



IMPROVING SYSTEM DEVELOPMENT METHODS
BY INCORPORATING THE PRINCIPLES OF
KNOWLEDGE MANAGEMENT

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DECLARATION

I declare that this research report is my own, unaided work. It is submitted for the degree of Master of Commerce in the University of the Witwatersrand, Johannesburg. It has not been submitted before for any other degree in any other university.

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ABSTRACT

Business managers have used principles of Knowledge Management to improve organisational performance by:

- o Identifying the knowledge that is needed to solve various problems
- o Acquiring the needed knowledge from sources that already have it
- o Creating the needed knowledge if it is not yet available
- o Validating the acquired or created knowledge
- o Retaining the validated knowledge
- o Destroying invalid or obsolete knowledge
- o Representing the knowledge in a consistent, easily readable format
- o Enabling people to easily access relevant knowledge
- o Enabling people to share the retained knowledge
- o Enabling people to apply the retained knowledge to improve performance

Statistical analysis of data obtained from 84 respondents confirmed that information systems practitioners can also benefit from applying the principles to their system development methods.

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CHAPTER 1: INTRODUCTION

1.1 BACKGROUND

Over the last few years two topics continue to appear at the top of the management agenda: Information Technology and Knowledge Management. Regarding Information Technology (IT), managers find themselves caught between the need for technological innovation and the reality of large-scale technology failures. So, one of the most challenging tasks in organisations is developing IT systems that create value for the organisation. One way that IT practitioners attempt to improve these systems is to utilise System Development Methods (SDM). These SDM's aim to improve the management and control of software development, and standardise the development process and product by specifying the activities that need to take place (Wynekoop and Russo, 1995, Lyytinen, 1987). Current SDMs have achieved these objectives with varying degrees of success (Avison et al. 1992). So IT practitioners are seeking ways of improving the SDMs in order to create more successful systems.

Knowledge management is defined by the Gartner Group as follows;

"KM is a discipline that promotes an integrated approach to identifying, managing and sharing all of an enterprise's information assets. These information assets may include databases, documents, policies and procedures, as well as previously unarticulated expertise and experience resident in individual workers" (Bair, 1999), and has been recognised as a management imperative to create and drive business value (Davis et al. 2004; Parlbay, 2000).

Senior executives in major organisations in the United States and Europe repeatedly indicate that knowledge is the most important asset in their organisations (Wiig, 1994). When organisations manage their knowledge effectively by ensuring that proper knowledge is made available and accessible to every knowledge worker, and by ensuring that it is used correctly, some of the business effects are: better products, better service, greater internal effectiveness and increased sales and profits. In fact many authors (e.g. Bresman et al, 1999 and Wiig, 1997) agree that the "winners in tomorrow's market place are the masters of knowledge management." This vision is repeated by Prusak (1998), who believes that what you know and how fast you can put it to use is the only sustainable competitive

advantage due to the growing complexity of work, products and the nature of organisations. This view is also supported by a survey of American and European executives where 87% believe their environment was “knowledge intensive” and 94% believed knowledge was a key to competitive advantage (Ruggles, 1998).

1.2 STATEMENT OF THE PROBLEM

With the emergence of a global society, companies are facing increased pressure to “do more with less”, by utilising their most valuable asset: their knowledge. According to Wiig (1994) organisations that manage their knowledge effectively have increased sales and profits. Since information system is a ‘factory within a factory’, and KM has had a positive influence on organisations, one would expect that it may also have a positive influence on SDM.

Organisations implement SDM's in order to assist them in developing information systems that would help them gain a competitive advantage, while avoiding the likely possibility of system failure. However SDMs so far have had varying degrees of success (Wynekoop and Russo, 1995) and deficiencies have been found as a cause of IS failure (Lyytinen, 1987). Therefore factors that lead to successful system development methods need to be identified in order to aid IT practitioners in selecting and modifying those methods. As KM has had success in improving organisations, these same principles need to be tested within system development methods. It is also important that the conditions under which the success occurs are determined.

The purpose of this study is to identify principles of KM, by a review of the literature, and determine whether the incorporation of these principles in the SDM results in improved information systems.

Therefore the following research question arises:

Under what conditions can the success of System Development Methods be improved by incorporating principles of Knowledge Management?

1.3 IMPORTANCE OF THE RESEARCH

Recent surveys have found that KM has provided organisations with the following benefits; improved effectiveness, delivered customer value and increased innovation (Sharp, 2003). Numerous authors have also argued that if businesses are to sustain their competitive advantage it is vital that they manage their knowledge as effectively as possible (Bresman, 1999; Wiig, 1997). The IBM study (2004) found that

"KM is a subject which is still highly relevant to innovation in the 21st-century business enterprise. In addition, KM is an important underlying discipline to how a modern business operates. "

According to Wiig (1994), with the emergence of the global society, managers and business commentators alike have observed that knowledge is the basic ingredient underlying the modern organisations success, because in order for organisations to compete successfully they are now asked to act intelligently with better knowledge more then ever before and to constantly improve to keep ahead. Several companies have claimed significant competitive advantage from KM. Some of the improvements claimed are:

- o Consistent quality
- o High performance products
- o Flexibility in offerings
- o Rapid volume changes
- o Fast reliable deliveries.

Martin (2000) posits that knowledge has become increasingly important because of the increased pace of globalization, and the interaction of technology and organizational change. Another reason for the rising valuation of knowledge in organizations is that it is no longer defined as just an input to businesses today; frequently, it is seen as the objective of the company. Bhatt (2001) elaborates by stating that the industrial economy that is based on goods and services is being

matched and in some cases displaced by a global knowledge economy, based on the production, distribution, and use of knowledge. According to Velker (1999) both business and academic communities believe that by leveraging knowledge, an organisation can sustain its long-term competitive advantages and that applying knowledge management principles are instrumental in reducing operating costs and improving organisational performance.

Seeing as information systems are important knowledge assets (Armour, 2000) it is necessary to determine whether the incorporation of these knowledge management principles into the methods used to develop systems is occurring and whether it improves the success of the resulting system.

Currently there is no research examining the impact of knowledge management principles on the success of system development methods. This study also provides additional insight into the types of system development methods that incorporate knowledge management principles and the conditions under which the incorporation of these principles is favourable.

This study will aid both fellow academics and practitioners in the IS field. It will add to the body of knowledge that can be taught to students in courses on knowledge management in IS. It will also help IS Managers to select and modify their system development methods in order to develop successful information systems.

1.4 AIMS AND OBJECTIVES OF THE RESEARCH

The types and uses of system development methods are well documented, but with a high percentage of information systems failing, the factors that result in successful SDMs are still unclear. Armour (2000) speculated that an information system's success would improve if knowledge management were applied. The objective of this research is to amplify and test Armour's hypothesis. This will be done using the classic approach of hypothesis formulation followed by empirical confirmation.

The findings will determine whether the incorporation of knowledge management principles within System Development Methods increases the success of the resulting systems.

1.5 OUTLINE OF THE RESEARCH REPORT

Chapter 1: Introduction

This chapter introduces the topic of KM and SDM. The chapter includes an overview of the reasons for the incorporation of KM principles in SDM.

Chapter 2: Literature Review

This chapter examines literature specifically related to the research problem. It shows that many researchers have addressed parts of the research problem but have failed to apply KM principles to SDMs. It identifies a specific question that has not yet been answered.

To begin to answer these questions, a model was developed to identify the interaction between the KM principles and SDM. Individual hypotheses are presented here with theoretical grounding to provide substance and lend credibility.

Chapter 3: Research Methods

The research methods used to test the hypotheses are described and justified. Constructs are conceptualised and operationalised in order to accurately measure the variables. Appropriate sample and data collection methods are selected along with statistical techniques to analyse the data.

Chapter 4: Data Analysis

Results are first presented at a descriptive level. To ensure validity of the conclusions, missing data and outliers were examined. The hypotheses are tested using correlation analysis.

Chapter 5: Discussion

The research results are interpreted in this chapter against the theoretical background in the literature review. The discussion is structured around the research objectives.

Chapter 6: Conclusion

Conclusions and implications are drawn from the research findings. A brief summary of the research report as well as its importance is presented with recommendations for future research. The limitations of the study are also identified.

1.6 CONCLUSION

This chapter established the importance of knowledge management, and suggested that the incorporation of these principles into the SDM could improve their success. It also suggested that there is a lack of IS literature on knowledge management within system development methods.

The subsequent chapters will determine whether the success of a SDM can be improved by incorporating KM principles.

CHAPTER 2 : LITERATURE REVIEW

2.1 CHAPTER OVERVIEW

This chapter identifies relevant knowledge management principles and indicates that previous researchers have not yet tackled the research problem.

The literature revealed that ten knowledge management principles, which will be described in this chapter, that have been successfully applied to business in order to improve performance:

- o Knowledge identification (Probst et al. 1999; Duffy, 1999)
- o Knowledge acquisition (Probst et al. 1999; Mphahlele and Kutu, 2002; Duffy, 1999)
- o Knowledge creation (Lahti and Beyerlein, 2000; Bhatt, 2001; Bryant, 2003; Mphahlele and Kutu, 2002)
- o Knowledge validation (Bhatt, 2001)
- o Knowledge retention (Probst et al. 1999; Wiig et al. 1997; Duffy, 1999 and 2000)
- o Knowledge destruction (Naidoo, 1999)
- o Knowledge representation (Lahti and Beyerlein, 2000; Bhatt, 2001)
- o Knowledge accessibility (Lahti and Beyerlein, 2000; Duffy, 1999)
- o Knowledge sharing (Probst et al. 1999; Lahti and Beyerlein, 2000; Bhatt, 2001; Bryant, 2003; Mphahlele and Kutu, 2002; Duffy, 1999)
- o Knowledge application (Probst et al. 1999; Bhatt, 2001; Bryant, 2003; Mphahlele and Kutu, 2002)

Yet no one has formally applied these principles to system development methods.

2.2 KNOWLEDGE MANAGEMENT PRINCIPLES

Knowledge Management can be traced back to Alfred Marshall (1920) who argued that people would pick up valuable ideas; and Max Weber (1922) who stated that organisations have the ability to learn from experience (Argote, McEvily and Reagans, 2003). Although these concepts have existed for some time, KM as a discipline is still emerging. It is also a topic that spans numerous areas of study, such as economics, information systems, organisational behavior and sociology (Davenport, 1998).

In order to examine the principles of KM the concepts underpinning it need to be examined. The concepts of data, information and knowledge are clarified with the following framework (Duffy, 1999):

- o Data is raw text, numbers, images and sounds
- o Information is processed data presented meaningfully within a given decision-making context
- o Knowledge is both an interpretation of information and a value-added application of that interpretation. It provides an understanding of why and how things work, or the step-by-step skills for accomplishing a task. "Knowledge is what drives many people's behaviors. It evolves continuously as they learn through interpretation of what is presented to them every day data can be described as the raw facts, while information provides the results from analysing or interpreting data " Bourdreau and Couillard (1999).

From a cognitive perspective knowledge is used on four conceptual levels (Wiig, 1994):

1. Idealistic knowledge: is knowledge that is selected or partly understood that is used to represent a concept. This knowledge enables the creation of new ideas.
2. Systematic knowledge: is knowledge that is more theoretical and systematic. This knowledge provides an understanding of how to proceed.
3. Pragmatic knowledge: is knowledge that pertains directly to a task and is used to provide an understanding of "how things work".
4. Automatic knowledge: is knowledge that is so familiar that it is used without thinking explicitly about it. This knowledge is used to make minute decisions and perform detailed knowledge work.

Armstrong et al. (1998) classify knowledge on a continuum between tacit and explicit. It is along this continuum that the nature of knowledge shifts from being complex, intangible and difficult to transfer to being simple, measurable and easily taught. Nonaka (1991) suggests

that making tacit knowledge explicit creates knowledge. This is done by knowledge passing through the following stages:

- o Socialization is the transferal of tacit knowledge from one individual to another, e.g. mentorship.
- o Externalization is when tacit knowledge, residing within an individual, is communicated to others, thereby creating explicit knowledge.
- o Combination is when explicit knowledge is standardized and recorded.
- o Internalization is when others then internalize explicit knowledge.

Garvin (1993) argues that Nonaka's spiral of knowledge does not provide sufficient insight for practitioners to act on, as the managerial principles are not clear. Ruggles (1998) supports Garvin's objection because in order to grasp the management of knowledge, the focus of research in this area should move away from describing knowledge, to focusing on principles that managers can apply.

Throughout the literature on Knowledge Management the terms principles, process, activities and objectives have been used interchangeably. In order to achieve consistency the term Knowledge Management principles has been used here to describe a collection of activities and objectives applicable to KM. From a review of the literature the following model of the KM principles was derived in order to assist in explaining these concepts.

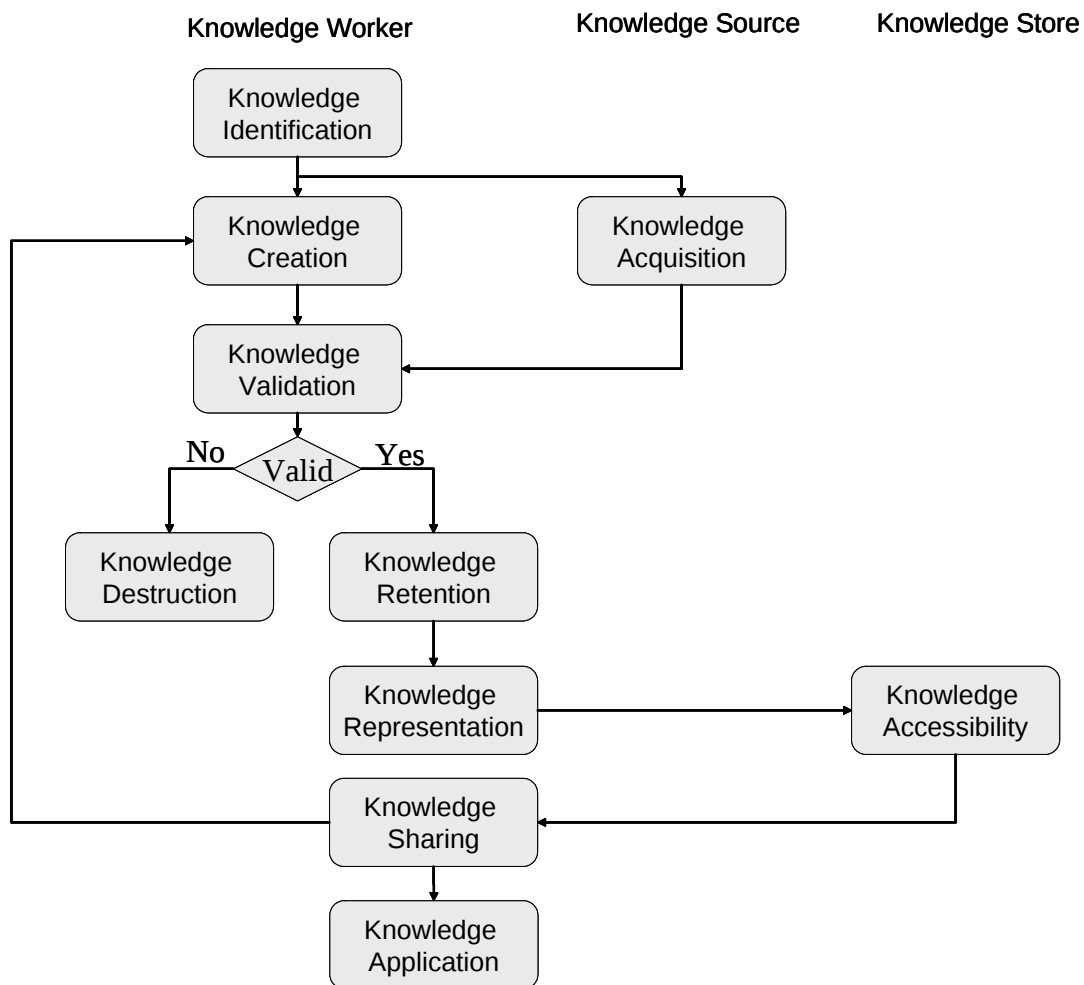


Figure 1: Model of KM Principles

- o **Knowledge identification** is the process of identifying the knowledge that is required to solve problems. Knowledge identification involves identifying the required knowledge sources, which may be people or documents. It also pertains to the concept of idealistic knowledge which Wiig (1994) describes as knowledge used to understand a concept.
- o **Knowledge acquisition** is the process of acquiring the necessary knowledge from the identified knowledge sources either internally or externally to the organisation.
- o **Knowledge creation** is the process of creating the required knowledge. Knowledge creation addresses the issue of knowledge gaps that are crucial for maintaining a competitive advantage (Wiig et al. 1997).
- o **Knowledge validation** is the process of validating the accuracy and applicability of the acquired or created knowledge. Determining the value of existing knowledge is an important aspect of knowledge management (Mphahlele and Kutu, 2002).
- o **Knowledge retention** is the process of retaining the required, validated knowledge. KM improves organisations if lessons from experience are embedded into information repositories, work processes and support systems (Cross and Baird, 2000; Duffy, 2000).

- o **Knowledge destruction** is the process of destroying invalid knowledge. This ensures that knowledge that is no longer applicable in the current context is archived or destroyed.
- o **Knowledge representation** is the process of capturing knowledge into a consistent, readable format that can easily be stored and therefore shared.
- o **Knowledge accessibility** is the process of ensuring that the represented knowledge is accessible to others. Accessible knowledge facilitates retrieval, which enhances the knowledge environment by creating a culture that enables knowledge sharing (Davenport et al. 1998).
- o **Knowledge sharing** is the process of ensuring that the knowledge that has been made accessible is disseminated. One of the most important aspects of KM is knowledge sharing because successful knowledge sharing implies that the received party accumulates new knowledge (Bresman et al. 1999 and Buckman, 1998). Song et al. (2003) support this by stating that knowledge sharing leads to knowledge creation. Argote et al. (2003) found that there is a relationship between knowledge sharing and knowledge retention because in order for knowledge to be shared it needs to be retained.
- o **Knowledge application** is the process of utilising the acquired or created knowledge for its intended purpose. This ensures that the existing knowledge is applied productively and effectively to affect the performance of the organisation or information system, as well as ensuring that where possible reuse occurs. Bryant (2003) states that for effective knowledge management to occur it is important for an organisation to examine the impact of the utilised knowledge on the success of the business unit and business initiatives respectively.

The model of KM principles has been synthesized from the literature, although as is evident from the summary below, no one has previously produced a comprehensive list of KM principles.

- o Duffy (1999 and 2000) identified the following knowledge management principles or activities: knowledge identification, acquisition, storage, access, distribution and application.
- o Davenport et al. (1998) identified the following knowledge management objectives or principles: store knowledge in repositories (this facilitates knowledge retrieval and improves knowledge access), enhance the knowledge environment (this creates a culture that enables knowledge transfer).
- o Probst et al. (1999) identified the following as the core processes of KM that have been utilized in organisations to improve performance: knowledge identification, knowledge acquisition, knowledge development, knowledge sharing and distribution, knowledge utilization, and knowledge retention.
- o Lahti and Beyerlein (2000) stated that KM is best understood in terms of

four key interrelated components: knowledge generation, knowledge representation, knowledge accessibility, and knowledge transfer.

- o Bhatt (2001) identified five major KM activities: knowledge creation, knowledge validation, knowledge presentation, knowledge distribution, and knowledge application.
- o Bryant (2003) extended the principles of KM to include three key processes of creating and sharing knowledge, and examining its impact on the success of business units and business initiatives.
- o Moore (1998) found that the success of KM initiatives is dependant on the integration of knowledge sharing, creation and retention into specific business processes.
- o Birkinshaw and Sheehan (2002) developed the concept of the knowledge life cycle and mentioned appropriate strategies for managing ideas at each stage of the cycle. The knowledge life cycle can be represented as a simple S-curve. Along the curve, knowledge progresses through four stages of creation, mobilization, diffusion and commoditisation. These four stages relate back to the knowledge principles of knowledge generation, knowledge application, knowledge sharing and knowledge retention.
- o Wiig et al. (1997) stated that knowledge management incorporates the following aspects: knowledge identification, knowledge acquisition, knowledge storage and access, and finally knowledge application and destruction. These principles are crucial for maintaining a competitive advantage.
- o Naidoo (1999) related the Knowledge Management principles to the stages of a product life cycle. The market development phase, involving research and development, would relate to the KM principles of knowledge identification and acquisition, which involve conversion of data and information into knowledge. The maturity phase would relate to the knowledge principles of sharing, accessibility and application, which are described as being the most technologically dependent phase. As the knowledge that an organisation acquires becomes more useful it is crucial that this knowledge is organised and stored effectively. The last phase of market decline would be related to knowledge retention or destruction.
- o Nonaka (1991) presented a model of the knowledge cycle and processes that was adopted by the Gartner group. The cycle incorporates the principles or activities of creation, capture, organising, access and use.

With the identification of these KM principles the question arises: why are they relevant to system development methods? Armour (2000) argues that “software is not a product it is a knowledge-storing medium”. About 50 years ago, the human race found another place to store knowledge – software, and it is growing at an astonishing rate. Vast numbers of people

are employed to gather knowledge from many sources, understand it, classify it and translate it into this medium. The value of the software is not the code but the knowledge that the code contains. Code that “works” encompasses: what the user wants to do? Under what conditions will the code work? etc. Each of these answers is a component of knowledge that must first be understood and inserted into the software.

Armour (2000) further argues that of the five knowledge storing media – DNA, brains, hardware, books and software – software is the medium of choice. It has all the characteristics valued for a knowledge storage medium: it is persistent, quick to update, intentional and most of all it is active. Storing knowledge in software allows the knowledge to be executed. This is incredibly important because doctors for example are putting medical knowledge in software. It is not the knowledge of software that is being captured; it is the knowledge of medicine – software is simply the storage medium.

Therefore if information systems are knowledge media they should be managed like knowledge, and the KM principles should be applied to the process used to develop them – the SDM. The following section examines typical SDMs and the literature in this area to determine whether KM principles are being applied.

2.3 SYSTEM DEVELOPMENT METHODS

As the use of information systems has grown, so too has the cost of poor quality and productivity in system development, while improvements have been shown to deliver proportionally greater benefits in profitability (McNamara, 1987; Russo and Stolterman, 2000). However the development of computer systems is a complex process, one with many opportunities for things to go wrong. In order to improve the management of the development process and thereby control the likelihood of error in the system design and development process, System Development Methods were developed, by specifying the steps that need to be done in order to produce an information system (Russo and Stolterman, 2000; Sprague and McNurlin, 1993).

A SDM is usually defined as a collection of procedures, techniques, tools and documentation aids which help the system developers in their efforts to develop and implement a new information system. It consists of phases, themselves consisting of sub-phases, which guide the system developers in their choice of the techniques that might be appropriate at each stage of the project and also help them plan, manage, control and evaluate information systems projects (Avison et al, 1992 and Sakthivel, 1992).

One of the most important challenges faced by system developers is the selection of the systems development method. The method chosen will have a large impact on different aspects of development. However, according to Wynekoop and Russo (1995) there has been little empirical evaluation of methods in use, or evaluation of the selection, development, adoption or use of methods in practice. Most research to date has focused on the development of new methods and frameworks rather than on their evaluation in practice. Russo and Stolterman (2000) reiterated that few studies have examined the application of methods. Lyytinen (1987) further emphasises this point by stating that by failing to evaluate the current state of methods, practices and needs, researchers may develop methods that are not only irrelevant but also flawed. In turn systems produced using these methods may be unsuccessful. By evaluating SDMs that incorporate KM principles and the extent to which this improves the system being produced, the present research may help IT practitioners develop and select SDMs that work.

The most practical way to evaluate and compare methods is to classify them according to their features, including the stages of the systems development lifecycle that they encompass, and deliverables and the techniques used (Olle et al. 1982). A classification of system development methods according to features can be done as follows: structured approach (SDLC), prototyping/iterative approach, rapid application development (RAD) and object orientated (Russo et al. 1995).

Structured approach (SDLC)

The SDLC evolved primarily during the 1970s, in response to the organisations need to better organise, plan and schedule projects. Methods closely related to the SDLC include the Waterfall model, which allows some overlap between phases, and the V Model, which emphasizes quality assurance (Knight et al. 2001).

The SDLC is based on two principles: dividing projects into phases, and using written documentation and approvals to maintain control. It typically includes the following phases: initial investigation, requirements definition, system design, coding, implementation and ongoing support (Knight et al. 2001). With its emphasis on documentation and quality assurance it can be assumed that it incorporates elements of knowledge representation and validation. However a criticism of the SDLC has been its inefficiency at sharing information both between phases and with the ultimate users. It is also does not formally employ any knowledge retention and application mechanisms. It is suspected that this would make reuse of knowledge difficult and thereby decrease efficiency.

Prototyping/iterative approach

By the mid-1980s, prototyping brought a more iterative dimension to system development methodology. Prototyping advantages include improving both user participation in system development and communication among project stakeholders; so the principle of knowledge sharing is improved with this method (Knight et al. 2001). However, Janson and Smith (1985) stated that in prototyping designers might neglect documentation, resulting in inadequate records for the future and therefore inadequate knowledge representation and accessibility. According to Sakthivel (1992) it is vital that an SDM document the knowledge that has been acquired during the development process and those templates are part of the SDM in order to ensure consistency and readability. The extent to which prototyping incorporates the other KM principles is uncertain.

Rapid application development

During the late 1990s and early 2000s, rapid application development (RAD) was created with the intention of being a lighter, faster, more flexible and responsive approach to development (Knight et al. 2001). It is defined as

“a framework for building software systems to meet tight time constraints through the use of an incremental development process supported by advanced software engineering technology and active user involvement” (McConnell, 1996).

Achieving rapid development entails a focused effort to cut out activities that add time to development this has led an increase in reuse where possible, which points to the principle of knowledge application; however it has been criticized for replacing initial requirements definition with extensive design and reducing documentation which may point to inadequate knowledge identification and representation. Knowledge acquisition is not a strength of RAD and it has been proved that it is important that an SDM adopt the appropriate requirement analysis strategy in order to acquire the appropriate information (Sakthivel, 1992). The extent to which RAD incorporates the other KM principles is uncertain.

Object orientated approach

A major factor in the invention of the object oriented (OO) approach was to remove some of the flaws encountered with the structured approach. Object-orientation simplifies the development of the models as object oriented notations are fairly expressive and therefore can express models that are 'closer' to what has to be modelled from the real world. This implies that it possesses the principle of knowledge representation (Monarchi et al, 1992).

Reusability also plays a central role in object-oriented approach which makes it easier for knowledge to be reused and applied when required (Booch, 1986). The extent to which OO incorporates the other KM principles is uncertain.

It is evident from the brief examination of the SDMs that they do not comprehensively incorporate KM principles, and the extent to which they do is uncertain. A review of the literature also indicated that only the following studies applied KM to SDM:

- o Hidding (1997), in a study of the use of method materials by IS practitioners at Andersen Consulting, found that the formats for distributing information was not effective. The result was the use of a worldwide intranet to distribute method knowledge. Although this study did not intentionally examine the relationship between Knowledge Management and System Development Methods, it did suggest that the method could be improved by the use of an intranet for distribution. This study did not examine whether this had an impact on the success of the method.
- o Byrd (1992) showed that knowledge acquisition was one of the factors that impacted the success of expert system projects; however this study did not relate knowledge acquisition to the system development method.
- o Disterer (2002) recommended that the knowledge management should be used to ensure that knowledge and experience from projects gets transferred to other projects and to the organisation. The paper stated the importance knowledge management principles for project management, but did not empirically test the recommendations, specify the KM principles or apply KM to a system development method.
- o Robillard (1999) identified various types of knowledge, and related them to the knowledge processing aspects of system development. This study does not mention any KM principles in relation to the SDM.
- o Yoon et al. (1995) identified some KM principles that affect successful development of expert systems. However they did not attempt to generalize those principles to the SDM of any information systems other than expert systems.
- o Armour (2000) suggested that software is a knowledge storage medium: so it should be managed as knowledge and not as a manufactured product. However Armour did not test this hypothesis empirically. Nor did he state what KM principles should be applied.

It is therefore evident from a review of the literature that IT practitioners would benefit from determining the extent to which current SDMs incorporate KM principles and the affect this has on the resulting system's success. Therefore the following research question arises.

Under what conditions can the success of System Development Methods be

improved by incorporating principles of Knowledge Management?

2.4 RESEARCH MODEL

In order to answer this question the following model was developed based on the literature review. The basic hypothesis is Armour's suggestion that System Development Methods can be improved when they are management like a knowledge asset. Armour's hypothesis has been amplified by explicitly including some of the KM principles that were identified in the literature survey.

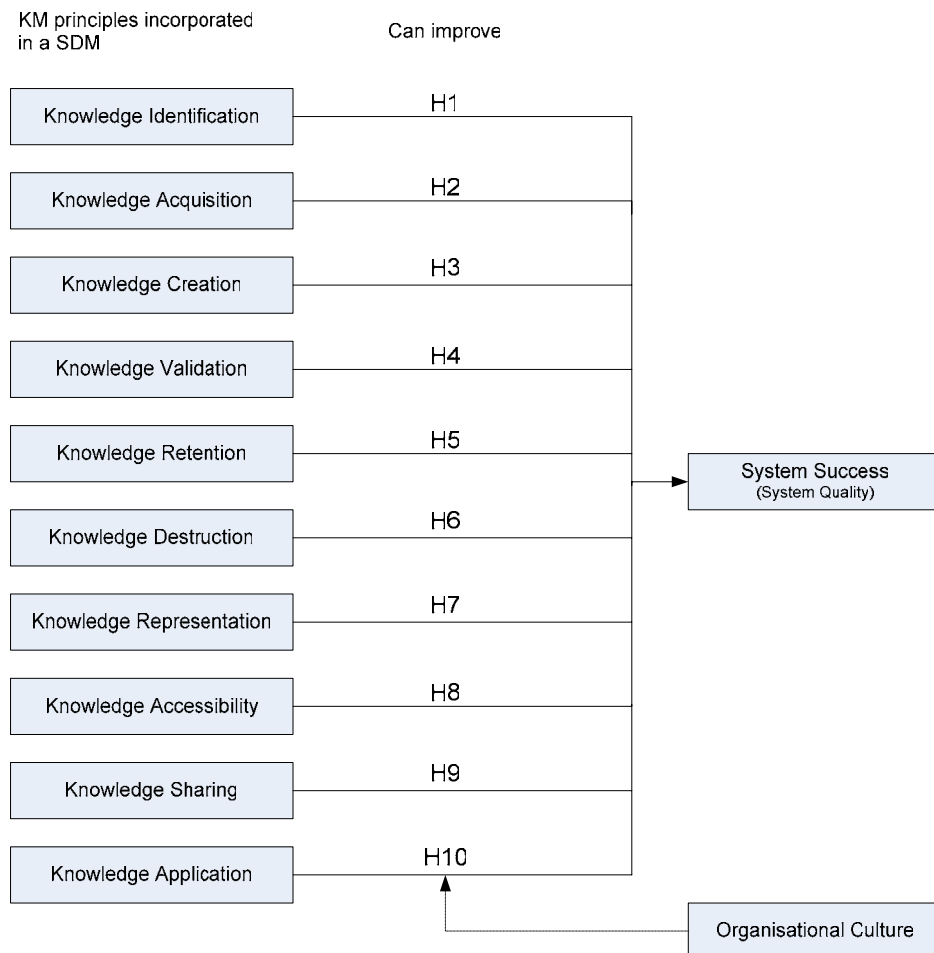


Figure 2: Research Model

Here the dependent variable is the degree of success of the resulting information system utilising the SDM, which will be measured in terms of system effectiveness. The independent variables are KM principles in the SDM: knowledge identification, knowledge acquisition, knowledge creation, knowledge sharing, knowledge application, knowledge retention,

knowledge destruction, knowledge representation, knowledge accessibility, and knowledge validation

Organisational culture has been included as a moderating variable because the majority of the studies conducted (Davenport, 1998 and Mason and Pauleen, 2003) have identified the most common barrier to successful Knowledge Management, as organizational culture. Sharp (2003) found that a corporate culture of innovation was one of the primary criteria of KM success.

In a study of more than 50 companies Delong and Fahey (2000) found that organisational culture is widely held to be the major barrier to creating and leveraging knowledge. They also found that there are four ways in which culture impacts knowledge management within an organisation. Firstly culture influences assumptions regarding what knowledge is and what knowledge is worth managing. Second, culture defines the relationship between the individual and the organisation in terms of who has access to what knowledge, who must share knowledge and who hoard it. Third, culture defines how knowledge will be used in social interactions. Finally culture influences the process by which knowledge is identified, generated and shared.

According to a 1997 Ernst and Young survey entitled "Executive Perspectives on Knowledge in the Organization," the biggest impediment to knowledge management is corporate culture (54 %), and the biggest difficulty in managing knowledge is changing people's behaviour (56 %).

H1: If a SDM incorporates knowledge identification then information systems will be more successful.

Probst et al. (1999) emphasised the importance of identifying knowledge created both internally and externally to the organisation in order for learning to occur. Carlile and Rebentisch (2003) recommended that knowledge identification should begin with the search for knowledge sources relevant to the task at hand, then determine whether they are relevant, or attempt to generate them if not.

Sakthivel (1992) pointed out that within a SDM this search for knowledge sources translates to the ability of the SDM to facilitate the identification of internal and external knowledge sources that can provide data – such as the system's goals, scope and feasibility.

Armour (2000) stated that in order for software to be developed the knowledge required for storage and use should be identified so that it can either be acquired from the correct people or generated. Knowledge identification has been shown to have a positive influence on

organisational performance (Probst et al. 1999, Wiig et al. 1997 and Naidoo, 1999). So it should also have a positive influence on SDM success.

H2: If a SDM incorporates knowledge acquisition then information systems will be more successful.

According to Wiig et al. (1997) the principle of knowledge acquisition addresses the issue of knowledge gaps that exist within the organisation or system development process, that are essential for effective operations and maintaining a competitive advantage. Carlile and Rebentisch (2003) stated that once the knowledge sources have been identified, strategies must be developed and implemented for acquiring the knowledge.

According to Sakthivel (1992) the concept of knowledge acquisition within a SDM translates to the ability of the SDM to adopt appropriate requirements analysis strategies in order to obtain diverse information from different sources, e.g. management, technical staff and customers, using information gathering techniques such as JAD sessions, interviews and questionnaires.

Armour (2000) recommends that the software development process should incorporate knowledge-acquiring activities, as the development of systems is a knowledge activity more than a product producing activity. Knowledge acquisition has been identified as having a positive influence on organisational performance (Probst et al. 1999; Mphahlele and Kutu, 2002; Wiig et al. 1997; Naidoo, 1999). So it should also have a positive influence on SDM success.

H3: If a SDM incorporates knowledge creation then information systems will be more successful.

According to Carlile and Rebentisch (2003), knowledge creation occurs when new knowledge is generated within an organisation. The core challenge of any organisation is the creation of new knowledge, i.e. solutions to problems. This is the process of making tacit knowledge explicit. Birkinshaw et al. (2002) found that in order to facilitate the process of knowledge creation it is useful to connect people who share an interest in an idea. They found that discussion forums and brainstorming are useful in nourishing the creativity needed to create knowledge.

Nahapiet and Ghoshal (1998) postulated that organisational knowledge is created as a result of the exchange of existing knowledge among employees. Therefore the concept of

knowledge creation applies to the SDM's ability to facilitate the movement of knowledge from a tacit to an explicit state, e.g. brainstorming.

Knowledge creation has been identified as having a positive influence on organisational performance (Lahti and Beyerlein, 2000; Bhatt, 2001; Bryant, 2003; Birkinshaw et al. 2002; Mphahlele and Kutu, 2002). So it should also have a positive influence on SDM success.

H4: If a SDM incorporates knowledge validation then information systems will be more successful.

Carlile and Rebentisch (2003) describe knowledge validation as the process of assessing the relevance of the knowledge created or acquired. This process entails the participants utilising specialised backgrounds and values to determine the utility of the knowledge in addressing the task at hand, as well as the credibility of the knowledge source.

According to Sakthivel (1992) this principle leads to an effective system by ensuring that the SDM facilitates the validation of the knowledge gathered regarding the system, and to ensure that it is complete, consistent and correct. The principle of knowledge validation also refers to the SDM facilitating the identification of controls, e.g. on who can use the system.

Knowledge validation has been identified as having a positive influence on organisational performance (Bhatt, 2001). So it should also have a positive influence on SDM success.

H5: If a SDM incorporates knowledge retention then information systems will be more successful.

Carlile and Rebenisch (2003) define knowledge retention as the act of adding to the existing knowledge in active use by an individual, group or organisation. Knowledge retention is similar to organisational memory; so retained knowledge serves as a source of competitive advantage if it can be reused in a way that increases effectiveness. Knowledge retention is an important KM principle because effectiveness of knowledge retention can impact the efficacy and the relevancy of the knowledge that is later retrieved. Cross and Baird, (2000) also believe that KM improves organisations if managers embed the lessons of experience into information repositories, work processes and support systems.

The principle of knowledge retention can be described as the SDM's ability to embed important system knowledge into the work processes and policies related to the system.

Knowledge retention has been identified as having a positive influence on organisational performance (Probst et al. 1999; Wiig et al. 1997). So it should also have a positive influence on SDM success.

H6: If a SDM incorporates knowledge destruction then information systems will be more successful.

As the organisational context changes and novelty increases within an organisation, stored knowledge no longer has the same value when it is applied, and it may even be detrimental. It is therefore important that knowledge that is no longer relevant be discarded to prevent it being applied in a context where it is no longer valid (Carlile and Rebentisch 2003).

Knowledge destruction has been identified as having a positive influence on organisational performance (Naidoo 1999; Carlile and Rebentisch 2003). So it should also have a positive influence on SDM success.

H7: If a SDM incorporates knowledge representation then information systems will be more successful.

According to Carlile and Rebentisch (2003) knowledge representation has an impact on whether knowledge is identified in the search space, because highly specialised knowledge tends to develop its own terminology and remain in the minds of specialists. So unless specialists are able to represent knowledge within their domain in a way that is useful to others, it could be as if that knowledge does not exist. How knowledge is represented also plays a vital role in the effectiveness with which knowledge is shared.

The principle of knowledge representation applies to SDM in the following ways;

- The SDM should facilitate completeness and consistency of documentation (Sakthivel, 1992).
- The SDM should facilitate the representing of the knowledge about what the system must do (Armour, 2000).

Armour (2000) recommends that once the knowledge to develop a system has been acquired, the knowledge content should be managed. This can only be done if it is represented in a usable format for development and application by the end users. Therefore for an SDM to be effective it would also need to facilitate the use of standardised representation models in order to manage the knowledge content of the domain.

Knowledge representation has been identified as having a positive influence on organisational performance (Lahti and Beyerlein, 2000 and Bhatt, 2001). So it should also have a positive influence on SDM success.

H8: If a SDM incorporates knowledge accessibility then information systems will be more successful.

According to Armour (2000) knowledge is only useful if it is accessible to those people who require it. Mphahlele and Kutu (2002) suggest that if the knowledge is readily accessible it does not have to be created again. Carlile and Rebentisch (2003) emphasise that stored knowledge serves as a source of competitive advantage if it can be reused in a way that increases effectiveness. These principles apply to SDM by ensuring that knowledge is stored and that the appropriate people know about it and have access to it.

Knowledge accessibility has been identified as having a positive influence on organisational performance (Lahti and Beyerlein, 2000; Wiig et al. 1997; Naidoo, 1999). So it should also have a positive influence on SDM success.

H9: If a SDM incorporates knowledge sharing then information systems will be more successful.

According to Argote et al. (2003), knowledge sharing occurs when experience acquired from one unit affects another. Bresman et al. (1999) argued that one of the most important aspects of KM is the process of knowledge sharing between business units. Knowledge is shared in an organisation whether it is specifically managed or not. Successful knowledge sharing implies that the receiving party accumulates new knowledge.

Nonaka (1994) argued that since individuals are the prime movers of knowledge creation in an organisation, knowledge sharing among individuals could assist in knowledge creation. The knowledge shared by individuals could be explicit as well as tacit. The explicit knowledge can be shared through verbal communication, while the recipient could gain tacit knowledge from the source through socialization, observation, and apprenticeship.

Avison et al. (1992) stated that during the development of an information system effective communication about the system needs to occur between the phases in the project and to individuals that require information, e.g. users.

Knowledge sharing has been identified as having a positive influence on organisational performance (Probst et al. 1999; Lahti and Beyerlein, 2000; Bhatt, 2001; Bryant, 2003; Mphahlele and Kutu, 2002; Naidoo, 1999). So it should also have a positive influence on SDM success.

H10: If a SDM incorporates knowledge application then information systems will be

more successful.

If knowledge that is gained through acquisition or creation is not applied or used when it is applicable then the value that it can potentially add is lost. Time pressures demand that an organisation capitalise on lessons learned in order to minimise the employee learning curve (Duffy, 2000). Organisations develop and refine their knowledge management systems in order to accelerate the learning curve, which implies that appropriate knowledge should be reused. It is also important for SDM to monitor knowledge that is useful and provides value as this enables SDM to evolve.

Knowledge application has been identified as having a positive influence on organisational performance (Probst et al. 1999; Bhatt, 2001; Bryant, 2003; Mphahlele and Kutu, 2002; Wiig et al. 1997; Naidoo 1999). So it should also have a positive influence on SDM success.

2.5 CHAPTER SUMMARY

This chapter shows that although publications exist on both knowledge management and system development methods, previous researchers have omitted to examine the application of knowledge management principles to system development methods for the purpose of improving their success.

A model was derived from the literature, hypothesising ten relationships between SDM success and the dependent variables of knowledge identification, knowledge acquisition, knowledge creation, knowledge sharing, knowledge application, knowledge retention, knowledge destruction, knowledge representation, knowledge accessibility, and knowledge validation.

CHAPTER 3: RESEARCH METHODS

3.1 CHAPTER OVERVIEW

The purpose of this chapter is to describe the research methods used in this study, and to explain why they are appropriate for confirming the hypotheses, so that the findings can be generalised to the population.

3.2 RESEARCH APPROACH

This study investigates the effect of knowledge management principles on system development methods. Leedy (1997) stated that a quantitative approach is best when one seek to test theory and when the researcher wishes to explain and predict a generalised outcome. As the research hypotheses dictate the methodology to be used, this research will be quantitative in nature. The research methodology used here is adapted from the research process presented by Emory and Cooper (1991, pp.74) and the research design by Remenyi and Williams (1993, pp.11). It is summarised in Figure 1.

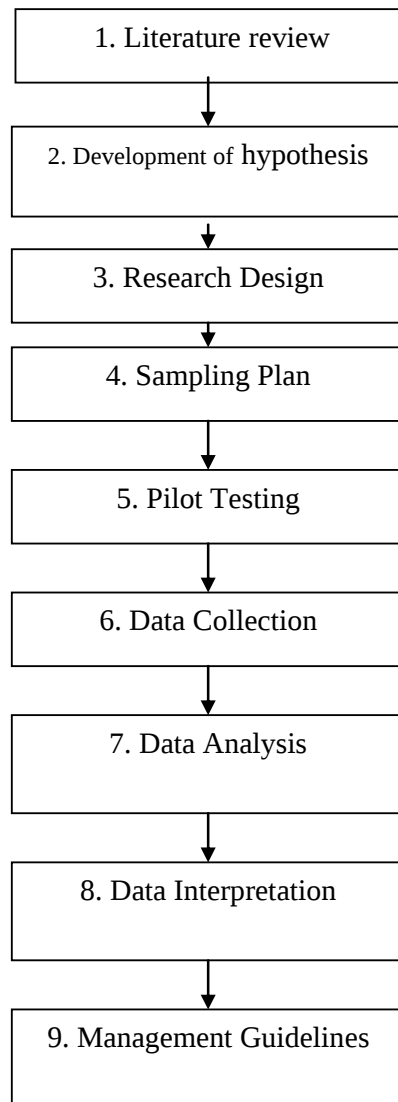


Figure 3: The Procedural Framework (Emory and Cooper, 1991 and Remenyi and Williams, 1993)

- Phase 1: The literature review is used to assist the researcher identify the unsolved problem that will become the focus of the research project and discuss related literature in the field (Leedy, 1989 cited in Remenyi and William, 1993). (Phase 1 was covered in Chapter 2).
- Phase 2: The Hypotheses that are formulated in order to answer the unsolved problem will determine how and why the data are collected (Remenyi and William, 1993). (Phase 2 was covered in Chapter 2).
- Phase 3: Frequently for testing a theory, the preparation of a questionnaire is required (Oppenheim, 1966). For this research project a structured questionnaire was used to collect the required data.

- Phase 4: In order to collect the evidence required, a sample of the population was selected, so that statistical inference can be used (Remenyi and Williams, 1993).
- Phase 5: The Questionnaire was pilot tested to ensure its comprehensiveness and appropriateness. Oppenheim (1966) and Leedy (1997) stress the importance of pretesting a questionnaire.
- Phase 6: The questionnaire was delivered to the chosen sample.
- Phase 7: The collected data was analysed with the appropriate statistical techniques.
- Phase 8: The outcomes of the data analysis were interpreted in order to provide an answer the research question.
- Phase 9: Management guidelines were developed.

This research methodology was used as a guideline and not as a rigid procedure. The following sections examine the sampling plan, method of data collection and the development of the questionnaire.

3.3 RESEARCH DESIGN

3.3.1 DATA COLLECTION DESIGN

Neuman (1994) identifies two steps that should always be undertaken at the beginning of the measurement phase, namely conceptualisation and operationalisation. The former involves giving each construct a conceptual or theoretical definition. The latter involves determining the specific operations, measurement instruments or procedures necessary to provide an accurate measurement of the construct.

According to Russo et al. (1995) surveys are the dominant research method used to examine the use and adoption of system development methods: therefore the use of surveys as a data collection method enables the findings of this study to be compared to other similar studies with greater ease. Leedy (1997) recommends a survey as a data gathering technique that is particularly suitable when the data needs to be obtained from geographically dispersed people. It must be noted that surveys do have the following limitations: they do not provide an in-depth understanding of the respondent's opinions; misunderstandings cannot be clarified, which may lead to inaccurate responses, and unlike experiments the effect of extraneous factors is not limited, although some control variables have been tested in the questionnaire to control for confounding variables.

The questionnaire captured elements of the KM principles and SDM. Developing questions that relate the KM principles to SDM was complex, as no previous research has described KM principles within that context. To give sufficient background into the construction of the questionnaire, each variable was examined independently.

3.3.2 DEPENDENT VARIABLE IN ALL 10 HYPOTHESES: THE DEGREE OF SUCCESS OF THE RESULTING INFORMATION SYSTEM

Numerous studies have attempted to identify the factors that contribute to an information system's success. A study by Sakthivel (1992), which surveyed 400 IT practitioners, found that the most desirable SDM capability is the ability to develop information systems that are effective. The reason is that organisations often find that the developed systems contain numerous errors and fail to meet the requirements completely. A measure of system effectiveness is the quality of the developed system, and the quality of a system can be measured by the extent to which a system performs to specification (Prell and Sheng, 1984).

This measure relates to the first category in Delone and Mclean's model, namely system quality, which focuses on the desired characteristics of the system itself. DeLone and McLean (1992) attempted to integrate these various views of the concept of information systems success into a comprehensive taxonomy. Their information system success model consists of six success categories, each citing both conceptual and theoretical studies. The following model summarises their six categories and shows the relationship between each of them.

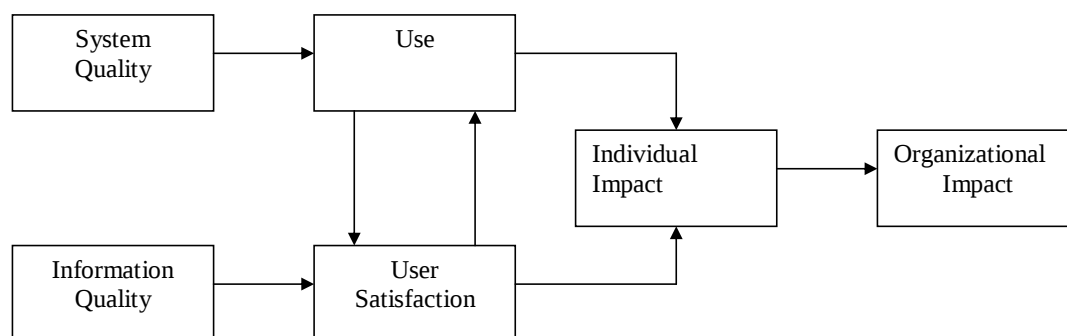


Figure 4: Information System Success Model (Delone and McLean, 1992).

Saarinen (1996), in an extension of Delone and McLean's study, defined a successful information systems development project as follows:

“The system development process leads to a high quality IS product whose use has a positive impact on the organisation”.

The quality of the IS product is often based on either the user’s or developer’s perception of the system. The model below depicts the main dimensions of IS success.

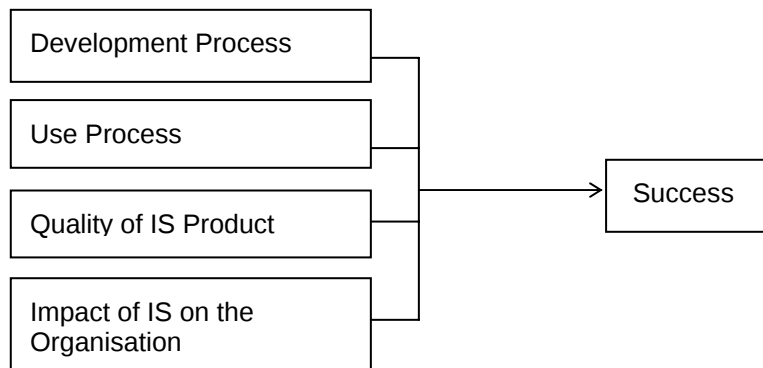


Figure 5: Main dimensions of IS success (Saarinen, 1996, pp.106)

This definition is in line with the Sakthivel (1992) findings that for a system development method to be successful it must produce a high quality system. Therefore for the purpose of this study, system effectiveness, which has been defined as a high quality system, will be used as the measure of the SDM success. The following question is used to measure this construct; this question has been selected as it best represents the construct that is being tested:

- To what extent did the developed information system meet the specified requirements on your most recent project that utilised the SDM?

3.3.3 INDEPENDENT VARIABLES

The hypothesis required 10 independent variables to be measured. The *independent variables* are the KM principles in SDM, namely:

- Knowledge identification
- Knowledge acquisition
- Knowledge creation
- Knowledge validation
- Knowledge retention

- Knowledge destruction
- Knowledge representation
- Knowledge accessibility
- Knowledge sharing
- Knowledge application

An interval scale was used for all items measuring these variables. The anchors were set at Not at All (1) and Completely (7). DeVellis (1991) describes that there are situations where it is necessary to deviate from the standard Likert scale in order to collect the required data. These questionnaire measurements are widely used when evaluating opinion in quantitative research (Emory and Cooper, 1991).

3.3.4 INDEPENDENT VARIABLE: KNOWLEDGE IDENTIFICATION

Knowledge identification has been defined for the purpose of this study as the process of identifying the knowledge that is required to solve a problem. This principle ensures that the knowledge assets are identified, e.g. domain experts and documents that are required by the system to support the overall objectives (Duffy, 1997). The following question measures this construct:

- To what extent does the SDM facilitate the identification of knowledge sources, e.g. experts with regards to the system being produced?

3.3.5 INDEPENDENT VARIABLE: KNOWLEDGE ACQUISITION

Knowledge acquisition is defined here as the process of acquiring the identified knowledge that is discovered to already exist either internally or externally to the organisation. Knowledge acquisition addresses the issue of bridging knowledge gaps that are crucial for maintaining a competitive advantage (Wiig et al. 1997). The following question measures this construct:

- To what extent does the SDM facilitate the selection of appropriate requirements analysis strategies in order to obtain diverse information, e.g. JAD sessions to extract information from management, questionnaires to extract information from customers?

3.3.6 INDEPENDENT VARIABLE: KNOWLEDGE CREATION

Knowledge creation is defined here as the process of generated required knowledge that does not already exist. According to Carlile and Rebentisch (2003) the core challenge of any organisation is the creation of new knowledge i.e. the solutions to problems. The following question measures this construct:

- To what extent does the SDM assist with the creation of knowledge, e.g. brainstorming and creative thinking?

3.3.7 INDEPENDENT VARIABLE: KNOWLEDGE VALIDATION

Knowledge validation is defined as the process of validating the accuracy and applicability of the acquired or generated knowledge. For a SDM to be effective it must facilitate the identification of controls, e.g. on people who can maintain the system data (Sakthivel, 1992). The following questions measure this construct:

- To what extent does the SDM facilitate the validation (verifying the accuracy) of the knowledge gathered regarding the system?

3.3.8 INDEPENDENT VARIABLE: KNOWLEDGE RETENTION

Knowledge retention is defined as the process of embedding the acquired or created knowledge within the organisation. KM improves organisations if lessons from experience are embedded into information repositories, work processes and support systems (Cross and Baird, 2000; Duffy, 2000). The following question measures this construct:

- To what extent does the SDM facilitate the embedding of knowledge gaining during the development process e.g. updating policies and procedures with new knowledge?

3.3.9 INDEPENDENT VARIABLE: KNOWLEDGE DESTRUCTION

Knowledge destruction is defined here as the process of destroying invalid knowledge. This ensures that knowledge that is no longer applicable is archived or stored. The following question measures this construct:

- To what extent does the SDM facilitate the process of ensuring that knowledge that is no longer valid is discarded?

3.3.10 INDEPENDENT VARIABLE: KNOWLEDGE REPRESENTATION

Knowledge representation is defined as the process of capturing knowledge into a format that can easily be shared. According to Sakthivel (1992) the documentation describing the system and its processes needs to be as complete and consistent as possible. The following questions measure this construct:

- To what extent does the SDM facilitate completeness and consistency of documentation e.g. through a quality assurance process?
- To what extent does the SDM make use of templates (both for modelling and documenting) to represent knowledge?
- To what extent does the SDM facilitate the capturing of the knowledge created or acquired relevant to the system being produced e.g. in the completion of system documentation?

3.3.11 INDEPENDENT VARIABLE: KNOWLEDGE ACCESSIBILITY

Knowledge accessibility is defined as the process of ensuring that the formatted knowledge is accessible to others. This principle enables the reuse of existing knowledge because it is assumed that once people who need the knowledge have access to it, it can be reused. The following question measures this construct:

- To what extent does the SDM facilitate storage of the knowledge regarding the system in an accessible database available to people who need it?

3.3.12 INDEPENDENT VARIABLE: KNOWLEDGE SHARING

Knowledge sharing is defined as the process of disseminating knowledge. Argote et al. (2003) found that there is a relationship between knowledge sharing and knowledge retention because in order for knowledge to be shared it needs to be retained. Avison et al. (1992) state that the SDM should ensure that knowledge is shared by the people involved with the system. The following questions measure this construct:

- To what extent does the SDM ensure that knowledge is shared by the different phases of the SDM?
- To what extent does the SDM ensure that knowledge is shared with the appropriate people within the organisation?

3.3.13 INDEPENDENT VARIABLE: KNOWLEDGE APPLICATION

Knowledge application is defined here as the process of utilising the acquired or created knowledge for its intended purpose. This ensures that the existing knowledge is applied productively and effectively to improve the performance of the information system. The following questions measure this construct:

- To what extent does the SDM facilitate monitoring of the knowledge used regarding the system e.g. tracking knowledge accessed from data stores?
- To what extent does the SDM incorporate reuse of knowledge gathered on other projects/system/business units?

3.3.14 MODERATING VARIABLE: ORGANISATIONAL CULTURE

Schein (1990) defines organisational culture as a pattern of basic assumptions held by the people in an organisation that are used to address problems of adoption and integration. According to Ladd and Ward (2002) several studies have identified a variety of organisational cultures—each using different terminologies and methods to describe seemingly similar concepts. Xenikou and Furnham (1996) consolidated much of this research using factor analysis. They identified four basic organisational cultures:

- Type 1: Competition/Confrontation, which has an oppositional orientation, focus on power, focus on the competition, and perfectionism.
- Type 2: Bureaucratic, which is focused on gaining approval, conventionality, dependence, avoidance, and lack of personal freedom.
- Type 3: Task-Oriented, which focused on being the best, innovation, attention to detail, quality orientation, profit orientation, and shared philosophy.
- Type 4: Openness to Change/Innovation, which has a humanistic orientation, achievement focus, affiliation, self-actualisation, task innovation, and hands-on management.

Ladd and Ward (2002) examined the relationship between KM success and types of organisational culture. They found that the first two cultural types (openness to change/innovation and task-oriented) were positively related to knowledge sharing and innovation, which in turn lead to KM success in the organisation. The following questions are used to measure this construct:

- What characteristics best describe the organisation possessing the SDM that was used to develop the system?
 - o Achievement focused, people orientated, self actualising, hands-on-management
 - o Focus on being the best, innovation, attention to detail, profit orientation
 - o Focus on gaining approval, risk avoidance, conventionality
 - o Focus on competition and power, perfectionism

3.3.15 CONTROL VARIABLES

In multivariate analysis it is useful to introduce one or more variables to control for alternative explanations (Neuman, 1994).

Type of SDM: various researchers have found that not all SDMs are equal in their usefulness (Sakthivel, 1992, Olle et al. 1982, Olle et al. 1986). Respondents select their SDM from the following five options: Structure Approach (SDLC), Iterative Development, Rapid Application Development (RAD), Object Orientated Development and Other. This classification for SDM type was used by Russo et al. (1995) to describe different types of SDMs.

Type of Project: According to Yoon et al. (1995) different types of projects are not affected by factors in the same way; therefore KM principles may only be effective with certain types of projects. Respondents were asked to select the project type from four options that have been used by the Data Management Consultancy (2003) to describe an information system application portfolio:

- Strategic Project: which is a project whose driver is future business or competitive advantage
- High Potential Project: which is a project whose driver is a new business idea or technology opportunity
- Key Operational Project: which is a project whose driver is improving core business activities
- Support Project: which is a project whose driver is improved performance of a specific task.

3.3.16 QUESTIONNAIRE DESIGN

The questionnaire began with a short cover letter explaining the purpose of the research and contained a brief overview of how the questionnaires should be completed (Easterby-Smith et al. 1991).

The questionnaire was made up of three parts: demographic questions used to assess whether the respondents were representative of the sample, system development questions used to gather data on the dependent and control variables, and section three which was made up of questions assessing the incorporation of KM principles within the SDM.

In order to answer the questionnaire the respondents needed to have used an SDM. So a filter question was asked, first.

The questionnaire is attached in Appendix 3. The sections cover the following areas:

- The questionnaire begins with instructions for answering the questions.
- Part 1 (questions 1-2): open-ended questions to establish the respondent's job title and company name, to ensure that they fall within the sample frame. The company name was made optional as some of the information gathered on the SDM and its perceived success could be sensitive.
- Part 2 (questions 1-2): Yes or no answer to establish whether the respondent has used an SDM. Negative answers allowed respondents to be filtered.
- Part 2 (questions 3-4): respondents were required to identify the type of SDM used from a list of four options; the data gathered is therefore nominal. An option was given for a SDM that did not fall within the list. Respondents were asked to elaborate their response if they selected "Other".
- Part 2 (question 5): respondents were required to rate the extent to which the system that was produced using the SDM met the specified requirements. This was done using a Likert scale from 1 to 7. The data gathered is regarded as interval.
- Part 2 (question 6): respondents were required to identify the type of project by selecting from a list of four types. The data is therefore nominal.
- Part 2 (question 7): respondents were required to identify their organisations culture from a list of four groups of characteristics. The data is therefore nominal.

- Part 3 (question 1-14): respondents were required to rate the incorporation of knowledge management principles within the SDM. This was done using a scale from 1 to 7. The data gathered is regarded as interval.

3.4 THE SAMPLING PROCEDURE

The research population comprised all IT practitioners who have used a SDM to produce an information system. The sampling frame included IT practitioners in organisations that operate within the PWV region and have developed one or more IT systems using a SDM and have access to email.

A sample of 250 IT practitioners was selected using convenience sampling on a judgemental basis. The sample was contacted in two different ways; 50 practitioners who met the above criteria were emailed directly while 200 members of the Computer Society of South Africa within the Business Analysis special interest group were emailed the questionnaire – this option was selected because of the limitations of time and the exacting nature of the respondents, as they require an understanding of System Development Methods.

3.5 PILOT STUDY

Dane (1990) defines a pilot study as “an abbreviated version of a research project in which the researcher tests the procedures to be used in the subsequent full-scale project”. The questionnaire was pilot tested in order to detect weakness in design and instrumentation and assess the average time for completion (Emory and Cooper, 1991).

The questionnaire was submitted to a small subset of the target population consisting of 10 IT practitioners. They were emailed the questionnaire as an attachment in order to simulate the procedure that had been designated for data collection.

7 questionnaires from the pilot test were returned, and the respondents' comments were used to make minor changes to the questionnaire, in order to make the instructions more comprehensive and the questions unambiguous.

3.6 DATA ANALYSIS

Correlation analysis has been used to assess the degree of interdependence or co-relationship between system success (dependent variable) and the ten KM principles (independent variables).

First, scatterplots were drawn, and checked visually to see whether system success was correlated with the ten KM principles.

Second, a Pearson correlation coefficient was calculated for each of the ten relationships. The Pearson coefficient is a widely used measure of goodness of fit of the regression line to the data (Wright, 1979). The Pearson product moment coefficient of correlation (or simply, the coefficient of correlation) r is a measure of the strength of the linear relationship between two variables x and y .

In order to determine whether organisation culture does in fact influence the relationship between KM Principles and SDM the correlation coefficients for each culture group have been compared and then a z score determined in order to ascertain the statistical significance.

3.6.1 VALIDITY AND RELIABILITY

Validity

Validity involves the soundness and effectiveness of the measurement instrument (Leedy, 1997). The following types of validity are ensured:

- Face validity: a pilot test was conducted and factor analysis was used to ensure that only the applicable KM principles were tested for correlation. The questionnaire also included a filter question regarding the use of an SDM by the respondent; this ensured that the respondents have adequate knowledge of the concept being measured.
- Criterion validity: scree plots and a correlation matrix were used to ensure that the criteria measured are valid.
- Content validity: was ensured by including only those KM principles that were confirmed by the literature and testing the questions in a pilot survey.
- Construct validity: was ensured by scree plots and a correlation matrix on the selected KM principles.
- Internal validity: this means freedom from bias on deriving conclusions from the data (Leedy, 1997). It was ensured by selecting only those correlation coefficients that can

be applied to the population with 95% probability. Control variables were tested to prevent inaccurate conclusions.

- External validity: as with the internal validity, only correlations with more than 95% probability were generalised to the population.

Reliability

Reliability refers to dependability and consistency, i.e. whether the instrument gives the same result each time the same construct is measured (Neuman, 1994, p. 127). It was difficult to determine the reliability of the research through the use of the test-retest approach, as there are situational factors that influence this test. However, Cronbach Alpha was used to test the reliability of the measuring instrument. This measures how well a set of variables measures a single latent construct like KM.

3.7 CHAPTER SUMMARY

The research methods selected provide a framework of steps for confirming the research hypotheses. The data collection approach explained how data on the variables will be collected, and a pilot study was conducted in order to ensure the comprehensiveness and applicability of the questionnaire.

An explanation of the questionnaire design was given along with the reasons for the use of an interval scale. Finally correlation analysis was selected as an appropriate data analysis method.

CHAPTER 4: DATA ANALYSIS

4.1 CHAPTER OVERVIEW

Chapter Four presents the findings of the questionnaire. In order to provide the reader with a graphical representation of the data, it will be presented using tables and histograms.

4.2 DATA ANALYSIS AND PRESENTATION

The data was collected in the form of a three-page questionnaire (see Appendix). The questionnaires were emailed to the sample as an attachment. Questionnaires were returned directly to the researcher, as the researchers email address had been provided. 250 people were selected from the sample frame and emailed the questionnaire. Of the 250 questionnaires distributed only 87 were returned, this is an overall response rate of 35%:

- 28 of the 50 people who were emailed the questionnaire responded, this is a response rate of 56%. The response rate was high as these are people who have a good understanding of System Development Methodologies and a number of these people are involved in their own research.
- 59 of the 200 people within the Computer Society of South Africa responded, this is a response rate of 30%.

It can be assumed that of those who did not respond they did so either because the topic did not interest them or they did not have the time.

Once the necessary data had been returned to the specified email address, the data was analysed using SPSS 10 for Windows Student Version.

4.2.1 MISSING DATA

The first step in the data analysis phase was to assess the extent of missing data and decide how to deal with it. Hair et al. (1998, p. 46) emphasise the importance of determining whether the missing data is scattered randomly throughout the cases and variables or whether one can find a pattern in the missing data. Secondly, one must determine the extent of the missing data. To address the above questions, a missing data analysis was conducted. 3 out of the 87 responses received did not use an SDM and therefore they were not within the sample. 19% of respondents did not disclose their organisation and 5% did not disclose their job title, of the 19% that did not disclose their organisation 66% described the extent to which the developed information system met the specified requirements as 3 or less. This implies that the motivation for not disclosing their organisation was due to the need to protect their organisations identity were system implementations had not been described as successful.

4.2.2 RELIABILITY

It is important before conducting any analysis to ensure that the selected scales are reliable. One of the main concerns is a scales internal reliability. One of the most common indicators of internal consistency is a Cronbach's alpha coefficient (Hair et al, 1998).

R E L I A B I L I T Y A N A L Y S I S - S C A L E (A L P H A)				
		Mean	Std Dev	Cases
1.	KM1	4.4524	1.5709	84.0
2.	KM2	4.8690	1.2967	84.0
3.	KM3	5.1905	1.5791	84.0
4.	KM4	4.6310	1.2874	84.0
5.	KM5	4.3155	1.5106	84.0
6.	KM6	4.5476	1.4841	84.0
7.	KM7	3.5476	1.7658	84.0
8.	KM8	4.7757	1.3902	84.0
9.	KM9	4.8214	1.7157	84.0
10.	KM10	3.7500	1.4879	84.0
Statistics for				
SCALE	Mean	Variance	Std Dev	N of Variables
	44.9007	113.4642	10.6520	10
Item-total Statistics				
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Alpha if Item Deleted
KM1	40.4483	98.7864	.3910	.8913
KM2	40.0317	93.0307	.7497	.8673
KM3	39.7102	88.6167	.7519	.8648
KM4	40.2698	91.8559	.8085	.8637
KM5	40.5852	93.6308	.6004	.8762
KM6	40.3531	89.8029	.7629	.8646
KM7	41.3531	96.8930	.3870	.8942
KM8	40.1250	90.3306	.8023	.8627
KM9	40.0793	91.1372	.5917	.8775
KM10	41.1507	96.6218	.5001	.8831
Reliability Coefficients				
N of Cases =		84.0	N of Items = 10	
Alpha =		.8860		

Table 1: Cronbach Alpha Results

The independent variables used in this study had a good internal consistency as it has a Cronbach alpha coefficient of 0.89.

4.2.3 RESPONDENT PROFILE AND DEMOGRAPHICS

The questionnaire contains a demographics section in order to allow various factors to be represented in relation to the population and provide further insight into the results. Frequency distribution is used to analyse the results and the findings are presented in tables and histogram, which follow.

4.2.4 RESPONDENT ORGANISATIONS

Respondents from the following organisations completed the questionnaire.

Organisation	Frequency	% of Sample
Business Systems Group	14	16%
Accenture	9	10%
IBM	9	10%
Standard Bank	9	10%
FNB	8	8%
Discovery Health	6	7%
Nedbank	6	7%
Siemens Business Services	5	6%
UTI	4	5%
Eskom	4	5%
IDC – Industrial Development Corporation of South Africa	3	4%
De Beers	3	4%
Gensec	3	4%
Standard Corporate Bank	2	2%
Microsoft	2	2%

Table 2: Respondent Organisation Results

As was expected responses came from organisations who are either involved in system implementations through their consulting services or large organisations who have funding for system implementations. This table shows that the data that was received from respondents came from a varied group of organisations.

4.2.5 RESPONDENT JOB TITLES

The respondents described their job titles as follows:

Job Title	Frequency	% of Sample
Consultant	28	32%
Business Analyst	25	29%
Project Manager	12	14%
E-business Consultant	9	10%
Head of Applications	4	5%
Manager Software Engineering	4	5%
Web Development Manager	3	3%
IT Security and Compliance Manager	2	2%

Table 3: Respondent Job Title Results

The majority of respondents described their job title as either Business Analyst or Consultant, which matches the requirements for the sample.

4.2.6 RESPONDENT SYSTEM DEVELOPMENT METHOD USED

Of the 87 respondents received, all except 3 had utilised a System Development Method. The responses of the 3 that did not use a SDM could not be used for the purpose of this research and had to be discarded. The majority of the respondents used the traditional System Development Lifecycle to develop systems and only 4 respondents used a SDM that did not fall into the predefined categories and was described as “home-grown methodology”. These findings are contrary to the popular belief that organisations have moved away from the SDLC.

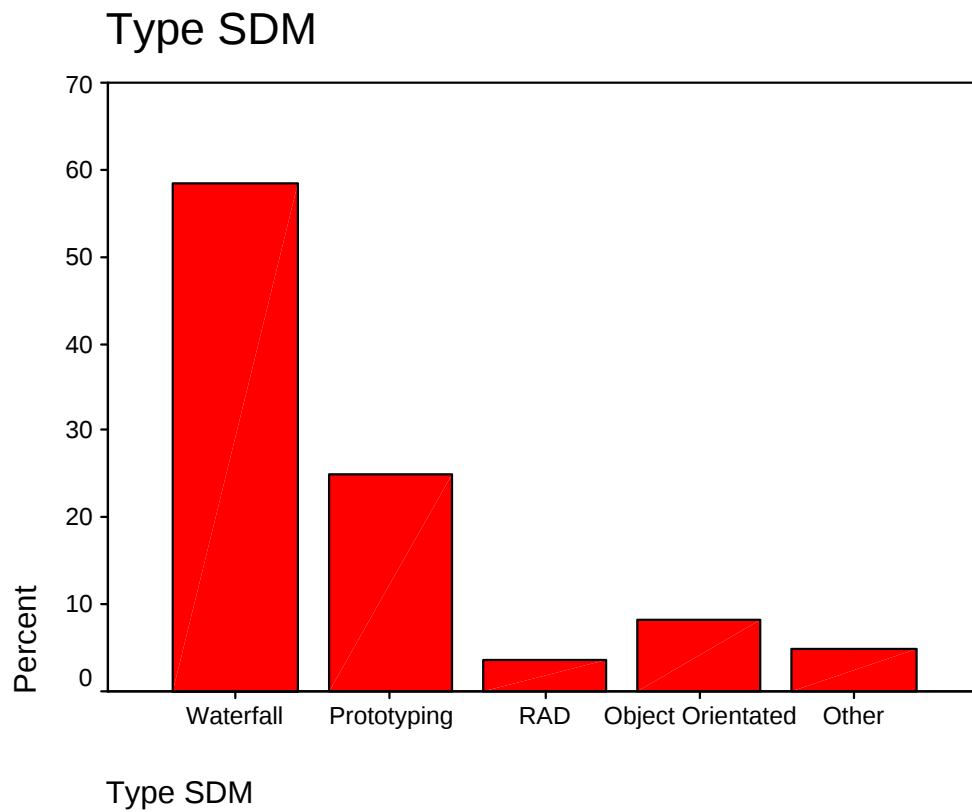


Figure 6: SDM Utilisation on Projects

58% of respondents stated that they utilised a standard SDLC waterfall methodology to develop their system, while only 4% utilised a Rapid Application Development. This showed that systems are still being implemented using the traditional SDLC.

Respondents were asked to evaluate the extent to which their system met the intended requirements, 1 indicated not at all while 7 indicated completely. Examining the relationship between the type of SDM used and the success of the system, the mean results are as follows:

SDM			
Type SDM	Mean	N	Std. Deviation
Waterfall	4.6735	49	1.3600
Prototyping	4.5714	21	1.5675
RAD	5.0000	3	.0000
Object Orientated	3.4286	7	.5345
Other	3.0000	4	.0000
Total	4.4762	84	1.3839

Table 4: Type of SDM Results

From the results it is difficult to say whether the type of system development used had an impact on the success of the system, as an overwhelming majority use the standard SLDC, which has a broad range of results on the success of the system. Rapid Application Development has the highest mean with regard to system success although there are only 3 respondents who utilised this approach; however “Other” which describes home-grown methodologies has the lowest mean.

4.2.7 RESPONDENT TYPE OF PROJECT

Respondents were asked to select the project type from four options that have been used by the Data Management Consultancy (2003) to describe an information system application portfolio

39% of the respondents described their project as either a Strategic Project or a High Impact Project; however the majority of respondents described their project as an Operational Project which is defined as a project whose driver is improving core business activities.

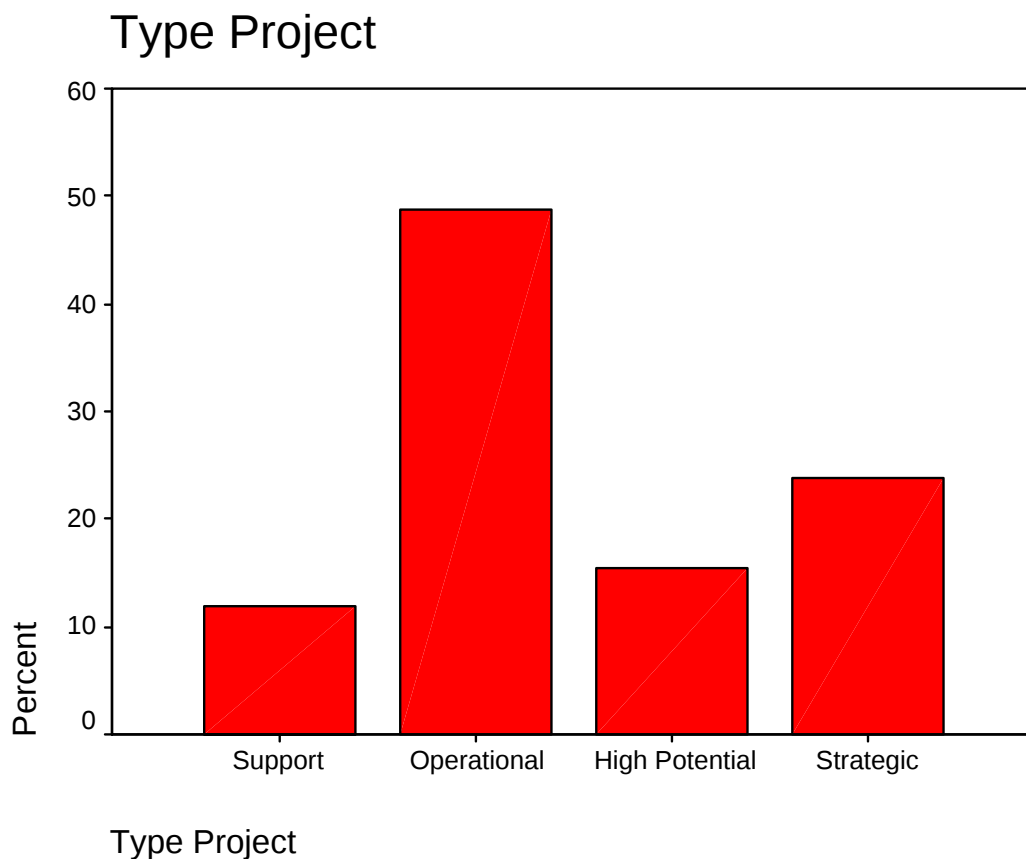


Figure 7: Type of Projects

Respondents were asked to evaluate the extent to which their system met the intended requirements, 1 indicated not at all while 7 indicated completely. Examining the relationship between the type of project and the success of the system the mean results are as follows;

SDM

Type Project	Mean	N	Std. Deviation
Support	2.6000	10	.9661
Operational	4.8293	41	1.2630
High Potential	4.4615	13	.8771
Strategic	4.7000	20	1.3803
Total	4.4762	84	1.3839

Table 5: Type of Project Results

The results for Operational projects which are defined as projects whose driver is to improve core business activities are consistently high with a mean of 4.8 while Support projects which are defined as projects whose driver is to improve performance of a specific task were noticeable lower at 2.6. This shows that the type of project could impact the relationship between KM principles and SDM Success.

4.2.8 TESTING THE HYPOTHESES

In order to determine the extent to which current SDMs incorporate KM principles and the affect this has had on the resulting system's success, the following research question was asked:

Under what conditions can the success of System Development Methods be improved by incorporating principles of Knowledge Management?

In order to answer this question the following model was developed based on the findings of the literature review.

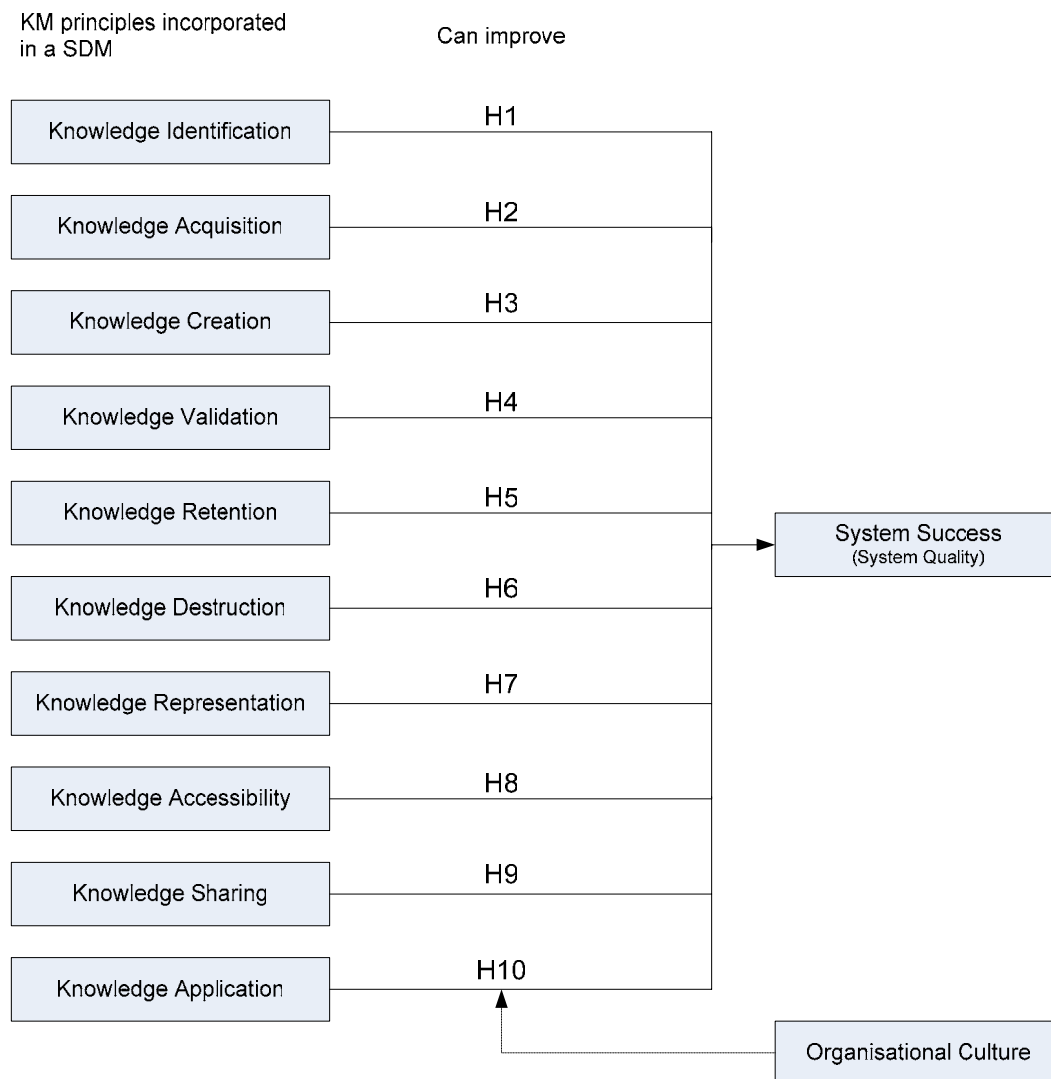


Figure 8: Research Model

Each hypothesis has been examined to determine whether that KM principle actually has an affect on the SDM. In order to determine the relationship between each pair of independent and dependent variables, Pearson Correlation was selected as the appropriate statistical

tool, as both sets of data were collected using an interval scale, correlation coefficients were calculated on the software package SPSS.

H1: If a SDM incorporates knowledge identification then information systems will be more successful.

Knowledge identification has been shown to have a positive influence on organisational performance (Probst et al. 1999, Wiig et al. 1997 and Naidoo, 1999). So it should also have a positive influence on SDM success. In order to check for violations of linearity and homoscedasticity a scatterplot was produced.

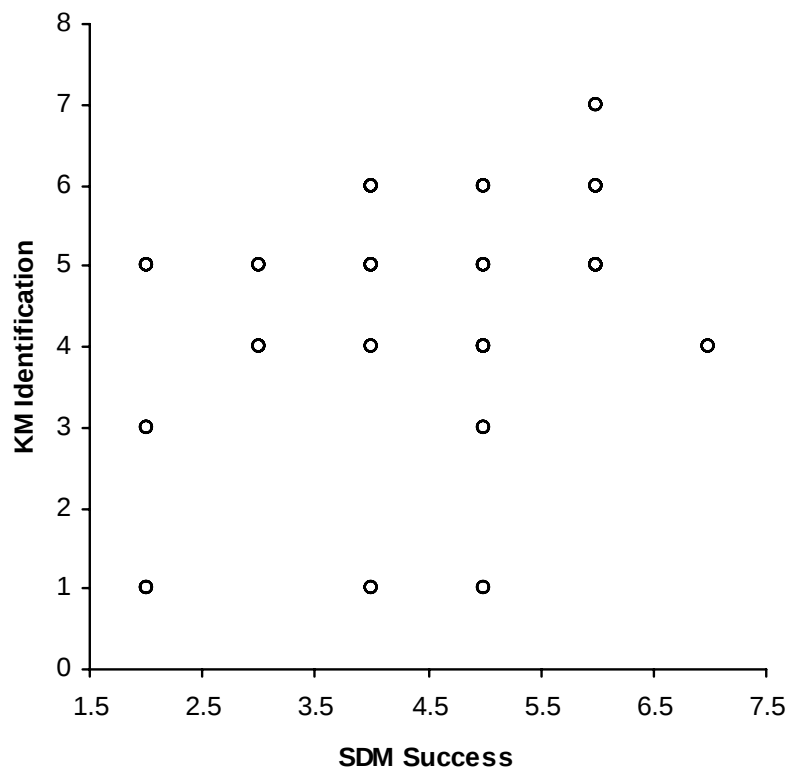


Figure 9: KM1 and SDM Success Scatterplot

The outliers were evaluated in order to determine the impact that they have on the results. The 5% trimmed mean and the original mean were very similar. It is recommended to retain these cases in the dataset as the impact of removing them would not change the distribution of data (Pallant, 2001).

Descriptives

			Statistic	Std. Error
KM Identification	Mean		4.4524	.1714
	95% Confidence	Lower Bound	4.1115	
	Interval for Mean	Upper Bound	4.7933	
	5% Trimmed Mean		4.5185	
	Median		5.0000	
	Variance		2.468	
	Std. Deviation		1.5709	
	Minimum		1.00	
	Maximum		7.00	
	Range		6.00	
	Interquartile Range		1.0000	
	Skewness		-.999	.263
	Kurtosis		.451	.520

Table 6: KM1 Descriptive Results

There is a medium positive correlation between the two variables [$r = 0.35$, $n = 84$, $p < .001$]. Therefore, Knowledge Identification is significantly correlated with success. However it explains only 12% of the variance in the respondents' scores on SDM Success.

Correlations

		SDM	KM Identification
SDM	Pearson Correlation	1.000	.354**
	Sig. (2-tailed)	.	.001
	N	84	84
KM Identification	Pearson Correlation	.354**	1.000
	Sig. (2-tailed)	.001	.
	N	84	84

Table 7: KM1 and SDM Success Correlation Results

H2: If a SDM incorporates knowledge acquisition then information systems will be more successful.

Knowledge acquisition has been identified as having a positive influence on organisational performance (Probst et al. 1999; Mphahlele and Kutu, 2002; Wiig et al. 1997; Naidoo, 1999). So it should also have a positive influence on SDM success. In order to check for violations of linearity and homoscedasticity a scatterplot was produced.

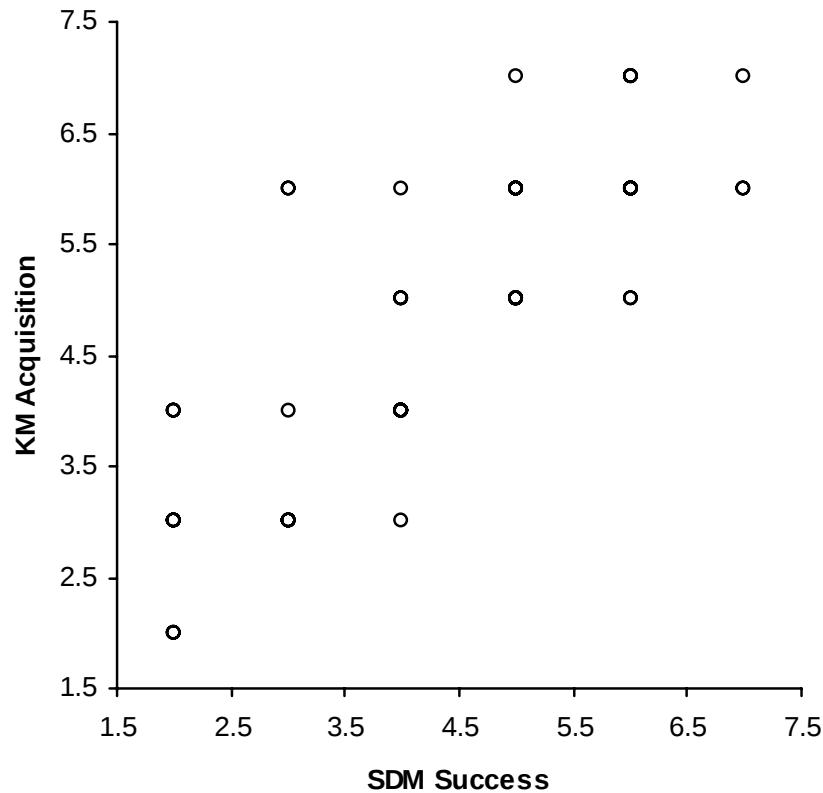


Figure 10: KM2 and SDM Success Scatterplot

Preliminary analyses were performed to ensure no violation of the assumptions of normality (checked by evaluating the normal distribution of the variables on a histogram), linearity (checked by evaluated the relationship of the two variables on the scatterplot diagram) and homoscedasticity (checked by ensuring that the variability in the score for KM Acquisition is similar at all values of SDM Success). The preliminary analysis showed that there was no violation of normality, linearity and homoscedasticity. There is a large positive correlation between the two variables [$r = 0.82$, $n = 84$, $p < .0001$]. Therefore, Knowledge Acquisition is very significantly correlated with success. It explains a very large percentage (70%) of the variance in the respondents' scores on SDM Success.

Correlations

		SDM	KM Aquisition
SDM	Pearson Correlation	1.000	.827**
	Sig. (2-tailed)	.	.000
	N	84	84
KM Aquisition	Pearson Correlation	.827**	1.000
	Sig. (2-tailed)	.000	.
	N	84	84

Table 8: KM2 and SDM Success Correlation Results

H3: If a SDM incorporates knowledge creation then information systems will be more successful.

Knowledge creation has been identified as having a positive influence on organisational performance (Lahti and Beyerlein, 2000, Bhatt, 2001, Bryant, 2003, Birkinshaw et al. 2002, Mphahlele and Kutu, 2002). So it should also have a positive influence on SDM success. In order to check for violations of linearity and homoscedasticity a scatterplot was produced.

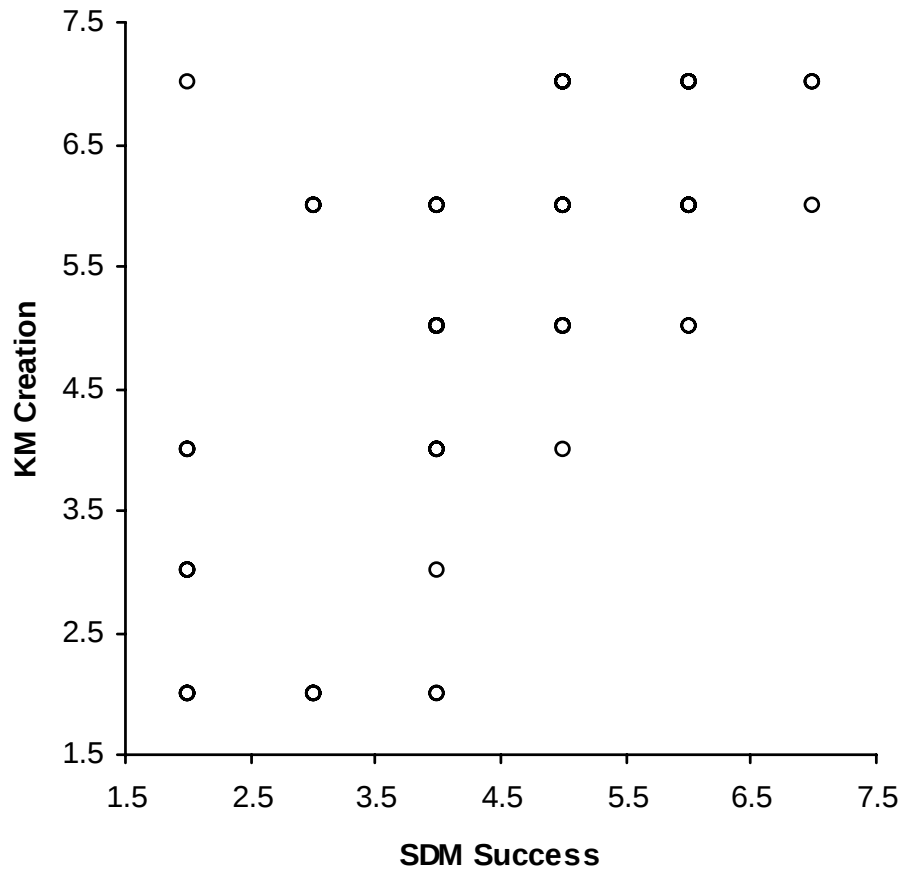


Figure 11: KM3 and SDM Success Scatterplot

The outliers were evaluated in order to determine the impact that they have on the results. The 5% trimmed mean and the original mean were very similar. It is recommended to retain these cases in the dataset as the impact of removing them would not change the distribution of data (Pallant, 2001).

Descriptives

			Statistic	Std. Error
KM Creation	Mean		5.1905	.1723
	95% Confidence Interval for Mean	Lower Bound	4.8478	
		Upper Bound	5.5332	
	5% Trimmed Mean		5.2672	
	Median		6.0000	
	Variance		2.493	
	Std. Deviation		1.5791	
	Minimum		2.00	
	Maximum		7.00	
	Range		5.00	
	Interquartile Range		2.0000	
	Skewness		-.830	.263
	Kurtosis		-.323	.520

Table 9: KM3 Descriptive Results

There is a large positive correlation between the two variables [$r = 0.67$, $n = 84$, $p < .0001$]. Therefore, Knowledge Creation is very significantly correlated with success. It explains a large percentage (45%) of the variance in the respondents' scores on SDM Success.

Correlations

		SDM	KM Creation
SDM	Pearson Correlation	1.000	.675**
	Sig. (2-tailed)	.	.000
	N	84	84
KM Creation	Pearson Correlation	.675**	1.000
	Sig. (2-tailed)	.000	.
	N	84	84

Table 10: KM3 and SDM Success Correlation Results

H4: If a SDM incorporates knowledge validation then information systems will be more successful.

Knowledge validation has been identified as having a positive influence on organisational performance (Bhatt, 2001). So it should also have a positive influence on SDM success. In order to check for violations of linearity and homoscedasticity a scatterplot was produced.

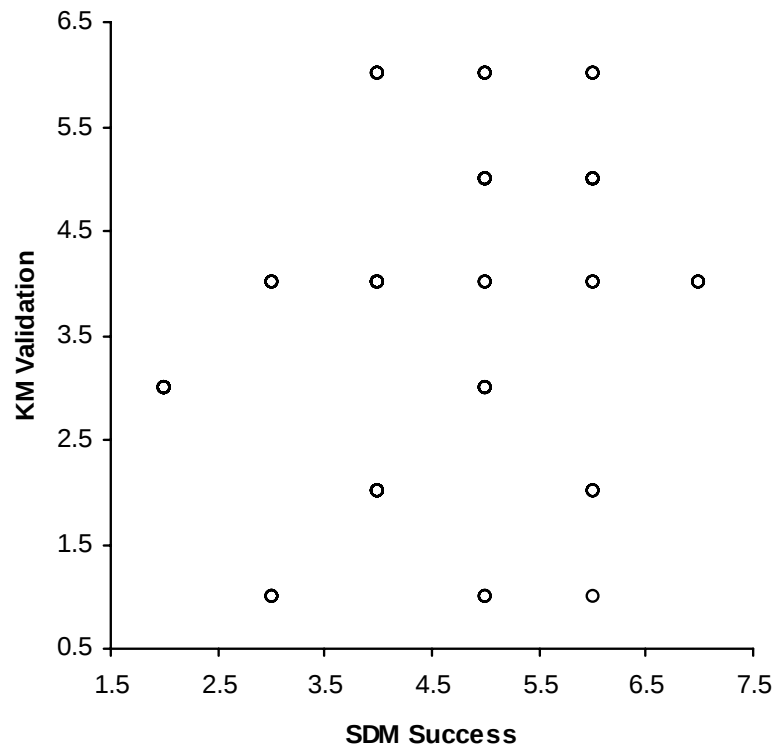


Figure 12: KM4 and SDM Success Scatterplot

The outliers were evaluated in order to determine the impact that they have on the results. The 5% trimmed mean and the original mean were very similar. It is recommended to retain these cases in the dataset as the impact of removing them would not change the distribution of data (Pallant, 2001).

Descriptives

			Statistic	Std. Error
KM Validation	Mean		3.7500	.1623
	95% Confidence Interval for Mean	Lower Bound	3.4271	
		Upper Bound	4.0729	
	5% Trimmed Mean		3.7778	
	Median		4.0000	
	Variance		2.214	
	Std. Deviation		1.4879	
	Minimum		1.00	
	Maximum		6.00	
	Range		5.00	
	Interquartile Range		2.0000	
	Skewness		-.254	.263
	Kurtosis		-.786	.520

Table 11: KM4 Descriptive Results

There was a medium positive correlation between the two variables [$r = 0.33$, $n = 84$, $p < .002$]. Therefore, Knowledge Validation is significantly correlated to SDM success. However it explains only 11% of the variance in the respondents' scores on SDM Success.

Correlations

		SDM	KM Validation
SDM	Pearson Correlation	1.000	.339**
	Sig. (2-tailed)	.	.002
	N	84	84
KM Validation	Pearson Correlation	.339**	1.000
	Sig. (2-tailed)	.002	.
	N	84	84

Table 12: KM4 and SDM Success Correlation Results

H5: If a SDM incorporates knowledge retention then information systems will be more successful.

The principle of knowledge retention can be described as the SDM's ability to embed important system knowledge into the work processes and policies related to the system. Knowledge retention has been identified as having a positive influence on organisational performance (Probst et al. 1999; Wiig et al. 1997). So it should also have a positive influence on SDM success. In order to check for violations of linearity and homoscedasticity a scatterplot was produced.

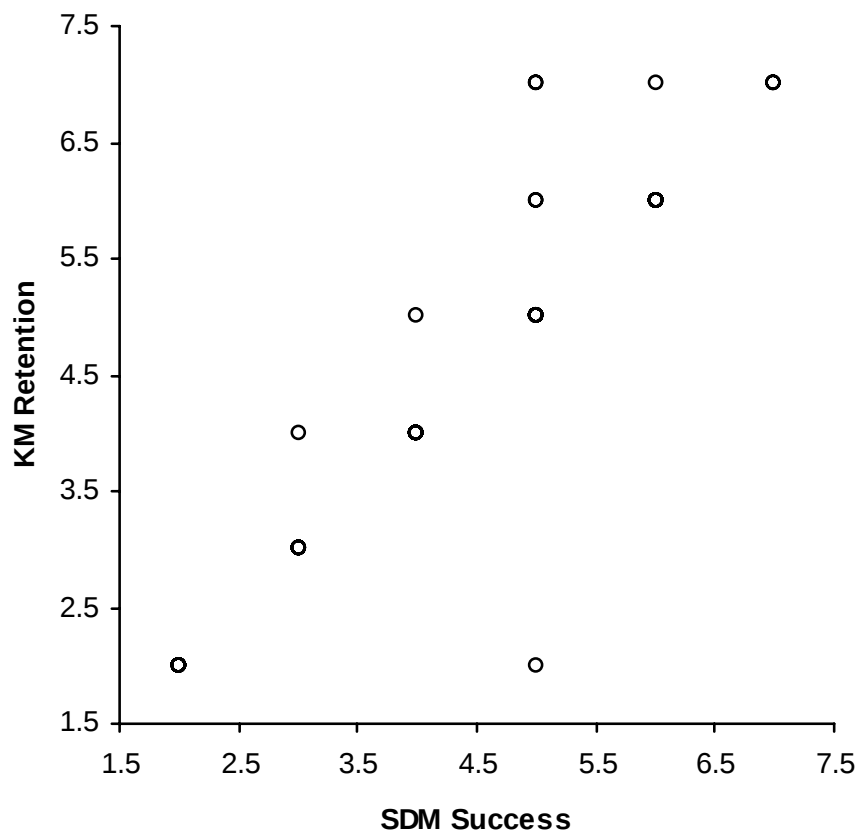


Figure 13: KM5 and SDM Success Scatterplot

Preliminary analyses were performed to ensure no violation of the assumptions of normality, linearity and homoscedasticity. The results from the preliminary analysis confirm that there was no violation of the above mentioned assumptions. There is a large positive correlation between the two variables [$r = 0.93$, $n = 84$, $p < .0001$]. Therefore, Knowledge Retention is very significantly correlated to SDM success. It explains a very large 88% of the variance in the respondents' scores on SDM Success.

Correlations

		SDM	KM Retention
SDM	Pearson Correlation	1.000	.939**
	Sig. (2-tailed)	.	.000
	N	84	84
KM Retention	Pearson Correlation	.939**	1.000
	Sig. (2-tailed)	.000	.
	N	84	84

Table 13: KM5 and SDM Success Correlation Results

H6: If a SDM incorporates knowledge destruction then information systems will be more successful.

Knowledge destruction has been identified as having a positive influence on organisational performance (Naidoo 1999; Carlile and Rebentisch 2003). So it should also have a positive influence on SDM success. In order to check for violations of linearity and homoscedasticity a scatterplot was produced.

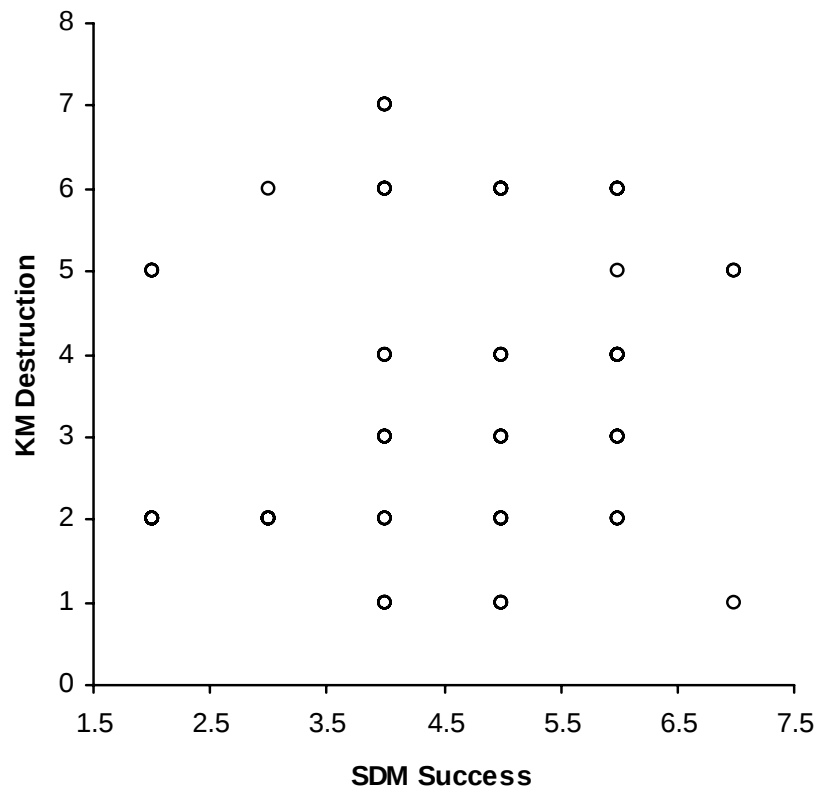


Figure 14: KM6 and SDM Success Scatterplot

The outliers were evaluated in order to determine the impact that they have on the results. The 5% trimmed mean and the original mean were very similar. It is recommended to retain these cases in the dataset as the impact of removing them would not change the distribution of data (Pallant, 2001).

Descriptives

			Statistic	Std. Error
KM Destruction	Mean		3.5476	.1927
	95% Confidence Interval for Mean	Lower Bound	3.1644	
		Upper Bound	3.9308	
	5% Trimmed Mean		3.5132	
	Median		3.0000	
	Variance		3.118	
	Std. Deviation		1.7658	
	Minimum		1.00	
	Maximum		7.00	
	Range		6.00	
	Interquartile Range		3.0000	
	Skewness		.370	.263
	Kurtosis		-1.144	.520

Table 14: KM6 Descriptive Results

The relationship between Knowledge Destruction and SDM Success was investigated using Pearson product-moment correlation coefficient. There is a small positive correlation between the two variables [$r = 0.20$, $n = 84$, $p < .058$]. Therefore, Knowledge Destruction is significantly correlated to SDM success. However it explains only a marginal 4% of the variance in the respondents' scores on SDM Success.

Correlations

		SDM	KM Destruction
SDM	Pearson Correlation	1.000	.208
	Sig. (2-tailed)	.	.058
	N	84	84
KM Destruction	Pearson Correlation	.208	1.000
	Sig. (2-tailed)	.058	.
	N	84	84

Table 15: KM6 and SDM Success Correlation Results

H7: If a SDM incorporates knowledge representation then information systems will be more successful.

The principle of knowledge representation applies to SDM in the following ways;

- o The SDM should facilitate completeness and consistency of documentation (Sakthivel, 1992).
- o The SDM should facilitate the representing of the knowledge about what the system must do (Armour, 2000).

Knowledge representation has been identified as having a positive influence on organisational performance (Lahti and Beyerlein, 2000 and Bhatt, 2001). So it should also have a positive influence on SDM success. In order to check for violations of linearity and homoscedasticity a scatterplot was produced.

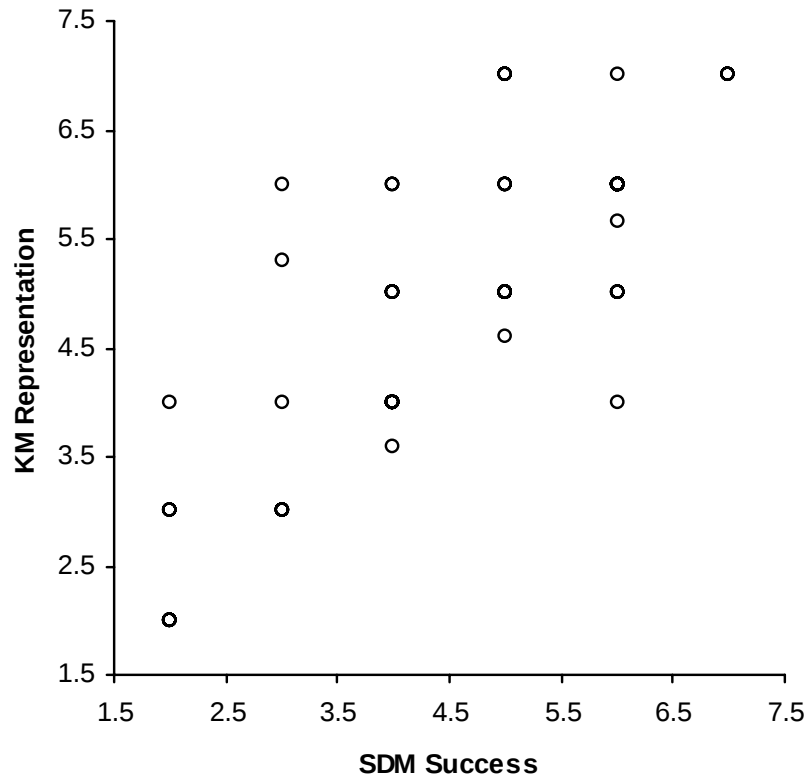


Figure 15: KM7 and SDM Success Scatterplot

Preliminary analyses were performed to ensure no violation of the assumptions of normality, linearity and homoscedasticity. The results confirm that there was no violation of the above mentioned assumptions. There is a large positive correlation between the two variables [$r = 0.83$, $n = 84$, $p < .0001$]. Therefore, Knowledge Representation is very significantly correlated to SDM success. It explains a large percentage (69%) of the variance in the respondents' scores on SDM success.

Correlations

		SDM	KM Representa- tion
SDM	Pearson Correlation	1.000	.830**
	Sig. (2-tailed)	.	.000
	N	84	84
KM Representation	Pearson Correlation	.830**	1.000
	Sig. (2-tailed)	.000	.
	N	84	84

Table 16: KM7 and SDM Success Correlation Results

H8: If a SDM incorporates knowledge accessibility then information systems will be more successful.

Knowledge accessibility has been identified as having a positive influence on organisational performance (Lahti and Beyerlein, 2000; Wiig et al. 1997; Naidoo, 1999). So it should also have a positive influence on SDM success. In order to check for violations of linearity and homoscedasticity a scatterplot was produced.

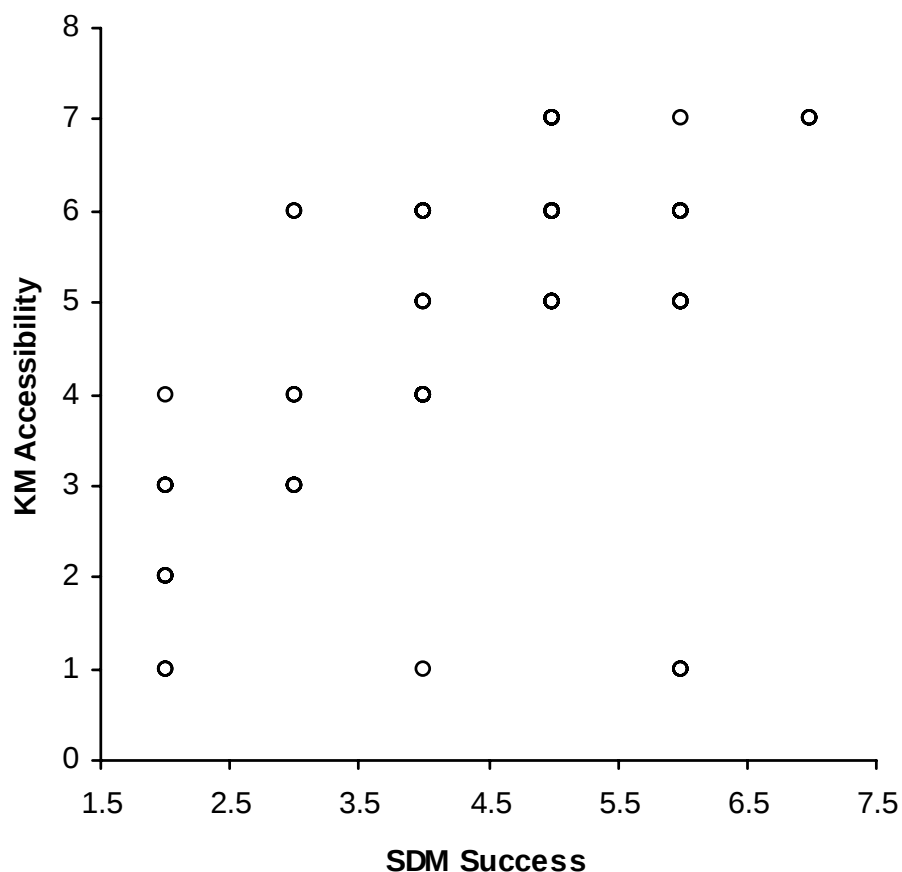


Figure 16: KM8 and SDM Success Scatterplot

The outliers were evaluated in order to determine the impact that they have on the results. The 5% trimmed mean and the original mean were very similar. It is recommended to retain these cases in the dataset as the impact of removing them would not change the distribution of data (Pallant, 2001).

Descriptives

			Statistic	Std. Error
KM Accesibility	Mean		4.8214	.1872
	95% Confidence Interval for Mean	Lower Bound	4.4491	
		Upper Bound	5.1938	
	5% Trimmed Mean		4.9127	
	Median		5.0000	
	Variance		2.944	
	Std. Deviation		1.7157	
	Minimum		1.00	
	Maximum		7.00	
	Range		6.00	
	Interquartile Range		2.0000	
	Skewness		-.786	.263
	Kurtosis		-.232	.520

Table 17: KM8 Descriptive Results

There is a large positive correlation between the two variables [$r = 0.56$, $n = 84$, $p < .0.0001$]. Therefore, Knowledge Accessibility Knowledge Representation is very significantly correlated to SDM success as it explains 31% of the variance in the respondents' scores on SDM Success.

Correlations

		SDM	KM Accesibility
SDM	Pearson Correlation	1.000	.564**
	Sig. (2-tailed)	.	.000
	N	84	84
KM Accesibility	Pearson Correlation	.564**	1.000
	Sig. (2-tailed)	.000	.
	N	84	84

Table 18: KM8 and SDM Success Correlation Results

H9: If a SDM incorporates knowledge sharing then information systems will be more successful.

Avison et al. (1992) stated that during the development of an information system effective communication about the system needs to occur between the phases on the project and to individuals that require information e.g. users. Knowledge sharing has been identified as having a positive influence on organisational performance (Probst et al. 1999; Lahti and Beyerlein, 2000; Bhatt, 2001; Bryant, 2003; Mphahlele and Kutu, 2002; Naidoo, 1999).

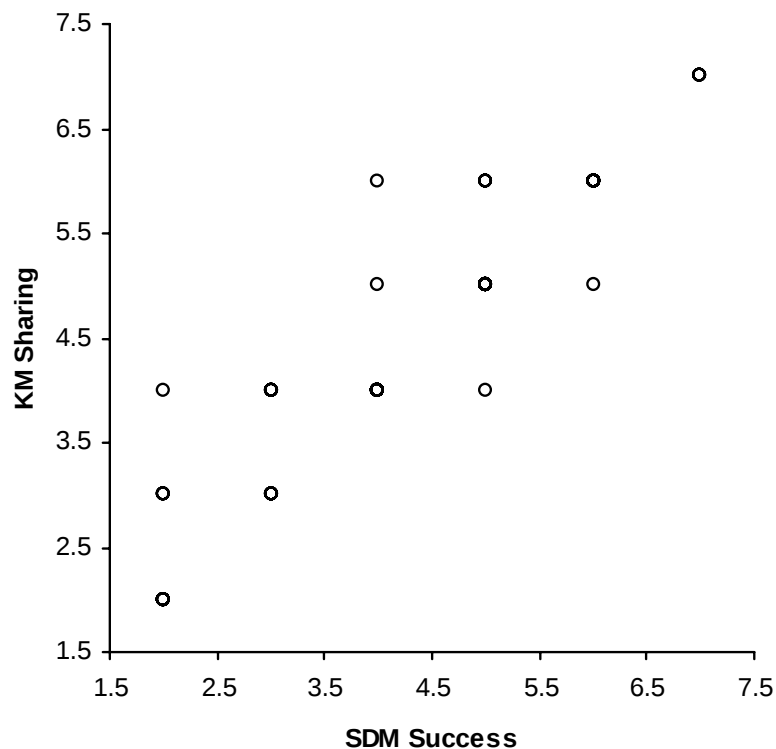


Figure 17: KM9 and SDM Success Scatterplot

Preliminary analyses were performed to ensure no violation of the assumptions of normality, linearity and homoscedasticity. The results confirm that there was no violation of the above mentioned assumptions. There is a large positive correlation between the two variables [$r = 0.93$, $n = 84$, $p < .0001$]. Therefore, Knowledge Sharing is very significantly correlated to SDM success as it explains 86% of the variance in the respondents' scores on SDM Success.

Correlations

		SDM	KM Sharing
SDM	Pearson Correlation	1.000	.938**
	Sig. (2-tailed)	.	.000
	N	84	84
KM Sharing	Pearson Correlation	.938**	1.000
	Sig. (2-tailed)	.000	.
	N	84	84

Table 19: KM9 and SDM Success Correlation Results

H10: If a SDM incorporates knowledge application then information systems will be more successful.

Knowledge application has been identified as having a positive influence on organisational performance (Probst et al. 1999; Bhatt, 2001; Bryant, 2003; Mphahlele and Kutu, 2002; Wiig et al. 1997; Naidoo 1999). So it should also have a positive influence on SDM success.

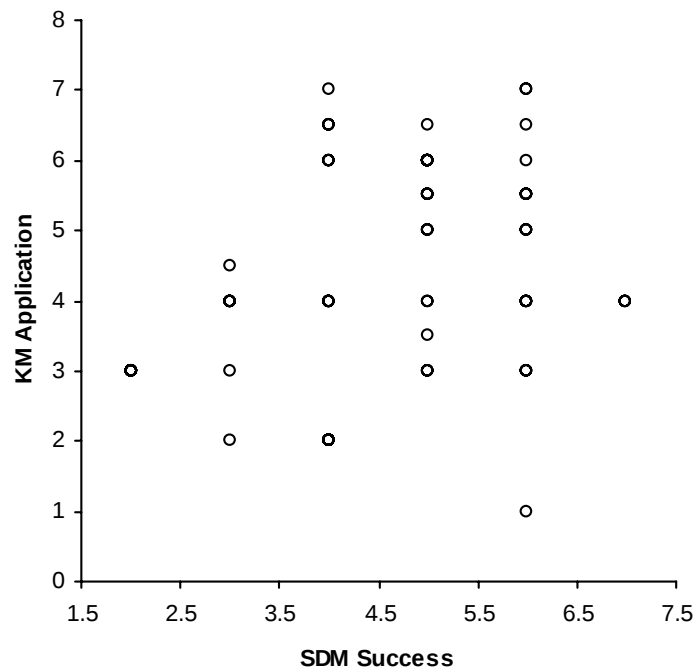


Figure 18: KM10 and SDM Success Scatterplot

The outliers were evaluated in order to determine the impact that they have on the results. The 5% trimmed mean and the original mean were very similar. It is recommended to retain these cases in the dataset as the impact of removing them would not change the distribution of data (Pallant, 2001).

Descriptives

			Statistic	Std. Error
KM Application	Mean		4.3155	.1648
	95% Confidence Interval for Mean	Lower Bound	3.9877	
		Upper Bound	4.6433	
	5% Trimmed Mean		4.3161	
	Median		4.0000	
	Variance		2.282	
	Std. Deviation		1.5106	
	Minimum		1.00	
	Maximum		7.00	
	Range		6.00	
	Interquartile Range		2.8750	
	Skewness		-.010	.263
	Kurtosis		-1.058	.520

Table 20: KM10 Descriptive Results

The relationship between Knowledge Application and SDM Success was investigated using Pearson product-moment correlation coefficient. There is a medium positive correlation between the two variables [$r = 0.37$, $n = 84$, $p < .0.0001$]. Therefore, Knowledge Application is significantly correlated to SDM success as it explains 14% of the variance in the respondents' scores on SDM Success.

Correlations

		SDM	KM Application
SDM	Pearson Correlation	1.000	.374**
	Sig. (2-tailed)	.	.000
	N	84	84
KM Application	Pearson Correlation	.374**	1.000
	Sig. (2-tailed)	.000	.
	N	84	84

Table 21: KM10 and SDM Success Correlation Results

4.2.9 OVERVIEW OF KNOWLEDGE MANAGEMENT PRINCIPLES RELATIONSHIP TO SDM SUCCESS

The table below summarises the results of the Pearson product-moment correlation analysis between the Knowledge Management principles and SDM Success:

Hypothesis	% Variance Explained	P Values
H1: Knowledge Identification to SDM Success	12%	p=0.001
H2: Knowledge Acquisition to SDM Success	70%	p=0.0001
H3: Knowledge Creation to SDM Success	45%	p=0.0001
H4: Knowledge Validation to SDM Success	11%	p=0.002
H5: Knowledge Retention to SDM Success	88%	p=0.0001
H6: Knowledge Destruction to SDM Success	4%	p=0.058
H7: Knowledge Representation to SDM Success	69%	p=0.0001
H8: Knowledge Accessibility to SDM Success	31%	p=0.0001
H9: Knowledge Sharing to SDM Success	86%	p=0.0001
H10: Knowledge Application to SDM Success	14%	p=0.0001

Table 22: Overview of KM and SDM Correlation Results

Even though some of the correlation coefficients are not substantively significant, all the hypotheses can be accepted as there is a statistically significant correlation between all the KM principals and SDM Success.

A correlation matrix shows that some of the KM principles are correlated to each other. This suggests that factor analysis is useful in order to reduce the variables to a smaller set (Tabachnick and Fidell, 1996).

Correlation Matrix

		KM Identification	KM Aquisition	KM Creation	KM Sharing	KM Application	KM Retention	KM Destruction	KM Represen tation	KM Accesibility	KM Validation
Correlation	KM Identification	1.000	.278	.310	.310	.409	.316	.457	.236	.066	.204
	KM Aquisition	.278	1.000	.671	.851	.418	.833	.126	.775	.525	.382
	KM Creation	.310	.671	1.000	.734	.452	.634	.252	.681	.609	.482
	KM Sharing	.310	.851	.734	1.000	.361	.883	.233	.829	.564	.410
	KM Application	.409	.418	.452	.361	1.000	.395	.447	.475	.547	.317
	KM Retention	.316	.833	.634	.883	.395	1.000	.192	.836	.555	.314
	KM Destruction	.457	.126	.252	.233	.447	.192	1.000	.228	.156	.461
	KM Representation	.236	.775	.681	.829	.475	.836	.228	1.000	.631	.447
	KM Accesibility	.066	.525	.609	.564	.547	.555	.156	.631	1.000	.251
	KM Validation	.204	.382	.482	.410	.317	.314	.461	.447	.251	1.000

Table 23: KM Correlation Matrix

Pallant (2001) also suggests that in order for factor analysis to be appropriate the Kaiser-Meyer-Olkin Measure of Sampling Adequacy needs to be above 0.6 and that the Barlett's Test of Sphericity should have a significance value of .05 or smaller. Knowledge destruction was removed from the factor analysis as it had the lowest correlation to SDM success and when it was incorporated into the factor analysis it reduced the results of the variance explained by the principles. However, the scree plot only contains one clear break and the Component Matrix does not load the principles uniquely into components. Therefore factor analysis was not appropriate. Due to the multicollinearity of the independent variables multiple regression is not advised, as correlations between independent variables do not result in a workable regression model (Pallant, 2001).

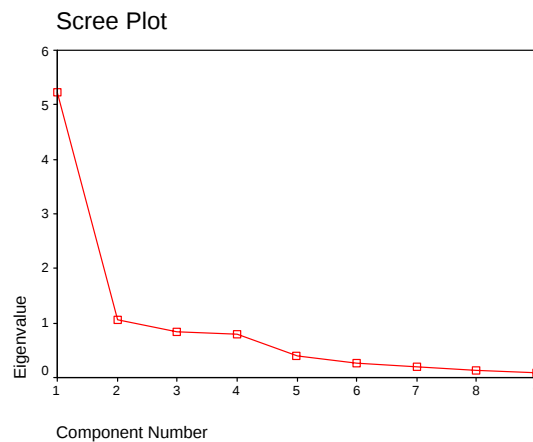


Figure 19: KM Scree Plot

Component Matrix^a

	Component	
	1	2
KM Identification	.398	.790
KM Aquisition	.879	
KM Creation	.834	
KM Sharing	.912	
KM Application	.609	.479
KM Retention	.887	
KM Representation	.903	
KM Accesibility	.718	
KM Validation	.532	

Extraction Method: Principal Component Analysis.

a. 2 components extracted.

Table 24: KM Factor Analysis Results

4.2.10 RESPONDENT TYPE OF ORGANISATIONAL CULTURE

Organisational culture has been examined to determine if it has a moderating effect on the relationship between KM principles and SDM success as organisational culture has been shown to impact the success of KM within an organisation (Sharp, 2003). So it is therefore assumed that KM principles will impact the success of the system differently within the four organisational cultures (Xenikou and Furnham, 1996):

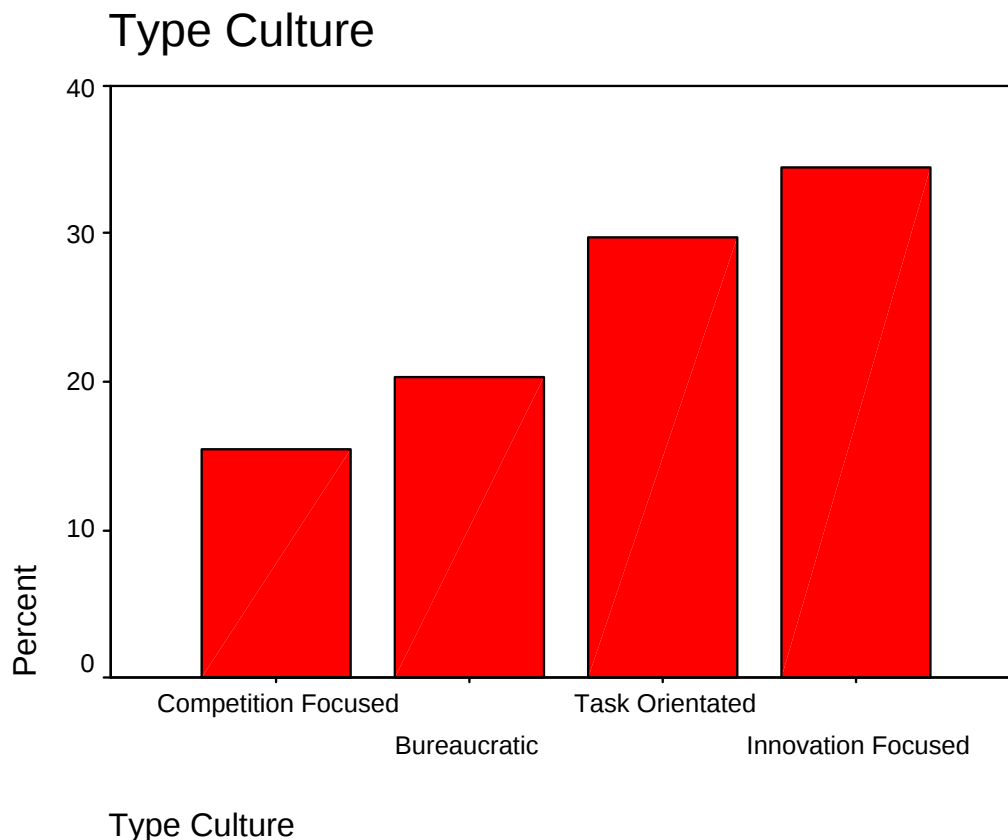


Figure 20: Type of Organisational Culture

29 out of 84 responses described the organisational culture as Innovation Focussed which is defined as having a humanistic orientation, achievement focus, affiliation, self-actualisation, task innovation, and hands-on management. The minority described the culture as Competition Focussed which is defined as having an oppositional orientation, focus on power, focus on the competition, and perfectionism. In order to determine whether organisational culture has a moderating effect the data was grouped by the four Organisational Cultural categories and then Pearson's Correlation was calculated in the four groups at a significance level of $p < 0.01$ and $n = 84$.

Hypothesis	Competition Focused	Bureaucratic	Task-Oriented	Innovation Focused
1. Correlation between KM 1 (Knowledge Identification) and SDM Success	r=.19	r=-.02	r=.71	r=.38
2. Correlation between KM 2 (Knowledge Acquisition) and SDM Success	r=.88	r=.70	r=.83	r=.81
3. Correlation between KM 3 (Knowledge Creation) and SDM Success	r=.89	r=.68	r=.72	r=.84
4. Correlation between KM 4 (Knowledge Validation) and SDM Success	r=.09	r=.97	r=.68	r=.29
5. Correlation between KM 5 (Knowledge Retention) and SDM Success	r=1.000	r=0.84	r=0.95	r=0.92
6. Correlation between KM 6 (Knowledge Destruction) and SDM Success	r=-.46	r=0.85	r=0.34	r=0.32
7. Correlation between KM 7 (Knowledge Representation) and SDM Success	r=.77	r=.78	r=.86	r=.76
8. Correlation between KM 8 (Knowledge Accessibility) and SDM Success	r=.82	r=.78	r=.76	r=.13
9. Correlation between KM 9 (Knowledge Sharing) and SDM Success	r=.97	r=.94	r=.90	r=.94
10. Correlation between KM 10 (Knowledge Application) and SDM Success	r=.10	r=.77	r=.68	r=.29
Mean Results	r=.52	r=.72	r=.74	r=.56

Table 25: Organisational Culture Type Correlation Matrix

As can be seen from the table above organisational culture type does have an influence on the relationship between KM principles and SDM success. The mean regression score for Competition focused is 0.525, for a Bureaucratic culture it is 0.729, for a Task orientated culture it is 0.74 and for an Innovation focused organisation it is 0.568. The results show that

the correlation between KM principles and SDM success is influenced by the organisational culture. The correlation is high when the culture is describes as being either Bureaucratic or Task-Orientated. The correlation between knowledge application and SDM Success is distorted by the organisation culture.

.z score was calculated in order to determine whether the difference in correlation values between the four culture groups is statistically higher. If $-1.96 < \text{zscore} < 1.96$: correlation coefficients are not statistically significantly different at $p < 0.05$ (Pallant 2001).

The table below shows the results for the zscores.

Correlation between	Competition Focused vs. Bureaucratic	Competition Focused vs. Task-Oriented	Competition Focused vs. Innovation Focused	Bureaucratic vs. Task-Oriented	Bureaucratic vs. Innovation Focused	Task-Oriented vs. Innovation Focused
1. Knowledge Identification and SDM Success	z=0.51	z=-1.82	z=-0.55	z=-2.65 Significant	z=-1.26	z=1.68
2. Knowledge Acquisition and SDM Success	z=1.22	z=0.49	z=0.66	z=-0.93	z=-0.78	z=0.21
3. Knowledge Creation and SDM Success	z=1.43	z=1.34	z=0.53	z=-0.22	z=-1.18	z=1.08
4. Knowledge Validation and SDM Success	z=-4.83 Significant	z=-1.9	z=-0.55	z=3.69 Significant	z=5.41 Significant	z=1.83
5. Knowledge Retention and SDM Success	z=3.44 Significant	z=2.13 Significant	z=2.84 Significant	z=-1.78	z=-1.10	z=0.83
6. Knowledge Destruction and SDM Success	z=-4.23 Significant	z=-2.23 Significant	z=-2.22 Significant	z=2.63 Significant	z=2.78 Significant	z=0.07
7. Knowledge Representation and SDM Success	z=-0.06	z=-0.71	z=0.06	z=-0.72	z=0.14	z=1.02
8. Knowledge Accessibility and	z=0.26	z=0.42	z=2.57	z=0.14	z=2.75	z=2.98

SDM Success			Significant		Significant	Significant
9. Knowledge Sharing and SDM Success	$z=0.855$	$z=1.62$	$z=0.95$	$z=0.77$	$z=0$	$z=-0.91$
10. Knowledge Application and SDM Success	$z=-2.22$ Significant	$z=-1.91$	$z=-0.53$	$z=0.559$	$z=2.17$ Significant	$z=1.83$
Mean Results	$z=-0.80$	$z=-0.98$	$z=-0.15$	$z=-0.12$	$z=0.82$	$z=1.09$

Table 26: Organisational Culture Z score Results

As can be seen from Table 26 the greatest differences are found when comparing Competition focused to a Bureaucratic focused organisation and when comparing a Bureaucratic focused to a Task-Oriented organisation. Therefore it can be concluded that KM principles explain significantly more of the variance in SDM success than in a Bureaucratic culture.

4.3 CHAPTER SUMMARY

This chapter analysed the data in order to test the hypotheses. From the various bar charts, scatter plot diagrams and Pearson correlations, it was determined that knowledge management principles are statistically significant and therefore their hypotheses can be confirmed.

Factor analysis was attempted in order to reduce the KM principles, however it was not appropriate to conduct this test because of the results from the scree plot and component loadings on the component matrix. Analysis was done to determine whether organisational culture moderates the relationship between KM principles and SDM success and it was found that for certain KM principles it is a moderating factor.

CHAPTER 5: DISCUSSION

5.1 CHAPTER OVERVIEW

The purpose of this chapter is to interpret the results from the data analysis and explain the results in relationship to the existing literature in the area.

5.2 DATA INTERPRETATION

In order to gain meaning from the statistical results, interpretation is required. Kritzer (1996) argues that quantitative studies involve more levels of interpretation than qualitative studies. This is because in quantitative studies the researcher first assembles the data and then produces statistical results and that at each stage the role of interpretation increases, while in qualitative studies the researcher has only to construct the text for interpretation.

“Data seldom speaks unless asked” (Kritzer, 1996, pp.3)

It is important that the interpretation of quantitative analysis moves beyond the discussions of the technical meaning of the results yielded by particular methodologies (Kritzer, 1996). It is for this reason that Kritzer (1996) describes three levels at which interpretation of quantitative data needs to be assessed in order for adequate meaning to be derived from the results.

The initial stage of interpretation involves explaining the meaning of the value that is derived from the Pearson's correlation test for each of the 10 hypotheses. The second level involves going beyond the simple meaning of the statistical indicator, to using the statistical results to identify “problems” in the data and the analysis. This involves uncovering intervening variables that are affecting the data and determining the impact that outlying data responses have on the result. The third level involves connecting the statistical results to a broader theoretical pattern. While data can be reported as an isolated statistic, a single datum is only useful in the context of theory (Brown, 1977 cited in Kritzer, 1996).

The diagram below displays the results of the hypotheses after the data was analysed. Pearson's correction was selected as the statistical technique used to determine the correlation between these two variables.

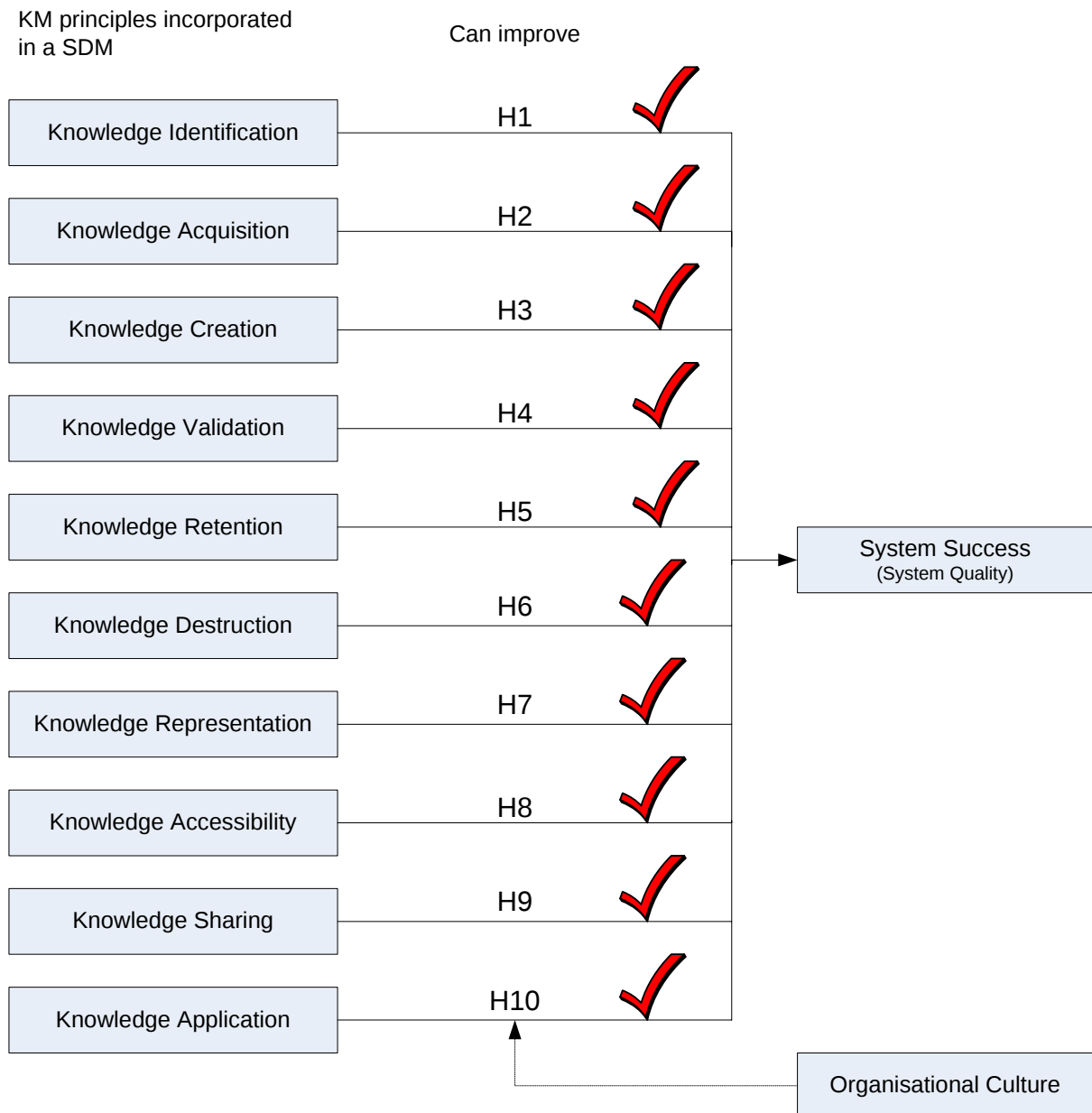


Figure 21: Hypothesis Results

H1: If a SDM incorporates knowledge identification then information systems will be more successful – is supported

I expected to find that knowledge identification would have a positive influence on SDM success as it has been shown to positive impact on organisational performance (Probst et al. 1999, Wiig et al. 1997 and Naidoo, 1999). Armour (2000) also stated that in order for software to be developed the knowledge required for storage and use should be identified so that it can either be acquired from the correct people or generated. I found that knowledge identification explains 12% of the variance of the respondents' scores on SDM success and that the strength of the relationship was only medium. However, for Task-Oriented

organisations the correlation was high at a significance level of $p=0.001$. Task-Oriented organisations are defined as those organisations that focused on being the best, innovation, attention to detail, quality orientation, profit orientation, and shared philosophy (Xenikou and Furnham, 1996).

This suggests that not all SDMs that incorporate knowledge identification are successful; however if the organisation is task-orientated and has a focus on attention to detail then knowledge identification does have a higher correlation to SDM success. This finding shows that the Knowledge Management framework needs to be adapted to its use within System Development Methodologies and that in order for the principle of knowledge identification to be effective it requires an organisation that has a culture of attention to detail.

H2: If a SDM incorporates knowledge acquisition then information systems will be more successful – is strongly supported

The results for this hypothesis are consistent with expectations. Knowledge acquisition has a positive influence on SDM success, as it has been proved to have on organisational success (Probst et al. 1999; Mphahlele and Kutu, 2002; Wiig et al. 1997; Naidoo, 1999). This finding is consistent with Armour's (2000) recommendations that the software development process should incorporate knowledge-acquiring activities, as the development of systems is a knowledge activity more than a product producing activity. It is also consistent Wiig et al. (1997) who stated that knowledge acquisition addresses the issue of knowledge gaps that exist within the organisation or system development process, that are essential for effective operations and maintaining a competitive advantage. The results show that knowledge acquisition explains 70% of the variance of the respondents' scores on SDM success at a significance level of $p<0.001$. This finding means that SDMs ought to incorporate knowledge acquiring tasks and processes in order to develop quality systems. The SDM should facilitate the selection of the appropriate strategies for acquire knowledge, e.g. when JAD sessions are required.

It is interesting to note that within an organisation that has a culture of Bureaucracy, which is defined as an organisation whose focus in on gaining approval, conventionality, dependence and avoidance (Xenikou and Furnham, 1996), the correlation with SDM success was lower. The reason could be that a bureaucratic culture hampers the ability to acquire knowledge from different sources.

H3: If a SDM incorporates knowledge creation then information systems will be more successful – is strongly supported

The results for this hypothesis are consistent with expectations. Knowledge creation has a positive influence on SDM success, as it has been shown to have on organisational success (Lahti and Beyerlein, 2000, Bhatt, 2001, Bryant, 2003, Birkinshaw et al. 2002, Mphahlele and Kutu, 2002). This finding supports Carlile and Rebentisch (2003) who stated that the core challenge of any organisation is the creation of new knowledge, i.e. solutions to problems, and that this needs to be done effectively in order for an organisation to be successful. The correlation matrix also confirmed the Birkinshaw et al. (2002) findings that in order to facilitate the process of knowledge creation it is useful to connect people who share an interest in an idea.

The results show that knowledge acquisition explains 45% of the variance of the respondents' scores on SDM success at a significance level of $p < 0.001$. This finding means that SDMs ought to incorporate knowledge creating tasks and processes in order to develop quality systems. The SDM should assist in guiding the creation of knowledge, e.g. assists with brainstorming techniques and knowledge forums.

It was also found that organisations who describe their culture as either Competition focused or as Innovation focused had a higher correlation. The reason could be that fact that a culture of innovation values the creation of knowledge and a culture of competition focused needs to create new knowledge to gain an advantage.

H4: If a SDM incorporates knowledge validation then information systems will be more successful – is supported

I expected to find that knowledge validation would have a positive influence on SDM success, as it has been shown to positive impact on organisational performance (Bhatt, 2001). I found that only 11% of the variance of the respondents' scores on SDM success is explained by knowledge validation and that the strength of the relationship was only medium. This finding is consistent with Bhatt (2001), who stated that knowledge validation is required as it is the process of assessing the relevance of the knowledge created or acquired. However, Bureaucratic and Task-Orientated organisations were more highly correlated at a significance level of $p < 0.001$. This could be due to the bureaucratic organisations are more focused on checks in processes and task-orientated organisations value attention to detail.

The finding that the degree to which knowledge validation impacts SDM success varies according to organisational culture shows that not all SDMs that incorporate knowledge

validation are successful; however if the organisation is bureaucratic or task-orientated, knowledge validation does have a higher correlation with SDM success. This finding also suggests that the Knowledge Management framework needs to be adapted to its use within System Development Methodologies, and that in order for the principle of knowledge validation to be effective it requires an organisation that has a culture of attention to detail and is methodical.

H5: If a SDM incorporates knowledge retention then information systems will be more successful – is strongly supported

The results for this hypothesis are consistent with expectations. Knowledge retention has a positive influence on SDM success, as it has been proved to have on organisational performance (Probst et al. 1999; Wiig et al. 1997). This finding supports Carlile and Rebenisch (2003) who state that knowledge retention is an important KM principle because effectiveness of knowledge retention can impact the efficacy and the relevancy of the knowledge that is later retrieved. Cross and Baird (2000) also believe that KM improves organisations if managers embed the lessons of experience into information repositories, work processes and support systems. The results revealed that knowledge retention explained 88% of the variance in the respondent's scores on SDM Success at a significance level of $p < 0.001$; the results also showed that knowledge retention was highly correlated to SDM success regardless of the culture of the organisation. Knowledge retention was also found to be very highly correlated with knowledge acquisition, knowledge sharing and knowledge representation.

This finding means that SDMs ought to incorporate knowledge retention tasks and processes in order to develop quality systems. The SDM needs to be able to facilitate embedding of knowledge gained.

H6: If a SDM incorporates knowledge destruction then information systems will be more successful – is supported

I expected to find that knowledge destruction would have a positive influence on SDM success as it has been shown to positive impact on organisational performance (Naidoo 1999; Carlile and Rebentisch (2003). I found that knowledge destruction only helps to explain 4% of the variance of the respondents scores on SDM success at a significance level of $p < 0.01$ and that the strength of the relationship was small. In fact this knowledge principle had the lowest correlation to SDM success. This finding is not consistent with Carlile and Rebentisch (2003) who stated that it is important that knowledge that is no longer relevant be

discarded to prevent it being applied in a context where it is no longer valid. However, Bureaucratic organisations were highly correlated at a significance level of $p < 0.01$. This could be because bureaucratic organisations are described as being more methodical in terms of the process that they follow. Organisations that have a competitive culture had a negative correlation with knowledge destruction; the reason could be that organisations that are focused on competition have time constraints, which are negatively affected by the time it takes to destroy knowledge that is no longer valid.

The finding that the degree to which knowledge destruction impacts SDM success varies according to organisational culture shows that not all SDMs that incorporate knowledge destruction are successful, however if the organisation is bureaucratic, knowledge destruction does have a higher correlation to SDM success. This finding also shows that the Knowledge Management framework needs to be adapted to its use within System Development Methodologies and that in order for the principle of knowledge destruction to be effective it requires an organisation that is methodical.

H7: If a SDM incorporates knowledge representation then information systems will be more successful – is strongly supported

The results found for this hypothesis are consistent with expectations. Knowledge representation has a positive influence on SDM success as it has been proved to have on organisational performance (Lahti and Beyerlein, 2000 and Bhatt, 2001). This finding supports the Armour (2000) recommendation that once the knowledge to develop a system has been acquired, the knowledge content should be managed. This can only be done if it is represented in a usable format for development and application by the end users. The results revealed that knowledge retention explained 69% of the variance in the respondent's scores on SDM Success at a significance level of $p < 0.001$; the results also showed that knowledge representation was highly correlated with SDM success regardless of the culture of the organisation.

This finding means that SDMs ought to incorporate knowledge retention tasks and processes in order to develop quality systems. Therefore for an SDM to be effective it would also need to facilitate the use of standardised representation models in order to manage the knowledge content of the domain.

H8: If a SDM incorporates knowledge accessibility then information systems will be more successful – is supported

The results for this hypothesis are consistent with expectations. Knowledge accessibility has a positive influence on SDM success as it has been proved to have on organisational performance (Lahti and Beyerlein, 2000; Wiig et al. 1997; Naidoo, 1999).

This finding supports Armour's (2000) statement that knowledge is only useful if it is accessible to those people who require it. The findings also support Mphahlele and Kutu (2002) who suggest that if the knowledge is readily accessible it does not have to be created again and therefore is connected to success. The results revealed that knowledge accessibility explained 31% of the variance in the respondent's scores on SDM Success at a significance level of $p < 0.001$; the results also showed that knowledge accessibility was relatively highly correlated to SDM success for competition focused, bureaucratic and task orientated cultures. It was however, not correlated to SDM success in organisations where culture is innovation focused. It could be that organisations that are innovation focused are more involved in creating knowledge, so that people who were involved in its creation did not require that it was accessible.

The finding that the degree to which knowledge accessibility impacts SDM success varies according to organisational culture means that SDMs ought to incorporate knowledge accessibility tasks and processes in order to develop quality systems. Therefore for an SDM to be effective it also ought to facilitate the storage of the knowledge regarding the system in an accessible place available to people who need it.

H9: If a SDM incorporates knowledge sharing then information systems will be more successful – is strongly supported

The results for this hypothesis are consistent with expectations. Knowledge sharing has a positive influence on SDM success as it has been proved to have on organisational performance (Probst et al. 1999; Lahti and Beyerlein, 2000; Bhatt, 2001; Bryant, 2003; Mphahlele and Kutu, 2002; Naidoo, 1999).

This finding supports the Bresman et al. (1999) argument that one of the most important aspects of KM is the process of knowledge sharing between business units. It also supports Avison et al. (1992) who stated that during the development of an information system effective communication about the system should occur between the phases on the project and between individuals who require information, e.g. users. The results revealed that knowledge sharing explained 86% of the variance in the respondent's scores on SDM

Success at a significance level of $p < 0.001$; the results also showed that knowledge sharing was highly correlated to SDM success regardless of the organisational culture.

This finding means that SDMs ought to incorporate knowledge sharing tasks and processes in order to develop quality systems. Therefore for an SDM to be effective it should also ensure that knowledge is shared between the different phases of the project and shared by the appropriate people.

H10: If a SDM incorporates knowledge application then information systems will be more successful – is supported

I expected to find that knowledge application would have a positive influence on SDM success, as it has been shown to positive impact on organisational performance (Probst et al. 1999; Bhatt, 2001; Bryant, 2003; Mphahlele and Kutu, 2002; Wiig et al. 1997; Naidoo 1999). I found that it only explains 14% of the variance of the respondents' scores on SDM success at a significance level of $p < 0.001$ and that the strength of the relationship was only medium.

This finding is not consistent with Duffy (2000) who found that organisations need to monitor the utilisation of knowledge. The results showed that Bureaucratic organisations and Task-orientated organisations were highly correlated at a significance level of $p < 0.001$. This could be due to the fact bureaucratic and task-orientated organisations are more methodical in terms of the process that they follow.

The finding that the degree to which knowledge application impacts SDM success varies according to organisational culture shows that not all SDMs that incorporate knowledge application are successful, however if the organisation is bureaucratic, knowledge application does have a higher correlation to SDM success. This finding also shows that the Knowledge Management framework needs to be adapted to its use within System Development Methodologies and that in order for the principle of knowledge application to be effective it requires an organisation that is methodical.

Organisational culture as a moderating factor

The results showed that organisational culture does influence the relationship between KM and SDM Success for some knowledge management principles. It is interesting to note that organisational culture influences the relationship between KM principles and SDM success significantly for those principles whose correlations with SDM success were lower and that there are some principles that are highly correlated to SDM success regardless of the

culture. This does not support Ladd and Ward (2002) findings that the cultural types (openness to change/innovation and task-oriented) were positively related to knowledge sharing and innovation, which in turn lead to KM success in the organisation.

5.3 CHAPTER SUMMARY

This chapter interpreted the results of the data analysis and found that although the literature showed that all the knowledge management principles described in this paper when incorporated within an organisation had a positive impact on its success, most of the KM principles when incorporated in a SDM had a positive impact on the success of the resulting system.

Therefore Armour's (2000) theory that information systems are knowledge media and that KM principles should be applied to the process used to develop them – the SDM, is true as the results are statistically significant.

CHAPTER 6: CONCLUSION

6.1 CHAPTER OVERVIEW

This chapter summarises this research study and highlights its value to the existing body of knowledge in the Information Systems field. The limitations of the study are discussed and areas for future research are stated.

6.2 SUMMARY OF STUDY

Armour (2000) speculated that an information system's success would improve if knowledge management were applied. This paper aimed to amplify and test Armour's hypothesis by determining whether the incorporation of knowledge management principles within System Development Methods increases the success of the resulting systems.

In order to test Armours theory a knowledge principles framework was developed by consolidating the literature in the area of knowledge management. This resulted in the identification of the following independent variables and KM principles in the SDM: knowledge identification, knowledge acquisition, knowledge creation, knowledge sharing, knowledge application, knowledge retention, knowledge destruction, knowledge representation, knowledge accessibility, and knowledge validation. The dependent variable used was the degree of success of the resulting information system utilising the SDM, which was measured in terms of system effectiveness.

The study also examined the influence that the organisational culture, type of SDM and type of project had on the information success results. The results of the moderating variable, organisation culture, supported the findings of Sharp (2003), that corporate culture does influence the success of KM.

It is evident from the study that, after analysing the ten hypotheses, Armours theory is correct. Therefore, it was proved that some knowledge management principles within System Development Methods increase the success of the resulting systems.

6.3 CONTRIBUTION OF STUDY

This study will aid both fellow academics and practitioners in the IS field. It will add to the body of knowledge that can be taught to students in courses on knowledge management in IS. It will also help IS Managers to select and modify their system development methods in order to develop successful information systems, because although publications exist on both knowledge management and system development methods, previous researchers have omitted to examine the application of knowledge management principles to system development methods for the purpose of improving their success.

6.4 LIMITATIONS OF THE STUDY

Although this research provides useful insights on the development and modification of SDMs in order to develop successful systems, it must be pointed out that limitations do exist.

Existing research

Although the lack of research on this topic does heighten its importance, difficulties were encountered, as there were few methodologies and frameworks to adopt or build upon.

Reliability

The reliability of this research has not been sufficiently verified. Situational factors, which cannot be controlled, could affect the outcome of the test-retest approach. As it was not applicable to use the split-halves approach, the three questions in pairs made them difficult to correlate.

Sample

The sampling frame is defined as IT practitioners who have used a SDM to produce an information system. The sampling frame included IT practitioners in organisations that operate within the PWV region and have developed one or more IT systems using a SDM and have access to email. However due to time and budget constraints, the sampling frame consisted of only those people who, at the time of the data collection resided in Gauteng, South Africa. This suggests that the sampling frame might not be representative of the South African Internet population.

6.5 SUGGESTIONS FOR FUTURE RESEARCH

The following topics are suggested for future research:

- Further study on culture and its impact on system development methodologies.
- Further analysis on the KM principles in order to develop a KM framework for SDM.
- An in-depth analysis of the KM principles utilized in the existing SDM.
- A study on additional factors that impact SDM success.

6.6 MANAGERIAL GUIDELINES

Although the results are not strong enough for prediction purpose, as some of the correlation coefficients are not that high and therefore alternative explanations for SDM success might be better predictors, the results of this study can aid managers in increasing the success of their information systems. Managers need to develop or modify their SDMs to incorporate the following KM principles:

- Knowledge identification: the SDM should facilitate the process of identifying the knowledge that is required to solve problems.
- Knowledge acquisition: the SDM should facilitate the selection of appropriate requirements analysis strategies in order to obtain diverse information.
- Knowledge creation: the SDM should assist with the creation of knowledge e.g. brainstorming
- Knowledge validation: the SDM should facilitate the validation of the accuracy and applicability of the acquired or created knowledge. Determining the value of existing knowledge is an important aspect of knowledge management (Mphahlele and Kutu, 2002).
- Knowledge retention: the SDM should facilitate the embedding of knowledge gaining during the development process e.g. updating policies and procedures with new knowledge.
- Knowledge destruction: the SDM should facilitate the destruction of invalid knowledge. This ensures that knowledge that is no longer applicable in the current context is archived or destroyed.

- Knowledge representation: the SDM should to facilitate the completeness and consistency of documentation, make use of templates (both for modelling and documenting) to represent knowledge and facilitate the capturing of the knowledge created or acquired relevant to the system being produced e.g. in the completion of system documentation.
- Knowledge accessibility: the SDM should facilitate the storage of the knowledge regarding the system in an accessible place available to the people who need it.
- Knowledge sharing: the SDM should ensure that knowledge is shared by the different phases of the SDM and shared the appropriate people within the organisation.
- Knowledge application: the SDM should provide guidelines for the utilisation of the acquired or created knowledge for its intended purpose. This ensures that the existing knowledge is applied productively and effectively to affect the performance of the organisation or information system, as well as ensuring that where possible reuse occurs.

The results of this study showed that different KM principles have a different impact depending on the organisational culture that they are employed.

6.7 CONCLUSION

This study analysed the data collected from 84 respondents who were asked to evaluate the incorporation of KM principles into the SDM and the resulting success of the system. The aim of this study was to determine whether the incorporation of knowledge management principles within System Development Methods increase the success of the resulting systems.

The study found that the KM principles when incorporated in the SDM do improve the success of the system. The data analysis further proved that organisational culture does impact the relationship between KM and SDM success for some principles. The results from this research indicate that knowledge management principles should be incorporated into a SDM in order for it to produce a success system.

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APPENDIX 1: LITERATURE SUMMARY

A summary of the main issues are provided in the table below:

Knowledge Management	KM has positively impacted the performance of organisations	Sharp (2003), Wiig (1994), Parlby (2000), Bresman et al. (1999), Wiig (1997), Prusak (1998), Ruggles (1998), Martin (2000), Bhatt (2001)
	The historical development of KM	Argote, McEvily and Reagans (2003), Davenport (1998)
	Description of KM	Duffy (1999), Davenport, (1998) Bourdreau and Couillard (1999), Wiig (1994), Armstrong et al. (1998), Nonaka (1991), Gavin (1993), Bair (1999)
Knowledge Management Principles	Applying KM principles improves organisational performance	Velker (1999), Disterer (2002), Argote et al. (2003), Song et al. (2003)
	Knowledge identification is a KM principle that improves organisational performance	Probst et al. (1999), Duffy (1999), Wiig et al. (1997), Naidoo (1999)

	Knowledge acquisition/creation is a KM principle that improves organisational performance	Probst et al. (1999), Lahti et al. (2000), Bhatt (2001) Bryant (2003), Mphahlele and Kutu (2002), Duffy (1999), Moore (1998), Birkinshaw et al. (2002), Wiig et al. (1997), Naidoo (1999), Nonaka (1991)
	Knowledge sharing is a KM principle that improves organisational performance	(Probst et al. (1999), Lahti and Beyerlein (2000), Bhatt (2001) Bryant (2003), Mphahlele and Kutu (2002), Duffy (1999), Davenport et al. (1998), Bresman et al. (1999), Moore (1998), Birkinshaw et al. (2002), Wiig et al. (1997), Naidoo (1999), Yoon et al. (1995)
	Knowledge application is a KM principle that improves organisational performance	Probst et al. (1999) Bhatt (2001), Bryant, (2003), Mphahlele and Kutu (2002), Duffy (1999), Duffy (2000), Birkinshaw et al. (2002), Wiig et al. (1997), Naidoo (1999), Nonaka (1991), Yoon et al. (1995)
	Knowledge retention/destruction is a KM principle that improves organisational performance	Probst et al. (1999), Wiig et al. (1997), Duffy (1999), Cross and Baird (2000), Duffy (2000), Moore (1998), Birkinshaw et al. (2002), Naidoo (1999)
	Knowledge representation is a KM principle that improves organisational performance	Lahti and Beyerlein, (2000), Bhatt (2001)

	Knowledge accessibility is a KM principle that improves organisational performance	Lahti and Beyerlein, (2000), Duffy (1999), Wiig et al. (1997), Naidoo (1999), Nonaka (1991)
	Knowledge validation is a KM principle that improves organisational performance	Bhatt (2001)
Factors Influencing the Success of KM	KM can only be effective when obstacles are identified and overcome	Davenport et al. (1998)
	Three categories of KM enables; cultural factors, IT infrastructure and KM related incentives	Wiig (1997)
	Most common barrier to successful KM is organisational culture	Davenport (1998), Mason et al. (2003), Sharp (2003), Delong et al. (2000), Ernst & Young (1997)
System Development Methods	The need for improved methods of producing IT systems	Davis et al. (2004), Wynekoop and Russo (1995), Lyytinen (1987), McNamara (1987), Russo et al. (2000)
	Description of SDM	Sprague et al. (1993), Russo et al. (1995), Wynekoop and Russo (1995), Sakthivel (1992), Olle et al. (1986), Wood-Harper et al. (1982), Olle et al. (1982), Avison et al. (1992), Russo et al. (2000), Lyytinen (1987)
	Effectiveness of SDM	Farrell (1994), Russo et al. (2000), Dekleva

		(1992), Wynekoop et al. (1995), Stolterman et al. (1997), Fichman et al. (1991), Russo et al. (1995), Monarchi et al. (1992) and Sakthivel (1992).
Application of KM to SDM	Information systems must be managed like knowledge assets	Armour (2000)
	SDM could be improved by utilizing the Intranet to improve knowledge sharing and distribution	Hidding (1997)
	Knowledge acquisition is a factor that impacts the success of expert systems	Byrd (1992)
	Different types of knowledge within the SDM need to be managed differently	Robillard (1999)
	KM principles impact the success of expert systems	Yoon et al. (1995)

Table 27: Summary of Literature

APPENDIX 2: COVER LETTER

My research is investigating the incorporation of Knowledge Management Principles in System Development Methods. Results of this study will provide IT practitioners with information that can be used to modify or select SDMs that will lead to more successful systems.

I would greatly appreciate it if you would complete the attached brief questionnaire. It will take no longer than 15 minutes of your time. Your contribution is critical to the success of the study. All information will be kept confidential and will be used for research purposes only. Please respond by answering the questionnaire and emailing it silver12@iafrica.com, as an attachment. If you request, the results of the research will be sent to you upon completion.

If you have any further queries or problems with the attached document, please do not hesitate to phone me on 082-857-0865 or 442-8846.

Thanks for your help and co-operation

With kind regards

Simone Silverman

APPENDIX 3: QUESTIONNAIRE

Please answer the following questions by filling out your details in section one and selecting the appropriate answer in section two and section three. All information provided will be kept strictly confidential.

Please answer truthfully. There is no correct or incorrect answer.

Section one: Demographics

1 Job title

2 Name of company (*OPTIONAL*)

Section two: System Development Method (SDM)

A SDM is usually defined as a collection of procedures, techniques, tools and documentation aids which help IT practitioners in their efforts to develop and implement an information system.

Please use an X, next to/below the appropriate answer to mark your response:

1 Have you used a System Development Method to develop an information system?

Yes

No

If you answered "No" to the above question
2 please describe how you have developed information systems and do not continue with the rest of the questionnaire

If you answered "Yes" to the above question
3 How would you best describe the type of System Development Method used on your previous project? Please only select the most applicable answer

Other	Object Orientated	Rapid Application Development (RAD)	Prototyping /iterative development	Structured approach (SDLC)
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4 If "Other" was selected please briefly describe the SDM?

5	To what extent did the developed information system meet the specified requirements on the previous project that utilised the SDM, referred to in question 3? Please mark an X below the appropriate response	Not at All					Completely	
		1	2	3	4	5	6	7

6	How would you best describe the type of information system project? Please mark an X below the appropriate answer	Strategic Project:	High Potential Project:	Key Operational Project:	Support Project:
		driver is future business or competitive advantage	driver is new business idea or technology advantage	driver is improving core business activities	driver is improved performance of a specific task

7	What characteristics best describe the organisation possessing the SDM that was used to develop the system?	Achievement focused, people orientated, self actualising, hands-on-management	Focus on being the best, innovation, attention to detail, profit orientation	Focus on gaining approval, risk avoidance, convention-ality	Focus on competition and power, perfectionism

Section three: Knowledge Management

Please indicate your response to the statements by marking an X below the appropriate answer. Please use the following scale 1 to 7. 1 indicates that the SDM does not incorporate the KM principle while 7 indicates that the principle is completely incorporated in the SDM

		Not at All							Sometimes			Completely		
1.	To what extent does the SDM facilitate the identification of knowledge sources, e.g. experts with regards to the system being produced?	1	2	3	4	5	6	7						
2.	To what extent does the SDM facilitate the selection of appropriate requirements analysis strategies in order to obtain diverse information, e.g. JAD sessions to	1	2	3	4	5	6	7						

	extract information from management, questionnaires to extract information from customers?							
3.	To what extent does the SDM assist with the creation of knowledge, e.g. brainstorming and creative thinking?	1	2	3	4	5	6	7
4.	To what extent does the SDM ensure that knowledge is shared by the different phases of the SDM?	1	2	3	4	5	6	7
5.	To what extent does the SDM ensure that knowledge is shared to the appropriate people within the organisation?	1	2	3	4	5	6	7
6.	To what extent does the SDM facilitate monitoring of the knowledge used regarding the system, e.g. tracking knowledge accessed from data stores?	1	2	3	4	5	6	7
7.	To what extent does the SDM incorporate reuse of knowledge gathered on other projects/system/business units?	1	2	3	4	5	6	7
8.	To what extent does the SDM facilitate the embedding of knowledge gained during the development process, e.g. updating policies and procedures with new knowledge?	1	2	3	4	5	6	7
9.	To what extent does the SDM facilitate the process of ensuring that knowledge that is no longer valid is discarded?	1	2	3	4	5	6	7
10.	To what extent does the SDM facilitate completeness and consistency of documentation, e.g. through a quality assurance process?	1	2	3	4	5	6	7
11.	To what extent does the SDM make use of templates (both for modelling and documenting) to represent knowledge?	1	2	3	4	5	6	7
12.	To what extent does the SDM facilitate the capturing of the knowledge created or acquired relevant to the system being produced, e.g. in the completion of system documentation?	1	2	3	4	5	6	7
13.	To what extent does the SDM facilitate storage of the	1	2	3	4	5	6	7

	knowledge regarding the system in an accessible database available to people who need it?							
14.	To what extent does the SDM facilitate the validation (verifying the accuracy) of the knowledge gathered regarding the system?	1	2	3	4	5	6	7