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Decision-making support systems: Theory & practice

Udo Richard Franz Averweg

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Contents

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This book has been made possible by a sea of efforts. Collating this book was a labour of love. I share the topic of Decision-making support systems with the reader with a sense of zeal and oceans of enthusiasm. I think that these attributes are reflected in this book and perhaps make it better.

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Finally I wish to thank all those who have assisted me in my Information Systems (IS) practitioner research endeavours. With evolving decision-making technologies in IS, I hope that this book presents a launch vehicle for exciting future professional practitioner work in the IS discipline. The challenges in managing Decision-making support systems is met by practitioner techniques and emerging technologies.

Udo Richard Franz Averweg

About the author

Udo Richard Franz Averweg is employed as an Information Technology (IT) Project Manager at eThekwini Municipality, Durban, South Africa. He entered the IT industry during 1979 and holds a Masters Technology degree in Information Technology (*cum laude*), a second Masters degree in Science from the University of Natal and a third Masters degree in Commerce from the University of KwaZulu-Natal, Durban, South Africa. As an IT practitioner, he is a registered professional member of the Computer Society of South Africa.

He has authored and co-authored more than 150 research outputs (80 being peer-reviewed): some research outputs have been delivered at local conferences, some have been published in accredited peer-reviewed journals, some have appeared as chapters in books and some research findings have been presented at international conferences on all five continents.

During January 2000 Udo climbed to the summit of Africa's highest peak, Mount Kilimanjaro (5,895 metres), in Tanzania. In 2009 Udo was appointed as an Honorary Research Fellow at the University of KwaZulu-Natal, Durban, South Africa.

Foreword

“Practice makes perfect” refers to repetition of a method improving quality and success. But, equally, it can refer to the process of continuing to look at an issue with updated methods based on experience. There is a cycle of improvement based on new data and adaptation of existing techniques, showing the importance of theory and practice as being mutually supportive.

The continual rate of change in organisations means that the context in which activities and research occur is not repeatable. The book shows a search for meaning and guidelines in a period of massive upheaval of business and government methods, spawned by the inroads of technology, such as the World Wide Web, enabling shared and ubiquitous information. Such fundamental rearrangements of the role of management decisions in an era of customer-centric and self-service features has not only accentuated the importance of decision-making activities, but has also often greatly increased the consequences, for good or ill, of inadequate or outdated decision-making.

This collection of work illustrates adaptation of approaches to the real world, flowing from the author’s curiosity and long experience in the field. It is not only a description of data and methods in the world, but a commentary on theoretical constructs in different contexts over many years, with a broad set of snapshots from the author’s ongoing participation in the field.

This book is a timely review and future look into the nature and content of decision-making styles and methods. It is also a valuable contribution from an author with a continuous and strong mix of practical and academic work, both locally and internationally. It will form an important base for evaluating the direction of decision-making as conditions continue to change.

(*retired Professor*) *Geoff Erwin*
Cape Town, South Africa
January 2012

Introduction

The book on introduction to Decision-making support systems and conclusions act as a frame for the field of decision support systems (DSS). There was an effort by Udo Averweg in the ordering of the sections and the presentation of information flows logically thereby helping the reader to follow the development of his project. It is also essential to remember that the book helps to choose concise but informative sections/chapters so that the reader/user knows exactly what type of information to expect in each section and how to apply it.

Readers in introductory Decision-making support systems often ask what decision-making is about. Lacking a clear vision in this regard, they make their own assumptions. Often they assume that DSS involves using a program with little human interaction. That DSS is a technical field could not be further from the truth. DSS descriptions typically require candidates to be able to collaborate, communicate, analyse needs and gather requirements. They also list the need for excellent written and communication skills. In other words, DSS users are constantly interacting with other people both inside and outside an organisation.

Udo Averweg has come up with creative decisions to approach business problems. *Decision-making support systems: Theory and practice* by Udo Averweg is designed to help business people get a feel for what DSS are like. I can report that Udo is knowledgeable about DSS. Consequently, he designed a book that looks very much like manual – an introduction to the field followed by an extended coverage of items that cover all spheres of DSS. The author begins Chapter One by introducing the history of DSS.

DSS and other aspects are discussed in Chapter Two. The rest of the textbook covers different aspects of DSS such as EIS, TAM, and their respective usefulness. Readers are engaged because the book is informative. However, they are simultaneously being shown concepts and DSS skills.

I have selected to write an introduction for the book by Udo because of his personality and because he is thorough. For example, if one chooses the book because of a DSS requirement, one should honestly use the book because of the quality of the material available in the book. I would choose the book because of it is a comprehensive guide covering aspects as stated previously and because of the genre this book falls in.

Sam Lubbe
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Mmabatho Area, South Africa
May 2012

Preface

Decision-making support systems are information systems (IS) which are designed to interactively support all phases of an end-user's decision-making process in organisations. Two specific decision-making support systems are Decision Support Systems (DSS) and Executive Information Systems (EIS) – they are the focus of this book.

Since decision-making support systems first appeared in the late 1970s, the developments and achievements during the last 35 years will guide IS practitioners in understanding the coming evolution of decision support technology. An IS practitioner is a professionally employed person who is gainfully employed in the information and communication technologies (ICT) field and who is concurrently carrying out systematic enquiry relevant to the job. Practitioner research is seen as research that is done by IS practitioners to advance their professional practice.

IS practitioners' research in research and general enquiry is usually small-scale, local, grounded and carried out by professionals who deliver ICT services – this is an essential component of good practice in the business world. As editor of this book and as an IS practitioner in KwaZulu-Natal, South Africa, the compilation of this book is a coalescing of the practitioner research with which I have been actively involved in. I have endeavoured to ensure that there is a two-way relationship between the theoretical knowledge base and the practice – each is given equal billing. In so doing I have attempted to close the some of the rift between theory and practice of decision-making support systems in the IS discipline.

The primary target audience of this book is senior managers, IS managers, IS professionals, information officers and business intelligence specialists of any organisations that need to enhance their organisation's capability towards decision-making support systems. The book has been written from an IS practitioner perspective and provides future direction and practical guidance to system developers to develop novel systems for managing decision-making support systems. It will also be of value to business consultants, IS researchers, academics, senior undergraduates, students at a Masters degree level and may also serve as a gateway for when doctoral degree level research is embarked on – the book provides a wealth of information, useful pointers and references for research (including IS practitioner research) into the challenging decision-making support systems arena.

The book is organised into eight chapters. A brief description of each of the chapters follows:

Chapter One: Chapter One traces the evolution of Decision Support Systems (DSS) and DSS frameworks. Some future trends for DSS are suggested.

Chapter Two: In this chapter the focus is on how DSS support decision-making processes in organisations.

Chapter Three: In this chapter an overview of Executive Information Systems (EIS) research in South Africa is given.

Chapter Four: In this chapter an investigation is made of the level of impact (if any) on portal technologies on EIS implementation in South Africa. Some future trends for EIS and portal technologies are suggested.

Chapter Five: In this chapter a survey is made of 31 organisations in KwaZulu-Natal, South Africa which implemented EIS. This chapter reports on the Technology Acceptance Model (TAM) constructs for the organisations surveyed in the selected area.

Chapter Six: In this chapter the applicability of TAM in three developing countries is discussed.

Chapter Seven: Following the footsteps of Chapter Six, a follow-up EIS case study was undertaken in KwaZulu-Natal, South Africa. In this chapter a comparative study is made from the findings of the earlier and more recent TAM/EIS studies in the selected area.

Chapter Eight: In this chapter a review is made of the literature of published critical success factors (CSFs) for DSS and EIS implementation in organisations in South Africa. Ten pointers are suggested towards a future CSFs for DSS and EIS implementation research agenda.

Udo Richard Franz Averweg
Durban, South Africa
May 2012

1 Historical overview of Decision Support Systems (DSS)

1.1 Introduction

During the late 1970s the term "Decision Support Systems" was first coined by P.G.W. Keen, a British Academic then working in the United States of America. In 1978, Keen and Scott Morton published a book entitled *Decision Support Systems: An Organizational Perspective* (Keen and Scott Morton, 1978) wherein they defined the subject title as computer systems having an impact on decisions where computer and analytical aids can be of value but where the manager's judgment is essential. Information Systems (IS) researchers and technologists have developed and investigated Decision Support Systems (DSS) for more than thirty-five years (Power, 2003b).

The structure of this chapter is as follows: The background to DSS will be given. Some DSS definitions, a discussion of DSS evolution, development of the DSS field and frameworks are then presented. Some future trends for DSS are then suggested.

1.2 Background

Van Schaik (1988) refers to the early 1970s as the era of the DSS concept because during this period the concept of DSS was introduced. DSS was a new philosophy of how computers could be used to support managerial decision-making. This philosophy embodied unique and exciting ideas for the design and implementation of such systems. There has been confusion and controversy in respect of the interpretation of the decision support system notion and the origin of this notion originated in the following terms:

- **Decision** emphasises the primary focus on decision-making in a problem situation rather than the subordinate activities of simple information retrieval, processing or reporting;
- **Support** clarifies the computer's role in aiding rather than replacing the decision maker; and
- **System** highlights the integrated nature of the overall approach, suggesting the wider context of machine, user and decision environment.

DSS deal with semi-structured and some unstructured problems.

1.3 Decision Support Systems

With the ever-increasing advances in computer technology, new ways and means of computer-assisted decision-making was born. As a result hereof, over the passage of time, different DSS definitions arose:

- Little (1970) defines DSS as a "model-based set of procedures for processing data and judgments to assist a manager in his decision making" (*sic*);
- the classical definition of DSS, by Keen and Scott Morton (1978), states that "Decision Support Systems couple the intellectual resources of individuals with the capabilities of the computer to improve the quality of decisions. It is a computer-based support system for management decision makers who deal with semi-structured problems";
- Mann and Watson (1984) state that "a decision support system is an interactive system that provides the user with easy access to decision models and data in order to support semi-structured and unstructured decision-making tasks";
- Bidgoli (1989) defines DSS as "a computer-based information system consisting of hardware/software and the human element designed to assist any decision-maker at any level. However, the emphasis is on semi-structured and unstructured tasks";
- Sprague and Watson (1996) define a DSS as computer-based systems that help decision makers confront ill-structured problems through direct interaction with data and analysis models;
- Sauter (1997) notes that DSS are computer-based systems that bring together information from a variety of sources, assist in the organisation and analysis of information and facilitate the evaluation of assumptions underlying the use of specific models; and
- Turban *et al.* (2005) broadly define a DSS as "a computer-based information system that combines models and data in an attempt to solve semi-structured and some unstructured problems with extensive user involvement".

From these definitions it seems that the basis for defining DSS has been developed from the perceptions of what a DSS does (*e.g.* support decision-making in semi-structured or unstructured problems) and from ideas about how a DSS's objectives can be accomplished (*e.g.* the components required and the necessary development processes).

Bidgoli (1989) contends that as the DSS field is in a state of flux, an exact definition of DSS is elusive. Turban (1995) indicates that previous researchers have collectively ignored the central issue in DSS; that is, "support and improvement of decision-making". Bidgoli (1989) suggests that there are several requirements for a DSS which must embrace a definition of a DSS. These are that a DSS

- requires hardware;
- requires software;
- requires human elements (designers and end-users);
- is designed to support decision-making;
- should help decision makers at all levels; and
- emphasises semi-structured and unstructured tasks.

Turban (1995) states that there is no consensus on what a DSS is and there is therefore no agreement on the characteristics and capabilities of DSS. As the definition by Turban *et al*. (2005) underscores Bidgoli's (1989) DSS requirements, for the purposes of this chapter, the DSS definition by Turban *et al.* (2005) will be used.

1.4 Evolution of DSS

During the 1970s and 1980s, the concept of DSS grew and evolved into a field of research, development and practice (Sprague and Watson, 1996). Clearly DSS was both an evolution and a departure from previous types of computer support for decision-making.

Currently DSS can be viewed as a third generation of computer-based applications. Sprague and Watson (1996) note that initially there were different conceptualisations about DSS. Some organisations and scholars began to develop and research DSS which became characterised as *interactive* computer based systems which *help* decision makers utilise *data* and *models* to solve *unstructured* problems. According to Sprague and Watson (1974), the unique contribution of DSS resulted from these key words. However, a serious definitional problem arose in that the words had certain 'intuitive validity' – any system that supports a decision (in any way) is a "Decision Support System". This term had such an instant intuitive appeal that it quickly became a 'buzz word' (Sprague and Watson, 1996). However, neither the restrictive nor the broad DSS definition provided guidance for understanding the value, the technical requirements or the approach for developing and implementing a DSS. For a discussion of DSS implementation, see for example, Averweg (1998).

Development of the DSS Field

According to Sprague and Watson (1996), DSS evolved as a 'field' of study and practice during the 1980s. During the early development of DSS, several principles evolved. Eventually, these principles became a widely accepted "structural theory" or framework – see Sprague and Carlson (1982). The four most important of these principles are summarised:

- **The DDM Paradigm**

  The technology for DSS must consist of three sets of capabilities in the areas of **d**ialog, **d**ata and **m**odelling and what Sprague and Carlson call the DDM paradigm. The researchers make the point that a good DSS should have *balance* among the three capabilities. It should be *easy to use* to allow non-technical decision makers to interact fully with the system. It should have access to a *wide variety of data* and it should provide *analysis and modelling* in a variety of ways. Sprague and Watson (1996) suggest that many early systems adopted the name DSS when they were strong in only one area and weak in the other. Figure 1 shows the relationship between these components in more detail and it should be noted that the models in the model base are linked with the data in the database. Models can draw coefficients, parameters and variables from the database and enter results of the model's computation in the database. These results can then be used by other models later in the decision-making process.

Figure 1 also shows the three components of the dialog function wherein the database management system (DBMS) and the model base management system (MBMS) contain the necessary functions to manage the database and model base respectively. The dialog generation and management system (DGMS) manages the interface between the user and the rest of the system.

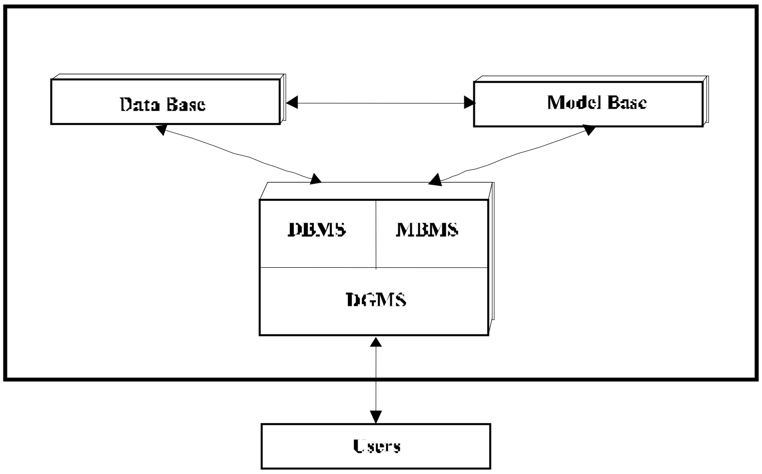

Figure 1: The Components of DSS
(Source: Adapted from Sprague and Watson, 1996)

- **Levels of Technology**
  Three levels of technology are useful in developing DSS and this concept illustrates the usefulness of configuring *DSS tools* into a *DSS generator* which can be used to develop a variety of *specific DSS* quickly and easily to aid decision makers – see Figure 2. The system which actually accomplishes the work is known as the *specific DSS*, shown as the circles at the top of the diagram. It is the software/hardware that allow a specific decision maker to deal with a set of related problems. The second level of technology is known as the *DSS generator*. This is a package of related hardware and software which provides a set of capabilities to quickly and easily build a specific DSS. The third level of technology is *DSS tools* which facilitate the development of either a DSS generator or a specific DSS.

While new technologies such as World Wide Web ('Web') browsers and data warehouses have emerged since Sprague and Watson's (Sprague and Watson, 1996) conceptual framework, nowadays the framework is still relevant.

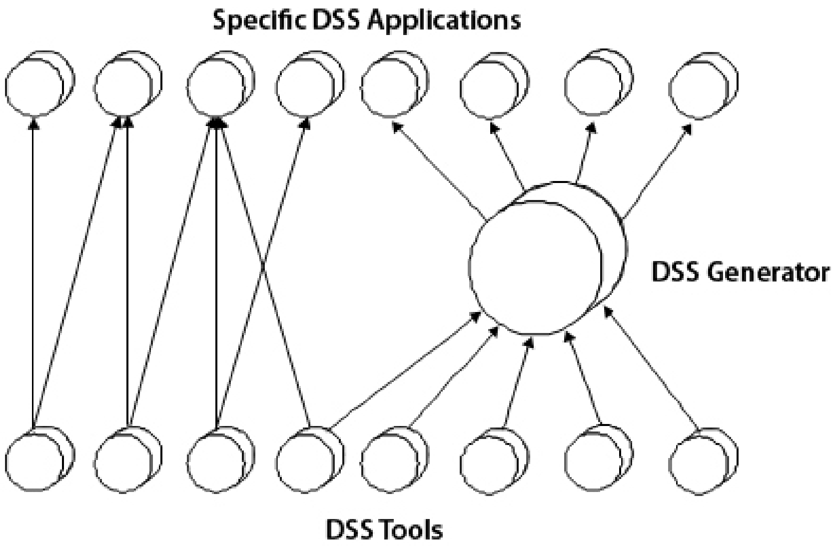

Figure 2: Three Levels of DSS Technology
(Source: Adapted from Sprague and Watson, 1996)

- **Iterative Design**
  Instead of the traditional development process, DSS require a form of iterative development which allows them to evolve and change as the problem or decision situation changes. They need to be built with short, rapid feedback from users thereby ensuring that development is proceeding correctly. In essence they must be developed to permit change quickly and easily.

- **Organisational Environment**
  The effective development of DSS requires an organisational strategy to build an environment within which such systems can originate and evolve. The environment includes a group of people with interacting roles, a set of software and hardware technology, a set of data sources and a set of analysis models.

The IS called DSS are not all the same. DSS differ in terms of capabilities and targeted users of a specific system and how the DSS is implemented and what it is called (Power, 2003a). Some DSS focus on data, some on models and some on facilitating collaboration and communication. DSS can also differ in terms of targeted users *e.g.* a 'primary' user or 'generic' users.

Holsapple and Whinston (1996) identified five specialised types of DSS:

- text-oriented;
- database-oriented;
- spreadsheet-oriented;
- solver-oriented; and
- rule-oriented.

Donovan and Madnick (1977) classified DSS as *ad hoc* DSS or institutional DSS. An *ad hoc* DSS supports problems that are not anticipated and which are not expected to reoccur. An institutional DSS supports decisions that reoccur. Hackathorn and Keen (cited in Power, 2003a) identified DSS into three interrelated categories:

- personal DSS;
- group DSS; and
- organisational DSS.

DSS frameworks

Power (2003a) suggests that the following DSS frameworks help categorise the most common DSS currently in use:

- **Communications-driven DSS**. These systems are built using communication, collaboration and decision support technologies;
- **Data-driven DSS**. These systems analyse large "pools of data" found in major organisational systems and they support decision-making by allowing users to extract useful information that was previously buried in large quantities of data. Often data from various transactional processing systems (TPS) are collected in data warehouses for this purpose. Online analytical processing (commonly known as OLAP) and data mining can then be used to analyse the data;

- **Document-driven DSS.** These systems integrate a variety of storage and processing technologies to provide complete document retrieval and analysis;
- **Knowledge-driven DSS**. These systems contain specialised problem-solving expertise wherein the 'expertise' consists of knowledge about a particular domain (and understanding of problems within that domain) and 'skill' at solving some of those problems; and
- **Model-driven DSS**. Early DSS developed in the late 1970s and 1980s were model driven as they were primarily standalone systems isolated from major organisational IS that used some type of model to perform "what if" and other kinds of analysis. Such systems were often developed by end-user groups or divisions not under central IS control (Laudon and Laudon, 1998). A DSS is not a black box – it should provide the end-user with control over the models and interface representations used (Barbosa and Hirko, 1980). Model-driven DSS emphasise access to and manipulation of a model.

Watson (2005) suggests that "I don't think that we need to find a single theory or framework. Furthermore, I don't think that we will see a single overarching theory emerge. Rather, there will be multiple theories, each one being appropriate for specific situations". Despite all the rapid developments of the late 1980s, 1990s and early 2000s, DSS as a field is now at a crossroads. Some functions that were once considered part of DSS now appear to be migrating to other areas. For example, Watson (2005) suggests that there is an increasing trend to integrate and embed decision support applications into operational systems (*e.g.* fraud detection system embedded in credit card processing).

1.5 Future trends

In future, it is envisaged that traditional DSS applications will be extended to a larger number of potential applications where the data required is only an interim stage or a subset of the information required for the decision. This will require the construction of DSS where the end-user can concentrate on the variables of interest in their decision while "other" processing is performed without the need of extensive end-user interaction. Some future trends for DSS are suggested:

- organisations that consolidate there is into a single environment reduce administration and license costs. By consolidating organisational data into a Web visualisation application, will facilitate better decision support;
- all organisations use metrics and key performance indictors to undertaken business and remain competitive. With the advent of Web-based technologies (*e.g.* portal technologies), a decision support portal will be able to present key information to the right audience;
- in future all data collection and analysis will be automated. This will "free up" domain experts from verifying the validity of data from TPS and data warehouses allowing them to *act* on the information from DSS instead;

- there will be an increase in visualised information in context with user-centric displays. By having the most recent data correlated and aggregated, will allow for better decisions and which are more relevant to a user's current conditions;
- there will be a surge to use advanced display techniques to highlight key issues. Consequently the design of future DSS interfaces will receive greater prominence since the interface should bring attention to the most important areas almost immediately; and
- decision support technology will continue to broaden to include monitoring, tracking and communication tools to support the overall process of unstructured problem solving. The broadening of this technology will be as a result of an increased availability of mobile computing and communication.

1.6 Conclusion

DSS continue to impact decision-making in organisations and this is largely dependent on the nature of the application. In order that optimal solutions may be identified, more alternatives may need to be explored and some decisions may need to be automated. The Internet and the Web have accelerated developments in decision support and decision-making and nowadays provide a new research focus area for DSS development and implementation.

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2 Decision Support Systems and decision-making processes

2.1 Introduction

Decision Support Systems (DSS) deal with semi-structured problems. Such problems arise when managers in organisations are faced with decisions where some but not all aspects of a task or procedure are known. To solve these problems and use the results for decision-making, requires judgement of the manager using the system. Typically such systems include models, data manipulation tools and the ability to handle uncertainty and risk. These systems involve information and decision technology (Forgionne, 2003). Many organisations are turning to DSS to improve decision-making (Turban *et al.*, 2004). This is a result of the conventional information systems (IS) not being sufficient to support an organisation's critical response activities – especially those requiring fast and/or complex decision-making. In general, DSS are a broad category of IS (Power, 2003).

A DSS is defined as "an interactive, flexible, and adaptable computer-based information system, specially developed for supporting the solution of a non-structured management problem for improved decision-making. It utilises data, it provides easy user interface, and it allows for the decision maker's own insights" (Turban, 1995). There is a growing trend to provide managers with IS that can assist them in their most important task – making decisions. All levels of management can benefit from the use of DSS capabilities. The highest level of support is usually for middle and upper management (Sprague and Watson, 1996). The question of how a DSS supports decision-making processes will be described in this chapter. This chapter is organised as follows: The background to decision-making is introduced. The main focus (of this chapter) describes the development of the DSS field. Some future trends for the DSS field are then suggested. Thereafter a conclusion is given.

2.2 Background to decision-making

H.A. Simon is considered a pioneer in the development of human decision-making models (Ahituv and Neumann, 1990). His individual work (Simon, 1960) and his joint research with A. Newell (Newell and Simon, 1972) established the foundation for human decision-making models. His basic model depicts human decision-making as a three-stage process. These stages are:

- **Intelligence**. The identification of a problem (or opportunity) that requires a decision and the collection of information relevant to the decision;
- **Design**. Creating, developing and analysing alternative courses of action; and
- **Choice**. Selecting a course of action from those available.

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). Decision-making can be categorised as:

- Independent;
- Sequential interdependent; or
- Pooled interdependent (Keen and Scott Morton, 1978).

Independent decision-making involves one decision-maker using a DSS to reach a decision without the need or assistance from other managers. This form of DSS use is found occasionally. Sprague and Watson (1996) contend that it is the exception because of the common need for collaboration with other managers. Sequential interdependent decisions involve decision-making at a decision point and are followed by a subsequent decision at another point. In this case the decision at one point serves as input to the decision at another point. A practical example is corporate planning and budgeting where a department formulates a plan which then serves as input to the development of the budget. Sprague and Watson (1996) indicate that DSS are frequently used in support of sequential dependent decision making but not as frequently as pooled interdependent decision-making.

Pooled interdependent decision-making is a joint, collaborative decision-making process whereby all managers work together on the task. A group of product marketing managers getting together to develop a marketing plan is an example of this type of decision. Specialised hardware, software and processes have been developed to support pooled interdependent decision-making but for the purposes of this study, these are not explored.

Problems and Decision-Making Processes

Ackoff (1981) cites three kinds of things that can be done about problems – they can be resolved, solved or dissolved:

- **Resolving**. This is to select a course of action that yields an outcome that is good enough that satisfices (satisfies and suffices);
- **Solving**. This is to select a course of action that is believed to yield the *best possible* outcome that optimises. It aspires to complete objectivity and this approach is used mostly by technologically oriented managers whose organisational objective tends to be *thrival* than mere survival; and
- **Dissolving**. This to change the nature and/or the environment of the entity in which it is embedded so as to remove the problem.

Sauter (1997) indicates that a DSS will not solve all the problems of any given organisation. The author adds, "however, it does *solve* some problems" (italics added by author).

In a structured problem, the procedures for obtaining the best (or worst) solution are known. Whether the problem involves finding an optimal inventory level or deciding on the appropriate marketing campaign, the objectives are clearly defined. Common business objectives are profit maximisation or cost minimisation. Whilst a manager can use the support of clerical, data processing or management science models, management support systems such as DSS and Expert System (ES) can be useful at times. One DSS vendor suggests that facts now supplement intuition as analysts, managers and executives use Oracle DSS® to make more informed and efficient decisions (Oracle Corporation, 1997).

In an unstructured problem, human intuition is often the basis for decision-making. Typical unstructured problems include the planning of a new service to be offered or choosing a set of research and development projects for the next year. The semi-structured problems fall between the structured and the unstructured which involves a combination of both standard solution procedures and individual judgment. Keen and Scott Morton (1978) give the following examples of semi-structured problems: (USA) trading bonds, setting marketing budgets for consumer products and performing capital acquisition analysis. Here a DSS can improve the quality of the information on which the decision is based (and consequently the quality of the decision) by providing not only a single solution but a range of alternatives. These capabilities allow managers to better understand the nature of the problems so that they can make better decisions.

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. The framework, see Figure 1, was proposed by Gorry and Scott Morton (1971) who combined the work of Simon (1960) and Anthony (1965).

	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, Management science models, Transaction processing
Semi-structured	4 Production scheduling, inventory control	5 Credit evaluation, budget preparation, plant layout, project scheduling, reward systems design	6 Building new plant, mergers and acquisitions, new product planning, compensation planning, quality assurance planning	DSS
Unstructured	7 Selecting a cover for a magazine, buying software, approving loans	8 Negotiating, recruiting an executive, buying hardware, lobbying	9 R & D planning, new technology development, social responsibility planning	DSS ES Neural Networks
Support Needed	MIS, Management science	Management science, DSS,	EIS, ES, Neural Networks	

Figure 1: Decision support framework
Technology is used to support the decisions shown in the column at the far right and in the bottom row
(Source: Adapted from Turban *et al.*, 1999: 394)

The details of this framework are:

The left-hand side of the 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).

The second half of this framework (upper half of Figure 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 Figure 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, conventional management science approaches are insufficient. They proposed the use of a supportive information system, which they labelled a **Decision Support System** (DSS). ES, which were only introduced several years later, are most suitable for tasks requiring expertise.

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, Executive Information Systems (EIS), neural computing and ES are more often applicable for top executives and professionals tackling specialised, complex problems.

The true test of a DSS is its ability to support the design phase of decision-making as the real core of any DSS is the model base which has been built to analyse a problem or decision. In the design phase, the decision-maker develops a specific and precise model that can be used to systematically examine the discovered problem or opportunity (Forgionne, 2003). The primary value to a decision-maker of a DSS is the ability of the decision-maker and the DSS to explore the models interactively as a means of identifying and evaluating alternative courses of action. This is of tremendous value to the decision maker and represents the DSS's capability to support the design phase (Sprague and Watson, 1996). For the DSS choice phase, the most prevalent support is through "what if" analysis and goal seeking.

In terms of support from DSS, the choice phase of decision-making is the most variable. Traditionally, as DSS were not designed to make a decision but rather to show the impact of a defined scenario, choice has been supported only occasionally by a DSS. A practical example is where a DSS uses models which identify a best choice (*e.g.* linear programming) but generally they are not the rule.

2.3 Development of the DSS Field

According to Sprague and Watson (1996), DSS evolved as a 'field' of study and practice during the 1980s. This section discusses the principles of a theory for SS. During the early development of DSS, several principles evolved. Eventually, these principles became a widely accepted "structural theory" or framework – see Sprague and Carlson (1982). The four most important of these principles are now summarised.

The DDM Paradigm

The technology for DSS must consist of three sets of capabilities in the areas of dialog, data and modelling and what Sprague and Carlson call the DDM paradigm. The researchers make the point that a good DSS should have *balance* among the three capabilities. It should be *easy to use* to allow non-technical decision-makers to interact fully with the system. It should have access to a *wide variety of data* and it should provide *analysis and modelling* in a variety of ways. Sprague and Watson (1996) contend that many early systems adopted the name DSS when they were strong in only one area and weak in the other. Figure 2 shows the relationship between these components in more detail and it should be noted that the models in the model base are linked with the data in the database. Models can draw coefficients, parameters and variables from the database and enter results of the model's computation in the database. These results can then be used by other models later in the decision-making process.

Figure 2 also shows the three components of the dialog function wherein the database management system (DBMS) and the model base management system (MBMS) contain the necessary functions to manage the data base and model base respectively. The dialog generation and management system (DGMS) manages the interface between the user and the rest of the system.

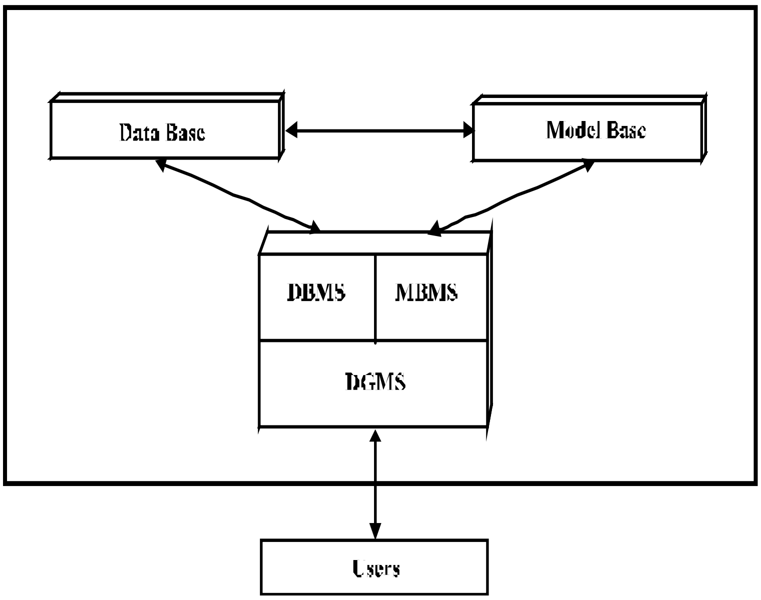

Figure 2: Components of DSS
(Source: Adapted from Sprague and Watson, 1996)

Even though the DDM paradigm eventually evolved into the dominant architecture for DSS, for the purposes of this chapter, none of the technical aspects is explored any further.

Levels of Technology

Three levels of technology are useful in developing DSS and this concept illustrates the usefulness of configuring *DSS tools* into a *DSS generator* which can be used to develop a variety of *specific DSS* quickly and easily to aid decision-makers. See Figure 3. The system which actually accomplishes the work is known as the *specific DSS*, shown as the circles at the top of the diagram. It is the software/hardware that allow a specific decision-maker to deal with a set of related problems. The second level of technology is known as the *DSS generator*. This is a package of related hardware and software which provides a set of capabilities to quickly and easily build a specific DSS. The third level of technology is *DSS tools* which facilitate the development of either a DSS generator or a specific DSS.

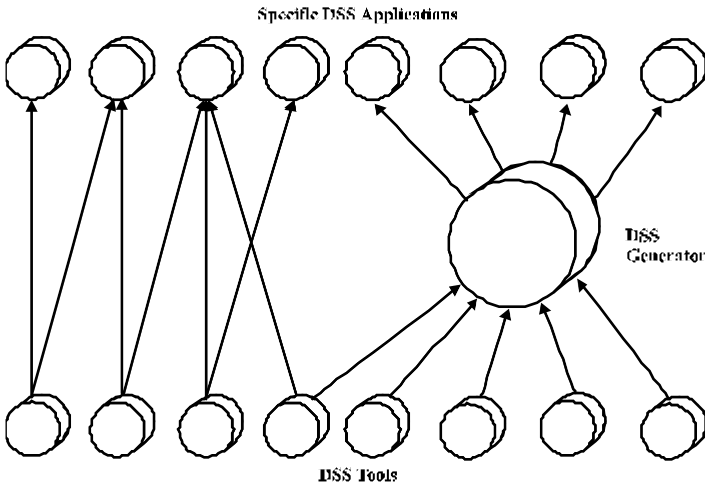

Figure 3: Three Levels of DSS Technology
(Source: Adapted from Sprague and Watson, 1996)

DSS tools can be used to develop a specific DSS application strictly as indicated on the left-hand side of the diagram. This is the same approach used to develop most traditional applications with tools such as general purpose languages, subroutine packages and data access software. The difficulty of the approach for developing DSS is the constant change and flexibility which characterises them. The development and use of DSS generators create a "platform" or staging area from which specific DSS can be constantly developed and modified with the co-operation of the user and with minimal time and effort.

Iterative Design

The nature of DSS requires a different design and development techniques from traditional batch and online systems. Instead of the traditional development process, DSS require a form of iterative development which allows them to evolve and change as the problem or decision situation changes. They need to be built with short, rapid feedback from users thereby ensuring that development is proceeding correctly. In essence they must be developed to permit change quickly and easily.

Organisational Environment

The effective development of DSS requires an organisational strategy to build an environment within which such systems can originate and evolve. The environment includes a group of people with interacting roles, a set of software and hardware technology, a set of data sources and a set of analysis models.

DSS: Past and Present

Van Schaik (1988) refers to the early 1970s as the era of the DSS concept because in this period the concept of DSS was introduced. DSS was a new philosophy of how computers could be used to support managerial decision-making. This philosophy embodied unique and exciting ideas for the design and implementation of such systems. There has been confusion and controversy over the interpretation of the notion decision support system and the origin of this notion is clear:

- **Decision** emphasises the primary focus on decision-making in a problem situation rather than the subordinate activities of simple information retrieval, processing or reporting;
- **Support** clarifies the computer's role in aiding rather than replacing the decision-maker; and
- **System** highlights the integrated nature of the overall approach, suggesting the wider context of machine, user and decision environment.

Sprague and Watson (1996) note that initially there were different conceptualisations about DSS. Some organisations and scholars began to develop and research DSS which became characterised as *interactive* computer based systems which *help* decision-makers utilise *data* and *models* to solve *unstructured* problems. According to Sprague and Watson (1974), the unique contribution of DSS resulted from these key words. They contend that the definition proved restrictive enough that few actual systems completely satisfied it. They believe that some authors have recently extended the definition of DSS to include any system that makes some contribution to decision-making; in this way the term can be applied to all but transaction processing. However, a serious definitional problem arises in that the words have certain 'intuitive validity'; any system that supports a decision (in any way) is a "Decision Support System". As Sprague and Watson (1996) indicate, the term had such an instant intuitive appeal that it quickly became a 'buzz word'. Clearly neither the restrictive nor the broad definition help much as they do not provide guidance for understanding the value, the technical requirements or the approach for developing a DSS.

A further complicating factor is that people from different backgrounds and contexts view a DSS quite differently: a computer scientist and a manager seldom see things in the same way. Turban (1995) supports this stance as DSS is a content-free expression whereby it means different things to different people. He states that there is no universally accepted definition of DSS and that it is even sometimes used to describe any computerised system. It appears that the basis for defining DSS has been developed from the perceptions of what a DSS does (*e.g.* support decision-making in unstructured problems) and from ideas about how the DSS's objectives can be accomplished (*e.g.* the components required and the necessary development processes).

2.4 Future trends

New technology continues to affect the dialog, data and models components. Differences in data, knowledge and model structures may necessitate the development of new technologies for model retrieval tasks (Forgionne, 2003). Relational database technology and object-oriented databases and data warehousing are influencing how data is stored, updated and retrieved. Drawing from artificial intelligence advances, there is the potential for representing and using models in new and different ways.

Decision support technology has also broadened to include monitoring, tracking and communication tools to support the overall process of ill-structured problem solving. DSS implemented on a corporate Intranet provides a means to deploy decision support applications in organisations with geographically distributed sites. Clearly these technologies and other emerging Web-based technologies will continue to expand the component parts of a DSS domain. An area of rapid growth is Web-based DSS. Even though Web-based technologies are the leading edge for building DSS, traditional programming languages or fourth generation languages are still used to build DSS (Power, 2003).

2.5 Conclusion

Moving from the early DSS concept era to almost 35 years later, DSS still comprise a class of IS intended to support the decision-making activities of managers in organisations. The concept has been buffeted by the hyperbole of marketing people and technologies have improved or changed (Power, 2003). While some major conceptual problems may be found with the current terms associated with computerised decision support (and which has been catalysed by marketing hype), the basic underlying concept of supporting decision-makers in their decision-making processes still remains important.

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3 An overview of Executive Information Systems research in South Africa

3.1 Introduction

Executive Information Systems (EIS) are designed to serve the needs of executive users in strategic planning and decision-making. Sometimes the terms "Executive Information Systems" and "Executive Support Systems" are used interchangeably (Turban *et al.*, 1999). Definitions of EIS are varied but all identify the need for information that support decisions about the organisation (Papageorgiou and de Bruyn, 2011: 2). EIS can be 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). As information technology (IT) and the global environment change, the variety of information to choose from by users for strategic planning and decision-making purposes, results in a major change for EIS implementation.

This chapter is organised as follows: The background to EIS implementation is given. EIS research studies undertaken in South Africa are then described. Some future EIS trends are then suggested.

3.2 Background to EIS implementation

A number of possible indicators for a successful information system (IS) have been suggested in various implementation studies – see, for example, Laudon and Laudon (1998). The definition of implementation includes the concept of success or failure. Implementation is a vital step in ensuring the success of new ISs.

The EIS implementation process is defined as the process used to construct an EIS in an effective manner (Srivihok, 1998). Different factors have been suggested by various researchers as influencing successful EIS implementation – see, for example, Rainer and Watson (1995). However, there is no agreement on which factors play key roles in EIS implementation. A large number of success factors have been repeatedly suggested by practitioners and researchers, even though empirical studies on the success factors are rare. There thus exists "a need… to document successful EIS development" and implementation (Papageorgiou and de Bruyn, 2011: 9).

EIS are high-risk application systems that are expensive to build and maintain (Strydwom, 1994). 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 ZAR4,5m in revamping its IT infrastructure to support that deployment. In the case of Rand Water, the organisation's EIS eventually played a major role in providing its executives with benchmarking information helping them track Rand Water's overall performance against a set of objective criteria. In organisations such as Rand Water, an EIS can therefore assist "in the decision-making process" and be of "added value to their business" (Papageorgiou and de Bruyn, 2011: 9).

EIS are found in many organisations in South Africa. For example, in the recent survey by Papageorgiou and de Bruyn (2011: 7), these researchers report the existence of EIS in 25 listed Johannesburg Stock Exchange (JSE) organisations and the existence of 13 listed JSE organisations which plan to implement EIS.

3.3 EIS research undertaken in South Africa

A review of previously conducted EIS research at universities in South Africa is undertaken. From this collection, the nature of EIS research for each study is discussed. South African databases were searched for research literature (in the form of essays, technical reports, thesis, dissertations) with the keywords 'Executive Information Systems' in the research title. Ten successful 'hits' were found. Those research articles are reflected in chronological publication sequence in Table 1. The existence of a recent journal article (Papageorgiou and de Bruyn, 2011) dealing with EIS in listed JSE organisations is acknowledged but for the sake of selection consistency, this journal article does not satisfy the author's chosen report type classification.

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
9	Averweg, U.R.F.	December 2002	Executive Information Systems Usage: The Impact of Web-based Technologies	Dissertation	M Science – University of Natal
10	Ako-Nai, S.A.M.	July 2005	Executive Information Systems: An identification of factors likely to affect user acceptance, usage and adoption of the Unilever EIS	Dissertation	MBA – University of KwaZulu-Natal

Table 1: Research literature (essays, technical reports, thesis or dissertations) with the keywords 'Executive Information Systems'

The nature of each of the above ten EIS studies in South Africa is now briefly discussed.

- **Researcher No 1: Design and Implementation of Executive Information System (EISs)** DeWitt (1992) discusses critical success factors (CSFs) for E IS implementation IS 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. From previous studies, DeWitt (1992) identifies nine CSFs for an EIS (see Table 2) and notes that there "are differences of opinion in the literature regarding the selection of the right technology" as a CSF.

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

Table 2: DeWitt's (1992) nine CSFs for an EIS

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 (South Africa) survey findings. The findings indicate (1) congruences between the literature search and survey findings; (2) major conflicting results between the local survey, the international survey and literature search; and (3) major problems encountered in developing EIS.

- **Researchers No 2: An Assessment of the Penetration of Executive Information Systems** Twemlow *et al.* (1992) carried out an exploratory study that showed the extent of EIS penetration in South Africa. The sample (61 companies) was selected from the 1992 Financial Mail survey (a reputable weekly financial publication) of "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 3.

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

Table 3: Problems with Implementation and Use of EIS
(Source: Adapted from Twemlow *et al.*, 1992)

Twemlow *et al.* (1992) suggest 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. Twemlow *et al.* (1992) note that "it is IS usage 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.

- **Researcher No 3: Executive Information Systems: A Fundamental Approach**

  Strydom's (1994) research investigated the problems concerning EIS "from a fundamental research perspective". Based on the results of the research an augmented EIS was proposed and referred to as a Computer Supported Executive System (CSES). Strydom (1994) discussed the role of training in successful implementation of IS and focuses on computer supported learning for EIS.

- **Researcher No 4: Critical Success Factors for Executive Information Systems 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". Seventeen well-established organisations in Gauteng (a province in South Africa) that have EIS experience were targeted and surveyed. The analysis of Steer's findings indicate 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 this study for the successful implementation of EIS are reflected in Table 4.

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

Table 4: The Top ten CSFs for the Successful Implementation of EIS
(Source: Adapted from Steer, 1995)

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". Steer (1995) labels these CSFs as 'secondary' CSFs for the successful implementation of EIS. These secondary CSFs are reflected in Table 5.

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

Table 5: Secondary CSFs for the Successful Implementation of EIS
(Source: Adapted from Steer, 1995)

- **Researcher No 5: The Impact of Executive Information System on the User**
  The focus of Faure's (1995) research was 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".

- **Researcher No 6: Critical Success Factors for the Management of Executive Information Systems in Manufacturing**
  The aim of Chilwane's (1995) research was "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 6 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".

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 ie. loaded on a notebook and accessed offline

Table 6. CSFs for the management of an operating EIS
(Source: Adapted from Chilwane, 1995)

- **Researcher No 7: The Benefits and Capabilities of Executive Information Systems**
  The objective of Khan's (1996) research was 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 these researchers 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. Khan's (1996) findings identify six major benefits of EIS and five major capabilities of EIS.

- **Researcher No 8: Experiences Gained from Executive Information Systems**
  Baillache's (1997) research investigated 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. Some thirty companies participated in this survey. Four users from each company surveyed were requested to complete a questionnaire.

  This researcher's findings indicate that (1) some important capabilities had been omitted in systems; (2) users expectations of benefits were far greater than benefits delivered; (3) key CSFs did not occur during the implementation of the project; and (4) the growth of the system by new users was not strongly correlated to the CSFs. Baillache's (1997) summary of results of CSFs implemented is reflected in Table 7.

	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

Table 7: Summary of results of CSFs implemented

- **Researcher No 9: Executive Information Systems Usage: The Impact of Web-based Technologies**
  The objective of Averweg's (2002) study was *inter alia* to identify and rank Web-based technologies in order of their perceived future impact on EIS.

  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 (Business-to-Consumer) 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. There was a positive impact level trend for all Web-based technologies on future EIS implementations. The largest trend increase was the Intranet rising from 32.2% to 87.1%. Averweg (2002) suggests that this "should occur as the use of Web-based technologies in the distribution of information becomes more widespread".

- **Researcher No 10: Executive Information Systems: an identification of factors likely to affect user acceptance, usage and adoption of the Unilever EIS**
  The focus of Ako-Nai's (2005) research was "…to investigate and identify potential factors that are likely to affect user acceptance, usage and adoption of an EIS implemented by Unilever South Africa. The research investigation was based on a proposed model derived from Davis (1989) Technology Acceptance Model (TAM) that explores the phenomena of 'perceived usefulness' and 'perceived ease of use', as drivers of user acceptance and illustrates the dynamics of the factors that affect the users' acceptance of the system". Ako-Nai used a case study approach. It should be noted that during the research period, the EIS in Unilever was "…at its earliest stage of diffusion in the company".

  This researcher's findings indicate that (1) users' attitudes towards usage of the Unilever EIS are positively influenced by both their 'perceived usefulness' and 'perceived ease of use' of the system; (2) Unilever EIS users' 'perceived usefulness' of the system positively influences their 'perceived ease of use' of the system; and (3) Unilever EIS users' 'perceived ease of use' of the system has a greater influence on their attitude towards the system usage than their 'perceived usefulness' of the system.

3.4 Discussion of previous EIS research undertaken in South Africa

From Table 1, four 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.

Like other systems, EIS are constantly changing. Khan (1996) suggests an investigation into new technologies being employed in the IT area and "to what extent advances in technology have influenced… EIS". Khan's (1996) EIS research "identified the employment of new technologies as the most important future trend of EIS". The EIS research undertaken by Averweg (2002) serves to fill that gap.

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 EIS implementation models may need to be revisited. While there is no single listing of key variables for EIS success factors (Rainer and Watson, 1995), strong human factors are nevertheless associated with EIS research. These are influenced by cultural, political and other 'soft' human factors. South Africa has "diverse cultures, languages, religions, races and social backgrounds" (Papageorgiou and de Bruyn, 2011: 5). It is therefore neither possible nor valid to generalise experiences on other continents to South Africa's conditions. This makes relevant local studies (in South Africa) of EIS implementation and usage.

3.5 Future EIS trends

IT is more than just computer systems and it is rapidly changing and developing, especially due to the Web, altering the way in which an IS is built. With the Internet, information is no longer a scarce resource. It has changed the way in which organisations are doing business and the way in which they compete.

The environment for EIS is undergoing upheaval based on the emergence of Web-based technologies. The following trends for EIS implementation are envisaged:

- data warehouses store data that have been extracted from the various operational databases of an organisation over some years. The intrinsic design of the Web resembles that of a data warehouse bringing access to data collected and provided by a host of users outside a specific organisation. The immediacy of the Web is *not* seen as a factor for improved decision-making since EIS are rarely used by executives in emergency or critical time-modes;
- with the increasing amount of IS 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. It is contended that wise judgement is needed when deciding on the selective use of IS and feel that this is particularly relevant to EIS in South Africa;
- there will be a significant degree of EIS diffusion to lower organisational hierarchical levels and use by these lower levels. EIS in organisations will spread to managers at various levels such as functional areas and other levels of management (Singh *et al*., 2002). This will be 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. 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 (Averweg and Erwin, 2000). Nowadays vendors of decision support software are making their products Web-enabled;
- Xu *et al*. (2003) suggest that the internal information orientation is the main reason for dissatisfaction with EIS. In order to overcome this dissatisfaction, it is felt that greater use will be made from data from *external* sources (for an organisation's CSFs);
- special care will be needed when implementing EIS because of its major potential importance to an organisation's performance – for example, by "creating a competitive edge and [for] adding strategic value" (Papageorgiou and de Bruyn, 2011: 9). Failure can lead to long delays in further attempts to use such technology effectively; and
- in the United States of America (USA), nowadays the term EIS is used infrequently. In the USA, EIS has now become part of Business Intelligence (BI). BI includes the functions of EIS but the emphasis is now on analytics. The trend is to include functionality such as predictive analysis, data mining, *etc* (Turban, 2011).

Generally speaking, this trend is particularly useful for IS practitioners in the planning of future EIS implementations in organisations in South Africa. Specifically this information may be of assistance to those 13 listed JSE organisations (as surveyed by Papageorgiou and de Bruyn, 2011) which plan to implement an EIS.

3.6 Conclusion

An understanding of Web-based technology taxonomies is important to EIS researchers and practitioners. Organisations must "start simple, grow fast" (McKenna Group, 1999) using technologies that will enable it to build on what it has, link to legacy systems, rather than throwing away what has been achieved and developed through each new innovative enhancement iteration. All innovation is now driven by technology in some way (Cramm cited in Papageorgiou and de Bruyn, 2011: 5). EIS will be impacted by these change catalysts as EIS become integrated with Web-based technologies not specifically designed for EIS usage.

EIS is going through a major change to take advantage of Web-based technologies in order to satisfy information needs of an increasing group of users (Averweg and Roldán, 2006). 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. EIS is being catalysed through a major change as technical barriers disappear.

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4 Portal technologies and Executive Information Systems implementation

4.1 Introduction

Portals may be seen as World Wide Web ('the Web') sites which provide the gateway to corporate information from a single point of access. The potential of the Web portal market and its technology has inspired the mutation of search engines (for example Yahoo!) and the establishment of new vendors (for example, Hummingbird and Brio Technology). Leveraging knowledge – both internal and external – is the key to using a portal as a centralised database of best practices that can be applied across all departments and all lines of business within an organisation (Zimmerman, 2003). A portal is simply a single, distilled view of information from various sources. Portal technologies integrate information, content and enterprise applications. However, the term portal has been applied to systems that differ widely in capabilities and complexity (Smith, 2004). Portals "aim to serve particular communities, including various business groups" (Deise *et al.*, 2000). A portal aims to establish a community of users with a common interest or need.

Portals include horizontal applications such as search, classification, content management, business intelligence (BI), Executive Information Systems (EIS) and a myriad of other technologies. Portals not only pull these together but are also absorbing much of the functionality from these complementary technologies (Drakos, 2003). When paired with other technologies such as content management, collaboration and BI, portals can improve business processes and boost efficiency within and across organisations (Zimmerman, 2003). Given the overlap between portal technologies and EIS, this article investigates the level of impact (if any) between them.

4.2 Background

Gartner defines a portal as "access to and interaction with relevant information assets (information/content, applications and business processes), knowledge assets and human assets, by select target audiences, delivered in a highly personalized manner" (Drakos, 2003). Drakos (2003) suggests that a significant convergence is occurring with portals in the centre. Most organisations are being forced to revisit their enterprise-wide Web integration strategies (Hazra, 2002). A single view of enterprise-wide information is respected and treasured (Norwood-Young, 2003). Enterprise Information Portals are becoming the primary way in which organisations organise and disseminate knowledge (PricewaterhouseCoopers, 2001).

Spoornet is southern Africa's largest railroad operator and heavy hauler with 3,500 locomotives moving approximately 180 million tons of freight annually. Securing a "comprehensive view of its [Spoornet's] own complex logistics environment has long been a dream for management" (Norwood-Young, 2003). During October 2002, vendor Sybase implemented the first stage of a project providing an executive portal to Spoornet management. Norwood-Young (2003) reports that executive management "had a single view of Spoornet's resources and applications – "digital dashboard"" … "Our executives waited for decades to be taken to such a high level of business functionality". The portal is a technology in search of a business problem (Drakos, 2003). With EIS established in organisations in South Africa and the presence of portal technologies, there is thus a need to investigate the link (if any) between EIS and portal technologies.

EIS grew out of the development of information systems (IS) to be used directly by executives and used to augment the supply of information by subordinates (Srivihok, 1998). For the purposes of this paper, 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). EIS are an important element of the information architecture of an organisation. Different EIS software tools and/or Enterprise Resource Planning (ERP) software with EIS features exist. EIS is a technology that is continually emerging in response to managers' specific decision-making needs (Turban *et al.*, 1999). Turban (2001) suggests that EIS capabilities are being "embedded in BI". All major EIS and information product vendors now offer Web versions of the tools designed to function with Web servers and browsers (PricewaterhouseCoopers, 2002).

Web-based technologies are causing a revisit to existing IT implementation models, including EIS (Averweg *et al.*, 2003). Web-based tools "are very much suited" to executives key activities of communicating and informing (Pijpers, 2001). With the emergence of global IT, existing paradigms are being altered which are spawning new considerations for successful IT implementation (Averweg and Erwin, 2000). Challenges exist in building enterprise portals as a new principle of software engineering (Hazra, 2002). Yahoo! is an example of a general portal. Yahoo! enables the user to maintain a measure of mastery over a vast amount of information (PricewaterhouseCoopers, 2001). Portals are an evolutionary offshoot of the Web (Norwood-Young, 2003). The Web is "a perfect medium" for deploying decision support and EIS capabilities on a global basis (Turban *et al.*, 1999).

4.3 Survey of Web-based technologies' impact on EIS

Computer or IS usage has been identified as the key indicator of the adoption of IT by organisations (Suradi, 2001). 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). Some Web-based 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 and portal technologies. The portal has become the most-desired user interface in Global 2000 enterprises (Drakos, 2003).

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 portal technologies as executives need systems that provide access to diverse types of information. As with any other IT investment, the use for a portal must be well-understood (Drakos, 2003). Emerging (Web-based) technologies can redefine the utility, desirability and economic viability of EIS technology (Volonino *et al.*, 1995). There exists a high degree of similarity between the characteristics of a "good EIS" and Web-based technologies (Tang *et al.*, 1997). With the absence of research efforts on the impact of portal technologies on EIS implementations in South Africa, this research begins to fill the gap with a study of thirty-one selected organisations in KwaZulu-Natal, South Africa which have implemented EIS.

A validated survey instrument was developed and contained seven-point Likert scale statements (anchored with (1) Not at all and (7) Extensively) dealing with how an interviewee perceives specific Web-based technologies impacted his organisation's EIS implementation. The Web-based technologies are (1) Intranet; (2) Internet; (3) Extranet; (4) e-Commerce: Business-to-Business (B2B); (5) e-Commerce: Business-to-Consumer (B2C); (6) Wireless Application Protocol (WAP) and other mobile technologies; and (7) Any other Web-based technologies (for example portal technologies). The questionnaire was administered during a semi-structured interview process. A similar approach was adopted by Roldán and Leal (2003) in their EIS survey in Spain. Pooling data across different technologies is consistent with prior research in user acceptance (see, for example, Davis, 1989, Venkatesh and Morris, 2000).

The sample was selected using the unbiased "snowball" sampling technique. This technique was also used by Roldán and Leal (2003). The sample selected included organisations with actual EIS experience with representatives from the following three constituencies: (1) EIS executives/users; (2) EIS team; and (3) EIS vendors or consultants. These three constituencies were identified and used in EIS research by Rainer and Watson (1995). A formal extensive interview schedule was compiled and used for the semi-structured interviews. Interviews were conducted during May-June 2002 at the interviewee's organisation in the eThekwini Municipal Area (EMA) in South Africa. EMA is the most populous municipality in South Africa (SA2002–2003, 2002) with a geographic area size of 2,300 km^2 and a population of 3,09 million citizens (Statistics South Africa, 2001). The survey of organisations in KwaZulu-Natal which implemented EIS is confined to organisations in the EMA.

From the author's survey instrument, a wide range of different available commercially purchased EIS software tools and/or ERP software with EIS features used by the respondents in the organisations surveyed was reported. These included Cognos®, JDEdwards BI®, Oracle®, Hyperion®, Lotus Notes®, Business Objects® and Pilot®. Cognos® was the most popular EIS software tool comprising 60,0% of the sample surveyed. In the USA, Cognos®, Business Objects® and Oracle® have the highest top-of-mind awareness (Gartner, 2002). Gartner (2002) reports that in Europe, SAP®, MicroStrategy®, Business Objects® and IBM® have highest top-of mind awareness. Furthermore Europe seems to focus more on full-solution vendors (for example IBM®, SAP®) than strictly EIS product-focused vendors. Drakos (2003) suggests that the portalisation of vertical applications such as ERP, customer relationship management (CRM) and supply chain management (SCM) is driving multiple vertical portals into single enterprises.

From the survey instrument, a summary of data obtained of the degree to which specific Web-based technologies impacted the respondent's EIS implementation in the organisations surveyed, is reflected in Table 1.

	The degree to which Web-based technologies impacted respondent's EIS implementation (N=31)						
Web-based technology	**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 technologies	26 (83,8%)	0 (0,0%)	0 (0,0%)	0 (0,0%)	2 (6,5%)	2 (6,5%)	1 (3,2%)

Table 1: Tally and associated percentage of the degree to which specific Web-based technologies impacted respondent's EIS implementation

Table 1 shows that only seven (22,5%) of organisations surveyed report that the Intranet significantly impacted their EIS implementation. Intranets are usually combined with and accessed via a corporate portal (Turban *et al.*, 2005). The level of impact by the Internet on EIS implementation is slightly lower with six (19,4%) of organisations surveyed reporting that the Internet has significantly impacted their EIS implementation. While 24 (77,4%) of organisations surveyed report that the Extranet had no impact on their organisation's EIS implementation, the balance of the data sample (22,6%) report different degrees of impact. The results show that the vast majority (90,4%) of respondents report that e-Commerce: (B2B) has not impacted EIS implementation in organisations 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.

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 1, 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. The potential benefit of mobile access to portals are numerous and self-evident. PricewaterhouseCoopers (2002) note that organisations must first establish the benefits of mobile access to its portal and assess the value of providing those benefits via mobile access to the organisation. However, portals and related technologies promise that applications will be more operable, integrative and adaptive to user needs (Drakos, 2003).

From Table 1, three interviewees reported that their organisation's EIS implementations were significantly impacted ("Very much" and "Extensively") by portal technologies. At first this may appear to be 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. However, it should be noted that the impact levels of all the Web-based technologies assessed are fairly low. This still means that after the Intranet and Internet, portal technologies have the third highest impact on EIS implementations in organisations surveyed. Combining the results ("Somewhat much", "Very much" and "Extensively") for each of the seven Web-based technologies, Table 2 gives a descending ranking order of the levels of impact of Web-based technologies on EIS implementations. This information is particularly useful for IT practitioners in planning future EIS implementations.

Rank	Web-based technology	Tally and level of impact on EIS implementations
1	Intranet	10 (32,2%)
2	Internet	8 (25,9%)
3	Portal technologies	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%)

Table 2: Descending rank order of impact levels of Web-based technologies on EIS implementation

4.4 Future trends

Meta Group expects B2B usage (encompassing partner and supplier portals) to expand by 50% by 2006 (Meta Group, 2003). The need for a portal usually becomes evident when an Intranet (or sometimes an Extranet or Internet site) accumulates more information than can be presented in a static manner. An Enterprise portal (also known as Enterprise Information Portal or corporate portal) is an approach in Intranet-based applications. Bajgoric (2000) notes that it goes a step further in the 'webification' of applications and integration of corporate data. The function of corporate portals may be described as "corecasting" since they support decisions central to particular goals of an organisation (Turban *et al.*, 2005).

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. Access to applications is a critical feature that distinguishes the current generation of enterprise portals from their predecessors (PricewaterhouseCoopers, 2002). The market for portal products will continue to coalesce during the next several years (Meta Group, 2003).

BI portal is a 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 an 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 system. Brio.Portal® from Brio Technology is another example of integrated BI software capable of retrieving, analysing and reporting information over the Internet. The role of portals is to ferry information to the users. Developers must be aware of emerging trends in the portal market to create systems that will be able to incorporate the latest technological developments and new methods of information delivery and presentation (Meta Group, 2003). This will serve to reduce costs, free busy executive's and manager's time and improve an organisation's profitability. Personalised technologies are becoming part of the portal environment (Zimmerman, 2003). Corporate portals help to personalise information for employees and customers (Turban *et al.*, 2005).

4.5 Conclusion

The findings of this survey show that while EIS have a significant role in organisations in the EMA, their technological base is not affected considerably by the latest innovations 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 portal technologies.

The author contends that portal technologies will become part of the organisational structure fabric and change the way infrastructure is viewed by the IT organisation. As evidenced in the case of Spoornet, "a simple portal has changed the company intrinsically" (Norwood-Young, 2003). Two trends will drive organisations to accept portals as business-critical: the ability to (1) deliver the availability and security required to support mission-critical functions; and (2) meet the needs of users outside the organisation's employees. Organisations will need to take the database knowledge in their organisations, open them to business partners and suppliers in an effort to try and build a community. There must be a desire to make these commitments worthwhile and draw users back to the portals.

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5 Technology Acceptance Model and Executive Information Systems

5.1 Introduction

Information Technology (IT) acceptance studies pay much attention to issues of significance in assessing the contributions of variables explaining IT usage for decision-making in organisations. Information Systems research continues to examine ways to improve support for decision-making in organisations. The importance of information in executive decision-making has been extensively documented (Walters, Jiang and Klein, 2003). Without concise and timely information (Khalil and Elkordy, 2005; Walters *et al.*, 2003), executives will not be able to determine whether their views of the environment and their organisation's position within it remain appropriate (Vandenbosch and Huff, 1997). An Executive Information System (EIS) is a computerised information system (IS) designed to provide managers in organisations access to internal and external information that is relevant to management activities and decision-making. Averweg and Roldán (2006) suggest that EIS should be flexible to support different classes of business data (*e.g.* external, internal, structured and unstructured) and different levels of users (*e.g.* executives and non-executive users).

User acceptance of IT has been a primary focus in the IT implementation research for the past two decades where IT adoption and use has been a major goal of organisations. Researchers in the field rely on the theories of innovation diffusion to study implementation problems (Al-Gahtani, 2001b). Davis' Technology Acceptance Model (TAM) states that perceived usefulness and perceived ease of use are the two factors that govern the adoption and use of IT (Davis, 1989). The objective of this chapter is to discuss the Perceived Usefulness (PU), Perceived Ease of Use (PEOU) and Actual System Use (U) constructs during EIS development and implementation stages in organisations in the developing country of South Africa in Africa.

Much of the extant IT focuses on developed countries (Van Slyke, Bélanger and Sridhar, 2005). Less attention has been paid to IT in developing countries. It is important to consider the influence of local conditions on the adoption and assimilation of technologies (Hebert and Benbasat, 1994) in developing countries, such as South Africa.

5.2 Information Systems adoption and usage

The greater the uncertainty in the business environment, the greater the need for information processing (Salmeron, Luna and Martinez, 2001). Computer or IS usage has been identified as the key indicator of the adoption of IT by organisations (Suradi, 2001). Igbaria 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. Clearly IS usage is an important topic in scholarly discourse.

Davis, Bagozzi and Warshaw (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, PU and PEOU, are the most important factors determining usage of computers or IS.

5.3 Technology Acceptance Model (TAM) literature review

TAM was developed by Davis (1989) and postulates that two particular beliefs, PU and PEOU, are of primary relevance for computer acceptance behaviours (Davis *et al.*, 1989; Igbaria, Zinatelli, Cragg, Cavaye, 1997; Keil, Beranek and Konsynski, 1995). According to TAM, system use is determined by a person's attitude towards the system. See Figure 1.

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 use. In IT terms this means that the model attempts to explain the attitude towards *using* IT rather than the attitude towards IT *itself*.

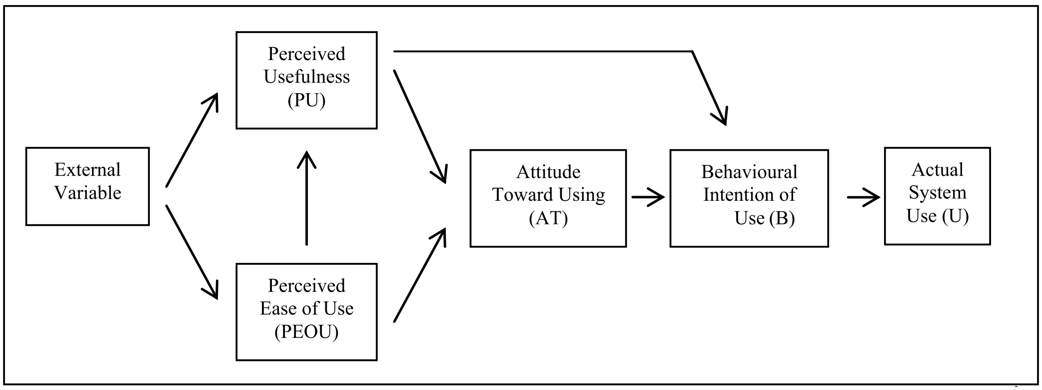

Figure 1: Technology Acceptance Model (TAM)
(Source: Davis *et al.*, 1989)

Davis' model specifically postulates that technology use is determined by behavioural intention to use the technology; which is itself determined by both PU and PEOU. Additionally behavioural intention to use the technology is also affected by PU directly. Behavioural intention to use the technology (B) is also affected by PU directly. Behavioural intention to use the technology is then positively associated with U. 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 (PU)**. PU 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 (PEOU)**. PEOU is the user's assessment that the system will be easy to use and requires little effort.

PU and **PEOU** are operationalised by obtaining users' assessment of their PU and PEOU of EIS based on twelve similar items developed by Davis and adapted for the author's study.

Actual System Use (U) (behaviour) consists of the number of times of systems use. Actual system usage is operationalised in terms of frequency of use of EIS (Davis, 1989, 1993; Fishbein and Ajzen, 1975; Kwon and Chidambaram, 2000; Malhotra and Galletta, 1999; Mao, 2002).

Straub, Keil and Brenner (1997) suggest that PU of computers has a positive effect on the adoption of IT. Adams, Nelson and Todd (1992) and Davis (1989) report that PU affects both attitudes and actual computer use. While Hu *et al*. (1999) suggest PU to be a significant determinant of attitude and intention, Brown (2002) reports that PU is not a significant influence on use.

Money and Turner (2007) report that evidence of the research community's growing acceptance of TAM is reflected in the Institute for Scientific Information Social Science Index (January 2006) which listed more than 1,150 journal citations of the initial TAM research papers published by Davis (1989) (628 citations) and Davis *et al*. (1989) (513 citations). Clearly the most commonly investigated variables of TAM by researchers are PU and PEOU (Adams *et al.*, 1992; Davis, 1989; Davis *et al.*, 1989; Garrity and Sanders, 1998; Hu, Chau, Liu Sheng and Yan Tam, 1999; Hubona and Geitz, 1998; Igbaria, 1993; Ikart, 2005; Mathieson, 1991; Rose and Straub, 1998; Venkatesh and Davis, 2000; Venkatesh and Morris, 2000; Venkatesh, Morris, Davis and Davis, 2003). TAM's popularity is due to "its common sense nature, appealing simplicity, and robustness" (Hendriks and Jacobs, 2003).

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 are: Japan and Switzerland (Straub *et al.*, 1997), New Zealand (Igbaria *et al.*, 1997), Hong Kong (Chua, 1996), Singapore (Teo, Lim and Lai, 1999), Malaysia (Suradi, 2001), Arab world (Rose and Straub, 1998; Al-Gahtani, 2001b) and United Kingdom (Al-Gahtani, 2001a). From the available literature, there is little evidence to suggest that TAM has been extensively investigated in developing countries or specifically in South Africa.

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 chapter, Davis' questionnaire has been adapted for the purposes of this research and the "internally developed systems" refers to existing EIS in organisations in KwaZulu-Natal, a region in South Africa.

5.4 Research method and data gathering

The survey instrument developed by the author was based on previous instruments used in published research papers (see Davis, 1989; Davis *et al.*, 1989). The questionnaire applicable to this research consisted of three parts. See Appendix 1.

Section 1 (demographic information comprised 8 statements) and Section 2 (attributes of an organisation's EIS comprised 16 statements) were extracted and translated from the Roldán (2000) EIS questionnaire. The measurement for usage (statements 2.12 and 2.13) was in terms of frequency of system use (i.e. 'how often'). For statement 2.12, interviewee responses were assigned numerical values in the range *Very rarely or not at all* = 1 to *Frequently (several times per day)* = 7. Similar measurement was used in research on TAM by Davis (1989), Davis *et al.* (1989) and Malhotra and Galletta (1999).

Section 3 (comprised 14 statements numbered 3.1–3.14) was drawn from the established Davis (1989) questionnaire. This section dealt with the PU, PEOU and U of the EIS in the interviewee's organisation. For the PU and PEOU 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 served to validate the author's instrument.

PU: 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*.

PEOU: This construct was 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*.

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

For questions 3.1–3.12, 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 anchored by *extremely frequently* = 3 to *extremely infrequently* = -3.

The sample was selected using the unbiased 'snowball' sampling technique. 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. The group is then used to locate others who possess similar characteristics and who, in turn, identified 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 (2003) in their EIS study of organisations in Spain. It is estimated by the author that the projected total population of organisations with EIS in the eThekwini Municipal Area (EMA), KwaZulu-Natal, South Africa is 150. From an identified organisation with EIS in the EMA and using the snowball sampling technique, the author was able to target 31 sizeable and organisations in the EMA which have EIS experience. Every individual organisation that was referred to the author was willing to participate in the survey and included in the convenience sample. A formal extensive interview schedule was compiled and used for the structured interviews. Interviews were conducted during May–June 2002 at the interviewee's organisation. eThekwini Municipality is the most populous municipality in South Africa and has a population of 3,09 million citizens (Statistics South Africa, 2001). EMA's geographic area size is 2,300 km^2. The author's survey of organisations in KwaZulu-Natal which have implemented EIS was confined to organisations in the EMA.

Some studies suggest that EIS should not only be accessed by executive users (see, for example, Rai and Bajwa, 1997; Volonino, Watson and Robinson, 1995). With the evolution of distributed IT, paved by the rapid adoption of Web technology, there is a growing need for improved decision-making at anytime, anywhere and with any participants (Erwin and Averweg, 2003). Due to a maturing market, corporate spending priorities are shifting from extracting and storing data toward accessing and delivering the information to a wider range of users (PricewaterhouseCoopers, 2002). Salmeron (2001) notes EIS as the technology for information delivery for all business end-users. It is evident that EIS requires continuous input from three different stakeholder groups (known as constituencies):

- EIS executives/business end-users;
- EIS providers (*ie*. persons responsible for developing and maintaining the EIS); and
- EIS vendors or consultants.

All constituencies were surveyed in the author's data sampling. A field study of 31 different organisations in the EMA which have successfully implemented EIS was conducted. From the previous EIS studies reflected in Table 1, it will be noted that the author's study of 31 organisations exceeds the previous EIS survey sample size in South Africa (during 1995 I.J. Steer surveyed 24 organisations) and the majority of EIS sample sizes in other countries.

Authors	Year	Investigation	Country	Replies (n)
Watson, H.J., Rainer, R.K., Jr. and Koh, C.E.	1991	Executive Information Systems: A Framework for Development and a Survey of Current Practices	United States of America	112 suitable replies of which 50 have an EIS in operation or in an advanced stage of implementation
Fitzgerald, G.	1992	Executive Information Systems and Their Development in the U. K.	United Kingdom	77 questionnaires received, 36 of whom are proceeding with an EIS
Watson, H.J., Rainer, R.K., Jr., and Frolick, M.N.	1992	Executive Information Systems: An Ongoing Study of Current Practices	United States of America	68 questionnaires received of which 51 indicated they have an EIS
Steer, I.J.	1995	The Critical Success Factors for the Successful Implementation of Executive Information Systems in the South African Environment	South Africa	24 questionnaires from organisations with EIS implementation
Theodenius, B.	1995	The Use of Executive Information Systems in Sweden	Sweden	29 replies from organisations with EIS implementation
Watson, H.J., Watson, T., Singh, S. and Holmes, D.	1995	Development Practices for Executive Information Systems: Findings of a Field Study	United States of America	43 suitable questionnaires from organisations with EIS implementation
Allison, I.K.	1996	Executive Information Systems: An Evaluation of Current UK Practice	United Kingdom	19 suitable questionnaires received from organisations with EIS
Park, H.K., Min, J.K., Lim, J.S. and Chun, K.J.	1997	A Comparative Study of Executive Information Systems between Korea and the United States	Korea and United States of America	27 suitable questionnaires from organisations with EIS implementation
Pervan, G.P. and Phau, R.	1997	A Survey of the State of Executive Information Systems in Large Australian Organisations	Australia	12 suitable questionnaires from organisations with EIS implementation
Poon, P. and Wagner, C.	2001	Critical success factors revisited: success and failure cases of information systems for senior executives	Hong Kong, China	6 suitable questionnaires from organisations with EIS implementation

Table 1: Investigations about EIS with descriptive endings
(Source: Averweg and Roldán, 2007)

The author's sample of 31 completed questionnaires complies with the minimum recommended size that is needed for statistical inference purposes (Siegel and Castellan, 1988).

5.5 Results and discussion

The three EIS constituencies and number of interviewees surveyed and associated percentages per constituency are reflected in Table 2.

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

Table 2: EIS constituencies and number of interviewees surveyed per constituency

Interviewees' responses to the other statements in Sections 1 and 2 of the author's questionnaire are reported in Averweg and Roldán (2006). Interviewee's responses to statements 2.12, 2.13 and the statements in Section 3 are reflected in Appendix 2.

For the PU and PEOU 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, Campbell and Zedeck, 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 http://www.ats.ucla.edu/stat/spss/faq/alpha.html), the Cronbach alpha can be written as a function of test items and the average intercorrelation among the items:

$$\alpha = \frac{N \cdot \bar{c}}{1 + (N-1) \cdot \bar{c}}$$

N is equal to the number of items (N = 31 in author's survey) and $\bar{c}$ is the mean inter item correlation among the items. Intercorrelations between the scale values to statements 3.1–3.6 (PU) and intercorrelations between the scale values to statements 3.7–3.12 (PEOU) constructs were calculated. The results are given in Tables 3 and 4 respectively.

Statement Number and associated text	3.1	3.2	3.3	3.4	3.5	3.6
3.1: Using the EIS enables me to accomplish tasks more quickly in my job	1					
3.2: Using the EIS improves my performance in my job	0.581381	1				
3.3: Using the EIS in my job increases my productivity	0.625311	0.451258	1			
3.4: Using the EIS enhances my effectiveness in my job	0.324384	0.334883	0.439406	1		
3.5: Using the EIS makes it easier for me to do my job	0.407905	0.293303	0.379525	0.589805	1	
3.6: I find the EIS to be useful in my job	0.343011	0.343651	0.320175	0.136704	0.379525	1

Table 3: Intercorrelations between scale values to statements 3.1–3.6 (PU)

From Table 3, the mean intercorrelation was 0.3966818. Substituting $\bar{c}$ = 0.3966818 and N = 6 in the above equation, the Cronbach coefficient alpha for PU construct = 0.80.

Statement Number and associated text	3.7	3.8	3.9	3.10	3.11	3.12
3.7: Learning to operate the EIS is easy for me	1					
3.8: I find it easy to get the EIS to do what I want it to do	0.122943	1				
3.9: Interacting with the EIS is clear and understandable	0.555738	0.065362	1			
3.10: I find the EIS to be flexible to interact with	0.320175	0.108040	0.423216	1		
3.11: It is easy for me to become skilful at using the EIS	0.517940	0.026549	0.361211	0.517940	1	
3.12: I find the EIS easy to use	0.406961	0.125034	0.561226	0.541171	0.630256	1

Table 4: Intercorrelations between scale values to statements 3.7–3.12 (PEOU)

From Table 4, the mean intercorrelation was 0.3378450. Substituting $\overline{c}$ = 0.3378450 and N = 6 in the above equation, the Cronbach coefficient alpha for PEOU 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, Guimaraes and Davis, 1995) to 0.95 (Davis *et al.*, 1989) for perceived usefulness and 0.85 (Igbaria *et al.*, 1995) 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 chapter, the multi-dimensionality aspect is not explored further since this was not within the scope of the Davis (1989) study. It may, however, provide an opportunity for future research.

The Spearman rank-order correlation coefficients *r* were calculated for PU and intended use; and PEOU and intended use. Allowing for tied observations (see Siegel and Castellan, 1988), $r = 0.144$ for PU and $r = 0.373$ for PEOU. 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-use ($r = 0.144$) is *lower* than for ease of use-use ($r = 0.373$) and is therefore not consistent with Davis' findings. Furthermore because of the author's low correlation values PU 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 PU (over PEOU) as the key determinant of acceptance. Empirical evidence has constantly borne out this claim leading to PEOU 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 support this finding ie. perceived ease of use can be a stronger catalyst (over PU) fostering IT acceptance. The author's results support Brown's (2002) findings that "perceived ease of use takes on increased importance, as it influences both usage and perceived usefulness". Doll, Hendrickson and Deng (1998) indicate that "[d]espite its wide acceptance, a series of incremental cross-validation studies have produced conflicting and equivocal results that do not provide guidance for researchers or practitioners who might use the TAM for decision making". Furthermore Legris, Ingham and Collerette (2003) suggest that analysis "of empirical research using TAM shows that results are not totally consistent or clear". In a developing country in Africa, the conventional wisdom that PU is the main predictor of adoption has been challenged (Anandarajan, Igbaria and Anakwe, 2002). TAM was developed and tested mainly in developed countries where the culture has been described as associative (Brown, 2002).

In order to investigate the author's low correlation values, an inspection was made of the raw data (interviewee's responses to statements 3.13 and 3.14). For statement 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 (2002) notes that when "a correlation coefficient is based on values from a 3 point scale there is the potential for a problem". For statement 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 (2002) 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, Al-Gahtani, 2001b; Davis, 1989; Suradi, 2001). While the author's study was limited to existing EIS in organisations in the EMA, 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. The author's results are therefore limited and at best provide a reflection of EIS adoption in the EMA. It is therefore concluded that in this study there is little evidence to support that the theoretical use aspects of TAM are echoed in EIS implementations in KwaZulu-Natal.

From the interviewee's responses to statement 2.12, the frequency of EIS usage reported by the respondents is reflected in Table 5. For comparative purposes, the results of an EIS usage study in organisations in Australia by Ikart (2005) are also included in Table 5. Obtaining a user's self-assessment of the number of times they use EIS in a week and/or their frequency of using EIS was the measure used in both the author's and Ikart (2005) studies. Although previous research suggests that self-reported frequency measures are appropriate or relative measures (Blair and Burton, 1987), they should not be regarded as precise measures of actual use frequency (Davis *et al.*, 1989).

Frequency of EIS use in organisation	**Tally and associated percentage of EIS use in organisation as reported by respondents in sample surveyed (N=31[a]) – author's study**	**Tally and associated percentage of EIS use in organisation as reported by respondents in sample surveyed (N=121) – Ikart (2005) study**
Rarely or not at all	1 (3.2%)	4 (3.3%)
Occasionally (less than 1 per week)	1 (3.2%)	21 (17.4%)
Sometimes (more than 1 but less than 4 times per week)	2 (6.4%)	43 (35.5%)
Regularly (several times per week)	16 (51.6%)	34 (28.1%)
Frequently (several times per day)	13 (41.9%)	19 (15.7%)

[a] – Respondents could give more than one answer

Table 5: Frequency of EIS usage reported by respondents and associated percentages

From Table 5, in the author's study, the modal group of EIS use was 'Regularly (several times per week)' – see left shaded area. However, in the Ikart (2005) study, the modal group was 'Sometimes (more than 1 but less than 4 times per week)' – see right shaded area. 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". Given the use results as reflected in Table 5, it can be concluded that there appears to be no consistency in the frequency of actual EIS use *ie*. no common frequency value for U. From a practitioner's perspective this tends to suggest that EIS use may also be mitigated by 'other' variables, such as

- an organisation's operational requirements (time of month); and
- the stage of EIS development and implementation.

In respect of the EIS development and implementation stages, Pervan and Phua (1997) note that "this issue may increase in significance as more organisations progress from the evaluation stage to the operational stage". However, in the author's study, one respondent who had reported his most recent EIS implementation as 'Not Successful', **had** progressed from the EIS evaluation stage to the operational stage and this finding does not appear to be consistent with the Pervan and Phua (1997) study. This may require further investigation.

5.6 Conclusion

In this study, the Cronbach coefficient alphas (degree of reliability) for PU and PEOU constructs were not within generally accepted limits. Low correlation coefficients were calculated for PU and Intended Use, and PEOU and Intended Use constructs. The correlation for usefulness-use was *lower* than for ease of use-use and therefore not consistent with Davis' findings. However, the author's results (1) *partially* support Venkatesh's (1999) findings that PEOU can be a stronger catalyst (over PU) in fostering IT acceptance; (2) support Brown's (2002) findings wherein the PEOU-Use TAM relationship was higher than PU-Use; and (3) indicate there is no consistency in the frequency of U of EIS.

Brown (2002) reports that PEOU takes on increased importance, as it influences both use and PU. Legris *et al*. (2003) suggest that while TAM is a useful model, it has to be integrated into a broader one which will include variables related to both human and social change processes and to the adoption of the innovation model. The author's results tend to support this viewpoint.

Future research may need to be directed to investigate the role of other potential antecedents to enhance IT adoption and assimilation variances in developing countries. One suggestion in this regard is investigating normative and cultural beliefs to increase the final IT usage prediction of EIS in organisations in South Africa. Some additional ideas for future research are:

- several recent studies have shown how contextual factors such as socio-economic conditions, national environment and culture can be incorporated into typical investigations of technology adoption (Brown, Hoppe, Mugera, Newman and Stander, 2004; Musa, Meso and Mbarika, 2005; Srite and Karahanna, 2006);
- the 'first' economy and 'second' economy dichotomy in South Africa may serve as an appealing context in which to investigate IT adoption; and
- further richness in IT studies can be used through the use of alternative qualitative research methodologies *e.g.* grounded theory methodology, actor network theory, etc.

Such IT acceptance studies should pay attention to issues of significance in assessing the contributions of variables explaining IT usage for decision-making in organisations in developing countries.

5.7 Acknowledgement

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Preamble To Structured Interview Questionnaire

Computers have been used as tools to support managerial decision-making for over three decades. 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 computerised system that provides executives with easy access to internal and external information that is relevant to their critical success factors**".

Dimension	Transaction 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

Attributes of Major Computerised Support Systems

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 (*e.g.* 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?

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

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 Use 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) use in your organisation. You are asked to judge the rating for each statement by ticking (T) 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.

likely								unlikely
	extremely	quite	Slightly	neither	slightly	quite	extremely	

3.2 Using the EIS improves my performance in my job.

likely								unlikely
	extremely	quite	Slightly	neither	slightly	quite	extremely	

3.3 Using the EIS in my job increases my productivity.

likely								unlikely
	extremely	quite	Slightly	neither	slightly	quite	extremely	

3.4 Using the EIS enhances my effectiveness in my job.

likely								unlikely
	extremely	quite	Slightly	neither	slightly	quite	extremely	

3.5 Using the EIS makes it easier for me to do my job.

likely								unlikely
	extremely	quite	Slightly	neither	slightly	quite	extremely	

3.6 I find the EIS to be useful in my job.

likely								unlikely
	extremely	quite	Slightly	neither	slightly	quite	extremely	

3.7 Learning to operate the EIS is easy for me.

likely								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.

likely								unlikely
	extremely	quite	Slightly	neither	slightly	quite	extremely	

3.9 Interacting with the EIS is clear and understandable.

likely								unlikely
	extremely	quite	Slightly	neither	slightly	quite	extremely	

3.10 I find the EIS to be flexible to interact with.

likely								unlikely
	extremely	quite	Slightly	neither	slightly	quite	extremely	

3.11 It is easy for me to become skilful at using the EIS.

likely								unlikely
	extremely	quite	Slightly	neither	slightly	quite	extremely	

3.12 I find the EIS easy to use.

likely								unlikely
	extremely	quite	Slightly	neither	slightly	quite	extremely	

3.13 I currently use the EIS in my job.

frequent								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.

frequent								infrequent
	extremely	quite	Slightly	neither	slightly	quite	extremely	

Respondent	Section 2		Section 3													
	2.12	2.13	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
1	6	4	1	1	1	1	1	2	2	2	1	2	2	2	1	1
2	6&7	4	2	2	2	4	2	1	1	3	1	3	2	1	2	1
3	6	1	2	2	2	2	1	1	2	2	2	3	1	1	1	1
4	6&7	3	2	3	2	1	1	2	2	2	2	2	2	1	3	1
5	7	4	1	2	1	2	2	2	1	2	1	1	1	1	1	1
6	7	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1
7	7	5	2	1	2	2	2	2	3	3	3	3	3	2	1	1
8	6	4	3	2	2	2	2	1	2	3	2	2	3	2	1	1
9	5	5	1	1	1	1	1	1	1	2	1	1	2	1	2	1
10	5	2	1	1	1	1	1	1	2	1	2	2	2	1	1	1
11	4	1	1	1	1	1	1	1	2	2	1	1	1	1	1	1
12	7	4	1	1	1	1	1	1	2	2	2	2	2	2	1	1
13	7	5	2	1	2	1	1	2	2	2	2	3	2	2	1	1
14	7	2	2	2	2	2	2	1	2	3	3	3	3	2	2	2
15	2	3	2	2	1	2	2	2	1	4	1	1	1	1	2	1
16	5	6	2	2	1	1	1	1	2	2	2	2	2	2	1	1
17	7	6	1	1	1	1	1	1	2	1	1	1	2	1	1	1
18	7	1	2	1	1	1	1	1	3	2	2	3	3	3	3	2
19	3	2	1	1	1	1	1	1	1	1	2	1	1	1	1	1
20	6	5	2	1	2	2	1	2	1	2	1	1	1	1	2	1
21	6	3	1	1	1	1	1	1	1	2	1	1	1	1	1	1
22	7	5	1	1	1	1	2	2	1	2	2	2	2	2	3	1
23	6	4	2	2	1	2	2	2	2	2	2	2	2	2	2	2
24	6	4	2	2	1	1	1	1	2	2	1	2	2	1	2	2
25	6	3	1	1	1	1	1	1	3	2	2	1	1	1	1	1
26	7	4	1	1	1	1	1	1	1	1	1	3	3	3	1	1
27	5	5	2	3	2	1	1	2	1	1	1	3	1	1	2	1
28	6	4	4	2	2	1	2	2	2	2	2	3	3	2	1	1
29	7	3	2	2	2	2	2	2	1	1	1	2	1	1	1	1
30	7	4	1	1	2	1	2	1	2	3	2	1	3	2	2	1
31	1	3	1	1	1	1	1	1	2	3	1	1	2	1	1	1

Interviewee's raw responses to statements in Sections 2 and 3 of survey instrument (Appendix 1)

6 Applicability of the Technology Acceptance Model in three developing countries: Saudi Arabia, Malaysia and South Africa

6.1 Introduction

User acceptance of information technology (IT) has been a primary focus in the IT implementation research for the past two decades where IT adoption and use has been a major goal of modern organisations. Recently, researchers in the field have begun to rely on the theories of innovation diffusion to study implementation problems (Al-Gahtani, 2001b). Davis' Technology Acceptance Model (TAM) states that perceived usefulness and perceived ease of use are the two factors that govern the adoption and use of IT (Davis, 1989).

Almost all research in Information Systems (IS) originates in Western countries, particularly the United States of America (USA), where conditions are very different from developing countries (Kirlidog, 1996). For a discussion of the term 'developing country', see Averweg and Erwin (1999). Saudi Arabia, Malaysia and South Africa are developing countries. Conditions in developing countries are often greatly different from those of developed countries. For example, the African continent has the least developed telecommunications network in the world (Coeur de Roy, 1997). For a discussion of the challenges to an IT-supported technology transfer to developing countries, see, for example, Nahar *et al.* (2000). There is a need for organisations to adapt to constantly changing business conditions (Erwin and Averweg, 2003).

TAM has been successfully tested by several previous empirical studies in North America; however, only some studies were carried out to test the applicability of TAM outside this region. The primary objective of this study is to report on the applicability of TAM studies in the Arab world (Saudi Arabia), Malaysia and Africa (South Africa).

6.2 Information Systems adoption and usage

The study of IT adoption has recently gained new attention after being popularly studied in the 1980s (Rose and Straub, 1998). The more sophisticated computer technology that includes the Internet is perceived to be part of modern organisations (Suradi, 2001). Many cases of technology adoption are direct political or cultural responses to the unwanted effects of globalisation rather than economic pursuits (Bird, 1995; Sherry, 2002). Little research on IT adoption has been conducted in less developed countries (Prescott and Conger, 1995). Developing countries have much to gain from the revolution in communication and information access (Vinaja, 2003). Even as IT in business organisations around the world converge, the meanings conveyed through them as well as the outcomes of their use may remain culture specific (Limaye and Victor, 1991).

Computer or IS usage has been identified as the key indicator of the adoption of IT by organisations (Suradi, 2001). Igbaria 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. 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). Given the complexity of data processing for decision support, the perception of a system's ease of use may significantly affect the level of its adoption by prospective users (Shin, 2003). 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.

6.3 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; Igbaria *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*.

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; Igbaria, 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.

Davis' model specifically postulates that technology usage is determined by behavioural intention to use the technology (B); which is itself determined by both perceived ease of use (PEOU) and perceived usefulness (PU). See Figure 1.

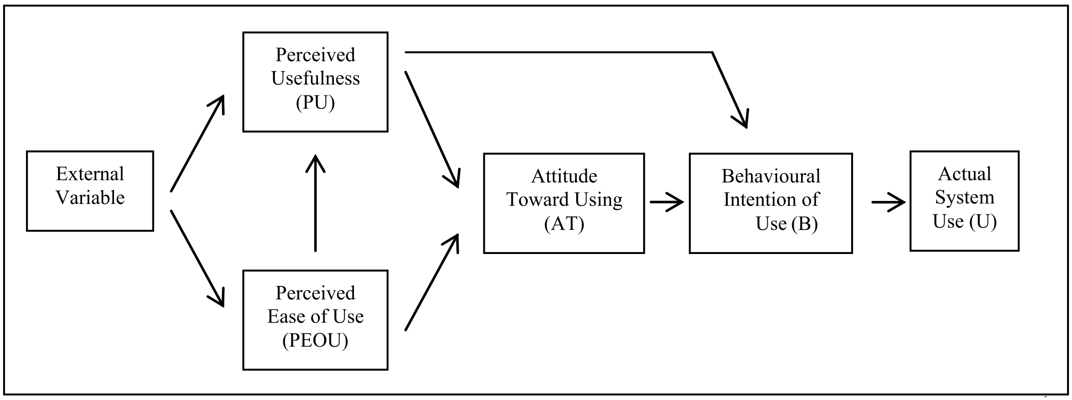

Figure 1: Technology Acceptance Model (TAM)
(Source: Davis *et al.*, 1989)

Additionally behavioural intention to use the technology (B) is also affected by perceived usefulness (PU) directly. Behavioural intention to use the technology is then positively associated with actual system use (U). 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 (PU) 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 (PEOU) is the user's assessment that the system will be easy to use and requires little effort.

In the context of the Internet and the World Wide Web several studies have confirmed these relationships still hold true (Teo *et al.*, 1999; Lederer *et al.*, 2000). However, Straub *et al.* (1997) demonstrate that the nature of relationships between these TAM constructs differs across cultures. Agarwal and Prasad (1999) show the importance of individual differences as predictors of perceived ease of use specifically demonstrating prior experience, role with regards to IT and level of experience as factors of influence.

6.4 TAM research in three selected developing countries

Few studies have been carried out to test the applicability of TAM outside North America. Some of these studies by country are: in Japan and Switzerland (Straub *et al.*, 1997), New Zealand (Igbaria *et al.*, 1997), Hong Kong (Chua, 1996), Singapore (Teo *et al.*, 1999), United Kingdom (Al-Gahtani, 2001a), Arab world (Rose and Straub, 1998; Al-Gahtani, 2001b), Malaysia (Suradi, 2001) and South Africa (du Plooy, 1998; Brown, 2002; Averweg, 2002). The author reports TAM findings from three selected developing countries: Saudi Arabia, Malaysia and South Africa.

TAM research in Saudi Arabia

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 an 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.

TAM research in Malaysia

The National IT Agenda (NITA) provides the foundation and framework for the utilization of information and communication technologies (ICT) to transform Malaysia into a developing nation. 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 (*e.g.* 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) and 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 viewpoint that TAM can be equally applied in the South African environment.

TAM research in South Africa

South Africa is a low to middle-income developing nation. In the study by Averweg (2002), the correlation for the TAM usefulness-usage construct was *lower* than for use-usage and was therefore not consistent with Davis' findings. Furthermore because of this researcher's low correlation values Perceived Usefulness was **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'. Averweg'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. Averweg's results partially support this finding *ie*. perceived ease of use can be a stronger catalyst (over perceived usefulness) fostering IT acceptance. In summary the results from Averweg's (2002) study shows that ease of use on intended usage is greater than the effect of perceived usefulness on intended usage.

Legris *et al.* (2002) suggest that analysis 'of empirical research using TAM shows that results are not totally consistent or clear'. Clearly, the results found in the TAM studies conducted in Saudi Arabia, Malaysia and South Africa highlights this inconsistency and provides support for Legris *et al.* (2002). TAM has been empirically proven successful in predicting about 40% of a system's use (Hu *et al.*, 1999). Legris *et al.* (2002) report that although the results are most convergent, there are situations where they are conflicting.

In summary, research by Al-Gahtani (2001b) in Saudi Arabia supports the applicability of TAM to the Arab culture. Similarly research by Suradi (2001) shows that TAM can be applied in the Malaysian environment. However, the study by Averweg (2002) does not provide any direct evidence to support the applicability of Davis' determinants of usage (within TAM) in South Africa. In this study 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, Averweg's (2002) results *partially* support Venkatesh's (1999) findings that perceived ease of use can be a stronger catalyst (over perceived usefulness) in fostering IT acceptance. Brown (2002) reports that it has been shown that perceived usefulness is not a significant influence on usage, consistent with previous studies in some developing countries. Averweg's (2002) results support Brown's (2002) findings that 'perceived ease of use takes on increased importance, as it influences both usage and perceived usefulness'.

6.5 Conclusion

Legris *et al.* (2002) suggest that while TAM is a useful model, it has to be integrated into a broader one which will include variables related to both human and social change processes and to the adoption of the innovation model. While Averweg's (2002) 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 IT acceptance, this is a possible indication of a difference in overall contextual factors, such as culture, prior experience and geography, and/or the impact of major user interface changes since the period (1986–1989) in which Davis published his studies. These issues may require further research in South Africa.

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7 A comparative analysis of Perceived Usefulness and Perceived Ease of Use constructs in organisations in an area of KwaZulu-Natal, South Africa

7.1 Introduction

The importance of information for decision-making by executives and managers in organisations, has been extensively documented. Without the provision of concise and timely information (Khalil and Elkordy, 2005; Walters, Jiang and Klein, 2003), executives will not be able to determine whether their views of the environment and their organisation's position within it, remain appropriate (Vandenbosch and Huff, 1997). To benefit from information systems (IS) in decision-making, an increasing number of organisations are implementing IS for direct use by executives and managers, in order to access information, both internally and externally to the organisation. An Executive Information System (EIS) is a computerised IS designed to provide managers in organisations with access to internal and external information that is relevant to management activities and decision-making. Averweg and Roldán (2006) suggest that EIS should be flexible enough to support different classes of business data (*e.g.* internal, external, structured and unstructured), and different levels of users such as executives and managers. Nowadays, pervasive computing embeds computing and information technology (IT) into organisational environments, by integrating them seamlessly into the everyday lives of executives and managers, in order to augment decision-making support.

User acceptance of IT has been a primary focus in IT implementation research for the past two decades – where IT adoption and use has been a major goal of organisations. Researchers in the field rely on the theories of innovation diffusion to study implementation problems (Al-Gahtani, 2001). Davis' Technology Acceptance Model (TAM) states that perceived usefulness and perceived ease of use are the two factors that govern the adoption and use of IT (Davis, 1989). TAM has strong behavioural elements and assumes that when someone forms an intention to act, that they will be free to act without limitation. TAM is one of the dominant research models which have been widely used (Chooprayoon and Fung, 2010: 31).

The purpose of this chapter is to discuss the Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) constructs during EIS development in the eThekwini Municipal Area (EMA), KwaZulu-Natal, South Africa. This chapter focuses on the findings of two selected TAM/EIS studies in the EMA:

- A survey of 31 conducted by Averweg, which is reported in Averweg (2008) and hereafter referred to as the 'Averweg (2002) study'; and
- A case study conducted at Unilever South Africa (Pty) Ltd (Head Office, Umhlanga Ridge) by Sonny Anyetei Moses Ako-Nai, which is hereafter referred to as the 'Ako-Nai (2005) study'.

Since this chapter focuses on the summarised results of these two studies, it should be noted that the research approaches adopted in the Averweg (2002) study and the Ako-Nai (2005) study, are not compared.

This chapter reviews IS adoption and use. A review of TAM is presented, and a report on the two selected TAM/EIS studies is given. A summary of the two PU and PEU constructs in these TAM/EIS study findings are presented. The chapter then concludes.

Information Systems Adoption And Use

User acceptance and continuous usage (adoption) are important determinants in gauging success or failure of an IS. Computer or IS usage has been identified as the key indicator of the adoption of IT by organisations (Suradi, 2001). Igbaria and Tan (1997) report that system usage is an important variable in IT acceptance, as it appears to be a good surrogate measure for the effective deployment of IS resources in organisations. User acceptance factors have been a long-standing research issue (Ako-Nai, 2005: 24). Clearly, IS adoption and use is an important topic in scholarly discourse.

Since EIS are classified as high-risk projects, organisations are cautious and critical in dealing with them, in order to ensure successful EIS implementation and continuous usage by executives – the intended users (Belcher and Watson, 1993). An organisation seeks to avoid failure of its newly implemented EIS, and proactively wants to identify possible factors relating to users' attitudes towards the IS. These factors are likely to influence (positively or negatively) the IS users' acceptance, adoption and use of the system. Lu and Gustafson (1994) report that people use computers because they believe they will increase their problem-solving performance (usefulness), and are relatively easy to use. These researchers suggest that the two belief variables, PU and PEOU, are the most important factors determining usage of computers or IS.

7.2 Technology Acceptance Model (TAM)

TAM was developed by Davis (1989), and postulates that two particular beliefs – PU and PEOU – are of primary relevance for computer acceptance behaviours (Davis, Bagozzi and Warshaw, 1989; Igbaria, Zinatelli, Cragg and Cavaye, 1997; Keil, Beranek and Konsynski, 1995). According to TAM, system use is determined by a person's attitude towards the system (see Figure 1).

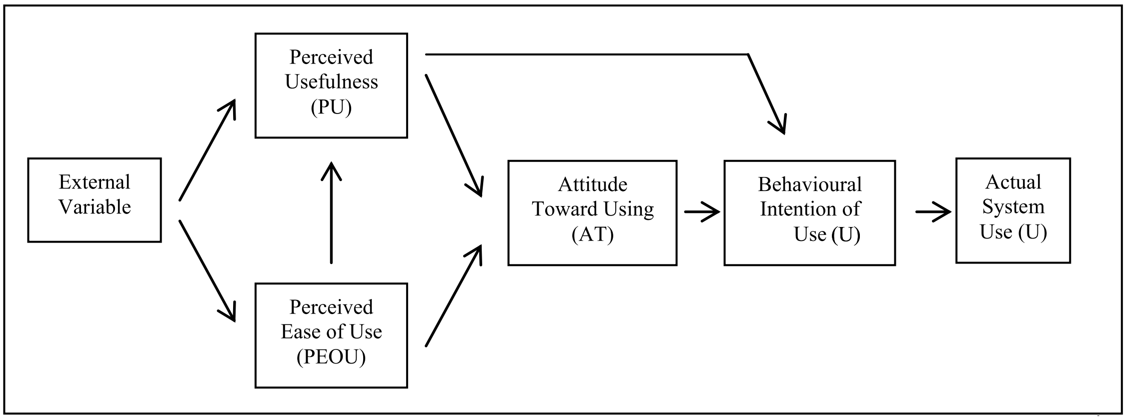

Figure 1: Technology Acceptance Model (TAM)
(Source: Davis *et al.*, 1989)

The basic TAM model consists of external variables which may affect beliefs. The model is derived from the general Theory of Reasoned Action (TRA) (Fishbein and Ajzen, 1975), in that TAM is intended to explain computer use. In IT terms, this means that the model attempts to explain the attitude towards *using* IT, rather than the attitude towards IT *itself*. According to Chooprayoon and Fung (2010: 33), TAM has been "verified and confirmed by many scholars as a practical theoretical model for the investigation of users' behaviour". Furthermore, according to Singh, Singh, Singh and Singh (2010: 62), TAM has examined the attitude and belief of users – that influences their acceptance or rejection of using IT. TAM has the advantage of 'first mover advantage', as one of the early IS theories.

Davis' model specifically postulates that technology use is determined by behavioural intention to use the technology; which is itself determined by both PU and PEOU. Additionally, behavioural intention to use the technology (B) is also affected by PU directly. Behavioural intention to use the technology is then positively associated with Actual System Use (U). The TAM model of IS success relies on the TRA of Fishbein and Ajzen (1975) and Ajzen and Fishbein (1980) – to assert that two factors are primary determinants of system use:

- **Perceived Usefulness** (PU). PU 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** (PEOU). PEOU is the end-user's assessment that the IS will be easy to use and requires little effort.

TAM-related studies have found that PU is generally a much stronger predictor of perceived intent to use than PEOU (Miller and Khera, 2010: 3–4). During the Averweg (2002) study and Ako-Nai (2005) study, the PU and PEOU constructs were operationalised by obtaining end-users' assessment of their PU and PEOU of EIS.

Straub, Keil and Brenner (1997) suggest that PU of computers has a positive effect on the adoption of IT. Jeyaraj, Rottman and Lacity (2006: 14) report that they "did not find good support for a direct relationship between *Ease of Use* and IT adoption, there is ample evidence of a direct relationship between *Perceived Usefulness* and IT adoption". Adams, Nelson and Todd (1992) and Davis (1989), report that PU affects both attitudes and actual computer use. Hu, Chau, Liu Sheng and Yan Tam (1999) suggest that PU is a significant determinant of attitude and intention, while Brown (2002) reports that PU is not a significant influence on use. Later research by Bagozzi (2007) questioned the possibility of determining behaviour by adding up measures for PU and PEOU. He considered that there may be differential contributions of salient beliefs. Bagozzi concluded that the TAM model may not be suitable for explaining and predicting system use.

Burton-Jones and Hubona (2006) replicated TAM with a survey of 125 employees in a United States of America government agency. Information regarding respondents' beliefs and usage behaviour were collated and analysed. The results showed that PU and PEOU may not mediate all influences from external environmental factors on systems usage. Burton-Jones and Hubona (2006) suggested that some external actors (*e.g.* system experience, level of education, age) may have a direct effect on system use. TAM has also been challenged as an appropriate model for developing countries and IS adoption (Anandarajan, Igbaria and Anakwe, 2000).

The most commonly investigated variables of TAM are PU and PEOU (Davis, 1989; Davis *et al.*, 1989; Venkatesh and Davis, 2000; Venkatesh and Morris, 2000; Hendriks and Jacobs, 2003; Venkatesh, Morris, Davis and Davis, 2003; Ikart, 2005; Jeyaraj *et al.*, 2006; Benbasat and Barki, 2007; Connelly, 2007; Chuttur, 2009; Chang, Chou and Yang, 2010; Chooprayoon and Fung, 2010). Jeyaraj *et al.* (2006: 7) suggest that the high utilisation of PU and PEOU shows the dominance of TAM in individual adoption research, and they state that the constructs have been used in the literature more than twice as often as other constructs. Chang, Chou and Yang (2010) indicate that TAM literature "has a steady growth as well as the citations". However, Chuttur (2009: 1) suggests that although TAM is a highly cited model, researchers share mixed opinions regarding its theoretical assumptions and practical effectiveness. Nevertheless, Hendriks and Jacobs (2003) argue that TAM's popularity derives from its common sense nature, simplicity and robustness. This serves as the rationale for exploring the PU and PEOU constructs in this chapter.

7.3 Discussion of two selected TAM/EIS studies

A discussion of the PU and PEOU constructs of EIS in the Averweg (2002) study and Ako-Nai (2005) study is now given.

Averweg (2002) study

The Spearman rank-order correlation coefficients r were calculated for PU and AT; and PEOU and AT. Averweg (2008: 8) reported that after allowing for tied observations, $r = 0.144$ for PU and $r = 0.373$ for PEOU. These correlation values were 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". Averweg's (2008) correlation for usefulness-use ($r = 0.144$) was *lower* than for ease of use-use ($r = 0.373$) and was therefore not consistent with Davis' findings. Furthermore, Averweg reported low correlation values and PU was *not* "significantly more strongly linked to usage than was ease of use" (Davis, 1989). Davis (1989) emphasised that PU and PEOU are people's subjective appraisal of performance and effort, respectively, and do not necessarily reflect objective reality.

Ako-Nai (2005) study

The Spearman rank-order correlation coefficients *r* were calculated for PU and AT; and PEOU and AT. They are reflected in Table 1 (below).

R	Before adjustment	After adjustments
Between PU and AT	0.238	0.238
Between PEU and AT	0.340	0.459

Table 1: Spearman rank-order correlation coefficients (Source: Ako-Nai, 2005: 59)

Ako-Nai (2005: 59–61) reported that the positive correlation coefficients between the variables PU, PEU and AT indicated a relationship between them (as postulated by TAM) and the strength of the relationship is measured by the indicated values (Freund *et al.*, 1993 cited in Ako-Nai, 2005). However, these values were low and this can be attributed to the low heterogeneous nature of the data results obtained. Ako-Nai reported that following an inspection of the raw data, there were very low variations in response (mostly in the range '5 – slightly agree' and '7 – strongly agree'). Ako-Nai further indicated that a similar result was obtained and highlighted in the Averweg (2002) study. Ako-Nai suggested that a positive but low correlation coefficient can also be attributed to the fact that the EIS at Unilever South Africa (Pty) Ltd is still at its earliest stage of diffusion in the organisation.

Ako-Nai indicated that it was his expectation (and in accordance with the TAM model) that the influence of PU on AT should be greater than that of PEOU on AT. However, the researcher experienced "surprise findings or a lack of expected findings" as there "was the reverse impact values of the two factors, PU and PEU, on AT" Ako-Nai (2005: 61). Ako-Nai found that the correlation factor of PEU on AT was higher (both before and after adjustments) than of PU – which is a contradiction of the expectations from the TAM postulated construct.

7.4 Averweg (2002) study and Ako-Nai (2005) study findings

A summary for each of the findings from the Averweg (2002) study and the Ako-Nai (2005) study is now presented.

Averweg (2002)
The Averweg (2008) study finding was that PEOU on intended use was greater than the effect of PU on intended use. As the researcher reported low correlation values, an investigation was made by him of the raw data. It was found that if a correlation coefficient is based on only three (out of seven possible different Likert-type scale categories), there is potential for a problem. For higher correlations, greater variation is required from respondents regarding their intended EIS use. In previous findings (see, for example, Al-Gahtani, 2001; Suradi, 2001) significantly higher correlation results were reported. Averweg (2008: 9) reported that while the low correlation results may be disappointing, this may be ascribed to the fact there were very small statistical variations in interviewee's responses.

While the Averweg (2002) study was limited to existing EIS in organisations in the EMA, the researcher felt that due to the similarities between the economy in KwaZulu-Natal and the rest of South Africa, the results can be considered as an approximate indicator for the South African economy. This means that although the researcher's results were limited, they do provide a meaningful reflection of EIS adoption in the EMA. The researcher concluded that in the Averweg (2002) study there was little evidence to support that the theoretical use aspects of TAM were echoed in EIS implementation in KwaZulu-Natal.

Ako-Nai (2005)
Ako-Nai (2005: 63, 62) reported that high emphasis on PEOU was recorded given respondent's comments on the flexibility of the EIS when compared to previous SAP/BW systems. According to these respondents, such previous IS lacked flexibility, were complex to use and were not user-friendly. On the other hand, since the EIS was more flexible and easy-to-use, the respondents responded positively.

PU scored a high mean value of 5.46. All the contributing factors to PU had mean score values above 5 ('slightly agree') except 'I can still do my work without EIS' and 'EIS provides me with all the information I need' factors. These two factors scored mean values of 4.21 and 3.93 respectively. The mean score value for the 'I can still do my work without EIS' factor suggested that end-users were still able to work and utilise other sources of information. The mean score value for the 'EIS provides me with all the information I need' factor suggested that end-users required additional information that was not available in the EIS. This was triangulated with the fact that respondents confirmed other sources of information: internal information (from other systems and SAP/BW) and external information (from Nielson database sources and customer information from customers). Ako-Nai (2005: 63) suggested that this finding may also be a contributing factor to the lower influence of PU on AT (when compared to PEOU on AT) and thereby weakened the perceived useful of EIS. The lower influence of PU was further supported when the respondents were asked whether they would continue to function effectively without EIS. While the respondents responded positively, they stated that it would be 'incredibly' difficult and some complexity will be experienced in obtaining all the information required to make decisions Ako-Nai (2005: 64).

The researcher in the Ako-Nai (2005) study concluded that for the respondents surveyed, the factors for PEOU and PU had a positive influence on respondents' attitude towards the EIS. The study results also highlighted that PEOU (when compared to PU) has a greater effect on end-users' attitude towards using the EIS.

7.5 Summary of the two TAM/EIS study findings

User acceptance of technology remains an important field of study in the IS discipline. While many models have been proposed to explain and predict the use of a system, TAM has been *the* model which has captured much attention of the IS community. Despite its frequent use, TAM has been widely criticised and original proponents have attempted to redefine it several times. Attempts by researchers to expand TAM in order to adapt it to constantly changing IT environments has led to "a state of theoretical chaos and confusion" (Benbasat and Barki, 2007).

The Averweg (2002) study and Ako-Nai (2005) study do not support the basic tenets of TAM. TAM has emphasised the importance of PU (over PEOU), as the key determinant of IT acceptance. Empirical evidence has constantly borne out this claim, leading to PEOU being treated as something of a 'stepchild' (Venkatesh, 1999). However, results of Venkatesh's research indicate that PEOU *can* be a strong catalyst fostering acceptance. Both the Averweg (2002) study and the Ako-Nai (2005) study partially support this finding, i.e. PEOU can be a stronger catalyst (over PU), in terms of fostering IT acceptance.

The Averweg (2002) study and Ako-Nai (2005) study both support Brown's (2002) findings that "perceived ease of use takes on increased importance, as it influences both usage and perceived usefulness". Doll, Hendrickson and Deng (1998) indicate that despite TAM's wide acceptance, a series of incremental cross-validation studies have produced conflicting and equivocal results that do not provide guidance for researchers or practitioners who might use TAM for decision-making purposes. One possible explanation for this is that human memory may not work in the same way that salient beliefs are processed in TAM. This may result in that the intention to use the EIS may not be representative enough of actual use – the time period between intention and adoption can be mitigated by decision-making uncertainties which may influence an individual's decision to adopt and use an IT. In a developing country in Africa, the conventional wisdom that PU is the main predictor of adoption, has been challenged (Anandarajan, Igbaria and Anakwe, 2002). It appears that application of the TAM model to IS (such as an EIS) in developing countries should be guided more by the specificities of local circumstances than by the performance of the TAM model in developed countries.

In summary then, the Ako-Nai (2005) study findings corroborated the earlier findings of the Averweg (2002) study. The four major findings (from *both* studies) are now summarised:

- Low correlation coefficients were calculated for the PU-AT and PEOU-AT constructs;
- The correlation for perceived usefulness-use was *lower* than for perceived ease of use-use, which is not consistent with Davis' findings;

- The results *partially* support Venkatesh's (1999) findings that PEOU can be a stronger catalyst (over PU) in fostering IT acceptance; and
- There is support for Brown's (2002) findings – wherein the PEOU-AT TAM relationship was higher than PU-AT.

7.6 Conclusion

Since the Averweg (2002) study and Ako-Nai (2005) study were conducted, pervasive computing has resulted in a move away from "the traditional desktop model of computing towards having technology embedded in the environment" (Connelly, 2007: 3). Future research may therefore need to be directed to investigating the role of other potential antecedents, in order to enhance IT adoption and assimilation variances in the EMA.

While it may be tempting to conclude that research on TAM may have reached a saturation level, future research should focus on developing new models that will exploit the strengths of the TAM model while discarding its weaknesses (Chuttur, 2009: 17). One suggestion in this regard, is investigating specificities of local circumstances and contextual factors such as experience, level of education, age, gender and socio-economic status conditions – to increase the final IT use prediction of EIS, in organisations in the EMA. Furthermore, general pervasive computing conditions in organisations in South Africa may serve as an appealing context in which to investigate IT adoption. Possible extensions to TAM should also be considered. Such IT acceptance studies should pay attention to issues of significance in assessing the contributions of variables explaining IT usage for decision-making by executives and managers in these organisations.

7.7 References

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8 Revisiting CSFs for decision-making support systems implementation in South Africa

8.1 Introduction

Organisation workplace dynamics are shifting with growing worker mobility and the need for quicker decision-making grows. In today's difficult economic times, organisations require the support of information systems (IS) to improve business performance and decision-making. In the discipline of IS, there are many decision-making support systems – popular ones under the broad category of Business Intelligence (BI) are Decision Support Systems (DSS) and Executive Information Systems (EIS). Organisations invest heavily in DSS and EIS to help users make better decisions. DSS are at the management level and EIS at the strategic level in organisations (Laudon and Laudon, 2007). Both such IS have been implemented in many organisations in developing countries. Implementation can be defined simplistically as getting a newly developed (or significantly changed) system to be used by those for whom it was intended – it is the 'software underbelly' of IS development. DSS and EIS implementation is usually brought about by a desire to improve business performance and decision-making.

Critical factors influencing IS implementation have been actively researched topics in the IS field (see, for example, Boon, Corbitt and Peszynski (2004); Salmeron and Herrero (2005)). The success of a well-designed IS can be seriously reduced by improper or inadequate attention to implementation issues. Organisational IS are often critical to the successful business performance and competitiveness of an organisation. The question arises whether the published critical success factors (CSFs) associated with the implementation of IS (such as DSS and EIS) in developing countries, are nowadays still *critical* (*i.e.* absolutely necessary) to improve business performance and decision-making in an organisation. An investigation of this question in the developing country of South Africa is the objective of this chapter.

This chapter is structured as follows: The CSF concept is introduced. Information Technology (IT) and IT in South Africa are then discussed. Thereafter BI is presented. Decision support for management is then briefly discussed. From the literature, CSFs for DSS and CSFs for EIS are then reviewed. From this review, some management implications and a future DSS and EIS implementation research agenda are suggested. Thereafter a conclusion is presented.

8.2 Critical Success Factors (CSFs)

The Critical Success Factors (CSFs) concept was developed to help identify the information needs of managers. CSFs for the whole field of IS have been systematically explored (see, for example, Boon *et al.*, 2004). Rockart (1979) defines CSFs as the few key areas of activity where 'things must go right' for the organisation to flourish and for a manager's goals to be attained *i.e.* favourable results are 'absolutely necessary' for a manager to reach his (or her) goals. CSFs are those areas of a project that are absolutely essential to its success (Vodapalli, 2009).

CSFs for an organisation are the limited number of areas in which results, if they are satisfactory, will ensure successful competitive performance for the organisation. They are the key areas where 'things must go right'. Human factors often make up CSFs *e.g.* top management support and a project champion (Somers and Nelson, 2001). Furthermore with the increasing move by organisations towards the Internet, the World Wide Web (hereinafter referred to as 'the Web') and Web-based technologies (*e.g.* portal technologies) are becoming integral to IS implementation initiatives. CSFs are areas of activity that must receive constant and careful attention from management. This chapter discusses published CSFs for the successful implementation of DSS and EIS in organisations in South Africa.

8.3 Information Technology (IT)

IT is rapidly changing and developing, especially due to the Web, altering the way in which IS are built. IT has changed the way in which organisations are doing business and plays an increasing important role in business performance and decision-making support. For example, social software is a key component of Web 2.0 which extends the collaborative decision-making process by allowing decision makers to discuss an issue, 'brainstorm' options, evaluate their pros and cons and agree on a course of action.

There are increasing trends in cloud computing, enterprise systems, predictive analysis, mobility, personalisation, data visualisation, green computing, portals and Intranet. The advent of the Internet has, for example, allowed an EIS to not only gather information from an organisation's existing Intranet but also externally through the Web and as a result EIS have become even more useful (Basu, Poindexter, Drosen and Addo, 2000). With the Internet, data and information are no longer a scarce resource and have a significant effect on decision-making support in organisations. For example, nowadays some organisations are investing in developing and leveraging business intelligence (BI) technology for improved collaborative decision-making. This means that the loci of focus of DSS and EIS has been expanded.

Many scholarly research articles on DSS still exist (see, for example, *Decision Support Systems* Journal, Imprint: Elsevier, ISSN: 0167-9236, eight issues per annum). While few articles are being written about EIS, they still exist because organisations have a need for EIS as the need for executive information remains (Wang, Xing and Yao, 2008).

IT in South Africa

It is essential for managers in developing countries to be sure that investment in IT is economically justified. In some organisations in South Africa, IT represents a significant ongoing capital expenditure. DSS and EIS are found in many organisations in South Africa.

The existence of research literature on DSS and EIS in South African organisations is contained in Strydom (1994), Chilwane (1995), Steer (1995), and Addison and Hamersma (1996), Khan (1996), Baillache (1997) and Averweg (1998) – during the pre-Internet era. This chapter focuses specifically on studies of CSFs for DSS and EIS implementation in the South African environment during the 1994–1998 period. The rationale for selecting this period is the availability of published DSS and EIS research findings. Furthermore from a scan of the literature it appears that no further and recent research has been undertaken in South Africa focusing on CSFs for DSS and EIS implementation. The author's chapter will therefore be useful to organisations which intend embarking on DSS and EIS implementation in the age of the Internet, the Web and Web-based technologies.

This chapter focuses on some of the non-technical issues for organisations embarking on DSS and EIS implementation programs. The scope of the research is limited to existing DSS in KwaZulu-Natal and existing EIS in Gauteng.

8.4 Business Intelligence (BI)

Business Intelligence is a broad category of applications and techniques for gathering, storing, analysing and providing access to data to help managers and executives in organisations make better business and strategic decisions (Oguz, 2003). BI employs a large number of techniques and tools. According to Turban, Rainer and Potter (2005), BI can be divided into two major categories:

- Information and knowledge discovery (*e.g. ad hoc* query, online analytical processing (OLAP), data mining, Web mining); and
- Decision support and intelligent analysis (*e.g.* DSS, executive and enterprise support, applied artificial intelligence).

Vodapalli (2009) suggests a list of seven CSFs for BI implementation and these CSFs (in alphabetical order) are reflected in Table 1.

Business driven methodology and project management
Clear vision and planning
Committed management support and sponsorship
Data management and quality issues
Mapping solutions to user requirements
Performance considerations of the BI system
Robust and extensible framework

Table 1: CSFs for the Successful Implementation of BI
(Source: Adapted from Vodapalli, 2009)

8.5 Decision Support for management

Changes in IS technology have produced a significant revolution in opportunities for improved managerial performance. Information is one of the key inputs in the decision-making process. An important key to the success of IS is its ability to provide users with the *right information* at the *right time*. DSS and EIS are examples of two such IS to assist managers and executives for improved decision-making. These IS are the focus of this chapter.

DSS

Executives recognise that IS allow organisations to compete and sometimes even survive. A DSS is "an interactive computer-based system or subsystem intended to help decision makers use communications technologies, data, documents, knowledge and/or models to identify and solve problems, complete decision process tasks, and make decisions" (Power, 2007). Clearly there is a need for improved decision-making for business performance in organisations.

EIS

Definitions of EIS are varied but all identify the need for information to make decisions about the business as the most important reason for the existence of EIS. An EIS is used by executives to extract, filter, compress and track critical data. EIS applications support executive information needs and decision-making activities. 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, Houdeshel and Rainer, 1997). Classified as high-risk projects, just like any other IS projects, organisations have been cautious and critical in ensuring EIS successful implementation (Ako-Nai, 2005). Traditional EIS has given way to Web-based resources (Basu *et al.*, 2000).

8.6 CSFs for DSS

The works of Guimaraes, Igbaria and Lu (1992) and Kivijärvi and Zmud (1993) suggest conditions which are critical to the successful implementation of DSS. Averweg and Erwin (1999) combined the conditions suggested by these researchers as being critical to the successful implementation of DSS and formed Table 2 reflecting nine CSFs. Averweg and Erwin (1999) targeted 27 sizeable and well-established organisations in KwaZulu-Natal that have DSS experience. Of the nine previously identified CSFs, only five were completely ('totally') supported by the highest total scoring group of surveyed organisations – see Table 3.

Top Management Support
User Involvement
User Training
Information Source
Level of Managerial Activity Being Supported
User Information Satisfaction
Relative Use
Perceived Utility
Goal Realisation

Table 2: CSFs for the successful implementation of DSS

CSF
Top Management Support
User Involvement
User Training
Relative Use
Perceived Utility

Table 3: CSFs 'totally' supported by all organisations from the highest total scoring group

The four CSFs 'totally' not supported by all organisations from the highest total scoring group of surveyed organisations are shown in Table 4. A summary of CSFs identified by the authors' survey as "absolutely necessary" (Rockart, 1979) for organisations embarking on a DSS implementation program is shown in Table 5. Only one of the CSFs in Table 5 (Top Management Support) partially 'matches' a CSF in Table 1 (Committed management support and sponsorship).

CSF
Information Source
Level of Managerial Activity Being Supported
User Information Satisfaction
Goal realisation

Table 4: CSFs 'totally' not supported by all organisations from the highest total scoring group

CSF
Top Management Support
User Involvement
User Training
Relative Use
Perceived Utility
Appropriate DSS Tools

Table 5: Summary of CSFs necessary by organisations embarking on a DSS implementation program

8.7 CSFs for EIS

The goal of EIS is to provide top management with immediate and easy access to data and information about an organisation's CSFs. 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).

The basis of Steer's (1995) research "was to identify the critical success factors for the successful implementation of an Executive Information System…where an EIS had been implemented" in organisations in Gauteng. An 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 6. None of these CSFs in Table 6 'match' those CSFs in Table 1. Steer (1995) 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). The researcher labels these CSFs as 'secondary' CSFs for the successful implementation of EIS and are discussed in Averweg (2009).

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
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

Table 6: The top ten CSFs for the successful implementation of EIS
(Source: Adapted from Steer,1995)

8.8 Management implications

Table 5 shows that organisations embarking on DSS implementation must ensure that six CSFs, *viz.* Top Management Support, User Involvement, User Training, Relative Use, Perceived Utility and Appropriate DSS Tools are properly addressed during the implementation process as these CSFs were found to be present in **all** successful organisations. The findings by Averweg and Erwin (1999) suggest that the remaining four CSFs may not be critical, in the sense that they are "absolutely necessary" to ensure success (Rockart, 1979). This does not imply that the remaining four CSFs (see Table 4) need not be addressed but the author contends that it may be inappropriate to regard the remaining four CSFs as 'critical'. Consequently, a contingency approach is suggested by labelling them as "important but not essential for success" (Averweg and Erwin, 2000).

In the EIS research undertaken by Steer (1995), he suggests that "South African executives require a set of guidelines that can help the identified the full implication of implementing an EIS, which will allow them to build a solid foundation from which to implement a successful system". The aim of the research was to provide local executives with a benchmark against which they can develop a sound EIS foundation from which a successful EIS implementation can be built. The ten CSFs for the successful implementation of EIS (in South Africa) are reflected in Table 6 and are seen as 'absolutely necessary'.

The author contends that in South Africa **not** all previously identified CSFs for the successful implementation of DSS and EIS are 'critical'. The existence of the other success factors is, however, recognised. The author suggests a contingency approach by labelling some of the identified CSFs for DSS and EIS implementation as 'of secondary importance but not essential for success'. Furthermore with the increasing move towards the Internet, the Web and Web-based technologies are having a "major impact on systems that support decision making" (Laudon and Laudon, 2007), there is a need to revisit the CSFs for the successful implementation of DSS and EIS in South Africa. Ten pointers are suggested towards a future CSFs for DSS and EIS implementation research agenda:

- **Cloud computing**. Cloud computing intersects with decision-making support systems as employees become more mobile and have multiple Internet-enables devices;
- **Enterprise systems**. Enterprise systems supply managers and executives with powerful analytical tools for analysing and visualising data *e.g.* an executive dashboard on a desktop may allow faster decision-making, identification of negative trends and a better allocation of business resources in an organisation;
- **Predictive analysis**. Predictive analysis combines known information with critical insight helping solve problems and uncover hidden patterns not easily solved through reports or dashboards;
- **Mobile**. The intersection of wireless devices and decision-making support systems allows mobile business executives and users to more easily view and interact with the same analytics as found on their desktop;

- **Personalisation**. Web portal technologies provide greater flexibility in determining the data and information a manager or executive 'sees' on his desktop. Personalisation of data can facilitate decision-making by enabling users to filter out irrelevant data or information (Laudon and Laudon, 2007);
- **Data visualisation**. This refers to the *best* representation of data to aid in the exploration of the information being visualised;
- **Green computing**. Virtualised paper reports on business performance can be distributed over the Web. Furthermore organisations have the ability to transform their ageing data centres with low environmental impact;
- **Intranet and portals**. Intranet and portal technologies create organisation-wide networks that facilitate the flow of information across organisational divisions and business units;
- **Emergence of collaborative decision-making**. This combines social software with BI. It is envisaged that this combination may significantly improve the quality of decision-making by directly linking data and information contained in BI systems with collaborative input gleaned by the use of social software (*e.g.* adding annotations or notes with comments on business reports); and
- **Loci of focus**. DSS and EIS were previously 'inwardly centric' IS in organisations. They did not rely on external data and information which is nowadays available via the Internet and on the Web. Future DSS and EIS implementation will have to ensure that such IS gain the benefit of external data and information and become 'externally centric' and thereby widen their loci of focus.

8.9 Conclusion

With the increasing amount of IT investment and substantial evidence of failures, IS implementation evaluation has become a key management issue. The author contends that wise judgement is needed when deciding on the selective use of IS and feels that this is particularly relevant to DSS and EIS implementation in the current difficult economic times.

Special care is needed when implementing DSS and EIS because of their major potential importance to an organisation's business performance and decision-making. It is suggested that instead of trying to 'catch up' with the industrialised world, South Africa follows the route that extreme care must be exercised by all parties involved in the transfer of technology from one country to another. CSFs for DSS and EIS should serve South Africa's own needs rather than echoing those of developed countries. The Internet, the Web, Web-based technologies and social networking have accelerated developments in decision-making support and provide a new research focus area for CSFs for DSS and EIS implementation.

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Glossary of terms

Analytical processing: Involves analysis of accumulated data, frequently by end-users in an organisation. Analytical processing activities include data mining, decision support and querying.

Business Intelligence: Business Intelligent systems combine data gathering, data storage and knowledge management with analytical tools to present complex internal and competitive information to planners and decision-makers.

Communications-driven DSS: Systems built using communication, collaboration and decision support technologies.

Corporate portal: World Wide Web site that provides the gateway to corporate information from a single point of access.

Critical Success Factors (CSFs): Those key areas of activity in which favourable results are *absolutely necessary* for a particular manager to reach his or her goals.

Data cube: In a multidimensional database, data can be viewed and analysed from different views or perspectives, known as business decisions. These dimensions form a cube.

Data-driven DSS: These systems analyse large "pools of data" found in major organisational systems and they support decision-making by allowing users to extract useful information that was previously buried in large quantities of data.

Data warehouse: A repository of subject-oriented historical data that is organised to be accessible in a form readily acceptable for analytical processing activities.

Decision-making: A three-stage process involving intelligence, design and choice.

Decision Support System: An interactive, flexible, and adaptable computer-based information system, specially developed for supporting the solution of a non-structured management problem for improved decision-making.

Document-driven DSS: These systems integrate a variety of storage and processing technologies to provide complete document retrieval and analysis.

Enterprise portal: Secure Web locations that can be customised or personalised that allow staff and business partners to, and interaction with, a range of internal and external applications and information sources.

Executives: Corporate knowledge workers responsible for corporate strategic management activities.

Executive Information System: A computerised system that provides executives with easy access to internal and external information that is relevant to their critical success factors.

Expert System: An IS which provides the stored knowledge of experts to non experts.

Extranet: A secured network that connects several Intranets via the Internet; allows two or more organisations to communicate and collaborate in a controlled fashion.

Information System (IS): A combination of technology, people and process to capture, transmit, store, retrieve, manipulate and display information.

Knowledge-driven DSS: These systems contain specialised problem-solving expertise wherein the "expertise" consists of knowledge about a particular domain.

Management Science: An approach that takes the view the managers can follow a fairly systematic process for solving problems.

Model-driven DSS: Model-driven DSS emphasise access to and manipulation of a model.

Pooled interdependent decision-making: A joint, collaborative decision-making process whereby all managers work together on a task.

Portal: Access to and interaction with relevant information assets (information/content, applications and business processes), knowledge assets and human assets, by select target audiences, delivered in a highly personalised manner.

Semi-structured problem: Only some of the intelligence, design and choice phases are structured and requiring a combination of standard solution procedures and individual judgement.

Structured problem: The intelligence, design and choice phases are all structured and the procedures for obtaining the best solution are known.

Unstructured problem: None of the intelligence, design and choice phases is structured and human intuition is frequently the basis for decision-making.

Web-based technology: A technology that did not exist prior to the World Wide Web ("the Web") and utilises core Internet and Web technologies as the platform on which the solution operates.

Wireless Application Protocol (WAP): A set of communication protocols designed to enable different kinds of wireless devices to talk to a server installed on a mobile network so users can access the Internet.

World Wide Web ("the Web"): An information space consisting of hyperlinked documents published on the Internet.

Editorial review

Decision-making support systems: Theory and practice by Udo Averweg is a valuable contribution to the contemporary literature on Decision Support Systems (DSS). Its value is in the coverage not only of the basics but also of its broader relationship to Executive Information Systems, of the impact of contemporary web based technologies on the field, of the exploration of the applicability to the DSS field of the most widely used Information Systems research method – the Technology Acceptance Model and the review of critical success factors for decision support systems implementation.

Some academic researchers have lost interest in this field in its traditional format as they are typically driven by the current fashion wave in the Information Systems field. That has limited the research interest in DSS mainly to Business Intelligence, discussed briefly by the author in the last chapter. However the coverage of the topics in this book is relevant both for the general research issues in DSS and for the practitioner understanding of the field. The latter is important as current books on DSS are rare while most of the implementation issues for Decision Support Systems need continuous and patient work on a daily basis and this book can be used as a valuable reference for that purpose. The value of the book as a reference for future practical and research work is considerable also because of the excellent collection of literature sources listed at the end of each chapter. The only omissions from those are the work of Steven Alter, whose 1980 DSS book was very influential; the reviews of the DSS field by Sean Eom and the more recent work by Graham Pervan.

The content of the book is a reflection of the author's deep practical experience and a focused fifteen year research program in Decision Support Systems. Some of the chapters are based on research by the author on DSS topics focused on South Africa and Spain, while others have appeared previously as reviews of the state of the art in several specialized encyclopedia on DSS related topics. I believe this book will have an impact on the international audience interested in learning more about understanding, researching, using and implementing Decision Support Systems.

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