless broadband data transmission can now be achieved by upgrading existing networks from 2G to 3G networks. While this upgrade is a quantum jump, most operators are taking a migratory path: upgrading their 2G networks to Two-and-a-half Generation (2.5G) networks as an intermediate step. This reduces initial deployment costs and supplies customers with richer and faster services more quickly.

Current Networks

Global System for Mobile Communication (GSM) is the prevailing mobile standard in Europe and most of the Asia-Pacific region. The problem with data transmission over the existing GSM network is that it is very slow with data speeds of only 9.6 kbps (de Villiers and

du Preez, 2001). Universal Mobile Telecommunications Systems (UMTS) is a full all IP core, 3G implementation for GSM networks. It uses Wideband Code Division Multiple Access (WCDMA) as its air interface. It provides initial data speeds of up to 2Mbps which allows the provision of full multimedia services (Nortel Networks, 2001; Perlman, 2001).

There are many supporting technologies *eg.* new programming languages such as Java and the Wireless Internet. eXtensible Markup Language (XML) is one of the more important technologies as it is key to creating others such as the Wireless Internet.

eXtensible Markup Language (XML)

Whilst HTML describes the display format of a document, XML describes the structure of a document and supports links to multiple documents. These researchers suggest that XML is expected to become a serious technology for Web-based applications and non Web-based applications (*eg.* document management, the movement of data from one system to another). XML promises to transform the structure of the Web, replacing HTML with a stronger, more flexible and extensible architecture that will return the Web to content-based structures (de Villiers and du Preez, 2001). This is necessary to create the Wireless Internet (Nokia, 2000).

Some other wireless technologies include Bluetooth, Local Multipoint Distribution Service and Fixed Wireless. These wireless technologies are mainly used to provide broadband solutions to LANs. They are implemented in conjunction with either the physical layer infrastructure (*eg.* fibre backbone) or wireless infrastructure (*eg.* 3G networks). Bluetooth, Local Multipoint Distribution Service and Fixed Wireless technologies will now be briefly discussed:

- **Bluetooth.** Bluetooth enables users to connect various computing and telecommunications devices without the need to carry, purchase or connect any devices (de Villiers, 2000). Bluetooth is a widely supported open standard for short-range wireless communication that operates in distances from 10 to 100m. Unlike infrared devices, Bluetooth units are not limited to line-of-sight communication. Whereas radio signals can be easily intercepted, Bluetooth devices have built-in security to prevent eavesdropping or spoofing (falsifying the origin of messages) (Ericsson, 2001a);

- **Local Multipoint Distribution Service.** Local Multipoint Distribution Service is a wireless, bi-directional broadband technology designed to allow communication service providers and network operators to rapidly and cost-effectively deliver a wide range of high-value, quality services to homes and businesses (CableFree Solutions Limited, 2000); and
- **Fixed Wireless.** A form of Fixed Wireless is to use Radio Frequency (RF) Transmission using the unlicensed 2.4GHz frequency band. For a further discussion on Fixed Wireless, see Cisco Systems (2001).

Power Technologies

Directly linked to the development and acceptance of wireless technologies, is the development of power technologies. Mobile devices are gaining greater capabilities but require ever increasing amounts of power to function (de Villiers and du Preez, 2001). To overcome this power problem, portable-power chemists are utilising new battery technologies (*eg.* fuel cell technology) and software and hardware designers more energy efficient devices and software (Orenstein, 2001).

PREAMBLE TO STRUCTURED INTERVIEW QUESTIONNAIRE

Computers have been used as tools to support managerial decision-making for over three decades (Turban, 1995). The evolutionary view of computer-based information systems has led to the classification of the following major computerised support systems:

- Transaction Processing Systems (TPS);
- Management Information Systems (MIS);
- Decision Support Systems (DSS);
- Expert Systems (ES); and
- Executive Information Systems (EIS).

The attributes of each support system are shown in the table below.

This interview conducted focuses **solely on the EIS classification**. Some (or all) of these support systems may exist in the interviewee's organisation but are not considered for the purpose of this study. This interview is concerned with non-technical EIS aspects. The focus is on perceived EIS usefulness, perceived EIS ease of use, EIS usage and the impact of Web-based technologies on EIS implementation. No consideration is to be given to aspects such as networks, hardware platforms and software development tools of the interviewee's EIS in his organisation.

Different EIS definitions exist, however, the author considers the following definition of an EIS as appropriate:

"A computerized system that provides executives with easy access to internal and external information that is relevant to their critical success factors".

Attributes of Major Computerised Support Systems

| Dimension | Transactions Processing Systems (TPS) | Management Information Systems (MIS) | Decision Support Systems (DSS) | Expert Systems (ES) | Executive Information Systems (EIS) |
|-----------------------------|--|---|---|---|--|
| Applications | Payroll, inventory, record keeping, production and sales information | Production control, sales forecasting, monitoring | Long-range strategic planning, complex integrated problem areas | Diagnosis, strategic planning, internal control planning, strategies | Support to top management decision, environmental scanning |
| Focus | Data transactions | Information | Decisions, flexibility, user friendliness | Inferencing, transfer of expertise | Tracking, control, 'drill down' |
| Data base | Unique to each application, batch update | Interactive access by programmers | Database management systems, interactive access, factual knowledge | Procedural and factual knowledge; knowledge base (facts and rules) | External (online) and corporate, enterprise wide access (to all databases) |
| Decision capabilities | No decisions | Structured routine problems using conventional management science tools | Semi-structured problems, integrated management science models, blend of judgment and modelling | The system makes complex decisions, unstructured; use of rules (heuristics) | Only when combined with a DSS |
| Manipulation | Numerical | Numerical | Numerical | Symbolic | Mainly numeric, some symbolic |
| Type of information | Summary reports, operational | Scheduled and demand reports, structured flow, exception reporting | Information to support specific decisions | Advice and explanations | Status access, exception reporting, key indicators |
| Organisational level served | Sub-managerial, low management | Middle management | Analysts and managers | Managers and specialists | Executives and business end-users |
| Focus | Expediency | Efficiency | Effectiveness | Effectiveness and expediency | Timeliness |

EXECUTIVE INFORMATION SYSTEMS (EIS) QUESTIONNAIRE

SECTION 1 - DEMOGRAPHIC INFORMATION

You are asked to answer each question by ticking (☑) the appropriate box.

1.1 To which activity sector does your organisation belong?

- Agriculture, stock farming, game and timber
- Chemical
- Commercial
- Communications
- Construction
- Financial services
- Fishing
- Food processing
- Health and veterinary, social services
- Hospitality and entertainment services
- Hotel
- Manufacturing
- Metal processing
- Ore Mining industries
- Production and distribution of electrical power, gas and water
- Public administration, defence and organisation's safety responsibilities
- Real estate and letting of property, management services
- Transport and warehousing
- Other (please specify)

1.2 What was the gross annual turnover (in South African Rands) of your organisation last year?

- More than 500 million
- Between 100 and 500 million
- Between 20 and 100 million
- Between 5 and 20 million
- Between 1 and 5 million
- Less than one million

1.3 How many permanent employees in your organisation?

- More than 5,001 employees
- Between 2,001 and 5,000 employees
- Between 501 and 2,000 employees
- Between 251 and 500 employees
- Between 51 and 250 employees
- Less than 51 employees

1.4 How many years has your organisation existed?

- More than 25 years
- Between 10 and 25 years
- Between 5 and 10 years
- Less than 5 years

1.5 How would you classify your organisation?

- Public listed
- Public non listed
- Government or quasi-government body
- Foreign enterprise
- Private company
- Incorporated not for gain
- Other (please specify)

1.6 Name of interviewee and contact e-Mail address. (Will not be published. For contact with author only)

.....

1.7 Job title of interviewee in organisation.

.....

1.8 Are you an EIS user, or do you expect to be an EIS user, or? Please explain.

.....

.....

.....

SECTION 2 - EIS IN YOUR ORGANISATION

You are asked to answer each question by ticking () the appropriate box(es). In some cases, there may be more than one answer.

2.1 What is the current situation regarding the executive information system (EIS) in your organisation?

- No EIS exists or is under consideration
- EIS has been proposed and its introduction is under evaluation
- Based on the evaluation, the EIS has been accepted and is under development and implementation
- The EIS is operational and in use by executives/business end-users
- EIS failure (where the EIS has gone into decline and has been phase out)

2.2 In the case of an operational EIS, how long did it take before it was in use by executives/business end-users?

..... days or months

2.3 For what application(s) is/are the EIS used in your organisation?

- Office automation activities (eg. diary, electronic mail)
- Access to current status information (eg. performance reports and graphs)
- Access to projected trends of the organisation (eg. forecasting reports and graphs)
- Querying corporate and external data bases
- Performing personal analysis (eg. using spreadsheets)
- Other (please specify)

2.4 How many (if any) EIS users are there in your organisation?

.....

2.5 At which hierarchical employee level(s) is the EIS used in your organisation?

- Managing Director/Chief Executive Officer
- Director (or delegated)
- General Manager
- Senior Operations Manager
- Middle Manager
- Line Manager
- Business end-user
- Other (please specify)

2.6 In which functional area(s) is/are the EIS used in your organisation?

- Finance
- Planning
- Marketing
- Sales
- Personnel
- Production/Operations
- Entire organisation
- Other (please specify)

2.7 What type(s) of information is/are held by the EIS in your organisation?

- Strategic planning
- Inventory management/Suppliers
- 'Soft' information (eg. opinions, ideas, predictions, attitudes, plans, etc)
- Finance
- Business/Sales
- Trade/Industry
- Human resources
- Quality
- External news services
- Production
- Competitors
- Stock exchange prices
- Other (please specify)

2.8 How is the information held in the EIS in your organisation?

- By products
- By projects
- By operational areas
- By geographic areas
- By strategic business units
- By processes
- By key performance indicators (KPIs)
- By company
- Other (please specify)

2.9 What source(s) of information support the EIS in your organisation?

- Corporate data bases
- Individuals
- Operational data bases
- External data bases
- Documents or reports
- Internet, intranet or extranet
- Other (please specify)

2.10 What approach was taken for the EIS development in your organisation?

- In-house development using existing software tools
- In-house development with critical EIS features developed initially and optional features added over time, using existing or commercially purchased software tools
- Fully developed by vendor
- In-house development with assistance from vendor

2.11 In the case of commercially purchased EIS software tools and/or ERP software with EIS features, which products (if any) are used in your organisation?

- | | |
|---|--|
| <input type="checkbox"/> Acuity/ES (Acuity) | <input type="checkbox"/> Hyperion (Hyperion) |
| <input type="checkbox"/> Brio.Portal/Brio Query (Brio Technology) | <input type="checkbox"/> InPhase (InPhase) |
| <input type="checkbox"/> Business Objects (Business Objects) | <input type="checkbox"/> JD Edwards BI (J.D. Edwards) |
| <input type="checkbox"/> Cognos (PowerPlay/Impromptu) | <input type="checkbox"/> Lightship/Command Center (Pilot) |
| <input type="checkbox"/> Commander Decision (Comshare) | <input type="checkbox"/> Lotus Notes (Lotus Corporation) |
| <input type="checkbox"/> Crystal Enterprise (Crystal Decisions Inc) | <input type="checkbox"/> Media (Speedware) |
| <input type="checkbox"/> DecisionSuite (Information Ad) | <input type="checkbox"/> MicroStrategy (MicroStrategy Inc) |
| <input type="checkbox"/> DSS Agents (MicroStrategy) | <input type="checkbox"/> Oracle (Oracle) |
| <input type="checkbox"/> EIS-Track (IOC) | <input type="checkbox"/> Pilot (Pilot) |
| <input type="checkbox"/> EKS/Empower (Metapraxix) | <input type="checkbox"/> ProClarity (ProClarity Corporation) |
| <input type="checkbox"/> Express/EIS (Oracle) | <input type="checkbox"/> SAP/EIS (SAP) |
| <input type="checkbox"/> FOCUS Six (Information Builders) | <input type="checkbox"/> SAS/EIS (SAS Institute) |
| <input type="checkbox"/> Forest & Trees (Platinum Technology) | <input type="checkbox"/> TRACK (Track Business Solutions) |
| <input type="checkbox"/> Gentia (Planning Sciences) | <input type="checkbox"/> Other (please specify) |
| <input type="checkbox"/> Holos (Seagate Software IMG) | |

2.12 How frequently is the EIS used in your organisation?

- Very rarely or not at all
- Rarely (a few times per month)
- Occasionally (a few times per week)
- Sometimes (about once per week)
- Fairly regularly (several times per week)
- Regularly (once a day)
- Frequently (several times per day)

2.13 When used in your organisation, what is the average duration of an EIS 'session'?

- More than three hours
- Between 2 and 3 hours
- Between 1 and 2 hours
- Between 30 minutes and one hour
- Between 15 minutes and 30 minutes
- Less than 15 minutes

2.14 Before the EIS was implemented, what was your personal expectation of the success or failure of the implementation?

.....

.....

.....

2.15 Was the EIS implementation **successful** in your organisation?

.....

.....

.....

2.16 What factors were important to your EIS implementation?

.....

.....

.....

SECTION 3 - PERCEIVED EIS USEFULNESS, EASE OF USE AND SYSTEM USAGE IN YOUR ORGANISATION

The following statements are designed to determine the degree to which you perceive the EIS in your organisation to be useful, facilitates ease of use and EIS (and future) usage in your organisation. You are asked to judge the rating for each statement by ticking (✓) one rectangular box in the 'likely'/'unlikely' and 'frequent'/'infrequent' ranges respectively.

- 3.1 Using the EIS enables me to accomplish tasks more quickly in my job.

| | | | | | | | | | |
|---------------------------------|-----------|-------|----------|---------|----------|-------|-----------|--|-----------------------------------|
| <input type="checkbox"/> likely | | | | | | | | | <input type="checkbox"/> unlikely |
| | extremely | quite | slightly | neither | slightly | quite | extremely | | |
- 3.2 Using the EIS improves my performance in my job.

| | | | | | | | | | |
|---------------------------------|-----------|-------|----------|---------|----------|-------|-----------|--|-----------------------------------|
| <input type="checkbox"/> likely | | | | | | | | | <input type="checkbox"/> unlikely |
| | extremely | quite | slightly | neither | slightly | quite | extremely | | |
- 3.3 Using the EIS in my job increases my productivity.

| | | | | | | | | | |
|---------------------------------|-----------|-------|----------|---------|----------|-------|-----------|--|-----------------------------------|
| <input type="checkbox"/> likely | | | | | | | | | <input type="checkbox"/> unlikely |
| | extremely | quite | slightly | neither | slightly | quite | extremely | | |
- 3.4 Using the EIS enhances my effectiveness in my job.

| | | | | | | | | | |
|---------------------------------|-----------|-------|----------|---------|----------|-------|-----------|--|-----------------------------------|
| <input type="checkbox"/> likely | | | | | | | | | <input type="checkbox"/> unlikely |
| | extremely | quite | slightly | neither | slightly | quite | extremely | | |
- 3.5 Using the EIS makes it easier for me to do my job.

| | | | | | | | | | |
|---------------------------------|-----------|-------|----------|---------|----------|-------|-----------|--|-----------------------------------|
| <input type="checkbox"/> likely | | | | | | | | | <input type="checkbox"/> unlikely |
| | extremely | quite | slightly | neither | slightly | quite | extremely | | |
- 3.6 I find the EIS to be useful in my job.

| | | | | | | | | | |
|---------------------------------|-----------|-------|----------|---------|----------|-------|-----------|--|-----------------------------------|
| <input type="checkbox"/> likely | | | | | | | | | <input type="checkbox"/> unlikely |
| | extremely | quite | slightly | neither | slightly | quite | extremely | | |
- 3.7 Learning to operate the EIS is easy for me.

| | | | | | | | | | |
|---------------------------------|-----------|-------|----------|---------|----------|-------|-----------|--|-----------------------------------|
| <input type="checkbox"/> likely | | | | | | | | | <input type="checkbox"/> unlikely |
| | extremely | quite | slightly | neither | slightly | quite | extremely | | |
- 3.8 I find it easy to get the EIS to do what I want it to do.

| | | | | | | | | | |
|---------------------------------|-----------|-------|----------|---------|----------|-------|-----------|--|-----------------------------------|
| <input type="checkbox"/> likely | | | | | | | | | <input type="checkbox"/> unlikely |
| | extremely | quite | slightly | neither | slightly | quite | extremely | | |
- 3.9 Interacting with the EIS is clear and understandable.

| | | | | | | | | | |
|---------------------------------|-----------|-------|----------|---------|----------|-------|-----------|--|-----------------------------------|
| <input type="checkbox"/> likely | | | | | | | | | <input type="checkbox"/> unlikely |
| | extremely | quite | slightly | neither | slightly | quite | extremely | | |
- 3.10 I find the EIS to be flexible to interact with.

| | | | | | | | | | |
|---------------------------------|-----------|-------|----------|---------|----------|-------|-----------|--|-----------------------------------|
| <input type="checkbox"/> likely | | | | | | | | | <input type="checkbox"/> unlikely |
| | extremely | quite | slightly | neither | slightly | quite | extremely | | |
- 3.11 It is easy for me to become skilful at using the EIS.

| | | | | | | | | | |
|---------------------------------|-----------|-------|----------|---------|----------|-------|-----------|--|-----------------------------------|
| <input type="checkbox"/> likely | | | | | | | | | <input type="checkbox"/> unlikely |
| | extremely | quite | slightly | neither | slightly | quite | extremely | | |
- 3.12 I find the EIS easy to use.

| | | | | | | | | | |
|---------------------------------|-----------|-------|----------|---------|----------|-------|-----------|--|-----------------------------------|
| <input type="checkbox"/> likely | | | | | | | | | <input type="checkbox"/> unlikely |
| | extremely | quite | slightly | neither | slightly | quite | extremely | | |
- 3.13 I currently use the EIS in my job.

| | | | | | | | | | |
|-----------------------------------|-----------|-------|----------|---------|----------|-------|-----------|--|-------------------------------------|
| <input type="checkbox"/> frequent | | | | | | | | | <input type="checkbox"/> infrequent |
| | extremely | quite | slightly | neither | slightly | quite | extremely | | |
- 3.14 Assuming the EIS will be available in my job, I predict that I will use the EIS in the future.

| | | | | | | | | | |
|-----------------------------------|-----------|-------|----------|---------|----------|-------|-----------|--|-------------------------------------|
| <input type="checkbox"/> frequent | | | | | | | | | <input type="checkbox"/> infrequent |
| | extremely | quite | slightly | neither | slightly | quite | extremely | | |

SECTION 4 - IMPACT OF WEB-BASED TECHNOLOGIES ON EIS IMPLEMENTATION

The following statements are designed to determine the degree to which Web-based technologies impacted your EIS implementation. You are asked to judge the rating for each Web-based technology by ticking (☑) the appropriate box and using the following scale.

| Scale | Description |
|-------|-----------------|
| 1 | Not at all |
| 2 | Very little |
| 3 | Somewhat little |
| 4 | Uncertain |
| 5 | Somewhat much |
| 6 | Very much |
| 7 | Extensively |

The degree to which the following Web-based technologies impacted your EIS implementation is as follows:

- | | | |
|-----|--|----------------------|
| 4.1 | Intranet | 1☐ 2☐ 3☐ 4☐ 5☐ 6☐ 7☐ |
| 4.2 | Internet | 1☐ 2☐ 3☐ 4☐ 5☐ 6☐ 7☐ |
| 4.3 | Extranet | 1☐ 2☐ 3☐ 4☐ 5☐ 6☐ 7☐ |
| 4.4 | e-Commerce: Business-to-Business (B2B) | 1☐ 2☐ 3☐ 4☐ 5☐ 6☐ 7☐ |
| 4.5 | e-Commerce: Business-to-Consumer (B2C) | 1☐ 2☐ 3☐ 4☐ 5☐ 6☐ 7☐ |
| 4.6 | Wireless Application Protocol (WAP) and other mobile technologies | 1☐ 2☐ 3☐ 4☐ 5☐ 6☐ 7☐ |
| 4.7 | Any other Web-based technologies (eg. portal)? Please name and rate each of these. | |
| | | 1☐ 2☐ 3☐ 4☐ 5☐ 6☐ 7☐ |
| | | 1☐ 2☐ 3☐ 4☐ 5☐ 6☐ 7☐ |
| | | 1☐ 2☐ 3☐ 4☐ 5☐ 6☐ 7☐ |

SECTION 5 - FUTURE EIS IMPLEMENTATIONS

The following statements are designed to determine the degree to which Web-based technologies are expected to impact future EIS implementations. You are asked to judge the rating for each Web-based technology by ticking (☑) the appropriate box and using the following scale.

| Scale | Description |
|-------|--------------------|
| 1 | Extremely likely |
| 2 | Quite likely |
| 3 | Slightly likely |
| 4 | Uncertain |
| 5 | Slightly unlikely |
| 6 | Quite unlikely |
| 7 | Extremely unlikely |

Do you expect any of the following Web-based technologies to impact on FUTURE EIS implementations?

- | | | |
|-----|--|----------------------|
| 5.1 | Intranet | 1☐ 2☐ 3☐ 4☐ 5☐ 6☐ 7☐ |
| 5.2 | Internet | 1☐ 2☐ 3☐ 4☐ 5☐ 6☐ 7☐ |
| 5.3 | Extranet | 1☐ 2☐ 3☐ 4☐ 5☐ 6☐ 7☐ |
| 5.4 | e-Commerce: Business-to-Business (B2B) | 1☐ 2☐ 3☐ 4☐ 5☐ 6☐ 7☐ |
| 5.5 | e-Commerce: Business-to-Consumer (B2C) | 1☐ 2☐ 3☐ 4☐ 5☐ 6☐ 7☐ |
| 5.6 | Wireless Application Protocol (WAP) and other mobile technologies | 1☐ 2☐ 3☐ 4☐ 5☐ 6☐ 7☐ |
| 5.7 | Any other Web-based technologies (eg. portal)? Please name and rate each of these. | |
| | | 1☐ 2☐ 3☐ 4☐ 5☐ 6☐ 7☐ |
| | | 1☐ 2☐ 3☐ 4☐ 5☐ 6☐ 7☐ |
| | | 1☐ 2☐ 3☐ 4☐ 5☐ 6☐ 7☐ |

SECTION 6 - ANY OTHER COMMENTS

6.1 Do you have any further comments which you regard as significant to the EIS implementation in your organisation?

.....
.....
.....
.....
.....
.....

Thank you for your assistance in this research project!

14 May 2002



Universidad de Sevilla



Departamento de Administración de Empresas y Marketing

**CUESTIONARIO SOBRE SISTEMAS DE INFORMACIÓN PARA EJECUTIVOS (EIS):
DESARROLLO, IMPLANTACIÓN, REPERCUSIONES ORGANIZATIVAS E
INFLUENCIA SOBRE EL RENDIMIENTO DE LA ORGANIZACIÓN.**

PARTE 1ª:

CUESTIONARIO DIRIGIDO A RESPONSABLES DE IMPLANTACIÓN DE EIS



Sistema de Información para Ejecutivos (*Executive Information System* -EIS-):
Sistema de información basado en ordenadores que es diseñado para proporcionar a los altos directivos un fácil acceso a la información interna y externa que es relevante para sus actividades de gestión.

El propósito de esta encuesta es determinar las características del estado actual y del proceso de desarrollo e implantación de los EIS en organizaciones españolas. Asimismo, pretendemos conocer los beneficios personales y colectivos que generan, el impacto organizativo que producen y su influencia sobre el rendimiento percibido de la organización. Como podrá comprobar, para garantizar el anonimato más absoluto, no se requiere ninguna información que identifique a su empresa en el presente cuestionario. El tratamiento estadístico de datos será siempre a nivel agregado, en ningún caso se procederá a estudios singulares de su compañía.



**CUESTIONARIO SOBRE SISTEMAS DE INFORMACIÓN PARA EJECUTIVOS (EIS):
DESARROLLO, IMPLANTACIÓN, REPERCUSIONES ORGANIZATIVAS E
INFLUENCIA SOBRE EL RENDIMIENTO DE LA ORGANIZACIÓN.**

**PARTE 1ª:
CUESTIONARIO DIRIGIDO A RESPONSABLES DE IMPLANTACIÓN DE EIS**

SECCIÓN I: INFORMACIÓN DEMOGRÁFICA.

1. ¿A qué sector de actividad pertenece su organización?

- | | | |
|---|---|---|
| a) Agricultura, ganadería, caza y selvicultura. <input type="checkbox"/> | e) Producción y distribución de energía eléctrica, gas y agua. <input type="checkbox"/> | j) Actividades inmobiliarias y de alquiler, servicios empresariales. <input type="checkbox"/> |
| b) Pesca. <input type="checkbox"/> | f) Construcción. <input type="checkbox"/> | k) Administración pública, defensa y seguridad social obligatoria. <input type="checkbox"/> |
| c) Industrias extractivas de minerales en su estado natural. <input type="checkbox"/> | g) Comercio. <input type="checkbox"/> | l) Actividades sanitarias y veterinarias, servicios sociales. <input type="checkbox"/> |
| d) Industria manufacturera. <input type="checkbox"/> | h) Hostelería. <input type="checkbox"/> | |
| | i) Transporte, almacenamiento y comunicaciones. <input type="checkbox"/> | |

2. ¿En qué región se encuentra ubicada su organización?

3. ¿Qué volumen aproximado de negocios obtuvo su organización en 1997? (Si es una organización pública - no lucrativa-, indique su volumen presupuestario).

4. ¿Qué volumen de trabajadores emplea su organización?

- | | | |
|--|---|---|
| a) Más 5000 empleados. <input type="checkbox"/> | c) Entre 500 y 2000 empleados. <input type="checkbox"/> | e) Entre 50 y 250 empleados. <input type="checkbox"/> |
| b) Entre 2000 y 5000 empleados. <input type="checkbox"/> | d) Entre 250 y 500 empleados. <input type="checkbox"/> | f) Menos de 50 empleados. <input type="checkbox"/> |

5. ¿Qué antigüedad posee su organización?

_____ años.

6. ¿Es una empresa?

- | | |
|---------------------------------------|--|
| a) Nacional. <input type="checkbox"/> | b) Multinacional. <input type="checkbox"/> |
|---------------------------------------|--|

7. ¿Qué puesto ocupa actualmente en la empresa?

8. ¿Qué experiencia tiene en dicho puesto?

_____ años, _____ meses.

SECCIÓN II: INFORMACIÓN SOBRE LA SITUACIÓN DEL EIS

9. ¿Cuál es la situación del Sistema de Información para Ejecutivos (EIS) en su organización?

- a) Disponemos de un EIS operativo y en uso por parte de los directivos.
- b) Se ha aprobado la introducción de un EIS y éste se encuentra en la fase de desarrollo e implantación.
- c) Un EIS ha sido propuesto y su introducción está en evaluación.
- d) No disponemos de un EIS.
- e) Tuvimos un EIS, pero éste fracasó.

10. En el caso de disponer de un EIS operativo, ¿Cuánto tiempo lleva en funcionamiento?

_____ años, _____ meses.

11. ¿Cuál es el ámbito de actuación del EIS de su organización?

- | | |
|--|---|
| a) Corporativo. <input type="checkbox"/> | d) Otro (Por favor, especifique cuál/es): _____ |
| b) Divisional. <input type="checkbox"/> | |
| c) Funcional (Por favor, especifique el área): _____ | |



SECCIÓN III: INFORMACIÓN ESTRUCTURAL DEL EIS.

12. En una escala 1-5 (1 = baja importancia; 5 = alta importancia), ¿qué nivel de importancia han tenido las siguientes afirmaciones como razones para introducir el EIS en su organización?

| | Baja importancia | 2 | 3 | 4 | Alta importancia |
|--|------------------|---|---|---|------------------|
| a) La disponibilidad de tecnología apropiada. | 1 | 2 | 3 | 4 | 5 |
| b) El mayor conocimiento que tienen los directivos acerca del potencial de las tecnología de la información para la organización y para el desarrollo de sus propias tareas. | 1 | 2 | 3 | 4 | 5 |
| c) La mayor disposición que presentan los directivos para usar ordenadores. | 1 | 2 | 3 | 4 | 5 |
| d) El entorno de la organización se ha vuelto cada vez más competitivo. | 1 | 2 | 3 | 4 | 5 |
| e) El aumento de la turbulencia y el cambio en el entorno de la organización. | 1 | 2 | 3 | 4 | 5 |
| f) Ser más proactivo con el entorno de la organización (anticiparse a los acontecimientos). | 1 | 2 | 3 | 4 | 5 |
| g) Acceder de forma rápida y fácil a la información de la organización. | 1 | 2 | 3 | 4 | 5 |
| h) Acceder a una información más consistente, exacta, pertinente y oportuna. | 1 | 2 | 3 | 4 | 5 |
| i) Extraer e integrar datos provenientes de fuentes incompatibles. | 1 | 2 | 3 | 4 | 5 |
| j) Mejorar la comunicación. | 1 | 2 | 3 | 4 | 5 |
| k) Mejorar el seguimiento del rendimiento organizacional. | 1 | 2 | 3 | 4 | 5 |
| l) Cambiar o mejorar la comprensión que tienen los directivos sobre la organización y su entorno. | 1 | 2 | 3 | 4 | 5 |
| m) Alcanzar mayores niveles de eficacia y eficiencia en el trabajo de los directivos. | 1 | 2 | 3 | 4 | 5 |
| n) Posibilitar recortes de personal (<i>Downsizing</i>). | 1 | 2 | 3 | 4 | 5 |
| o) Otras (Por favor, especifique cuál/cuáles): _____ | 1 | 2 | 3 | 4 | 5 |

13. Inicialmente, ¿qué objetivo/s de negocio se especificaron formalmente para el EIS?

- a) Mejorar la sensibilidad de la organización hacia los clientes o la calidad del producto.
- b) Incrementar la productividad de la organización.
- c) Reducir costes en la organización.
- d) Realizar un seguimiento de los proyectos en curso que la organización lleva a cabo.
- e) Asegurar y proporcionar una información de gestión consistente para toda la organización.
- f) Apoyar el programa de Calidad de la organización (*TQM*).
- g) Otros (Por favor, especifique cuál/cuáles): _____
- h) No se especificaron objetivos de negocios para el EIS inicialmente.

14. ¿Quién fue la persona responsable de la idea original de introducir un EIS?

- a) Presidente del Consejo de Administración.
- b) Consejero Delegado.
- c) Director General.
- d) Director del Departamento de Informática /Sistemas de Información.
- e) Director de nivel superior de área funcional (Por favor, especifique cuál/cuáles): _____
- f) Otro (Por favor, especifique cuál/cuáles): _____

15. ¿Quién desempeñó en su organización el rol de espónsor ejecutivo? (*Espónsor ejecutivo*: directivo de nivel superior que solicita inicialmente el EIS, asigna los recursos necesarios, gestiona y controla el proceso de implantación y patrocina el sistema)

- a) Presidente del Consejo de Administración.
- b) Consejero Delegado.
- c) Director General.
- d) Director del Departamento de Informática /Sistemas de Información.
- e) Director de nivel superior de área funcional (Por favor, especifique cuál/cuáles): _____
- f) Otro (Por favor, especifique cuál/cuáles): _____
- g) No existió compromiso por parte de la alta dirección.

16. ¿Cuál es el cargo de la persona responsable de liderar el equipo de desarrollo e implantación del EIS?

- a) Director del Departamento de Informática / Sistemas de Información.
- b) Director de nivel superior de área funcional (Por favor, especifique cuál/cuáles): _____
- c) Directivo intermedio (Por favor, especifique área/s): _____
- d) Personal staff.
- e) Otro (Por favor, especifique cuál/cuáles): _____



17. ¿Cuántas personas componían el equipo de desarrollo del EIS?.

18. Señale qué persona/s componían el equipo de desarrollo del EIS:

- a) Miembros del Departamento de Informática /Sistemas de Información.
- b) Directores de nivel superior de áreas funcionales (Por favor, especifique cuál/cuáles): _____
- c) Directivos intermedios (Por favor, especifique área/s): _____
- d) Miembros de la compañía vendedora del software empleado.
- e) Consultores.
- f) Otros (Por favor, especifique cuál/es): _____

19. Actualmente, ¿cuántas personas componen el equipo de apoyo y mantenimiento del EIS?.

20. Señale qué persona/s componen el equipo de apoyo y mantenimiento del EIS:

- a) Miembros del Departamento de Informática /Sistemas de Información.
- b) Directores de nivel superior de áreas funcionales (Por favor, especifique cuál/cuáles): _____
- c) Miembros de la compañía vendedora del software empleado.
- d) Consultores.
- e) Otros (Por favor, especifique cuál/es): _____

21. ¿Cuál es el número aproximado de usuarios del EIS en su organización?

22. Señale el/los nivel/es en los que son usados el EIS dentro de su organización:

- a) Presidente.
- b) Consejero Delegado.
- c) Director General.
- d) Directores Funcionales de nivel superior.
- e) Directivos intermedios.
- f) Otros (Por favor, especifique cuál/es): _____

23. Señale el/las área/s en las que el EIS está siendo utilizado:

- a) Finanzas.
- b) Planificación.
- c) Marketing.
- d) Ventas.
- e) Personal.
- f) Producción/Operaciones.
- g) Otras (Por favor, especifique cuál/es): _____

24. Señale el/los tipo/s de información que contiene el EIS de su organización:

- a) Planificación estratégica.
- b) Gestión de inventarios.
- c) Proveedores.
- d) Financiera.
- e) Comercial/ventas.
- f) Mercado/industria.
- g) Recursos humanos.
- h) Calidad.
- i) Servicios externos de noticias.
- j) Producción.
- k) Competidores.
- l) Cotización bursátil.
- m) Otras (Por favor, especifique cuál/es): _____

25. ¿Cómo está contenida la información en el EIS? (Señale más de una en caso necesario)

- a) Por productos.
- b) Por proyectos.
- c) Por áreas funcionales.
- d) Por áreas geográficas.
- e) Por unidades estratégicas de negocio.
- f) Por procesos.
- g) Por indicadores clave de rendimiento.
- h) Otras (Por favor, especifique cuál/cuáles): _____
- i) _____

26. Señale la/s fuente/s de información que alimentan al EIS:

- a) Bases de datos corporativas.
- b) Humanas.
- c) Bases de datos de las áreas funcionales.
- d) Bases de datos externas.
- e) Documentos o informes.
- f) Internet.
- g) Otras (Por favor, especifique cuál/es): _____

27. En el caso de utilizar fuentes de información humanas en el EIS, ¿qué tipo/s de información se introducen?

- a) Opiniones, sentimientos, ideas.
- b) Predicciones, especulaciones, previsiones, estimaciones.
- c) Explicaciones, justificaciones, valoraciones, interpretaciones.
- d) Programas, planes formales.
- e) Informes de noticias, tendencias de industria, datos de encuestas externas.
- f) Rumores.
- g) Otras (Por favor, especifique cuál/es): _____



SECCIÓN IV: INFORMACIÓN SOBRE EL PROCESO DE DESARROLLO E IMPLANTACIÓN DEL EIS.

28. Señale qué tipo de análisis coste/beneficio se realizó con anterioridad a la implantación del EIS:

- a) Se determinaron costes y beneficios tangibles (beneficios cuantitativos). c) Se determinaron sólo los costes.
 b) Se determinaron costes y beneficios intangibles (beneficios cualitativos). d) Se determinaron sólo los beneficios.
 e) Ni los costes ni los beneficios fueron determinados.

29. Señale qué tipo de análisis coste/beneficio se realizó con posterioridad a la implantación del EIS:

- a) Se determinaron costes y beneficios tangibles (beneficios cuantitativos). c) Se determinaron sólo los costes.
 b) Se determinaron costes y beneficios intangibles (beneficios cualitativos). d) Se determinaron sólo los beneficios.
 e) Ni los costes ni los beneficios fueron determinados.

30. Cuáles han sido los costes iniciales de desarrollo y los costes anuales de mantenimiento del EIS de su organización:

| | Versión inicial | Versión en funcionamiento |
|-----------|-----------------|---------------------------|
| Hardware | Pts. | Pts. |
| Software | Pts. | Pts. |
| Personal | Pts. | Pts. |
| Formación | Pts. | Pts. |

31. ¿Cómo fue desarrollado el EIS?

- a) Sin la asistencia de consultores externos y suministradores del software.
 b) Con la asistencia de los suministradores del software.
 c) Con la asistencia de consultores externos.
 d) Con la asistencia de consultores externos y suministradores del software.

32. ¿Qué tiempo se empleó para desarrollar la primera versión del EIS?

_____ años, _____ meses.

33. Teniendo en cuenta dos metodologías extremas como un enfoque lineal y un enfoque evolutivo, ¿cómo posicionaría la metodología de desarrollo empleada en el EIS?

| | | | | | | |
|--|---|---|---|---|---|--|
| Enfoque lineal. | 1 | 2 | 3 | 4 | 5 | Enfoque evolutivo, iterativo. |
| Proceso de fases secuenciales similar al tradicional <i>modelo de ciclo de vida para el desarrollo de sistemas</i> | | | | | | Ciclo continuo de desarrollo y distribución de un EIS creciente. |

34. En una escala 1-5 (1 = muy insatisfecho; 5 = muy satisfecho), ¿qué nivel de satisfacción tiene con la metodología de desarrollo empleada?

Muy insatisfecho 1 2 3 4 5 Muy satisfecho.

35. Señale qué método/s se han empleado para determinar los requerimientos de información de los usuarios. En aquellos métodos que usted señale, por favor indique asimismo el nivel de utilidad percibido en una escala 1-5 (1 = baja utilidad; 5 = alta utilidad).

a) Diálogos con los ejecutivos. El analista determina las necesidades de información preguntando por las responsabilidades del puesto, problemas que actualmente experimenta e información que habitualmente usa.

Baja utilidad 1 2 3 4 5 Alta utilidad

b) Encuentros de planificación del equipo de desarrollo del EIS.

Baja utilidad 1 2 3 4 5 Alta utilidad

c) Exámenes de la información generada por ordenador que el ejecutivo actualmente recibe.

Baja utilidad 1 2 3 4 5 Alta utilidad

d) Diálogos con el personal de apoyo de los ejecutivos para comprender la información que es importante para dichos directivos.

Baja utilidad 1 2 3 4 5 Alta utilidad

e) Recomendaciones que voluntariamente realiza el ejecutivo en relación a la información que le gustaría que estuviera incluida en el EIS.

Baja utilidad 1 2 3 4 5 Alta utilidad

f) Examen de la información no informatizada a las que el ejecutivo se refiere o necesita habitualmente (Ej. artículos de prensa, correspondencia, publicaciones del gobierno, etc.).

Baja utilidad 1 2 3 4 5 Alta utilidad

g) Sesiones en las que se aplica el método de los Factores de Éxito Crítico¹ (CSF). Durante estas sesiones se identifican las metas organizacionales, se discuten los CSF que sirven de base a dichas metas, se exploran las medidas o indicadores de los CSF y son discutidos los métodos para proporcionar información relevante para dichos CSF.

¹ Factores de Éxito Crítico -Critical Success Factors- (CSF): "Aquel limitado número de áreas en las cuales los resultados, si son satisfactorios, asegurarán un rendimiento competitivo de éxito para la organización. Son aquellas pocas áreas donde las



- Baja utilidad

| | | | | |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|

 Alta utilidad
- h) Método de los Objetivos de Negocio Estratégicos -*Strategic Business Objectives*- (SBO). El EIS se diseña enfocándose y proporcionando apoyo a los objetivos de negocio estratégicos de la organización. Una vez que éstos han sido determinados, se identifican los procesos de negocio relacionados con su cumplimiento. Se proporciona información relacionada con el seguimiento de los objetivos de negocio estratégicos y con el apoyo al cumplimiento de los procesos de negocio.
- Baja utilidad

| | | | | |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|

 Alta utilidad
- i) El equipo de desarrollo del EIS asiste a encuentros en los que participan ejecutivos.
- Baja utilidad

| | | | | |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|

 Alta utilidad
- j) Examen del plan estratégico.
- Baja utilidad

| | | | | |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|

 Alta utilidad
- k) Seguimiento de la actividad de los ejecutivos para comprender cómo trabajan y la información que ellos usan.
- Baja utilidad

| | | | | |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|

 Alta utilidad
- l) Método *Balanced Scorecard* (Nolan, Norton & Company, Inc.). Proporciona a los ejecutivos un marco completo que traduce la estrategia de la empresa en un conjunto coherente de indicadores de rendimiento que permiten observar la actividad de la organización desde cuatro perspectivas: 1) P. del cliente. ¿Cómo nos ven los clientes?. 2) P. interna. Medida de procesos internos claves. 3) P. de la innovación y del aprendizaje. 4) P. financiera. ¿Cómo nos ven los accionistas?.
- Baja utilidad

| | | | | |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|

 Alta utilidad

36. ¿Qué configuración *hardware* da soporte al EIS de su organización?

- a) Arquitectura Cliente-Servidor de 3 niveles (3 *tiers*).
- b) Arquitectura Cliente-Servidor de 2 niveles (2 *tiers*).
- c) Arquitectura tradicional *Mainframe*-Terminales.
- d) Arquitectura de Red (sin cliente/servidor).
- e) Sólo ordenadores personales aislados (*PC stand-alone*).
- f) Otra (Por favor, especifique cuál/es): _____

37. ¿Disponen de una estructura de almacenamiento *Data Warehouse*?

- a) Disponemos de una arquitectura *Data Warehouse* de 2 niveles.
- b) Disponemos de una arquitectura *Data Warehouse* de 3 niveles (nivel 3º: *Data Mart*).
- c) No disponemos de arquitectura *Data Warehouse*.

38. ¿Cómo fue desarrollado el programa informático del EIS de su organización?

- a) Fue desarrollado con *software* realizado en la organización (*in-house*).
- b) Fue desarrollado con *software* comercial suministrado por vendedores.
- c) Fue desarrollado con una combinación de *software* realizado en la organización y *software* comercial.

39. En el caso de haber utilizado un *software* comercial, podría indicarnos qué producto/s han usado:

- a) Commander (Comshare).
- b) DSS Agents (MicroStrategy).
- c) EIS-Track (IOC).
- d) Express/EIS (Oracle IRI).
- e) FOCUS/EIS (Information Builders).
- f) Forest & Trees (Platinum Technology)
- g) Gentia (Planning Sciences).
- h) Holos (Seagate Software IMG).
- i) Lightship / Command Center (Pilot)
- j) Lotus Notes (Lotus Corporation)
- k) Powerplay (Cognos).
- l) SAP/EIS (SAP)
- m) SAS/EIS (SAS Institute).
- n) Otro (Por favor, especifique cuál/es): _____

40. ¿Qué número de usuarios tienen acceso al EIS?

- a) Al inicio de la implantación _____
- b) A los 6 meses _____
- c) Al año _____
- d) A los dos años _____
- e) A los tres años _____
- f) Actualmente _____

cosas deben ir correctamente para que el negocio prospere. Si los rendimientos en estas áreas no son adecuados, los resultados de la organización durante el período considerado serán menores que los deseados”



41. Señale qué capacidades se encuentran presentes en el EIS de su organización

- | | |
|---|--|
| a) <i>Drill down</i> (capacidad de profundizar en un mayor nivel de detalle al señalar una cifra o gráfico). <input type="checkbox"/> | l) Integración con un Sistema de Apoyo a Grupos (<i>Group Support System -GSS-</i>). <input type="checkbox"/> |
| b) Pantallas a color. <input type="checkbox"/> | m) Acceso a bases de datos multidimensionales. <input type="checkbox"/> |
| c) Extracción de datos provenientes de las bases de datos existentes en la organización. <input type="checkbox"/> | n) <i>Data Mining</i> (herramienta avanzada de análisis y síntesis de información que descubre patrones de comportamiento no explícitos). <input type="checkbox"/> |
| d) Integración de datos provenientes de diferentes fuentes de información. <input type="checkbox"/> | o) Correo Electrónico. <input type="checkbox"/> |
| e) Información textual, tabular y gráfica en la misma pantalla. <input type="checkbox"/> | p) Múltiples métodos de localizar la información (Ej. menús, palabras clave, funciones). <input type="checkbox"/> |
| f) Múltiples interfaces de usuario (Ej. ratón, teclado, pantalla táctil). <input type="checkbox"/> | q) Pantallas de ayuda contextuales. <input type="checkbox"/> |
| g) Capacidad para imprimir informes y pantallas. <input type="checkbox"/> | r) Ficheros de comando para ver las pantallas en una determinada secuencia. <input type="checkbox"/> |
| h) Interface/s con otro/s software (Ej. Excel, Access, Lotus, etc.). <input type="checkbox"/> | s) Seguridad para datos, pantallas y sistema. <input type="checkbox"/> |
| i) Acceso a bases de datos externas (Ej. Reuters, Dow Jones, My News). <input type="checkbox"/> | t) Sistema de seguimiento o monitorización de uso. <input type="checkbox"/> |
| j) Integración con un Sistema de Apoyo a la Toma de Decisiones (<i>Decision Support System -DSS-</i>). <input type="checkbox"/> | u) Procesador de textos. <input type="checkbox"/> |
| k) Integración con un Sistema Experto (<i>Expert System -ES-</i>). <input type="checkbox"/> | v) Agenda. <input type="checkbox"/> |
| | w) Herramientas de gestión de proyectos. <input type="checkbox"/> |
| | x) Videoconferencia. <input type="checkbox"/> |
| | y) Acceso a Internet. <input type="checkbox"/> |
| | z) Otras (Por favor, especifique cuál/cuáles): |

42. Utilizando una escala (1 = baja importancia; 5 = alta importancia), señale el nivel de importancia que han tenido los siguientes problemas en el desarrollo del EIS de su organización:

| | Baja importancia | | Alta importancia | | |
|--|------------------|---|------------------|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| a) Acceder a datos precisos, correctos. | 1 | 2 | 3 | 4 | 5 |
| b) Definir los objetivos del sistema. | 1 | 2 | 3 | 4 | 5 |
| c) Tener suficientes recursos humanos y técnicos. | 1 | 2 | 3 | 4 | 5 |
| d) Mantenerse al corriente de los cambiantes requerimientos de información de los ejecutivos. | 1 | 2 | 3 | 4 | 5 |
| e) Mantener el interés de los ejecutivos. | 1 | 2 | 3 | 4 | 5 |
| f) Gestionar la difusión del sistema. | 1 | 2 | 3 | 4 | 5 |
| g) Lograr que los ejecutivos usen el sistema. | 1 | 2 | 3 | 4 | 5 |
| h) Superar resistencias de carácter político. | 1 | 2 | 3 | 4 | 5 |
| i) Lograr una esponsorización comprometida por parte de la alta dirección. | 1 | 2 | 3 | 4 | 5 |
| j) Identificar los requerimientos de información iniciales. | 1 | 2 | 3 | 4 | 5 |
| k) Aprender a usar la tecnología requerida para desarrollar el sistema. | 1 | 2 | 3 | 4 | 5 |
| l) Mantener la esponsorización. | 1 | 2 | 3 | 4 | 5 |
| m) Lograr apoyo por parte del departamento de Informática / Sistemas de Información. | 1 | 2 | 3 | 4 | 5 |
| n) Vincular el sistema a los objetivos de negocio de la organización. | 1 | 2 | 3 | 4 | 5 |
| o) Identificar los requerimientos técnicos del sistema. | 1 | 2 | 3 | 4 | 5 |
| p) Justificar el coste de desarrollar y mantener el sistema. | 1 | 2 | 3 | 4 | 5 |
| q) Incompatibilidad de los sistemas existentes en la organización con los requerimientos del sistema EIS. | 1 | 2 | 3 | 4 | 5 |
| r) Encontrar una aplicación inicial de alto impacto. | 1 | 2 | 3 | 4 | 5 |
| s) Decidir qué hardware y software usar. | 1 | 2 | 3 | 4 | 5 |
| t) Sobrevivir a la marcha del espónsor. | 1 | 2 | 3 | 4 | 5 |
| u) Justificar la necesidad de dedicar tiempo de personal interno para el desarrollo y/o mantenimiento del nuevo sistema. | 1 | 2 | 3 | 4 | 5 |

Por favor, una vez cumplimentado, incluya el presente cuestionario en el sobre franqueado que se adjunta y remítanoslo. Le estamos muy agradecidos por su colaboración.

Si desea que le enviemos los resultados de la investigación, indíquenos su nombre, dirección y formato del fichero informático en el que desea que le remitamos el documento.

APELLIDOS: _____ NOMBRE: _____
 EMPRESA: _____ DIRECCIÓN: _____
 PROVINCIA: _____ CÓDIGO POSTAL: _____
 FORMATO DEL FICHERO INFORMÁTICO: _____ E-MAIL: _____

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Author's Interview schedule

Interview schedule reflecting interview number, time and date of interviewee, interviewee name and organisation

| | Time | Date | Interviewee Name | Organisation |
|----|-------|-------------|-----------------------|--|
| 1 | 09h00 | 15 May 2002 | Zelda Visagie | Tibbett & Britten (SA) (Pty) Ltd |
| 2 | 08h00 | 16 May 2002 | Hervais Maurel | Robertsons Foods (Pty) Ltd |
| 3 | 08h30 | 16 May 2002 | Bryce Dukes | Robertsons FoodService (Pty) Ltd |
| 4 | 12h30 | 16 May 2002 | Trevor King | eThekwini Municipality |
| 5 | 08h00 | 17 May 2002 | Renzo Cordano | Beacon Sweets and Chocolates (Pty) Ltd |
| 6 | 09h00 | 17 May 2002 | Deborah Beirowski | Tifozi (Pty) Ltd |
| 7 | 10h00 | 17 May 2002 | Mark Barnett | GUD Filters (Pty) Ltd |
| 8 | 14h00 | 17 May 2002 | Bernhard Lanzendörfer | Sika (Pty) Ltd |
| 9 | 15h00 | 17 May 2002 | Richard Coleman | DaimlerChrysler SA |
| 10 | 12h30 | 20 May 2002 | Charles Thompson | Durban Institute of Technology |
| 11 | 14h00 | 20 May 2002 | Roy Maharaj | eThekwini Water Services |
| 12 | 08h30 | 21 May 2002 | Kathy Roberts | Dunlop Africa Ltd |
| 13 | 10h00 | 22 May 2002 | Chris Lowe | Standard Corporate Merchant Bank |
| 14 | 12h30 | 22 May 2002 | Siva Moodley | eThekwini Electricity |
| 15 | 14h30 | 22 May 2002 | Kelvin Pakaree | BOE Retail Banking Division (Pty) Ltd |
| 16 | 09h00 | 23 May 2002 | Steve Shepherd | Albaraka Bank |
| 17 | 15h00 | 23 May 2002 | Seelan Govender | McCarthy Motor Holdings Ltd |
| 18 | 08h15 | 24 May 2002 | Geoff Moores | Sovereign Health (Pty) Ltd |
| 19 | 09h30 | 24 May 2002 | Michael Parker | BOE Bank Ltd |
| 20 | 10h30 | 24 May 2002 | Richard de Vos | MetroRail |
| 21 | 15h00 | 27 May 2002 | Mike Cowan | IT Dynamics (Pty) Ltd |
| 22 | 16h00 | 27 May 2002 | Stella Wulfsohn | Tongaat-Hulett Sugar Refinery Ltd |
| 23 | 17h00 | 27 May 2002 | Siva Naicker | Smith's Manufacturing (Pty) Ltd |
| 24 | 18h00 | 27 May 2002 | Michelle Bradshaw | Synergy Computing (Pty) Ltd |
| 25 | 08h30 | 28 May 2002 | Ian Hopewell | (Not for disclosure) |
| 26 | 14h00 | 28 May 2002 | Albert van Tonder | BOE Corporate |
| 27 | 07h45 | 29 May 2002 | Cindy von Pannier | Infowave Holdings Ltd |
| 28 | 16h30 | 30 May 2002 | Kevin Norris | Corobrik (Pty) Ltd |
| 29 | 14h00 | 4 June 2002 | Deborah Frost | Sara Lee Household & Body Care |
| 30 | 16h30 | 4 June 2002 | Hilton Briner | The Spar Group Ltd |
| 31 | 17h00 | 5 June 2002 | Jacqui de Heer | Ithala Development Finance Corp Ltd |

Tables reflecting demographic information of organisations participating in Study

Table 1 Activity Sectors of organisations participating in study

| Activity Sector | Number of Activity Sectors in survey sample and associated percentage of total sample surveyed (N=31) |
|---------------------------------|---|
| Agriculture | 1 (3,2%) |
| Catering | 1 (3,2%) |
| Construction and Automotive | 1 (3,2%) |
| Education | 1 (3,2%) |
| Electrical Power Distribution | 1 (3,2%) |
| Financial Services | 6 (19,3%) |
| Food Processing | 1 (3,2%) |
| Information Technology Services | 2 (6,5%) |
| Manufacturing | 7 (22,6%) |
| Medical Scheme Administrators | 1 (3,2%) |
| Public Administration | 1 (3,2%) |
| Public Transportation | 1 (3,2%) |
| Publishing | 1 (3,2%) |
| Retail | 2 (6,5%) |
| Software Development | 1 (3,2%) |
| Warehousing and Distribution | 2 (6,5%) |
| Water Distribution | 1 (3,2%) |
| TOTAL | 31 (100,0%) |

Table 2 Gross annual turnover of organisations participating in study

| Gross annual turnover (in South African Rands) | Number of organisations in survey sample and associated percentage of total sample surveyed (N=30) |
|--|--|
| More than 500 million | 16 (53,3%) |
| Between 100 and 500 million | 8 (26,7%) |
| Between 20 and 100 million | 3 (10,0%) |
| Between 5 and 20 million | 0 (0,0%) |
| Between 1 and 5 million | 3 (10,0%) |
| Less than one million | 0 (0,0%) |
| TOTAL | 30 (100,0%) |

Table 3 Number of permanent employees in organisations participating in study

| Number of permanent employees in organisation | Number of organisations in survey sample and associated percentage of total sample surveyed (N=31) |
|---|--|
| More than 5,001 employees | 6 (19,5%) |
| Between 2,001 and 5,000 employees | 5 (16,1%) |
| Between 501 and 2,000 employees | 9 (29,0%) |
| Between 251 and 500 employees | 5 (16,1%) |
| Between 51 and 250 employees | 5 (16,1%) |
| Less than 51 employees | 1 (3,2%) |
| TOTAL | 31 (100,0%) |

Table 4 Number of years that organisations, which participated in the study, have existed

| Number of years that organisation has existed | Number of organisations in survey sample and associated percentage of total sample surveyed (N=31) |
|---|--|
| More than 25 years | 25 (80,6%) |
| Between 10 and 25 years | 3 (9,7%) |
| Between 5 and 10 years | 2 (6,5%) |
| Less than 5 years | 1 (3,2%) |
| TOTAL | 31 (100,0%) |

Table 5 Classification of organisations participating in study

| Classification of organisation | Number of organisations in survey sample and associated percentage of total sample surveyed (N=31) |
|-------------------------------------|--|
| Public listed | 11 (35,5%) |
| Public non listed | 3 (9,7%) |
| Government or quasi-government body | 6 (19,3%) |
| Foreign enterprise | 2 (6,5%) |
| Private company | 9 (29,0%) |
| TOTAL | 31 (100,0%) |

Table 6 Alphabetic inventory of interviewee job titles

| Job Title of interviewee in organisation surveyed (N=31) |
|---|
| Account Manager |
| Accountant |
| BI Consultant |
| Business Analyst |
| Business Systems Manager |
| Decision Support Analyst |
| Director: Management Information Services |
| Director |
| Distributed National Inventory Project Leader |
| Distribution and Corporate Systems Manager |
| Financial Manager |
| General Manager |
| Head of Information Technology |
| Management Accountant |
| Manager |
| Managing Director |
| Marketing Services Manager |
| MIS Manager |
| Profitability Analyst |
| Project Manager |
| Regional Manager |
| Risk Analyst |
| Senior Profitability Analyst |
| Systems Administrator |
| Systems Analyst |
| Tariff Engineer |

Tables reflecting EIS situation in organisations participating in Study

Table 1 Current EIS situation in respondent's organisation

| Current situation of EIS in respondent's organisation | Number of respondents surveyed and associated percentage of total sample surveyed (N=31) |
|--|--|
| Based on the evaluation, the EIS has been accepted and is under development and implementation | 3 (9,7%) |
| The EIS is operational and in use by executives/business end-users | 27 (87,1%) |
| EIS failure (where the latest EIS implementation has been successful) | 1 (3,2%) |
| TOTAL | 31 (100,0%) |

Table 2 Time taken before EIS was in use by executives/business end-users

| For operational EIS, time taken before EIS was in use by executives/business end-users | Tally and associated percentage of the time taken as reported by respondents in sample surveyed (N=25) |
|--|--|
| 3 days | 1 (4,0%) |
| 10-15 days | 1 (4,0%) |
| 14 days | 1 (4,0%) |
| 1 month | 2 (8,0%) |
| 2 months | 1 (4,0%) |
| 2-3 months | 1 (4,0%) |
| 3 months | 2 (8,0%) |
| 3-6 months | 3 (12,0%) |
| 5 months | 1 (4,0%) |
| 6 months | 2 (8,0%) |
| 8 months | 2 (8,0%) |
| 12 months | 3 (12,0%) |
| 15 months | 1 (4,0%) |
| 18 months | 1 (4,0%) |
| 24 months | 2 (8,0%) |
| 36 months | 1 (4,0%) |
| TOTAL | 25 (100,0%) |

Table 3 Applications for which EIS is used in organisations surveyed

| EIS applications used in respondent's organisation | Tally and associated percentage of the number of applications reported by respondents in total sample surveyed (N=31) |
|--|---|
| Office automation activities | 5 (16,1%) |
| Access to current status information | 22 (71,0%) |
| Access to projected trends of the organisation | 23 (74,2%) |
| Querying corporate and external data bases | 16 (51,6%) |
| Performing personal analysis | 16 (51,6%) |
| Measuring Key Performance Indicators (KPIs) | 1 (3,2%) |

Table 4 EIS users in organisations surveyed

| EIS user statistics in organisations (N=27) | |
|---|-----|
| Minimum number of EIS users reported | 6 |
| Maximum number of EIS users reported | 700 |
| Mode | 20 |
| Mean | 54 |
| Standard Deviation | 134 |

Table 5 EIS users in organisations surveyed

| EIS user statistics in organisations (N=31) | |
|---|-----|
| Minimum number of EIS users reported | 2 |
| Maximum number of EIS users reported | 700 |
| Mode | 20 |
| Mean | 50 |
| Standard Deviation | 126 |

Table 6 Hierarchical employee levels where EIS is used in organisations

| Hierarchical employee level where EIS is used in organisation | Tally and associated percentage of the number of employee levels reported by respondents in total sample surveyed (N=31) |
|---|--|
| Managing Director/Chief Executive Officer | 14 (45,2%) |
| Director (or delegated) | 18 (58,1%) |
| General Manager | 20 (64,5%) |
| Senior Operations Manager | 19 (61,3%) |
| Middle Manager | 24 (77,4%) |
| Line Manager | 14 (45,2%) |
| Business end-user | 12 (38,7%) |
| Financial Consultants | 1 (3,2%) |

Table 7 Functional areas where EIS is used in organisations

| Functional area where EIS is used in organisation | Tally and associated percentage of the number of functional areas reported by respondents in total sample surveyed (N=31) |
|---|---|
| Finance | 20 (64,5%) |
| Planning | 10 (32,3%) |
| Marketing | 20 (64,5%) |
| Sales | 16 (51,6%) |
| Personnel | 5 (16,1%) |
| Production/Operations | 12 (38,7%) |
| Entire organisation | 7 (22,6%) |

Table 8 Functional areas where EIS is used in organisations

| Types of information held by EIS in organisation | Tally and associated percentage of the number of types of information as reported by respondents in total sample surveyed (N=31) |
|--|--|
| Strategic planning | 11 (35,5%) |
| Inventory management/Suppliers | 10 (32,3%) |
| 'Soft' information | 4 (12,9%) |
| Finance | 28 (90,3%) |
| Business/Sales | 23 (74,2%) |
| Trade/Industry | 4 (12,9%) |
| Human Resources | 9 (29,0%) |
| Quality | 7 (22,6%) |
| External news services | 1 (3,2%) |
| Production | 8 (25,8%) |
| Competitors | 3 (9,7%) |
| Stock Exchange prices | 1 (3,2%) |

Table 9 How information is held by an EIS in an organisation

| How information is held by EIS in organisation | Tally and associated percentage of how information is held as reported by respondents in total sample surveyed (N=31) |
|--|---|
| By products | 22 (71,0%) |
| By projects | 5 (16,1%) |
| By operational areas | 20 (64,5%) |
| By geographic areas | 18 (58,1%) |
| By strategic business units | 10 (32,3%) |
| By processes | 6 (19,4%) |
| By key performance areas | 14 (45,2%) |
| By company | 11 (35,5%) |
| By customers | 1 (3,2%) |

Table 10 Sources of information that support EIS in an organisation

| Sources of information that support EIS in organisation | Tally and associated percentage of sources of information as reported by respondents in total sample surveyed (N=31) |
|---|--|
| Corporate data bases | 25 (80,6%) |
| Individuals | 12 (38,7%) |
| Operational data bases | 20 (64,5%) |
| External data bases | 8 (25,8%) |
| Documents or reports | 7 (22,6%) |
| Internet, Intranet or Extranet | 5 (16,1%) |

Table 11 Approaches taken for EIS development in organisations

| Approach taken for EIS development in organisation | Tally and associated percentage of approach taken for EIS development as reported by respondents in total sample surveyed (N=31) |
|--|--|
| In-house development using existing software tools | 6 (19,4%) |
| In-house development with critical EIS features developed initially and optional features added over time, using existing or commercially purchased software tools | 9 (29,0%) |
| Fully developed by vendor | 7 (22,6%) |
| In-house development with assistance from vendor | 12 (38,7%) |

Table 12 Distribution of market amongst vendors of EIS tools according to responses

| Name of commercially purchased EIS software tools and/or ERP software with EIS features | Tally and associated percentage of commercially purchased EIS software tools and/or ERP software with EIS features as reported by respondents in total sample surveyed (N=30) |
|---|---|
| Business Objects | 2 (6,7%) |
| Cognos | 18 (60,0%) |
| Crystal Enterprise | 1 (3,3%) |
| Holos | 1 (3,3%) |
| Hyperion | 3 (10,0%) |
| JDEdwards BI | 4 (13,3%) |
| Lotus Notes | 3 (10,0%) |
| Oracle | 4 (13,3%) |
| Pilot | 2 (6,7%) |
| ProClarity | 1 (3,3%) |
| SAP/EIS | 1 (3,3%) |
| MIMMS | 1 (3,3%) |
| MISYS | 1 (3,3%) |
| BI Query | 1 (3,3%) |

Table 13 Frequencies of EIS use in organisations

| Frequency of EIS use in organisation | Tally and associated percentage of EIS use in organisation as reported by respondents in total sample surveyed (N=31) |
|---|---|
| Very rarely or not at all | 1 (3,2%) |
| Rarely (a few times per month) | 1 (3,2%) |
| Occasionally (a few times per week) | 1 (3,2%) |
| Sometimes (about once per week) | 1 (3,2%) |
| Fairly regularly (several times per week) | 4 (12,9%) |
| Regularly (once a day) | 12 (38,7%) |
| Frequently (several times per day) | 13 (41,9%) |

Interviewee's raw responses of organisations participating in Study

Interviewee's raw responses to questions in Sections 2, 3, 4 and 5 of survey instrument (Appendix 3)

| | Section 2 | | | Section 3 | | | | | | | | | | | | | | Section 4 | | | | | | | Section 5 | | | | | | |
|----|-----------|-----|-----|-----------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|-----------|-----|-----|-----|-----|-----|-----|-----------|-----|-----|-----|-----|-----|-----|
| | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 3.3 | 3.4 | 3.5 | 3.6 | 3.7 | 3.8 | 3.9 | 3.10 | 3.11 | 3.12 | 3.13 | 3.14 | 4.1 | 4.2 | 4.3 | 4.4 | 4.5 | 4.6 | 4.7 | 5.1 | 5.2 | 5.3 | 5.4 | 5.5 | 5.6 | 5.7 |
| 1 | 6 | 4 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 1 | 1 | 6 | 1 | 4 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 3 | 6 | 6 | 7 | |
| 2 | 6&7 | 4 | 2 | 2 | 2 | 4 | 2 | 1 | 1 | 3 | 1 | 3 | 2 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 4 | 5 | 6 | 2 | 2 | |
| 3 | 6 | 1 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 2 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 4 | 3 | 4 | 2 | 2 | 4 | 7 | |
| 4 | 6&7 | 3 | 2 | 3 | 2 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 2 | 7 | 7 | 7 | 7 | 7 | |
| 5 | 7 | 4 | 1 | 2 | 1 | 2 | 2 | 2 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 4 | 3 | 2 | 7 | |
| 6 | 7 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 6 | 7 | 1 | 6 | 7 | 7 | 6 | 6 | 7 | 4 | 7 | 7 | 7 | 6 | |
| 7 | 7 | 5 | 2 | 1 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 7 | 5 | 7 | 3 | 1 | 1 | 1 | 1 | 4 | 1 | 1 | 4 | 7 | |
| 8 | 6 | 4 | 3 | 2 | 2 | 2 | 2 | 1 | 2 | 3 | 2 | 2 | 3 | 2 | 1 | 1 | 1 | 1 | 3 | 1 | 1 | 1 | 1 | 2 | 3 | 2 | 2 | 4 | 4 | 1 | |
| 9 | 5 | 5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 2 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 3 | 6 | 6 | 7 | 7 | |
| 10 | 5 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 2 | 2 | 2 | 1 | 1 | 1 | 7 | 6 | 6 | 1 | 5 | 1 | 1 | 1 | 1 | 6 | 6 | 2 | 2 | 3 | |
| 11 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 4 | 7 |
| 12 | 7 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 3 | 7 | |
| 13 | 7 | 5 | 2 | 1 | 2 | 1 | 1 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | |
| 14 | 7 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 1 | 2 | 1 | 2 | 3 | 3 | 2 | 7 | |
| 15 | 2 | 3 | 2 | 2 | 1 | 2 | 2 | 2 | 1 | 4 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 4 | 4 | 4 | 2 | 2 | 7 | |
| 16 | 5 | 6 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 5 | 7 | 2 | 2 | 7 | 6 | |
| 17 | 7 | 6 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 5 | 5 | 1 | 1 | 5 | 1 | 5 | 1 | 1 | 4 | 2 | 1 | 1 | 7 | |
| 18 | 7 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 3 | 2 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 4 | 4 | 4 | 3 | 3 | 3 | 7 | |
| 19 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 3 | 3 | 6 | 6 | 6 | 7 | |
| 20 | 6 | 5 | 2 | 1 | 2 | 2 | 1 | 2 | 1 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 7 | 1 | 1 | 1 | 1 | 1 | 1 | 5 | 1 | 6 | 7 | 4 | 3 | 4 | |
| 21 | 6 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 3 | 7 | |
| 22 | 7 | 5 | 1 | 1 | 1 | 1 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 4 | 4 | 5 | 5 | 2 | 7 | |
| 23 | 6 | 4 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 5 | 7 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 2 | 7 | 3 | 7 | |
| 24 | 6 | 4 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | 2 | 1 | 2 | 2 | 1 | 2 | 2 | 2 | 6 | 6 | 2 | 2 | 1 | 6 | 1 | 1 | 2 | 2 | 2 | 2 | 1 | |
| 25 | 6 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 7 | 7 | 7 | 7 | |
| 26 | 7 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 3 | 3 | 1 | 1 | 5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 6 | 2 | |
| 27 | 5 | 5 | 2 | 3 | 2 | 1 | 1 | 2 | 1 | 1 | 1 | 3 | 1 | 1 | 2 | 1 | 7 | 6 | 1 | 1 | 1 | 1 | 7 | 1 | 1 | 1 | 3 | 7 | 2 | 1 | |
| 28 | 6 | 4 | 4 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 3 | 6 | 5 | 7 | 5 | |
| 29 | 7 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 | 7 | 7 | 7 | 7 | |
| 30 | 7 | 4 | 1 | 1 | 2 | 1 | 2 | 1 | 2 | 3 | 2 | 1 | 3 | 2 | 2 | 1 | 6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 | 1 | 1 | 7 | 7 | 7 | |
| 31 | 1 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 3 | 7 | 7 | 7 | 7 | 7 | |

Interviewee's scale values (Section 3) of organisations participating in Study

From Section 3 in Appendix 6, associated scale values and totals

| | Section 3 | | | | | | | | | | | | | | 3.13 | 3.14 |
|----|-----------|-----|-----|-----|-----|-----|-------|-----|-----|-----|------|------|------|-------|------|------|
| | 3.1 | 3.2 | 3.3 | 3.4 | 3.5 | 3.6 | Total | 3.7 | 3.8 | 3.9 | 3.10 | 3.11 | 3.12 | Total | | |
| 1 | 3 | 3 | 3 | 3 | 3 | 2 | 17 | 2 | 2 | 3 | 2 | 2 | 2 | 13 | 3 | 3 |
| 2 | 2 | 2 | 2 | 0 | 2 | 3 | 11 | 3 | 1 | 3 | 1 | 2 | 3 | 13 | 2 | 3 |
| 3 | 2 | 2 | 2 | 2 | 3 | 3 | 14 | 2 | 2 | 2 | 1 | 3 | 3 | 13 | 3 | 3 |
| 4 | 2 | 1 | 2 | 3 | 3 | 2 | 13 | 2 | 2 | 2 | 2 | 2 | 3 | 13 | 1 | 3 |
| 5 | 3 | 2 | 3 | 2 | 2 | 2 | 14 | 3 | 2 | 3 | 3 | 3 | 3 | 17 | 3 | 3 |
| 6 | 3 | 3 | 3 | 3 | 3 | 3 | 18 | 3 | 3 | 3 | 3 | 3 | 3 | 18 | 3 | 3 |
| 7 | 2 | 3 | 2 | 2 | 2 | 2 | 13 | 1 | 1 | 1 | 1 | 1 | 2 | 7 | 3 | 3 |
| 8 | 1 | 2 | 2 | 2 | 2 | 3 | 12 | 2 | 1 | 2 | 2 | 1 | 2 | 10 | 3 | 3 |
| 9 | 3 | 3 | 3 | 3 | 3 | 3 | 18 | 3 | 2 | 3 | 3 | 2 | 3 | 16 | 2 | 3 |
| 10 | 3 | 3 | 3 | 3 | 3 | 3 | 18 | 2 | 3 | 2 | 2 | 2 | 3 | 14 | 3 | 3 |
| 11 | 3 | 3 | 3 | 3 | 3 | 3 | 18 | 2 | 2 | 3 | 3 | 3 | 3 | 16 | 3 | 3 |
| 12 | 3 | 3 | 3 | 3 | 3 | 3 | 18 | 2 | 2 | 2 | 2 | 2 | 2 | 12 | 3 | 3 |
| 13 | 2 | 3 | 2 | 3 | 3 | 2 | 15 | 2 | 2 | 2 | 1 | 2 | 2 | 11 | 3 | 3 |
| 14 | 2 | 2 | 2 | 2 | 2 | 3 | 13 | 2 | 1 | 1 | 1 | 1 | 2 | 8 | 2 | 2 |
| 15 | 2 | 2 | 3 | 2 | 2 | 2 | 13 | 3 | 0 | 3 | 3 | 3 | 3 | 15 | 2 | 3 |
| 16 | 2 | 2 | 3 | 3 | 3 | 3 | 16 | 2 | 2 | 2 | 2 | 2 | 2 | 12 | 3 | 3 |
| 17 | 3 | 3 | 3 | 3 | 3 | 3 | 18 | 2 | 3 | 3 | 3 | 2 | 3 | 16 | 3 | 3 |
| 18 | 2 | 3 | 3 | 3 | 3 | 3 | 17 | 1 | 2 | 2 | 1 | 1 | 1 | 8 | 1 | 2 |
| 19 | 3 | 3 | 3 | 3 | 3 | 3 | 18 | 3 | 3 | 2 | 3 | 3 | 3 | 17 | 3 | 3 |
| 20 | 2 | 3 | 2 | 2 | 3 | 2 | 14 | 3 | 2 | 3 | 3 | 3 | 3 | 17 | 2 | 3 |
| 21 | 3 | 3 | 3 | 3 | 3 | 3 | 18 | 3 | 2 | 3 | 3 | 3 | 3 | 17 | 3 | 3 |
| 22 | 3 | 3 | 3 | 3 | 2 | 2 | 16 | 3 | 2 | 2 | 2 | 2 | 2 | 13 | 1 | 3 |
| 23 | 2 | 2 | 3 | 2 | 2 | 2 | 13 | 2 | 2 | 2 | 2 | 2 | 2 | 12 | 2 | 2 |
| 24 | 2 | 2 | 3 | 3 | 3 | 3 | 16 | 2 | 2 | 3 | 2 | 2 | 3 | 14 | 2 | 2 |
| 25 | 3 | 3 | 3 | 3 | 3 | 3 | 18 | 1 | 2 | 2 | 3 | 3 | 3 | 14 | 3 | 3 |
| 26 | 3 | 3 | 3 | 3 | 3 | 3 | 18 | 3 | 3 | 3 | 1 | 1 | 1 | 12 | 3 | 3 |
| 27 | 2 | 1 | 2 | 3 | 3 | 2 | 13 | 3 | 3 | 3 | 1 | 3 | 3 | 16 | 2 | 3 |
| 28 | 0 | 2 | 2 | 3 | 2 | 2 | 11 | 2 | 2 | 2 | 1 | 1 | 2 | 10 | 3 | 3 |
| 29 | 2 | 2 | 2 | 2 | 2 | 2 | 12 | 3 | 3 | 3 | 2 | 3 | 3 | 17 | 3 | 3 |
| 30 | 3 | 3 | 2 | 3 | 2 | 3 | 16 | 2 | 1 | 2 | 3 | 1 | 2 | 11 | 2 | 3 |
| 31 | 3 | 3 | 3 | 3 | 3 | 3 | 18 | 2 | 1 | 3 | 3 | 2 | 3 | 14 | 3 | 3 |

Interviewee's scale values (Section 4) of organisations participating in Study

From Section 4 in Appendix 6, associated scale values, totals and number of Web-based technologies

| | Section 4 | | | | | | | | Total | Number of Web-based technologies which impacted EIS implementations in organisations surveyed |
|----|-----------|-----|-----|-----|-----|-----|-----|-----|-------|---|
| | 4.1 | 4.2 | 4.3 | 4.4 | 4.5 | 4.6 | 4.7 | | | |
| 1 | 2 | -3 | 0 | -3 | -3 | -3 | -3 | -13 | 2 | |
| 2 | -3 | -3 | -3 | -3 | -3 | -3 | -3 | -21 | 0 | |
| 3 | -3 | -3 | -3 | -3 | -3 | -3 | -3 | -21 | 0 | |
| 4 | -3 | -3 | -3 | -3 | -3 | -3 | -3 | -21 | 0 | |
| 5 | -3 | -3 | -3 | -3 | -3 | -3 | -3 | -21 | 0 | |
| 6 | 2 | 3 | -3 | 2 | 3 | 3 | 2 | 12 | 6 | |
| 7 | -3 | 3 | 1 | 3 | -1 | -3 | -3 | -3 | 4 | |
| 8 | -3 | -3 | -1 | -3 | -3 | -3 | -3 | -19 | 1 | |
| 9 | -3 | -3 | -3 | -3 | -3 | -3 | -3 | -21 | 0 | |
| 10 | 3 | 2 | 2 | -3 | 1 | -3 | -3 | -1 | 4 | |
| 11 | -3 | 1 | -3 | -3 | -3 | -3 | -3 | -17 | 1 | |
| 12 | -3 | -3 | -3 | -3 | -3 | -3 | -3 | -21 | 0 | |
| 13 | -3 | -3 | -3 | -3 | -3 | -3 | -3 | -21 | 0 | |
| 14 | -2 | -2 | -2 | -3 | -3 | -2 | -3 | -17 | 4 | |
| 15 | -3 | -3 | -3 | -3 | -3 | -3 | -3 | -21 | 0 | |
| 16 | -3 | -3 | -3 | -3 | -3 | -3 | -3 | -21 | 0 | |
| 17 | 1 | 1 | -3 | -3 | 1 | -3 | 1 | -5 | 4 | |
| 18 | -1 | -1 | -1 | -3 | -3 | -3 | -3 | -15 | 3 | |
| 19 | -1 | -3 | -3 | -3 | -3 | -3 | -3 | -19 | 1 | |
| 20 | 3 | -3 | -3 | -3 | -3 | -3 | 1 | -11 | 2 | |
| 21 | -3 | -3 | -3 | -3 | -3 | -3 | -3 | -21 | 0 | |
| 22 | -3 | -3 | -3 | -3 | -3 | -3 | -3 | -21 | 0 | |
| 23 | 1 | 3 | -3 | -3 | -3 | -3 | -3 | -11 | 2 | |
| 24 | -2 | 2 | 2 | -2 | -2 | -3 | 2 | -3 | 6 | |
| 25 | 2 | -3 | -3 | -3 | -3 | -3 | -3 | -16 | 1 | |
| 26 | 1 | -3 | -3 | -3 | -3 | -3 | -3 | -17 | 1 | |
| 27 | 3 | 2 | -3 | -3 | -3 | -3 | 3 | -4 | 3 | |
| 28 | -3 | -3 | -3 | -3 | -3 | -3 | -3 | -21 | 0 | |
| 29 | -3 | -3 | -3 | -3 | -3 | -3 | -3 | -21 | 0 | |
| 30 | 2 | -3 | -3 | -3 | -3 | -3 | -3 | -16 | 1 | |
| 31 | -3 | -3 | -3 | -3 | -3 | -3 | -3 | -21 | 0 | |

Interviewee's scale values (Section 5) of organisations participating in Study

From Section 5 in Appendix 6, associated scale values, totals and number of Web-based technologies

| | Section 5 | | | | | | | | Total | Number of Web-based technologies which may impact future EIS implementations in organisations surveyed |
|----|-----------|-----|-----|-----|-----|-----|-----|-----|-------|--|
| | 5.1 | 5.2 | 5.3 | 5.4 | 5.5 | 5.6 | 5.7 | | | |
| 1 | 2 | 2 | 2 | 1 | -2 | -2 | -3 | 0 | 6 | |
| 2 | 3 | 2 | 0 | -1 | -2 | 2 | 2 | 6 | 7 | |
| 3 | 0 | 1 | 0 | 2 | 2 | 0 | -3 | 2 | 6 | |
| 4 | 1 | 2 | -3 | -3 | -3 | -3 | -3 | -12 | 2 | |
| 5 | 3 | 3 | 2 | 0 | 1 | 2 | -3 | 8 | 6 | |
| 6 | -2 | -3 | 0 | -3 | -3 | -3 | -2 | -16 | 3 | |
| 7 | 3 | 3 | 0 | 3 | 3 | 0 | -3 | 9 | 6 | |
| 8 | 2 | 1 | 2 | 2 | 0 | 0 | 3 | 10 | 7 | |
| 9 | 2 | 3 | 1 | -2 | -2 | -3 | -3 | -4 | 5 | |
| 10 | 3 | 3 | -2 | -2 | 2 | 2 | 1 | 7 | 7 | |
| 11 | 3 | 3 | 3 | 3 | 2 | 0 | -3 | 11 | 6 | |
| 12 | 2 | 2 | 2 | 2 | 2 | 1 | -3 | 8 | 6 | |
| 13 | -3 | -3 | -3 | -3 | -3 | -3 | -3 | -21 | 0 | |
| 14 | 2 | 3 | 2 | 1 | 1 | 2 | -3 | 8 | 6 | |
| 15 | 3 | 0 | 0 | 0 | 2 | 2 | -3 | 4 | 6 | |
| 16 | 2 | -1 | -3 | 2 | 2 | -3 | -2 | -3 | 5 | |
| 17 | 3 | 3 | 0 | 2 | 3 | 3 | -3 | 11 | 6 | |
| 18 | 0 | 0 | 0 | 1 | 1 | 1 | -3 | 0 | 6 | |
| 19 | 1 | 1 | 1 | -2 | -2 | -2 | -3 | -6 | 6 | |
| 20 | 3 | -2 | -3 | 0 | 1 | 1 | 0 | 0 | 6 | |
| 21 | 3 | 3 | 3 | 2 | 2 | 1 | -3 | 11 | 6 | |
| 22 | 3 | 0 | 0 | -1 | -1 | 2 | -3 | 0 | 6 | |
| 23 | 2 | 3 | 3 | 2 | -3 | 1 | -3 | 5 | 5 | |
| 24 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 17 | 7 | |
| 25 | 3 | 2 | 3 | -3 | -3 | -3 | -3 | -4 | 3 | |
| 26 | 3 | 2 | 2 | 2 | 2 | -2 | 2 | 11 | 7 | |
| 27 | 3 | 3 | 3 | 1 | -3 | 2 | 3 | 12 | 6 | |
| 28 | 3 | 1 | 1 | -2 | -1 | -3 | -1 | -2 | 6 | |
| 29 | 3 | 3 | -3 | -3 | -3 | -3 | -3 | -9 | 2 | |
| 30 | 3 | -3 | 3 | 3 | -3 | -3 | -3 | -3 | 3 | |
| 31 | 1 | 1 | -3 | -3 | -3 | -3 | -3 | -13 | 2 | |

Expected cell frequency Tables

Table 1 From Table 5.8, expected cell frequencies

| | | | | | | |
|----------|---|----------|----------|----------|----------|----------|
| 24.42857 | 1 | 0.857143 | 0.142857 | 1.428571 | 1.714286 | 1.428571 |
| 24.42857 | 1 | 0.857143 | 0.142857 | 1.428571 | 1.714286 | 1.428571 |
| 24.42857 | 1 | 0.857143 | 0.142857 | 1.428571 | 1.714286 | 1.428571 |
| 24.42857 | 1 | 0.857143 | 0.142857 | 1.428571 | 1.714286 | 1.428571 |
| 24.42857 | 1 | 0.857143 | 0.142857 | 1.428571 | 1.714286 | 1.428571 |
| 24.42857 | 1 | 0.857143 | 0.142857 | 1.428571 | 1.714286 | 1.428571 |
| 24.42857 | 1 | 0.857143 | 0.142857 | 1.428571 | 1.714286 | 1.428571 |

Table 2 From Table 5.12, expected cell frequencies

| | | | | | | |
|----------|----------|----------|----------|----------|----------|---|
| 6.285714 | 6.857143 | 3.571429 | 3.142857 | 0.857143 | 2.285714 | 8 |
| 6.285714 | 6.857143 | 3.571429 | 3.142857 | 0.857143 | 2.285714 | 8 |
| 6.285714 | 6.857143 | 3.571429 | 3.142857 | 0.857143 | 2.285714 | 8 |
| 6.285714 | 6.857143 | 3.571429 | 3.142857 | 0.857143 | 2.285714 | 8 |
| 6.285714 | 6.857143 | 3.571429 | 3.142857 | 0.857143 | 2.285714 | 8 |
| 6.285714 | 6.857143 | 3.571429 | 3.142857 | 0.857143 | 2.285714 | 8 |
| 6.285714 | 6.857143 | 3.571429 | 3.142857 | 0.857143 | 2.285714 | 8 |

Discussion of some Business Intelligence (BI) trends and BI popularity in South Africa

BI is a key driver for strategic and tactical business decisions (Soejarto, 2001). Soejarto (2001) notes that in organisations DSS and EIS are at table stakes when it comes to BI applications. Responsiveness of these systems is limited by the availability of information. Analysis resulting from these aggregated data reports is becoming stale as Internet-based tracking and analysis tools for less expensive and more powerful data collection frameworks are made available by multiple vendors. Though some service providers have already integrated BI with enterprise integration platforms (eg. Informatica's PowerCentre5® product), Soejarto (2001) reports that Gartner expects that by 2005, BI tools will be used by 70% 'of corporate end users in midsize and large enterprises'. The impact thereof on future EIS implementations may be an opportunity for discussion (eg. Business Intelligence 2003, 3-4 February 2003, Amsterdam, The Netherlands) and research avenues. Bajwa (2002) suggests that 'the next generation of BI will be interfaced with AI applications, whereby information in the form of messages will be broadcast to key managers and executives using intelligent agents'. Clearly BI applications and their deployments have exposed and given meaning to terabytes of data, essentially turning that data into valuable business information. However, as Kenney (2002) notes, as these additions and changes are being made, corporate and information security policies are not being taken into account. This requires further investigation.

Gartner's 2002 BI Market Study was released on 5 November 2002. The report notes that organisations are hopeful that BI can deliver enterprise applications such as ERP and CRM. Packaged BI applications have tremendous focus and collaborative BI seems to be emerging as a new requirement. However, 'enterprises are still struggling with the notion of Extranet information deployment' (Dresner, 2002). Dresner (2002) reports that currently common market concerns include wireless and mobile applications, Extranet deployment and scalability. These concerns present future research opportunities.

BI continues to enjoy popularity in South Africa. A scan was made of the weekly periodical, *Computing S.A.*, for articles containing the text 'Business Intelligence' or 'BI'. Recent articles which appeared in *Computing S.A.* are: 'Volkswagen drives BI technology' (p.8, 16 September 2002), 'BI company makes impact on local market' (p.9, 30 September 2002), 'BI: the move to integrated analytic infrastructures' (p.12, 21 October 2002), 'Technikon uses BI to enhance student retention' (p.30, 28 October 2002) and 'Data fusion holds the key to true business intelligence' (p.9, 18 November 2002).

Clearly BI is now a vanguard technology that organisations are harnessing to realise the full potential of the information age. In order to ensure BI implementation success, research needs to be directed in this field.