The relationship between organizational and national culture and the use and effectiveness of systems development methodologies

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Soli Deo Gloria.

Abstract

The aim of this research is to investigate the relationship between organizational and national culture and the use and effectiveness of systems development methodologies. Various different aspects of both culture and systems development methodologies are analysed.

The first aspect studied is the state of systems development methodology use in South Africa. The results indicate that 74% of the organizations that participated in this study use a systems development methodology.

Relationships between horizontal use of systems development methodologies and the success of the IS system and the success of the development process are also found. This relationship shows that when the systems development methodology knowledge is used in a bigger proportion of projects and by a bigger proportion of people, then both the development process and the IS system will be more successful.

A relationship is also found that exists between organizational culture and system development methodologies. Organizations with a more hierarchical culture have been using SDMs longer than other organizational cultures. Relationships between national culture and systems development methodologies are also studied. The results show that when people prefer to work in a group (low individualism), the systems development methodology knowledge will be used more horizontally in the organization.

The results also show relationships between the success of the IS system, the success of development process and the national and organizational cultures. When managers involve people at lower levels in the organizations in the decision making process, the developed IS system is more successful. The results show that organizations with a more developmental culture will have a more successful

development system. The more an organization have a rational culture the more successful the IS system is perceived to be.

Keywords

Competing values framework, information systems development, information systems developers, national culture, organizational culture, systems development methodology, software engineering.

Opsomming

Die doel van hierdie navorsing is om die verhouding tussen organisatoriese en nasionale kultuur en die gebruik en doeltreffendheid van die stelsels ontwikkeling metodologieë te ondersoek. Verskillende aspekte van beide kultuur en stelsels ontwikkeling metodologieë word ontleed.

Die eerste aspek wat bestudeer is, is die toestand van die stelsels ontwikkeling metodologie gebruik in Suid-Afrika. Die resultate dui daarop dat 74% van die organisasies wat in hierdie studie deelgeneem het, gebruik 'n stelsels ontwikkeling metodologie.

Verhoudings tussen die horisontale gebruik van stelsels ontwikkeling metodologieë en die sukses van die IS-stelsel en die sukses van die ontwikkelingsproses is ook gevind. Hierdie verwantskap toon dat wanneer die stelsels ontwikkeling metodologie kennis gebruik word in 'n groter deel van die projekte en deur 'n groter deel van die mense, dan is beide die ontwikkelingsproses en die stelsel meer suksesvol.

'n Verhouding is ook gevind wat bestaan tussen die organisatoriese kultuur en stelsel ontwikkeling metodologieë. Organisasies met 'n hiërargiese kultuur maak langer gebruik van stelsels ontwikkeling metodologieë as ander organisatoriese kulture. Verhoudings tussen die nasionale kultuur en stelsels ontwikkeling metodologieë word ook bestudeer. Die resultate toon dat wanneer mense verkies om te werk in 'n groep (lae individualisme), die stelsels ontwikkeling metodologie kennis meer horisontaal in die organisasie gebruik word.

Die resultate dui ook op verhoudinge tussen die sukses van die stelsel, die sukses van die ontwikkelingsproses en die nasionale en organisatoriese kulture. Wanneer bestuurders mense betrek in die besluit proses, is die ontwikkelde stelsel is meer suksesvol. Die resultate toon dat organisasies met 'n ontwikkelings-kultuur sal 'n meer suksesvolle ontwikkeling proses hê. Hoe meer 'n organisasie 'n rasionele kultuur het, hoe meer suksesvol word die stelsel beskou.

Sleutelwoorde

Kompeterende waardes raamwerk, inligtingsstelselontwikkeling, inligtingsstelsel ontwerpers, nationale kultuur, organisasie kultuur, stelselontwikkelings metodologie, sateware ingeneur.

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Chapter 1 – Problem Statement

1.1 Introduction

The aim of this chapter is to briefly introduce the research. Firstly, the problem statement of the research and the reason why it is important to study this area are discussed. A look at why Information Systems (IS) are important and the problems associated with the development of these systems follow. Next, the aims and objectives of this research are discussed. In this area the focus falls on the expectations of this research and why it is important to the field of Computer Science and Information Systems. The research method utilised is also briefly examined followed by a brief outline of the study as well as a brief description of the purpose of and the outline for each of the chapters.

1.2 Problem statement and substantiation

In today's society people are becoming more and more dependent on Information systems. This can be witnessed in their daily lives. They are woken up by their cell phone alarm clock and eat breakfast bought from a store that operates various information systems. After breakfast they drive to work in a car that has a micro chip in it to aid safe driving and they drive through traffic lights controlled by information systems. At work they check their e-mail and various other online social sites. From this example, it is visible how even a small part of a person's day is affected by a number of different information systems. The same is true for organizations (Gorla

et al., 2010:208). Organizations use various information systems on a daily basis. These systems include staff, sales and delivery systems all of which are crucial to the success of an organization.

The problem is that many of these IS projects fail during the developmental stage. An IS project is considered to have failed when either the budget costs are much higher than expected, or, the time schedules are overrun. Another factor that contributes to the success or failure of an IS is whether the IS project is completed with more or less functionality than planned or expected. This is further explained by the CHAOS report (2009).

According to the CHAOS report (2009), only 32% of all IS projects succeed, meaning that they are completed on schedule, within budget and with all the required functions. Challenged projects (projects that are over schedule, over budget or with fewer features than originally planned) comprise 44% of all projects while 24% of all these projects fail. Drummond (2005) also states that the number of major projects that fail lingers around 70%.

When a project fails there are a number of consequences that are felt, mostly monetary. Gauld (2007:108) describes a failure in New Zealand that eventually cost $NZ18 million and the system was not implemented. Another consequence is that the image of an organization is impacted by its IS project failures. Bharadwaj et al. (2009:74) found that investors care about IS project failures and that severe failures cause an even greater negative impact.

These problems associated with the development of IS have been called the “software crises” by many researchers. During the NATO Software Engineering Conference held in Germany in 1968 it was agreed that software engineering should use philosophies similar to those in engineering disciplines. This led to the development of Systems Development Methodologies (SDMs). An SDM, as described in Chapter 2 is, according to Huismain and Iivari (2006:32), defined as a combination of the following:

- A developmental approach

  This approach involves a philosophical view around which the SDM is built. This view determines the goals, views and beliefs of an SDM.
- A process model

  This model is an illustration of the stages in the development of the system. Some examples are the spiral model and the waterfall model.
- A development method

  This method is a systematic way of creating at least one part of the IS. It consists of tools and techniques, guidelines and activities that are based on the developmental approach. An example of a development method is Information Engineering.
- A development technique

  These techniques could be viewed as procedures that are utilised to perform a particular activity, which aid the development of the IS. An example of one of these techniques is that of Data Flow Diagrams.

SDMs are not the only solution to this software crisis, but they have been found to assist with the development of IS (Chatzoglou and Macauly, 1996; Fitzgerald and Russo, 2005; Pan, et al., 2006; Rahim, et al., 1998).

Many organizations still do not utilise SDMs (Chatzoglou and Macaulay, 1996; Fitzgerald, 1998; Hardy, et al., 1995) and there are also a number of organizations which adapt SDMs to suit their needs (Fitzgerald, et al., 2003; Hardy, et al., 1995; Russo, et al., 1996).

There are also a number of instances when the use of SDMs has been unsuccessful (Kim & Pan, 2006; Lam & Chua, 2005; Lemon et al., 2002; Pan, 2005). Thus, SDMs are being researched to better understand their use and effectiveness in organizations.

According to Jayarantna (1994) who conducted research in 1994, the number of SDMs are estimated to be in the thousands. Masrek, et al. (2008:138) also mention that the number of SDMs could be in the hundreds or thousands. Therefore an

organization has a large number of very different SDMs to choose from if they decide to use SDMs.

There are a number of different factors that could have an influence on a company's choice of SDM. These factors include the type of organization, the type of IS that is to be developed, the expertise of the people involved in the project and the culture in the organization. Much research is required on each of these different factors. The aim of this research is to study only one of these factors, the national and organizational culture. This factor may or may not have an influence on the successful use of SDMs.

Culture is difficult to define, according to Taras, et al. (2009:358). While there is no scientific definition of culture when used in academic studies, a few different definitions do exist. According to Kaarst-Brown, et al. (2004:34), culture is seen in the values, beliefs, practices and underlying assumptions about situations that are found in both formal and informal groups.

Another definition that is very often cited is given by Hofstede and Hofstede (2005:4); culture is the joint programming of people's minds that distinguishes one group of people from another.

According to both these definitions culture is a trait that a group of people have in common as well as a shared belief that exists amongst people. Cultures can vary greatly in different organizations and countries. In this research the focus falls on the organizational and national culture and the use and effectiveness of SDMs.

To classify the organizational cultures for this research the Competing values framework (CVF) is used. According to Thakor (2010:46) and Ancarani et al. (2009:1814) the CVF has been found to be a very effective model for classifying and understanding the different cultures of different organizations. The CVF classifies an organization into one of four different groups. These groups are explained in Cameron and Quinn (2006:29-35) and Yu and Wu (2009:38). The CVF is also used

by Shih and Huang (2010:272) and Iivari and Huisman (2007:37) to classify an organization's culture. These four groups are now explained.

- The clan culture (Group)

In clan cultures there are shared values and common goals, and an atmosphere of togetherness and mutual help. There is also an emphasis on empowerment and gaining employee participation. This type of culture is usually found in organizations with a long history and stable membership.

- The adhocracy culture (Developmental)

This culture is like a temporary institution, dismissed when finished and reloaded rapidly when there are new projects to complete. This type of culture is usually found in software development and consulting.

- The market culture (Rational)

This culture focuses on the environment outside the organization and not on internal management, so its goal is usually to make a profit.

- The hierarchy culture (Hierarchical)

This culture is evident in an organization with a clear structure, standard rules and procedures, strict control and defined responsibilities for each employee.

To study the national culture, this research utilises Hofstede's (1994) dimensions for classifying national culture. These four dimensions are: Power Distance, Individualism, Uncertainty Avoidance and Masculinity. As Fang (2003:350) explained, the four dimensional model has been employed in various studies; therefore this research does the same. The fifth dimension is not used because of the critique it received from Fang (2003:362), these criticisms are further explained in Chapter 2. The four dimensions that are utilised are also all explained and discussed in Chapter 2.

The main purpose of this research is to investigate the relationship between organizational culture, national culture and the successful use of SDMs. There are

various reasons for this research. One being that culture is a part of everybody's life and influences his or her decisions, yet very little research has been carried on this subject to aid an understanding of the influence it has on IS development. The problems associated with IS development should be investigated and culture is another factor that may, or may not exert an influence on the use of SDMs in an organization.

1.3 Research aims and objectives

The research question to answer is: Is there a relationship between organizational and national culture, and the use and effectiveness of systems development methodologies?

Iivari and Huisman (2007:43) conducted similar research, on culture and SDMs in South Africa, but only focussed on the culture of organizations. They (Iivari and Huisman, 2007:42) found that the more hierarchical the culture of an organization, the more support SDM is believed to provide to a project and the more an SDM is utilised. A hierarchical culture is one that is orientated towards security, control, and following a routine. In this culture, regulations are made and must be followed (Iivari and Huisman, 2007:37).

Shih and Huang (2010:278) found that organizational culture does influence the deployment of software process improvement (SPI). SPI is an approach that assists in improving the software products in software development organizations. Shih and Huang (2010:278) also found that organizations that have a hierarchical culture found the deployment of SPI much easier.

Some limitations are given by Iivari and Huisman (2007:48) with regards to their research. It was carried out in only one country and the national culture of that country was not considered. In this research, the national culture is included so as to determine its effect on the use and effectiveness of SDMs.

The main aim of this research, as stated before, is to investigate the relationship between organizational and national cultures of different organizations as well as the use and effectiveness of SDMs in these organizations.

This aim is achieved by completing the following objectives as depicted in Figure 1.1:

- Research the organizational and national cultures of organizations.
- Research the use and effectiveness of SDMs in these organizations.
- Investigate relationships between culture and SDM use and effectiveness.

The results of this research will contribute to the small amount of research that has been carried out on culture and SDMs. They also answer questions about the use and effectiveness of SDMs and if their use lead to better products or a better process in developing these products.

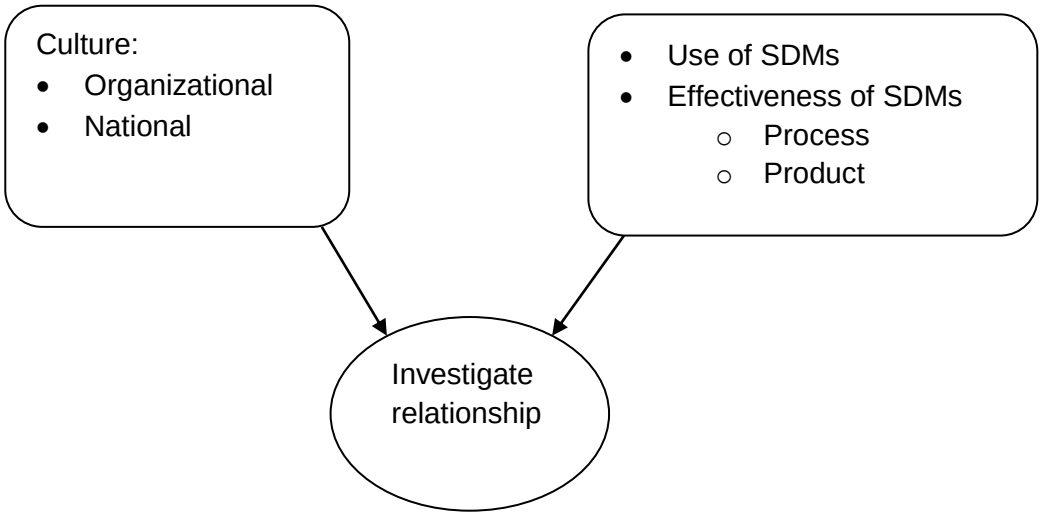

Figure 1.1 - Objectives in this research

There are a number of different questions that this research answers:

1. What is the state of SDM use in South Africa?
2. Does organizational culture have an influence on the use of SDMs?
3. Does national culture have an influence on the use of SDMs?
4. Does organizational culture have an influence on the success of the IS product or the success of the process?

5. Does national culture have an influence on the success of the IS product or the success of the process?
6. Is there any relationships between the use of SDMs and the success of the IS product or the success of the process?

Answering all of these questions improves an understanding of SDMs, not only in South Africa, but also in the wider international community, because the results of this research could also be applied and tested in other countries as all countries have their own culture and not much is known about culture and SDMs. This research is therefore useful to the research community as well as practitioners. More diverse information would be available to practitioners when they choose and implement their SDMs. Organizations, who want to be recognised in overseas markets, are under pressure to obtain ISO 9000-3 or CMM certification. This certification is much sought after because it indicates that an organization develops quality systems, but in order to qualify for it an organization has to use an SDM. Therefore, these research results could be very useful to organizations that are planning to be certified.

1.4 Method of investigation

This research functions in the positivist research paradigm as described by Orlikowski and Baroudi (1991:5) and Oates (2006:281-289). This paradigm is utilised for research when searching for relationships between different variables in a certain situation using a structured approach. Positivist research strives to give a factual and objective overview of the situation that is to be studied.

The research method used in this research was a survey. Surveys are used to collect data from a large group of people in a standard and systematic manner. Surveys are also very useful when searching for patterns in data (Oates, 2006). The manner in which the survey was used together with its advantages is discussed further in Chapter 3.

The data generation method employed was a questionnaire, as it was easier to distribute questionnaires across the different provinces involved in the research. A questionnaire is also used to generate the data in a more standardised and systematic manner (Oates, 2006). The questionnaire is fully described in Chapter 3.

1.5 Outline of this study

The research is organised as follows:

Chapter 1: Introduction

In this chapter, the problem statement and objectives of the research are defined.

Chapter 2: Literature survey

In this chapter, previous research and the various elements in the research are discussed. These elements include system development methodologies, national and organizational culture and ways to measure these cultures.

Chapter 3: Method of research

The manner in which the research is conducted is discussed in this chapter. The research paradigm, research method, data collection method and data analyses are addressed.

Chapter 4: Results

The results of the survey and the various findings are discussed in this chapter.

Chapter 5: Discussion and interpretation

In this chapter, the results reported in the previous chapter are discussed and interpreted. Subsequently, final conclusions are drawn and recommendations are made. Recommendations for future research are also made.

1.6 Conclusion

This chapter furnished a brief overview of the research. This included the problem statement and previous research done in this area. This chapter also described the expected contributions of this research and the different people who would find it relevant. The aims and objectives of the research were then discussed as well as the method employed in the research. In the next chapter previous research concerning SDMs, culture and ways to measure culture on both an organizational and national level are examined.

Chapter 2 - Literature Survey

2.1 Systems Development Methodology

In this chapter, Systems Development Methodologies (SDMs) and culture are discussed as depicted in Figure 2.1.

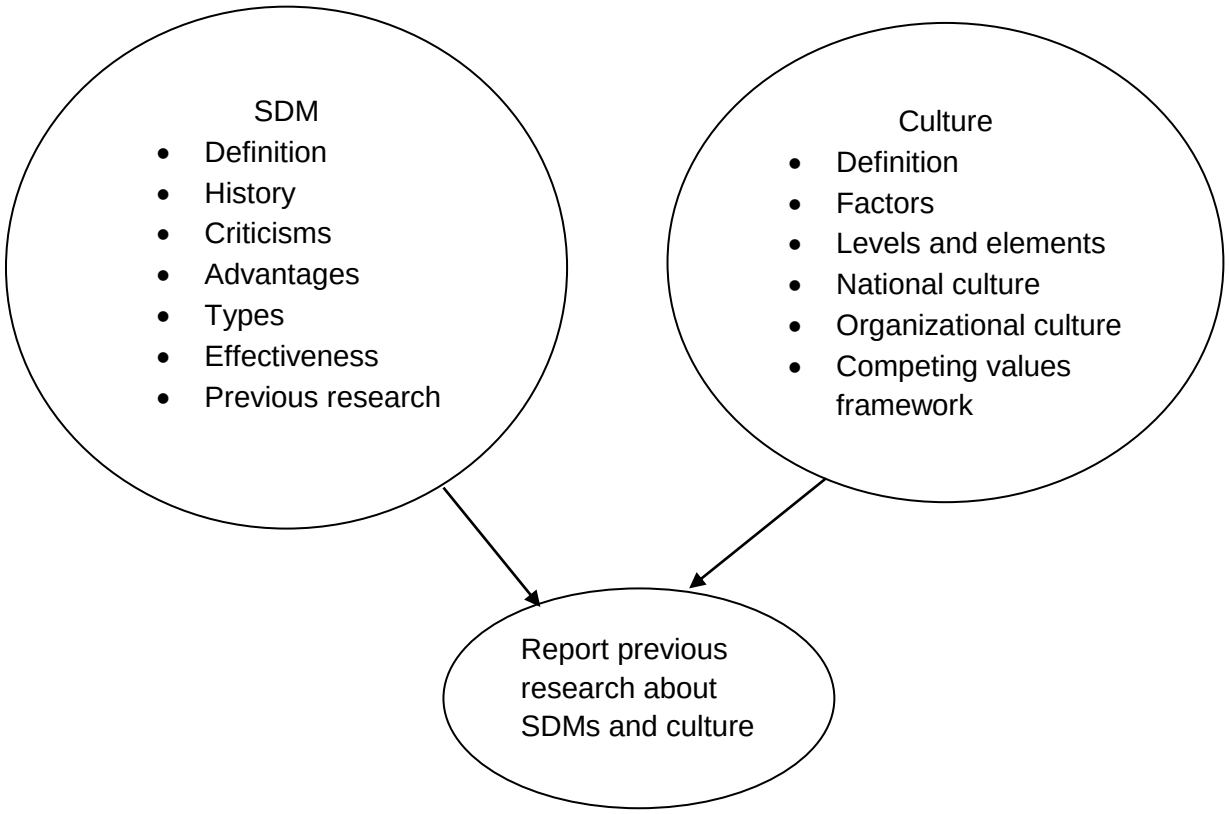

Figure 2.1 - Outline of this chapter

At the outset, a definition of SDM is presented followed by a study of the history of SDMs which aid a better understanding of the role they play in the development

process today. The criticisms and advantages of SDM use are discussed next in order to engender an understanding of the problems experienced with SDMs and the reasons why using them seem beneficial. Next, the different types of SDMs are evaluated to establish how they differ from each other, followed by a discussion on the effectiveness of SDMs, and lastly, reference is made to previous research carried out on SDMs.

The second area of discussion is culture. Culture and the different factors that have an influence on culture are defined. Subsequently, the different levels and elements of culture are discussed with particular focus on the two main levels of culture, that is, national culture and organizational culture. Finally, the competing values framework as a means of classifying organizational culture is assessed.

In conclusion, as seen in Figure 2.1, research on both SDMs and culture is combined and discussed. In this section, previous research on the existing relationship between SDM use and effectiveness as well as national and organizational culture are discussed.

2.1.1 Defining System Development Methodologies

To define systems development methodology is no easy task as there is no accepted definition for the term and arguments exist over the use of the word ‘methodology’ (Huisman and Iivari, 2006:3; Wynekoop and Russo, 1997:66; Iivari et al., 1999:1).

An SDM is defined by Chan and Thong (2008:803) as a documented set of policies, procedures and processes.

According to Avison and Fitzgerald (2006:568), an SDM could be defined as a means to develop an IS or a part of an IS. It is therefore based on a philosophical view that helps to guide the development process. According to this definition, there

are also phases, tasks, tools, guidelines and procedures that aid the development process.

Iivari et al. (1998:165) define an SDM as “a set of goal-oriented procedures that guide the work and co-operation of various parties (stakeholders) involved in the building of an IS application”. There are also activities, tools and techniques that support these procedures.

A methodology could thus be defined as a combination of the following (Huisman and Iivari, 2006:32):

- A developmental approach

This is the philosophical view on which the methodology is based. It is the goals and principles that are involved in the development process and that drive the directions and actions of the methodology. An example of a developmental approach is people-orientation, i.e. when the needs of people are a key focus when creating an information system.

- A process model

The process model is a representation of the different stages through which a system evolves, from the beginning (when the project starts) to the end of the project (after it is implemented). There are various examples of a process model; for example, a linear life-cycle and spiral model.

- A development method

A method is a systematic blueprint which assists developers in at least one phase of systems development. This method helps to direct developers by providing guidelines, activities, tools and techniques that could be used to assist in the development of a system. It is usually based on the philosophy of a methodology. There are many different development methods, for example STRADIS, IE and RUP, which are discussed later in this chapter.

- Tools and techniques

Tools and techniques are procedures that are usually part of the methodology and could assist the developer in performing a task. It usually simplifies a task or tries to involve end-users more in the development process, depending on the philosophy of the methodology. A Data Flow Diagram (DFD) is an example of a tool. DFDs are used to illustrate the flow of data in a system.

The definition of Huisman and Iivari (2006:32) is used in this research when referring to a systems development methodology (SDM). This definition is a combination of all the previously mentioned definitions and describes all the different parts of an SDM. Thus an SDM is an approach-driven method that is segmented/divided into a number of phases and assists in the development of at least a part of an IS. In each of these phases there are tools and techniques that help with the development of the IS.

2.1.2 History of SDMs

As mentioned in Chapter 1, in 1968 during the NATO Software Engineering Conference in Germany it was agreed that software engineering should use similar philosophies to those in engineering. This led to the development of SDMs. Thus we can see that SDMs were not always used to create Information Systems, as illustrated in the timeline in Figure 2.2.

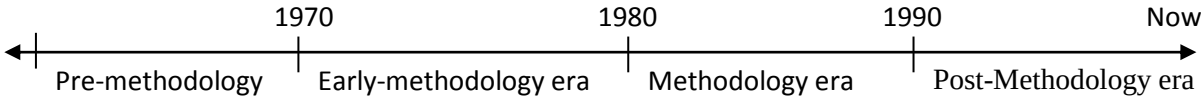

Figure 2.2 - SDM timeline

The next section discusses the history of SDMs, according to the timeline as described by Avison and Fitzgerald (2003:79-81).

1. Pre-methodology era

This is the first era in systems development. In this era, systems were developed without any formalised process or methodology. Most of the problems related to computers were technical and developers were technically trained. Developers very rarely understood the context in which the system had to operate and did not gather all the user requirements.

This era lasted up to the early 1970s and despite encountering many problems, a demand for these systems increased. This led to a desire for a more structured approach to developing information systems and the first SDMs were established.

2. Early-methodology era

This era, from the 1970s to the early 1980s, was characterised by the use of an SDM called the Systems Development Life Cycle (SDLC). This approach comprised phases that were processed in order from start to finish. One phase had to be completed before the next one could begin. It was believed that this approach would aid control and improve management when new systems were developed.

The SDLC was well tested and, to some, proved to be a very effective means of developing new systems. Documentation communicated requirements between developers and users. Despite all the positives of the SDLC, it also experienced various weaknesses and limitations. Avison and Fitzgerald (2003:79-80) name some of these weaknesses: ISs failed to meet the requirements of organizations, because the SDLC focused overly much on technology; user dissatisfaction caused by the fact that users had problems with computer oriented documentation, and could not see the system before it was completed and implemented. These problems led to the next era.

3. Methodology era

In this era, in response to the limitations of the SDLC, many different SDMs were created and developed to assist in the creation of new systems. Also, the term methodology was first used. New SDMs emerged from two main sources; some developed from practice while others developed from theory.

SDMs were developed to suit the organization using them and many organizations were by now using an SDM. This era stretched from the 1980s to the early 1990s.

4. Post-Methodology era

This is the most recent era of SDMs and stretches from the 1990s onwards. The main characteristic of this era was a serious reappraisal of the concepts used in methodologies. The result of this was that some organizations turned to new SDMs while others abandoned SDMs completely. Truex et al. (2000:53) describe these two views of the use or non-use of SDMs. According to Truex et al. (2000:73), the development of IS unfolds differently to what was previously believed and SDMs were adapted to suit each situation. Truex et al. (2000:74) explain that blindly following and focusing on what an SDM states limits the understanding of the "human organization".

Some organizations believed that their SDM did not provide any improvements or advantages. There were also organizations that had adopted the wrong SDMs or adopted them for the wrong reasons. Consequently, SDMs in this era received many criticisms.

In addition, organizations started moving in different directions with regard to SDMs. Some organizations chose to develop systems in an ad hoc manner without any formal processes, while others tried to obtain further developments for their SDM, and still others chose to develop their system externally. Many organizations, however, believed in contingency; the belief that an SDM is designed for a perfect state (a state without any problems). In reality, however, every project is different and the SDM that is used must be adapted to the specific project. These organizations believed that SDMs are only to be used as a guideline in a specific project on which an organization is currently working.

2.1.3 Criticisms of SDMs

From the previous discussion it is evident that there are many problems associated with SDMs. Different sources give similar criticisms; the main ones are summarised in Table 2.1.

Table 2.1 - Problems associated with SDMs

Problems associated with SDMs	References
There are more than a thousand SDMs, in many different forms. It is difficult to decide which SDM to use.	Fitzgerald (1998:318)
The SDMs make generalisations without adequate foundations. SDMs also have not been reviewed independently to determine if they are appropriate or tested for successful application in real-world situations.	Fitzgerald (1998:318); Fitzgerald (1996)
SDMs treat system development as an orderly rational process, but in reality systems development is very different.	Fitzgerald (1998:318); Fitzgerald (1996)
Some developers blindly adhere to methodologies and lose sight of the bigger picture and the system they are developing.	Fitzgerald (1998:318)
The assumption exists that methodologies are universally applicable for all information systems projects.	Fitzgerald (1998:318); Fitzgerald (1996)
SDMs do not recognise factors like creativity and learning over time. The role of the developer is not recognised.	Fitzgerald (1998:318); Fitzgerald (1996)
SDMs fail to deliver the promised productivity benefits.	Avison and Fitzgerald (2006:583-586)
SDMs are also criticised for being very complex.	Avison and Fitzgerald (2006:583-586); Vavpotic and Bajec (2009:529)

The skills needed to effectively work with some SDMs are difficult for developers and end-users to aquire.	Avison and Fitzgerald (2006:583-586)
The use of SDMs does not necessarily result in a better or improved system.	Avison and Fitzgerald (2006:583-586)

2.1.4 Advantages of SDMs

So the question arises: Why are so many organizations using SDMs if there are so many criticisms? The answer is gained by studying the advantages of SDMs. Table 2.2 tabulates some of the most important advantages that SDMs offer an organization.

Table 2.2 - Advantages associated with SDMs

Advantages associated with using SDMs	**References**
The development of systems is very complex. SDMs reduce this complexity into smaller steps that accomplish the creation of the system.	Fitzgerald (1998:317)
SDMs make the development more visible, which aids project management and control in the project and could reduce uncertainty and risk when developing a system.	Fitzgerald (1998:317)
SDMs provide a framework that assists the application of techniques at the right stages in a project, during the development process.	Fitzgerald (1998:317)
SDMs allow skills specialisation and also the distribution of labour in an organization.	Fitzgerald (1998:317)
SDMs provide a structural framework where knowledge could be acquired, because past experiences could be stored and referenced.	Fitzgerald (1998:317)
The development process could be standardised. This allows developers to be interchangeable and could lead to increased productivity and higher quality systems.	Fitzgerald (1998:317)
The desirability of ISO-certification is also a reason for adopting a methodology.	Fitzgerald (1998:317)

There are also other reasons why organizations decide to use SDMs. Avison and Fitzgerald (2006:570-572) name and describe three main reasons:

- To improve the end product

The first reason why organizations adopt an SDM is to improve the new Information System that is being developed and should not be confused with the development process itself.

- A better development process

Organizations generally desire to improve the process that is followed when creating a new system. In turn, the project management and control of the new system is improved. It is further argued that productivity could also be improved with a better process.

- A standardised process

In this category, the benefits of having a standardised process throughout the organization are included. This implies that developers could more easily adapt to a new project environment if they are moved across projects and a lot of experience and knowledge could be retained within the organization. This would be useful with new projects.

As can be seen from the discussion thus far, methodologies are a very complex subject and are difficult to define. Even the use of SDMs in an organization is a diverse and difficult topic in SDMs. It is therefore appropriate to assess the different types of methodologies. These are classified according to their varying philosophical views.

2.1.5 Types of SDMs

Before discussing the different types of SDMs, a reminder about the definition of an SDM is required; namely, it is an approach-driven method that consists of a number

of different phases or steps that assist in the development of an IS. The tools and techniques in each of these phases are core to this process.

An SDM therefore consists of four main parts:

- Development method
  This is the blueprint followed by developers and aids the design of the IS.
- Developmental approach
  This is the philosophical view upon which the development method is based.
- Process model
  The process model describes the steps or phases that are involved in the creation of the IS.
- Tools and techniques
  These are procedures that form part of the SDM and aid the development of the IS.

Iivari et al. (1998) and Avison and Fitzgerald (2006:395-536) name and describe the different types of methodologies. They are classified according to their philosophical view. Iivari et al. (2001:198) also classifies an SDM according to its paradigm and approaches. These types of methodologies are: process-oriented, blended, object-oriented, rapid development, people-oriented and organizational-oriented methodologies. In the next section these different types are discussed and examples of methodologies in every type are furnished.

2.1.5.1 Process-oriented Methodologies

These types of methodologies focus on processes and make use of functional decomposition. Functional decomposition is a technique whereby a large and complex problem is segmented into smaller pieces, each of which in turn could be broken down further into minor pieces and thus a greater level of detail could be represented (Avison and Fitzgerald, 2006:109-111).

Development method of STRADIS

An example of a process-oriented methodology is a methodology called Structured Analysis, Design and Implementation of Information Systems (STRADIS). It was first described by Gane and Sarson (1979) in their book “Structured Systems Analysis”. Here Gane and Sarson (1979) only briefly discuss the outline of the methodology, the main focus of the book being to describe the tools and techniques that are used in the methodology.

Developmental approach of STRADIS

The developmental approach of STRADIS is, according to Avison and Fitzgerald (2006:395), in contrast with many other methodologies. Unlike most methodologies, STRADIS does not outline the steps of the SDM in great detail. The most important aspect of STRADIS is the techniques and tools in the methodology and using them correctly to aid in the development of the IS. Again it is evident that this SDM focuses on the process when developing an IS.

Process model of STRADIS

The process model of STRADIS contains the phases or steps into which the methodology is divided. These steps are named and described by Gane and Sarson (1979):

- Initial study

This is the starting point of the methodology, which tries to ensure that the correct decision has been made to develop this system and that the proposed system will aid in solving a specific problem.

One of the most important aspects discussed in this stage is the benefits of different solutions to the problem that the system must solve. The benefits could be monetary (financial value) or other benefits, for example saving time. In this step an overview

Data Flow Diagram (DFD) is constructed to gain an understanding of the existing system.

A DFD is a diagram that shows how the data flows in a system. It is one of the most important techniques used in STRADIS and improves the communication between developers, management and users of the system.

- Detailed study

The next step in STRADIS is called the detailed study. As the name suggests, this step involves an in-depth study of the current system. Another aspect is that potential users of the system are identified in this step.

After all these studies have been completed the developer is able to create a logical DFD, which extends beyond the current system and includes how the system interacts with other systems and people.

The detailed study must also include a statement highlighting the benefits of having an improved system and containing estimates of the financial values of these benefits.

A cost and time estimation for the next step in the methodology should be included if the benefits are sufficient to continue with the proposed new system.

- Defining and designing alternative solutions

In this phase of STRADIS, alternative solutions to the problems of the current system are defined and designed. At first, the organization's objectives for the new system as stated in the initial study are converted into a set of objectives for it.

These system objectives are subsequently used to create a DFD of the new system. With this DFD, a designing phase is initiated during which the various solutions are designed. Each of these solutions should resolve the problem for which the new system is being created. Each solution should also include cost, time and benefit estimates.

The best solution is then chosen and the next step is approached.

- Physical design

During this phase the physical system is designed. All the details, that is, the physical and database files as well as all the other parts of the new system, as seen in the DFD, are created and tested.

Tools and techniques of STRADIS

Some of the tools and techniques have already been discussed, including: DFDs, decision trees and decision tables.

STRADIS is only one of many types of process-oriented methodologies – other examples include:

- Yourdon Systems Method (YSM) (Yourdon, 1993); and
- Jackson Systems Development (JSD) (Avison and Fitzgerald, 2006).

2.1.5.2 Blended Methodologies

A blended methodology is an SDM that focuses on both data and process.

Development method of Information Engineering

Information Engineering (IE) is an example of a blended methodology. It was created by Martin and Finkelstein (1981) who describe the methodology in their book "Information Engineering" (Martin and Finkelstein, 1981).

There are many versions of IE currently available (Avison and Fitzgerald, 2006:435) as people have changed and modified IE to suit their needs. The so-called 'classical IE' is presented in this study.

Developmental approach of IE

IE ascribes to a few different philosophical beliefs, according to Avison and Fitzgerald, 2006:435; the first being that data is more stable than the processes that act on the data. However, unlike some other methodologies, IE also recognises that the processes must be studied in detail. IE (and all blended methodologies) attempts to balance the data and processes of a new system.

Another aspect of the philosophy of IE is the belief that diagrams are the best way to communicate a methodology (Avison and Fitzgerald, 2006:435). Diagrams are believed to be easier to understand by end-users and management, thus they are a more effective way of gathering the requirements of the system to be developed.

Process model of IE

Avison and Fitzgerald (2006:437) indicate that a methodology is divided into four levels and at each of these levels there is an objective to be met. Progress is measured by the objectives at each of these levels. Martin and Finkelstein (1981) describe these four levels:

- Information strategy planning

The objective at this stage is to create an information architecture to assist the organization as a whole in supporting the overall needs and objectives of the organization.

- Business area analysis

The objective at this level is to understand the different business areas and determine these needs in these areas in terms of ISs.

- System planning and design

In system planning and design the objective is to plan the new system to solve the problem and to design the system according to user specifications/requirements. It is also advisable to study any available technology in this phase.

- Constructions and cut-over

The objective at this level is to create the system as described for the previous levels and to implement it in the business.

Tools and techniques of IE

The tools and techniques used in IE include: entity modelling and the entity life cycle.

This is only an overview of IE and of note is that for IE both processes and data are important; thus it constitutes a blended methodology.

2.1.5.3 Object-oriented Methodologies

According to Avison and Fitzgerald (2006:114), object-oriented modelling is concerned with the modelling of objects; both data and processes, and representing the interactions of the objects with each other. Object-oriented methodologies employ this technique when developing systems.

Development method of RUP

The Rational Unified Process (RUP) methodology is an example of an object-oriented methodology.

The full version of RUP was first described in the book “The Unified Software Development Process” first published in 1999 by Jacobsen, Booch and Rumbaugh.

Developmental approach of RUP

The entire developmental approach of RUP is based on object-orientation. Many of the newer programming languages use object-orientation and by focusing the SDM on this, RUP assists in simplifying the development process. As previously mentioned, object-orientation uses objects to represent data and these objects subsequently interact with each other to complete the various tasks of an IS.

Process model of RUP

RUP is iterative and incremental, because the creators of RUP believe that all the requirements of a system cannot be accurately determined in only one cycle. In every cycle there are phases that make up that cycle (Jacobsen et al., 1999):

- Inception
- Elaboration
- Construction
- Transition

Every one of these phases could have a number of iterations and in every iteration the nine workflows of RUP are involved.

These workflows according to Jacobsen et al., (1999) are:

- The business workflow

In this workflow the context of the new system is established.

- The requirements workflow

In this workflow the requirements of the system is established.

- The analysis and design workflow

This workflow's objective is to convert the requirements into an implementation specification.

- The implementation workflow

This workflow's objective is to convert the designs into an implementation workflow.

- The test workflow

In this instance the various parts of the system are tested and verified.

- The deployment workflow

In this workflow, the finished software is deployed to end-users.

- The configuration and change management workflow

In this workflow the integrity of the project is tracked and maintained.

- The project management workflow

This workflow aids project management in the project.

- The environment workflow

This workflow is created to help the project with processes and tools from the organization.

Tools and techniques of RUP

Unified Modelling Language and Use Case-diagrams are some of the tools and techniques that are part of the RUP methodology.

Another type of object-oriented methodologies is object-oriented analysis (Coad and Yourdon, 1991).

2.1.5.4 Rapid development Methodologies

According to Jain and Chandrasekaran (2009:30), rapid development methodologies (RDMs) are a structured approach to the development of an information system with severe time limits. Rapid System development attempts to create systems that are

cheaper, better and produced in a less time. To do this, it incorporates agile and rapid development in the development process.

Development method of Extreme Programming

There are various types of rapid development methodologies; to further understand them, a study of Extreme Programming (XP) is required.

Developmental approach of XP

The focus of XP falls on developing new systems as fast as possible. It is particularly used in small to medium sized organizations (Avison and Fitzgerald (2006:479). XP is also considered to be an agile SDM, meaning that it should be easier to change when the requirements of a project change.

Process model of XP

According to Beck (1999:71), XP is not a formal SDM; it has a set of practices that are followed when developing a new IS. All of these practices focus on developing systems as fast simply as possible.

Beck (1999:71) describes some of these practices.

- The planning game
  The customer defines the scope and timing of the release they require based on estimations made by the programmers. Only the functionality as demanded in this iteration is implemented and when completed and implemented, the next iteration begins.
- Small releases
  The system is developed in small releases with each being developed in a short space of time. Therefore the whole problem is not solved within one release, but rather in a number of small releases until the entire system is developed.
- The 40-hour week

Developers should only work 40 hours a week and no more. This keeps them effective and minimises errors that could cost time and money.

The phases of XP, according to Beck (1999:70), are similar to those of other SDMs: Analysis, Design, Implementation and Testing. The difference with XP is that these phases occur in a very short period, before the cycle starts again. This ensures that the results are produced rapidly.

Tools and techniques of XP

Some of the techniques used in XP include Pair Programming, where two programmers work on one computer, and the Tests, where they carry out a great deal of testing of the program throughout the development of the IS (Beck, 1999:71).

Other types of rapid development methodologies include:

- Dynamic Systems Development Method (DSDM)
- Web Information Systems Development Methodology (WSDM)

2.1.5.5 People-oriented Methodologies

People-oriented methodologies, as the name suggests, aims its focus on people. The methodology discussed here is called Effective Technical and Human Implantation of Computer-based Systems (ETHICS).

Development method of ETHICS

ETHICS was designed and described by Mumford (1995) in his book “Effective Requirements Analysis and Systems Design: The ETHICS Method”.

Developmental approach of ETHICS

The philosophy of ETHICS according to Avison and Fitzgerald (2006:487-489) attempts to provide job satisfaction and also tries to encourage people participation.

When people feel that they are part of the decision-making process they tend to feel more involved and become more productive.

Process model of ETHICS

ETHICS comprises 15 steps (Mumford, 1995):

1. Why change?
2. System boundaries
3. Description of existing system
4. 5. and 6. Definition of key objectives and tasks
7. Diagnosis of efficiency needs
8. Diagnosis of job satisfaction needs
9. Future analysis
10. Specifying and weighting the needs and objectives of efficiency and job satisfaction
11. The design of the organization's new system
12. Technical options
13. The preparation of a detailed work design
14. Implementation
15. Evaluation

These steps are completed in order from 1 to 15. As seen from their names, they are easy to understand. When all the steps have been completed, the finished product is available.

Tools and techniques of ETHICS

One of the tools and techniques of ETHICS is: Joint Application Development (JAD). JAD emphasises that a group of people work together to agree on the various aspects involved in the development process. Another technique that ETHICS uses is the stakeholder analysis where the people who are affected by the proposed system are also studied.

Another type of people-oriented methodology is KADS (Wielinge et al., 1993).

2.1.5.6 Organizational-oriented Methodologies

The focus of organizational-oriented methodologies falls on the organization itself. To understand these methodologies, a study of the Soft System Methodology (SSM) is required.

Development method of SSM

The original SSM is described in Checkland (1981). There have been many revisions and upgrades since 1981, but the core of the SDM has remained the same.

Developmental approach of SSM

The philosophy of SSM according to Avison and Fitzgerald (2006:507) is based on the systems theory; a system is greater than the sum of its parts, implying that something of a system is lost if it is broken down into pieces. Therefore, the SSM philosophy states that a new system must be created for the organization as a whole.

Process model of SSM

The SSM, according to Checkland (1981), has seven stages, but for any given project the process does not necessarily begin at stage one, while a person could be working in many phases simultaneously. These stages are named and described by Checkland (1981):

- The problem situation: unstructured

An informal representation of the problem is created by talking to as many people as possible.

- The problem situation: expressed

The problem is represented in a more formal manner and rich diagrams are created for users to view.

- Root definitions of relevant systems

This stage involves naming the relevant systems and defining their involvement in the new system. Tools and techniques like Rich pictures (a picture showing great detail of the system) and Root definitions (a kind of hypothesis about the systems involved and ways they could be improved) are utilised.

- Building conceptual models

A conceptual model is created. This is a diagram that depicts the various activities of the proposed new system.

- Comparing conceptual models with reality

In this stage, the models created are compared to the real situation (as described in the problem situation: expressed phase)

- Assessing feasible and desirable changes

Changes proposed in the previous stage are discussed and assessed.

- Action to improve the problem situation

The action decided on is recommended, also providing the reasoning behind it.

Note that this methodology does not implement the action, it only recommends what could be done to solve the problem. It aims to improve the organization and not only solve the problem.

Tools and techniques of SSM

The tools and techniques of an SSM are Rich pictures, Root definitions and Conceptual models. All of these tools aim to include the organization in the process to further the organization's cause.

Another type of organizational-oriented methodology is Process Innovation (PI) (Davenport and Short, 1990).

2.1.6 Comparing the different SDMs

In the next section, these different types of methodologies are compared to find differences and similarities. This aids an understanding of the variety of SDMs that are available in the IS industry. Table 2.3 displays a brief summary of SDMs based on the definition that SDMs all consist of a development method, approach, process model and tools and techniques.

2.1.6.1 Similarities and differences in the different methodologies

The framework for comparing SDMs as described in Avison and Fitzgerald (2006:597-613) is utilised here. A comparison is made by discussing the seven different elements of SDMs: Philosophy, Model, Techniques and Tools, Scope, Outputs, Practice and Product. A discussion on each of these elements follows, as well as a discussion on the SDMs based on these elements.

Philosophy

The philosophy of an SDM is the same as the developmental approach as previously discussed and clarified in this chapter. The philosophies relevant to this study are summarised in Table 2.3 above and are clearly all different.

Model

This area discusses ways of communication by which SDMs represent problems and other relevant information about the development of the system. There are four different types that have been identified.

1. Verbal
2. Analytical
3. Pictorial or schematic
4. Simulation

Table 2.3 - Comparison of SDMs

Types of SDMs	Process-oriented	Blended	Object-oriented	Rapid development	People-oriented	Organizational-oriented
Development method	STRADIS • Initial study • Detailed study • Defining and designing alternative solutions • Physical design	IE • Information strategy planning • Business area analysis • Systems planning and design • Constructions and cut-over	RUP • Inception • Elaboration • Construction • Transition	XP • Analysis • Design • Implementation • Test	ETHICS • Why change? • System boundaries • Description of existing system • Definition of key objectives and tasks • Diagnosis of efficiency needs • Diagnosis of job satisfaction needs • Future analysis • Specifying and weighting the needs and objectives of efficiency and job satisfaction • The design of the organization's new system • Technical options • The preparation of a detailed work design • Implementation • Evaluation	SSM • The problem situation: unstructured • The problem situation: expressed • Root definitions of relevant systems • Building conceptual models • Comparing conceptual models with reality • Assessing feasible and desirable changes • Action to improve the problem situation
Developmental Approach	Functional decomposition, focusing on the process	Data is more stable and diagrams is the best way to communicate	Object-orientated Modelling	Faster development and prototyping	People-oriented (job satisfaction and participation)	Systems Theory and focus on the organization's requirements
Process model	Phases – that are executed in order one after another until the phase is complete	Parallel development – all the objectives on a level must be met	Iterative and incremental	Phases – These phases are carried out very quickly to create a part of the system, before being repeated.	Phases or steps – that are executed in order one after another until the phase is complete	Phases –Not necessarily start at the first phase, could simultaneously be working in many phases
Tools and Techniques	DFDs, Decision trees, Decision tables	Entity modelling, Entity life cycle	Unified Modelling Language and Use Case-diagrams	Pair Programming, Tests, 40-hour week	Joint Application Development, Stakeholder- analysis	Rich pictures, Root definitions, Conceptual models

Most of the more modern SDMs fall into the third category because they attempt to simplify problems and representations of the IS.

Most of the SDMs discussed earlier also fall into the pictorial or schematic category. Their tools utilise pictorial or schematic representations of the system to simplify the communication between developers and stakeholders. XP however also uses prototyping which could be seen as a form of simulation.

Tools and Techniques

The tools and techniques of this framework are exactly the same as those that have already been discussed earlier in this chapter. Table 2.3 indicates that all SDMs utilise different tools and techniques.

STRADIS is viewed as an SDM that is largely described in terms of its tools and techniques. The SDM itself focuses on specific tools and techniques to simplify the development process. IE, on the other hand, explicitly states that tools and techniques are not fundamental to the SDM, but are recommended and could be replaced and changed to suit the organization's needs.

Scope

The scope of an SDM involves the different stages of an IS development that the SDM assists in developing. As mentioned before, an SDM could assist with the development of an IS or a part thereof, which in essence constitutes its scope.

STRADIS encompasses almost all of the phases of the IS development. It does, however, not include maintenance as part of the SDM and its focus falls more on designing the IS.

The scope of IE is one of the largest of all the SDMs discussed – it embraces the entire development process. All of the phases of the SDM development from strategising to the maintenance of the completed system are all included in this SDM.

ETHICS on the other hand, is only concerned with the design of the IS and does not include any aspect of development or maintenance.

Outputs

Outputs are concerned with what an SDM produces at the end of each stage. These outputs, or deliverables, could vary from being a system specification to a prototype or even the final developed system.

When initially studied, SDM outputs appear to differ to a great extent; the reason being that they have different stages and in all of these stages different objectives are being realised. For example, XP operates by providing small implementable parts of a system after each cycle, while ETHICS only establishes an answer to the question of why the current system has to change.

However, in studying SDMs more closely, we discover many similarities. All SDMs include a phase that is similar to STRADIS's initial study, a phase that determines the scope of the IS system to be developed. The depth of study in this phase varies, but it is nonetheless present.

Another output present in most SDMs is obviously the developed IS system; the coded and completed system. Only ETHICS does not have this output, as it believes that if the IS is defined correctly, development will proceed without the need for an SDM.

Practice

Practice measures SDMs in terms of their background, whether they have their origins in academics or were developed in a commercial environment. It also determines the user base and the skills level requirements of the SDM.

STRADIS and IE stem from a commercial background, while ETHICS and RUP stem from an academic background. The user base is more difficult to discover, but in this study the research questionnaire included a question to determine the number of people who use various SDMs. These results are discussed in chapter 4.

All SDMs also require some form of user training. ETHICS, however places the highest demand on the people involved in the SDM and therefore requires the highest user skills.

Product

Product describes the item that an organization receives when purchasing an SDM as well as the overall costs. Therefore this element looks at the SDM itself as a product sold to organizations.

Most SDMs offer a wide range of products, and tools and techniques; organizations make their own buying decisions. Some SDMs also provide trainers and consultants at a cost. For example, RUP has a wide range of documents and books for sale, but it also increasingly has multimedia and Internet tools available for purchase.

2.2 Effectiveness of SDMs

In this ‘reassessment age’ of methodologies, organizations are more sceptical about the usefulness of methodologies. On the one hand, SDMs are unsuccessfully utilised in many organizations (Kim and Pan, 2006; Lam and Chua, 2005; Lemon et al., 2002; Pan, 2005), but it is also known that SDMs are successfully utilised in

many other organizations (Chatzoglou and Macauly, 1996; Fitzgerald and Russo, 2005; Pan, *et al.*, 2006; Rahim, *et al.,*1998).

A discussion follows on why some of the systems of these organizations failed while using SDMs. Kim and Pan (2006:73-74) studied three different cases and found the skills level of the project team to be a core factor for estimating how successful an IS would be. Other factors such as change and requirements management are also affected.

Lam and Chua (2005:739) studied five knowledge management cases that had been abandoned. Their findings indicated that there are three main categories of causes for project abandonment. These three categories are: poor project implementation, organizational mismatch and content deficiencies.

Poor implementation, according to Lam and Chua (2005:733), is caused by exorbitant technology costs as well as project delays.

Organizational mismatch occurs when the project is well-aligned to, or considerate of, the current structures and roles in the organization for which the new IS is being developed. This causes problems with the new system not related to technology.

Content deficiencies are caused by knowledge that is out-of-date, poor access to knowledge and knowledge hoarding (Lam and Chua, 2005:739).

End user involvement and executive manager leadership are key factors that could affect project failure (Lemon et al. 2002:28).

Pan's (2005:180) findings indicate that one of the problems associated with the project investigated was that the procurement manager did not acknowledge suppliers as important stakeholders. Another problem was that the project manager did not secure the full participation of the users in the project.

The focus now turns to some success stories about organizations that had successfully implemented IS projects. The first is a system studied by Fitzgerald and Russo (2005:254).

Lessons learnt from a previous failed project led to the development of a successful project. The following factors contributed to the success of the second project: better project management, realistic timescales and budget, experienced developers, extensive tests, and the use of prototyping and support from senior management. These are all factors that form part of most SDMs and if they had been implemented in the first project, the outcome would have been different.

The use of an SDM was found to improve both productivity and quality (Rahim et al., 1998:959). The age of the IS department and the type of organization was also found to have exerted an influence on the use of SDMs (Rahim et al., 1998:959).

Pan, et al*.,* (2005:1155) studied a case of an IS project that was failing and was eventually saved and implemented. They (Pan, et al., 2005:1155) named four different activities that assisted with the de-escalation and helped to save the project. These activities were: making the negative outcomes feel less threatening, identifying problems, unambiguously giving negative feedback and appealing to the stakeholders for help.

It is now evident that there are different factors that have an influence on the success or failure of IS projects. In this research the focus remains, as previously mentioned, on only one of the reasons that might have an influence on the success, namely culture.

Different organizations possess different cultures. These cultures could influence how successful SDMs are used in an organization. Iivari and Huisman (2007:42) also researched culture and found that a hierarchical culture (discussed below) has a positive influence on the success of an SDM. In this research, the cultures of organizations in South Africa are discussed.

In the next section, the author conducts a study on culture, describes what culture is, and studies ways to determine the type of culture in different organizations and countries.

2.3 Culture

The research focus falls on culture, what it is and the nature of the different definitions and levels of culture. Subsequently, a detailed discussion follows on each of these different levels and ways in which to measure the culture within these levels.

2.3.1 Defining Culture

To determine what culture is, this study must first define the term. This is complicated because according to Taras et al., (2009:358), there is no accepted definition for the word 'culture' when used in a scientific study. Culture is however agreed to be many layered and complex, meaning that culture is difficult to understand and that one person could be involved in many different levels of culture (national, regional, organizational or individual) at the same time.

According to Kaarst-Brown et al. (2004:34), it is agreed that culture "is reflected in the practices, values, beliefs, and underlying assumptions of formal and informal groups".

One definition most often cited is the one by Hofstede and Hofstede (2005:4) which states that culture is "the collective programming of the mind which distinguishes the members of one group or category of people from others."

For the purposes of this research, similar attributes from various definitions are combined and culture is therefore defined as the similar values, beliefs and practices that distinguish groups from one another.

2.3.2 Factors that influence culture

Hofstede and Hofstede (2005:4) explain that culture is not genetic but is learned from the environment in which a person lives. There is a difference between a person's personality and his or her culture, but it is difficult to know exactly where the boundary lies. Culture is not fixed, but changes over time for each group. Hofstede and Hofstede (2005:4) explain that every person is both an observer and a participant in their culture. This implies that people involved in a culture could cause changes within that culture.

Skelton and Allen (1999:4), and Hofstede and Hofstede (2005:4) reject claims that culture is fixed, coherent or natural. Culture changes over time and space and is the product of how humans interact with each other, therefore, forming a significant part of peoples' lives. This is one of the reasons why people may struggle to "fit in" when immigrating to another country: people find it difficult to adjust to a change in culture.

According to Skelton and Allen (1999:4), culture is first and foremost influenced by history. The history of both the place and the people influences the culture of the people. Other factors that have an influence on the culture of a group include political changes, the economy, and various social aspects. Another very important factor is the geographic location of a group of people.

Political changes could have an immense effect on the culture of people living where the change occurs. For example, if the political situation changes people change their culture to "fit in" with the changes.

The economy also exerts a significant impact on the culture of people. When there is a problem in the economy or the price of an item changes, people change their use of the product, and any cultural aspect associated with this product or service could change as well.

The geographic location of people also has an influence on their culture. Skelton and Allen (1999:4) explain that this not only encompasses the area or region where they live, but also their beliefs about how the place and space around them influence them as a people.

A distinction should be drawn between culture and human nature as well as between culture and a person's personality (see Figure 2.3). Hofstede and Hofstede (2005:4) aver that human nature is what all people around the world have in common. It is inherited and determines a person's physical and basic psychological functions. Examples of human nature are the ability to feel fear, joy and sadness. However, what a person does with these feelings and how a person expresses them, forms part of a person's culture.

A person's personality refers to that person's own unique set of mental thoughts that he or she does not share with other people. It is usually partly inherited within a person's unique set of genes and partly learnt.

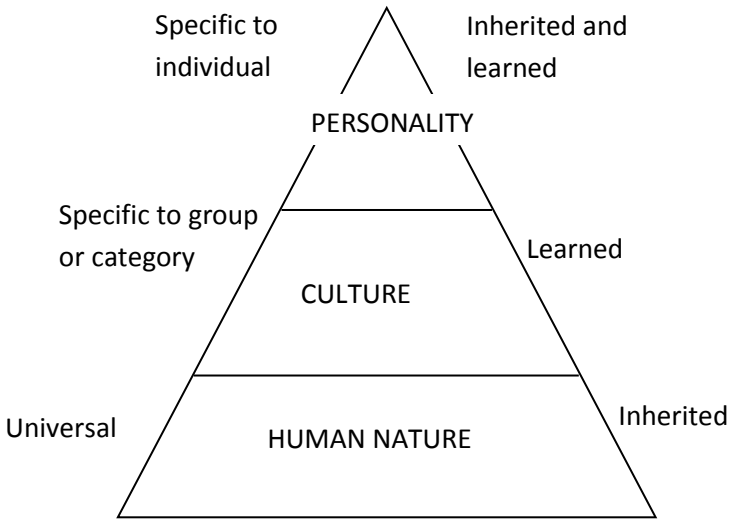

Figure 2.3 - Three levels of uniqueness in human mental programming (Hofstede, 2005)

2.3.3 Levels and elements of Culture

Hofstede (1991) explains that every person belongs to a number of different groups and categories at the same time; these groups could be classified into different levels of culture. Groschl and Doherty (2006:316) also describe culture as having levels. Figure 2.4 shows the levels of culture and the influence these levels have on an individual's culture.

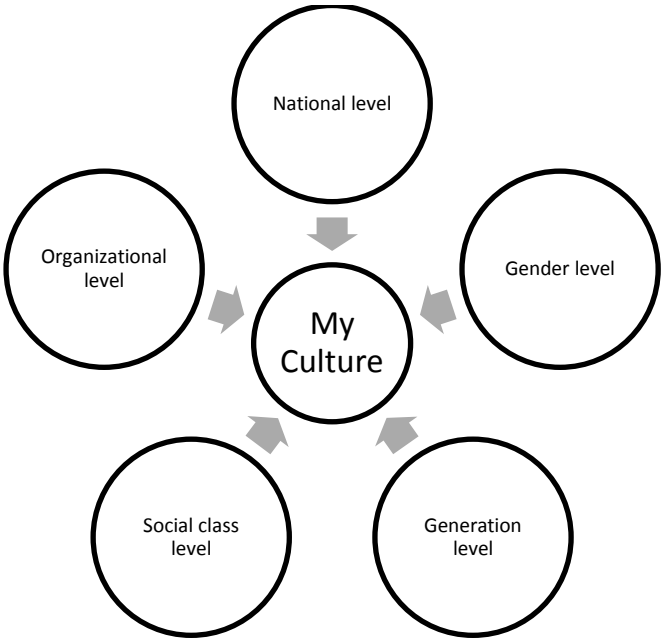

Figure 2.4 - Levels of culture

Groschl and Doherty (2006:314) refer to these levels as the “hierarchy of cultures” and Hofstede (1991) explains these levels:

National level – on this level, the culture of a person is examined as part of the persons’ country. Persons who have lived in more than one country are influenced by the cultures of all those countries.

The next level consists of different groups that could influence a person’s culture including: regional level, ethnic level, religious level and linguistic affiliation level.

Gender level – a person’s gender also affects that person’s culture. Gender could influence the things one likes, which in turn influences one’s culture.

Generation level – people are classified according to when they were born. For instance, grandparents are separated from parents and grandchildren.

A social class level – is associated with a person's education and a person's occupation or profession.

Organizational level – if a person is employed, the culture in the organization also affects the person's culture.

On every one of these levels, culture comprises many different elements (as illustrated in Figure 2.5) which are grouped into four categories: symbols, heroes, rituals and values. According to Hofstede, *et al.* (1990:291), these four terms were selected because they are "mutually exclusive" and "reasonably comprehensive". Every level of culture (as explained above) could have different elements in each.

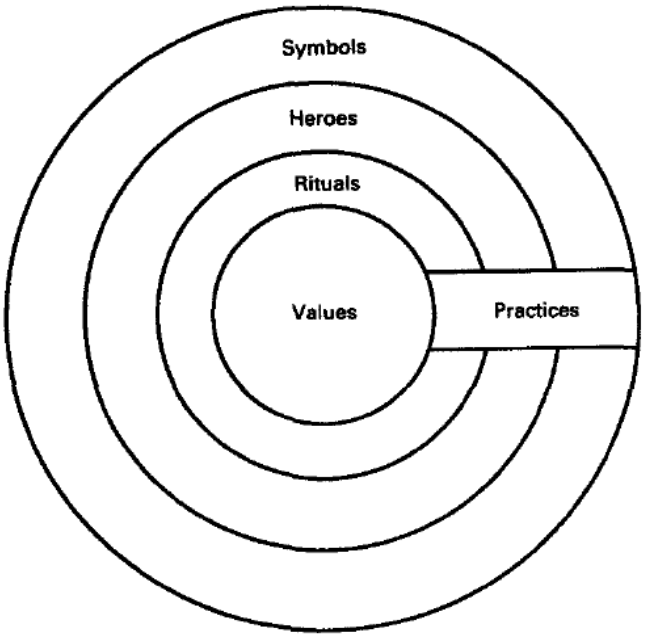

Figure 2.5 - Categories of cultural elements (Hofstede *et al.*, 1990:291)

Hofstede (1994) explains each of these categories:

Symbols are objects, words and gestures that carry a certain meaning in a specific culture. Examples of these symbols are: the languages spoken in a country (in national cultures) and the dress code of an organization (in organizational cultures). These symbols of a culture are generally only recognised by the people in that culture.

Heroes are people who are models for a culture and whose behaviour reflects those of the culture. These heroes could be real or imaginary idols and could influence a culture. For example, a person who founded an organization could become a mythical hero and incredible stories could be told about him or her.

Rituals consist of activities in a culture that are technically superfluous, but in a specific culture they hold meaning and form an essential part of that culture. These rituals include celebrations, formal meetings and written memos. They play an important role in the culture of an organization while new employees have to embrace them to become a part of the organization.

Values are the broad feelings of the people in a culture. They are often unconscious and not discussed, but are present in most members of a culture. These are feelings about what is good or what is bad, clean or dirty, beautiful or ugly, rational or irrational, normal or abnormal, natural or paradoxical, decent or indecent.

According to Hofstede, *et al.* (1990:291), as evident in Figure 2.5, these categories form the successive layers of an onion. The first layers could be viewed as shallow and superficial, while symbols for the deepest layer consist of the rituals.

Symbols, heroes and rituals are the three categories viewed by observers and are therefore called ‘practices’, but their cultural meaning is understood only by insiders.

The core of culture as depicted in Figure 2.5 is values in the sense that they determine what is right or wrong, good or evil, etcetera, as mentioned earlier (Hofstede, et al. 1990:291).

Figure 2.6 depicts a brief summary of the discussion of culture thus far. As illustrated in this figure, culture, which differs from human nature and personality, has different levels. In addition, each of these levels consists of different elements, all of which have an influence on the culture of a group.

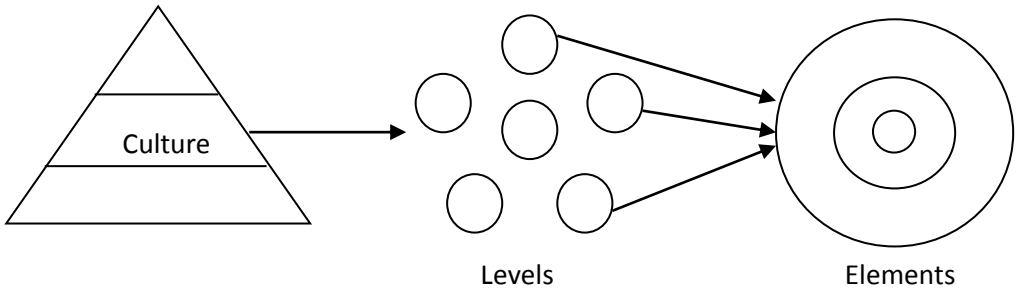

Figure 2.6 – The relationship between culture, levels of culture and the elements of culture

An example of this is the culture of South Africans. One of the levels of South African culture is its national culture. Within the national culture there are different elements, for example the heroes' element. These refer to heroes that all South Africans share, for example, a successful sports figure or a highly influential politician who could therefore influence the culture of a group.

This is the same for all levels and all cultures.

This research focuses mainly on organizational culture (business culture) and national culture. A more in-depth study of each of these types of cultures follows.

2.3.4 National Culture

Hofstede (1994) researched the differences in national cultures and he classifies national culture along five dimensions. Groschl and Doherty (2006:316-317) also used these dimensions to classify and study national culture. These dimensions are explained by Hofstede (1994).

- Power distance

Power distance is the “degree of inequality among people which the population of a country considers normal from relatively equal to extremely unequal” (Hofstede, 1994). In other words, power distance is the extent to which the so-called less powerful people of an organization (people not in managerial positions) expect and accept that these power positions are distributed unequally.

- Individualism

Individualism is the belief that people in a country have learnt to act as individuals or act as a member of a group. This dimension classifies the individualism of national culture from collectivist to individualist.

- Masculinity

Masculinity is the degree to which masculine values prevail over feminine values. Masculine values include: performance, success and competition, and is classified in a range from tender to tough. Feminine values include: quality of life, service and caring.

- Uncertainty avoidance

Uncertainty avoidance refers to whether people in a country prefer structured over unstructured situations, or whether they prefer structure or not. This is classified from relatively flexible to extremely rigid. In some countries people tend to avoid uncertainty and plan their whole day ahead, whereas in others they prefer to be more flexible.

- The fifth dimension

The above mentioned four dimensions were first identified by Hofstede (1994), but according to him, a fifth dimension was also later recognised. The fifth dimension is called Long-term Orientation (LTO) and determines that positive values are given for thrift and perseverance while negative values are given for respect for tradition and fulfilling social requirements. According to this dimension, too much respect for tradition could negatively influence work and work rate in a national culture. Also,

social requirements could negatively affect work, which Hofstede (1994) calls “keeping up with the Joneses.”

This fifth dimension is also critiqued by Fang (2003:362) who states that the validity of this dimension is doubted. He explains that respect for tradition does not necessarily have a bad influence on work. Fang (2003:350) further mentions that the first four dimensions have been greatly used in various research whereas the fifth dimension is not used that often as researchers tend to feel that it is more a theoretical platform.

In the next section the cultures of organizations in a country are reviewed.

2.3.5 Organizational Culture

According to Kaarst-Brown et al. (2004:34), organizational culture is viewed as the beliefs, practices, values and underlying assumptions of formal and informal groups in organizations. Schein (1985:15) claims that there are three levels to organizational culture, namely: artefacts and creations, values, and basic assumptions.

Hofstede’s (1994) research into the culture of organizations revealed that there are huge differences in the symbols, heroes and rituals in all organizations, but only small differences in values. Symbols, heroes and rituals are known as practices. Hofstede (1994) also maintains that different organizations that work in the same country could have very different practices, even when the employees hold similar values.

Six independent dimensions were identified to describe the varieties in organizational practices.

- Process-oriented versus results oriented

Process-oriented organizations are concerned with the process to be followed and results oriented organizations are concerned with the outcomes. “Strong cultures are more results-oriented than weak ones” (Hofstede, 1994).

- Job-oriented versus employee-oriented

Job-oriented cultures only study the job aspects of an employee, while employee-oriented cultures take responsibility for a broader range of employee needs.

- Professional versus parochial units

In professional units members identify with their profession and in parochial units members acquire their identity from their organization.

- Open systems versus closed systems

In this dimension the organization’s style of internal and external communication is examined. It also discusses the way in which outsiders and newcomers are accepted into the organization.

- Tight control versus loose internal control

This dimension studies the degree of formality and punctuality in a particular organization. This largely depends on the type of organization. In banks, for example a tighter control is evident while advertising agencies present a more loose and flexible culture.

- Pragmatic versus normative

This dimension focuses on how an organization deals with its customers. Businesses that offer a service usually tend to be pragmatic (flexible), while those that are involved in the application of legal rules usually tend to be more normative (rigid).

2.3.6 Classifying Organizational Culture

With sufficient knowledge gained about an organization's culture, it is now necessary to examine how to measure and classify it. One of the best models to use for this is the Competing Values Framework (CVF). Various authors, including Iivari and Iivari (2011:512-513), Shih and Huang (2010:272), Ancarani et al. (2009:1814) and Iivari and Huisman (2007:37), use the CVF to classify organizational culture. In recent studies, Thakor (2010) and Ancarani et al. (2009:1814) argues that the CVF has been found to be a very useful model for understanding the wide variety of organizational cultures. A study of the CVF and its workings follow.

2.3.6.1 Competing Values Framework

The CVF was developed by Quinn and Rohrbaugh (1981; 1983) and is still used today to measure the culture of an organization.

Quinn and Rohrbaugh (1983:363) found three value dimensions: internal-external, control-flexible and means-ends. The third dimension was integrated into the other two and a CVF was established, as depicted in Figure 2.7 (Yu and Wu, 2009:37).

The first dimension (the horizontal line in Figure 2.7), according to Yu and Wu (2009:37), indicates the organizational focus, from internal, where the focus falls on the well-being of the people in the organization, to external, where the focus falls on the well-being of the organization itself. Thakor (2010) avers that some organizations are effective if harmony exists in their internal relationships and processes while others are successful only if they compete against each other in an established market.

The second value dimension (the vertical line in Figure 2.7), according to Yu and Wu (2009:37), depends on the structure of the organization, from the emphasis being placed on flexibility within the organization to rigid control over all the employees and projects. According to Thakor (2010), "some organizations and managers are

viewed as effective if they are changing, adaptable and transformational. Other organizations and managers are viewed as effective if they are stable, predictable and consistent".

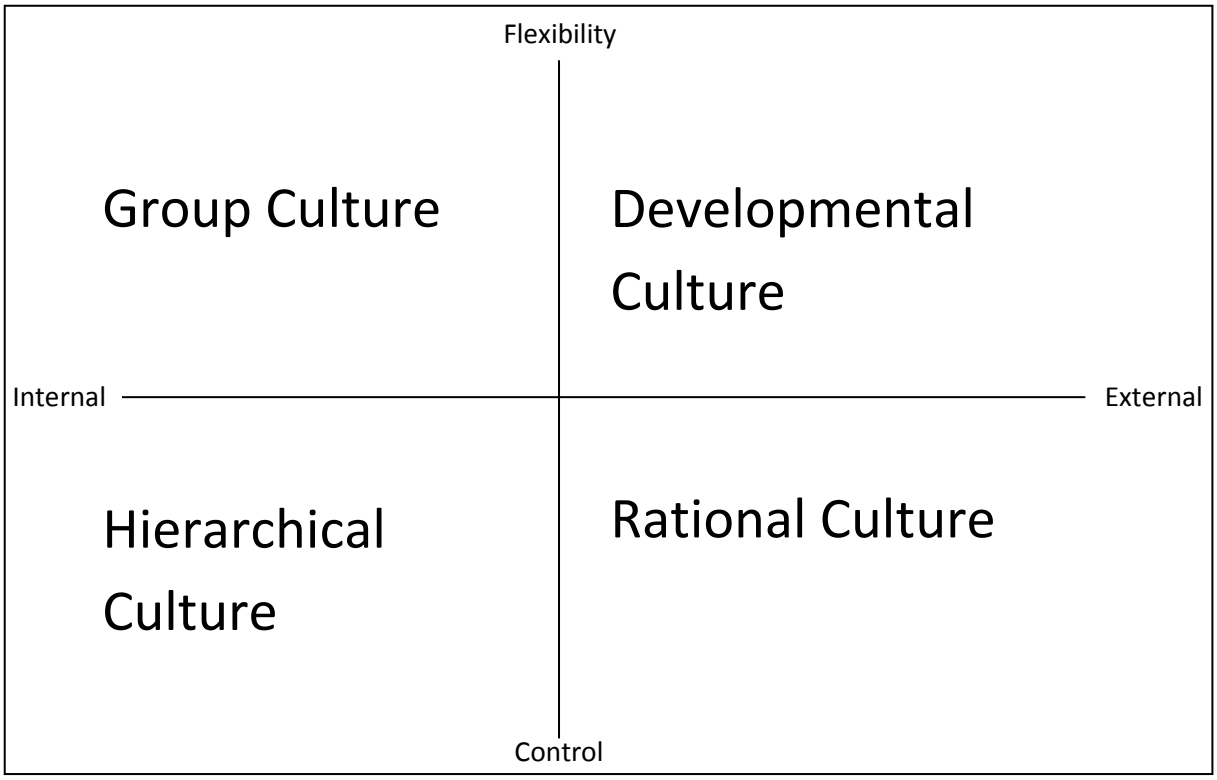

Figure 2.7 - Competing Values Framework adapted from Yu and Wu (2009:42)

Four models can be found in the CVF. They were named by Quinn and Rohrbaugh (1983): human relations model (group culture), open systems model (development culture), rational goal model (rational culture) and internal process model (hierarchical culture) (as illustrated in Figure 2.7).

These four models are also called the four organizational culture types. Cameron and Quinn (2006:28) named the four culture types: Clan, Adhocracy, Market, and Hierarchy. Other names are also used for each of these culture types, for instance, Iivari and Huiman (2007:37) name these culture types: Group, Developmental, Rational and Hierarchical cultures. Each of these cultures is explained by Cameron and Quinn (2006:29-35), and Yu and Wu (2009:38):

- The clan culture (Group)

In clan cultures there are shared values and common goals, and an atmosphere of togetherness and mutual help. There is also an emphasis on empowerment and gaining employee participation. This type of culture is usually found in organizations with a long history and stable membership.

- The adhocracy culture (Developmental)

This culture is like a temporary institution, dismissed when finished and reloaded rapidly when there are new projects to complete. This type of culture is usually found in software development and consulting.

- The market culture (Rational)

This culture focuses on the environment outside the organization and not on internal management so its goal is usually to make a profit.

- The hierarchy culture (Hierarchical)

This culture is evident in an organization with a clear structure, standard rules and procedures, strict control and defined responsibilities for each employee.

2.4 Existing Research in Information Systems and Culture

This section of the research reviews previous studies on IS and culture. Leidner and Kayworth (2006:363) explain that they have found ten studies researching how culture could influence information systems design. Seven of these studies considered national culture while the remaining three focused on organizational culture.

Leidner and Kayworth (2006:363) elucidate that the most common theme found in these different studies was that differences in cultural values lead to varying approaches and perceptions of the manner in which information systems are

developed. These researchers did not focus on the SDMs used by the organizations.

Dagwell and Weber (1983:996) researched the different approaches that certain countries took in terms of IS development. They found that Swedish and Australian designers were more orientated towards people (Theory Y), while U.K. and U.S. designers were more directed towards processes and efficiency (Theory X).

Experiments by Keil et al. (2000:316) reveal that cultures with lower uncertainty avoidance held lower perceptions of a project's risk than cultures with higher uncertainty avoidance. This means that project managers in these lower uncertainty cultures tend to continue with troubled IT projects more often than project managers would in higher uncertainty avoidance cultures.

Tan et al. (2003) researched the impact of a national culture on the tendency to report bad news about IT projects that are failing. In their research they found that individualistic cultures (as found in the U.S.) were more inclined to report bad news about IT projects than collectivistic cultures.

2.4.1 Research on Cultures and SDMs

Very little research has been carried out on SDMs and culture. As already discussed, Iivari and Huisman (2007:35) studied the relationship between organizational culture and SDMs. Iivari and Huisman (2007:37) also used a CVF and found that an organization with a more hierarchical culture perceived SDMs to be more beneficial and used them more in an organization, whereas in rational cultures IT managers seemed to be more critical of SDMs.

Chow and Cao (2008:962-963) categorise these failure factors into four categories:

- Organizational
  Factors like managerial support and organizational culture are categorised.

- People

  Factors about people, which could cause a project to fail, are placed in this category, for example, a lack of the necessary skills or bad relationships between employees.
- Process

  Incorrectly defined scope and lack of user involvement are examples of the type of problems in this category. In addition, factors that influence the success of the development process are also placed here.
- Technical

  Problems with the tools and techniques or technology fall into this category.

According to Reel (1999:19), there are ten signs that indicate that an IS project is failing or going to fail. These signs could also be classified into the failure factor categories as determined by Chow and Cao (2008:962-963). These signs are named by Reel (1999:19):

- Project managers do not understand the requirements of the users (Process).
- The scope of the IS project is ill-defined (Process).
- Changes in the project are managed poorly (Process).
- The technology changes (Technical).
- The business needs to change (Organizational).
- The deadlines for the IS project are unrealistic (Process).
- The users are resistant to the change in technology (People).
- Sponsorship is lost (Organizational).
- The people do not possess the necessary skills to complete the project (People).
- The managers of the projects ignore the lessons and best practices that they have learnt (Process).

In both Reel (1999:19) and Chow and Cao (2008:962-963), it was clear that the organization exerts an influence on the factors and signs of failure. Chow and Cao (2008:962-963) also described the organization's culture as having an influence.

Chow and Cao (2008:962-963) mention five categories to classify the success factors:

- Organizational

  Factors like strong managerial support and a cooperative organizational culture instead of a hierarchical culture.

- People

  Employee skills and managers with good skills levels are classified.

- Process

  Good communication and strong customer commitment are some of the factors that are classified in this area.

- Technical

  Factors that influence success include well-defined coding standards and a simple design.

- Project

  Projects with small teams and projects that do not have multiple independent teams constitute some of the factors that aid the success of a project.

In both Chow and Cao (2008:962) and Reel (1999:19), the organization is mentioned as being important to the success of the IS project; Chow and Cao (2008:962) name culture as one factor that exerts an influence.

A recent study has also been conducted on organizational culture and the deployment of agile methods by Iivari and Iivari (2011). Iivari and Iivari (2011:517) describe the relationship between agile SDMs and organizational culture as being "rich and interesting". Iivari and Iivari (2011:517) found that a hierarchical culture is not suitable for agile SDMs and that in organizations with a more hierarchical culture, SDM use is more mandatory. Developmental, group and rational cultures all favour agile SDMs, while a hierarchical culture does not.

Shih and Huang (2010:278) researched organizational culture and the deployment of software process improvement (SPI). SPI is an approach that helps to improve software products in software development organizations, very similar to some of the

advantages of SDMs. Shih and Huang (2010:278) established that an organization with a more hierarchical culture find the deployment of SPI much easier.

It is clear that very little research has been carried out in this area. It is however an important aspect that should receive further attention. From past research it is evident that the culture of an organization does exert an influence on the perceived success of the SDM or the process of development of an IS.

2.5 Conclusion

This chapter has described SDMs, search for a definition of SDMs, as well as a study of the history, advantages and criticisms of SDMs. The types of SDMs and examples of SDMs in each of these types were then discussed.

Next followed a study on culture. Again there was a search for a definition followed by a study on the levels and elements of culture. Organizational culture and national culture, in particular, were reviewed in depth and ways to study and classify these cultures were highlighted.

Finally, the research on both SDM and culture were combined and discussed. In this section, the relationship that exists between SDM use and effectiveness, and the national and organizational culture were discussed.

In the next chapter, the methods used in this research are discussed. The paradigm with which this research works and the manner in which the research data was collected, are also addressed.

Chapter 3 – Research Methodology

3.1 Introduction

In this chapter the research method is discussed as illustrated in Figure 3.1.

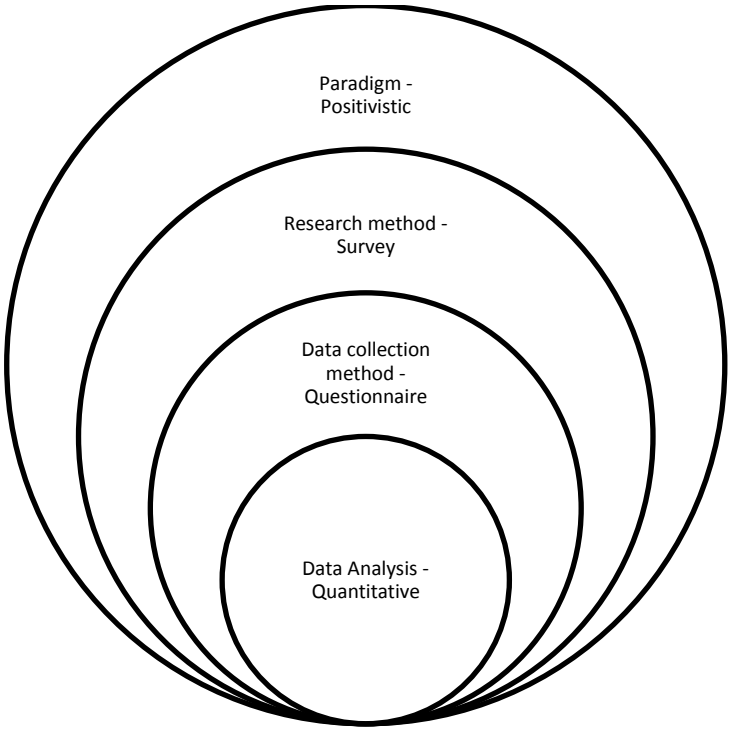

Figure 3.1 - Method used in this research

Firstly, the different research paradigms are examined and the one best suited to this research is discussed. Figure 3.1 shows the methods of research and indicates that

this research is set within the positivist paradigm. Of the various research methods in this paradigm, the survey is utilised in this study. Various data collection methods are used for surveys which in turn are associated with a particular method for the data analysis. In this study, questionnaires and quantitative data analyses are utilised. The advantages and disadvantages of the research paradigm, research method, data collection method and data analysis method are discussed in this chapter as well as the reasoning behind the use of this paradigm and methods.

3.2 Research paradigms

There are many different research paradigms that researchers could follow. These, are identified and discussed by Chua (1986:613), and McCutcheon and Jung (1990:147) which include positivist, interpretive and critical studies. Conclusions are subsequently drawn from the results of the research. A discussion on the different paradigms follows to illustrate their differences and also the reason why this research is set in the positivist paradigm.

3.2.1 Positivist research

“Positivist studies are premised on the existence of a priori fixed relationship within phenomena which are typically investigated with structured instrumentation” (Orlikowski and Baroudi, 1991:5). Therefore, in this type of study the researcher has a theory or hypothesis that needs to be tested in order to understand more about a specific phenomenon.

Positivism is described by Cooper and Schindler (2011:17) as comprising three basic principles:

- The world exists externally and is viewed objectively.
- Research is described as being value-free.
- The researcher is an independent and objective analyst.

According to McCutcheon and Jung (1990:147), positivism views reality as something that could be broken down into smaller pieces and where an event could be explained by real causes and simultaneous effects.

In order to classify studies as positivist research, Orlikowski and Baroudi (1991:5) identified criteria such as formal propositions, quantifying and measuring of variables, testing of hypotheses as well as drawing inferences from a population.

There are, however, exceptions called “descriptive” studies. A distinction must be made, in the positivist category, between researchers working within a theoretical tradition and those whose intentions lean more towards descriptive work. In the latter, researchers do not use a theory, but rather present what they call “objective” or “factual” accounts of events to illustrate an issue to the community.

3.2.2 Interpretive research

Interpretive studies make the assumption that people “create and associate their own subjective and inter-subjective meanings as they interact with the world around them” (Orlikowski and Baroudi, 1991:5). Researchers thus attempt to understand a situation by the meanings that participants assign to the situation.

Interpretive studies are in contrast with descriptive studies (as explained above) in that they reject the possibility of an “objective” or “factual” account of a situation and try to find a relativistic understanding of the phenomena. Interpretive research does not generalise a population but attempts to understand the deeper structure of phenomena. The insights found in the phenomena could then be used to provide information for other settings.

Cooper and Schindler (2011:17) explain the three basic principles of interpretive research:

- The world is constructed and meaning is provided by the people.
- Research cannot be neutral and is part of what is observed.
- Research is driven by the interest of the people conducting the research.

There are certain criteria which classify research as interpretative studies. According to Orlikowski and Baroudi (1991:5) these include: evidence that the researcher held a nondeterministic perspective and the research was completed in order to gain a better understanding of the phenomena in a certain culture and in certain situations; the phenomena should be researched in their natural setting; and, the researchers should not have imposed their own opinions and beliefs on the situation.

3.2.3 Critical studies

These studies aim to "critique the status quo, through the exposure of what are believed to be deep-seated, structural contradictions within social systems and thereby to transform these alienating and restrictive social conditions." (Orlikowski and Baroudi, 1991:5)

Oates (2006:296) describes critical research as research that is interested in conflicts and contradictions as well as empowering people. In this type of research the researcher also seeks to make a difference. According to Cooper and Schindler (2011:18) critical studies recognise that there is a gap between the researcher's understanding and the "true" reality.

Criteria used to classify these studies are, according to Orlikowski and Baroudi (1991:6) evidence of a stance toward undervalued assumptions about organizations and information systems, and an analysis that attempts to reveal the nature (historical, ideological and contradictory) of existing social practices.

3.2.4 Paradigm for this research

The paradigm utilised in this research is positivist as it is best suited to answer the research question. The objective of this research is to study the link between an organization's culture (including both organizational culture and national culture) and

the successful use of Systems Development Methodologies (SDMs) in that organization.

This research could also be viewed as “descriptive” as noted by Orlikowski and Baroudi (1991:5) because it attempts to reveal “factual” or “objective” accounts about the employees of the organization as well as the organization’s use of SDMs.

In order to present factual and objective accounts, the variables involved in the research had to be investigated, hence, different organizations in the country were involved in this part of the research. These variables included the type of organizational culture, the national culture, and the organization’s use and effectiveness of SDMs.

Once all the data was collected it was statistically analysed and inferences were drawn from the data about organizations in general.

Oates (2006:286) explains the characteristics of positivism research, some of these characteristics are also mentioned in McCutcheon and Jung (1990:145-146), and Cooper and Schindler (2011:19):

- The world exists, independent of the humans in it.

The world exists “out there”; both the physical and social worlds. It does not only exist in people’s minds, but it can be studied, measured and captured. For example the law of gravity exists independently of whether there are humans on earth or not.

In this research, the use and effectiveness of SDMs are studied. They cannot be studied from only an academic point of view. It is also necessary to study real-world examples of IS projects and people in order to find solutions for improving development processes and IS systems.

- Measurement and modelling

A researcher could discover aspects of the world by making observations and measurements, and producing models about how the world works. An assumption is

made that there is only one model (explanation) for any aspect of the world and it is called ‘the truth’.

The object of this research is to measure the use and effectiveness of SDMs by using a standardised method. The “truth” collected by this measurement is then used to draw conclusions about the use of SDMs in organizations.

- Objectivity

It is usually assumed that a researcher is objective and neutral and that facts are collected independently of the researcher’s personal values and beliefs.

In this research, it was easy for the researcher to remain objective. By reducing all the answers and information to numbers, he could analyse the data without any personal feelings becoming involved.

- Hypothesis testing

Research is carried out by the creation and testing of hypotheses. The results of these tests either confirm or disprove the hypotheses and reveal truths about the situation being studied.

The research question enquires: Is there a relationship between the use and effectiveness of SDMs and the national and organizational cultures in an organization? By answering this question, “truths” about the situation are revealed.

- Quantitative data analysis

The use of mathematics is strongly preferred in this type of research as it provides a logical and objective means of analysing observations and results. In this research it also assists the researcher in remaining objective and neutral.

- Universal laws

One of the aims of this research is to look for generalisations; universal laws that are true regardless of the researcher or the situation. These laws should be applicable to different situations with similar variables and conditions.

The laws, if any, found in this research should be universally applicable.

From the literature consulted, it is clear that there are also criticisms of positivism that the researcher must be aware of in order to ensure avoidance of these if at all possible. Oates (2006:288-289) explains these criticisms:

- Reductionism or breaking things down into smaller simpler pieces. This is not always possible or it could miss the bigger picture.
- Repetition is not always possible; the experiment cannot always be repeated to verify the results.
- Generalisation is not always what is desired by the research; the generalised law could miss out on much.
- Every person holds different world views. For example, some people are optimists while others are more pessimistic. These differences could cause difficulties in research.
- Some laws could be observed in the world, but those are usually created by people and not by nature.

When research is conducted, it is important to ensure that it is of a high standard. Being familiar with the criteria used to judge the research, it is possible to avoid problems and ensure quality research. Oates (2006:287-288), and Braa and Vidgen (1999:27) explain four aspects for judging the quality of positivism research:

- Objectivity

It is important for the researcher to be objective when making observations and drawing conclusions from the data collected. The researcher must be neural and unbiased.

- Reliability

The most important questions raised here are: Are the instruments used in the experiment neutral, accurate and reliable? These instruments could include

equipment used in the experiment, the questions asked in a questionnaire, and in some cases, the researcher could also be seen as an instrument.

- Internal validity

The research must be well designed in order to measure the correct aspects in the experiment or collect data from appropriate places. The data must also support the researcher's claimed findings.

- External validity

The research must be generalised to different people, places and times. This means that the rules and generalisations drawn from the research should be applicable to most situations with similar variables.

3.3 Research Method

There are three different types of research methods that could be used in positivist studies: surveys, experiments and case studies, according to Oates (2006:141) and Bhattacherjee (2012). Each of these methods is suited for different situations and could be effective, depending on the situation. A brief overview of these methods is also furnished by Oates (2006:141):

- Survey

The main idea of a survey is to obtain the same data from a large group of people in a standard and systematic manner. The data is subsequently analysed by searching for patterns in the data and drawing conclusions (Oates, 2006:93). Surveys test different hypotheses systematically by using data collected from a known population. (Wynekoop & Russo, 1997:51)

- Experiment

In an experiment the researcher must remove a phenomenon from its situation and recreate it in the experiment. The researcher then verifies that the different outcomes, resulting from changing the variables, could only have been caused by

the researcher's manipulations. According to Wynekoop and Russo (1997:51), laboratory research (experiments) take place in an artificial setting, where the researcher controls the independent variables.

- Case study

Case studies are used in positivist studies, but less often than surveys or experiments. The case study should be carried out in a positivistic manner, as case studies are generally not used in positivistic research. This means a case study should be done by asking pre-defined questions and not follow the form of a general discussion. The case study focuses on one instance of the situation to be investigated. This one instance is then studied in detail using a variety of methods and the aim is to obtain a rich detailed view of the instance and the relationships and processes involved.

According to (Wynekoop & Russo, 1997:51), a case study studies small samples intensely by means a variety of methods. Case studies are therefore rarely used in positivist studies.

Next, the method used in this research is discussed.

3.3.1 Method in this research

The method used in this research is surveys. Data needed to be collected from a large number of people in a standard way, which was best done through a survey. The data was then analysed to search for patterns in the data. As discussed earlier this is best suited to a survey method. Surveys are also generally associated with the positivism paradigm (Oates, 2006:93).

Another reason for the use of surveys in this research is that the data needed to be collected from people and organizations around South Africa. Because of physical distances, e-mails were used to transfer the questionnaires.

When conducting research, it is important to note both the strengths and weaknesses of the chosen method in order to avoid the weaknesses and exploit the strengths. Surveys comprise the following strengths according to Oates (2006:104):

- They provide a wide coverage of people or events and the results are usually very representative of the population. This is good for generalisations.
- Much of the data is produced in a short time at a relatively low cost. The cost and time are also predictable, which aids the planning of the research project.
- Surveys use quantitative data analysis.
- The research project could generally be replicated using another sample. This is useful for verifying the results of the research and to search for more patterns.
- It is possible to send surveys via the web or by post and they are therefore suited to people who do not have good inter-personal skills.

Shough and Yates (2002) also name some of the advantages that they found when employing an online survey:

- The time taken to create and send the survey was very short.
- The response time was also much shorter, than other forms of data generation methods
- The cost to both researcher and respondent was almost negligible.

It is thus evident that there are various advantages to using surveys. To ensure that these advantages are utilised, they are exploited in several ways in this research:

- The survey was distributed to many different organizations to obtain representative data as far as possible.
- The research costs were minimised by using a survey, because much data was generated at low cost.
- The same questionnaire could be used to repeat the survey and verify the data at any time.
- The data collected in the research could be used to find other patterns and relationships that were not a part of this research.

- The survey was carried out by means of e-mails as well as dropping the questionnaire off at various organizations.

There are also disadvantages and pitfalls to using questionnaires. In order to minimise the effects of these in this research an awareness of the disadvantages associated with surveys was required. The disadvantages of surveys are discussed in Oates (2006:105):

- Surveys lack depth. Not much focus falls on the details of the research topic.
- Surveys usually focus on that which is counted and measured then use statistical analyses to find patterns. However, there are aspects of research that cannot be reduced to numbers and these are often overlooked.
- Surveys show snapshots in time and do not always analyse events over time.
- Surveys do not collect data about the cause and effect of certain situations; they only examine the relationships and patterns in the data.
- If the Internet and postal services are used it is not possible for the researcher to judge the honesty and accuracy of the answers of the respondents'.

In this research the weaknesses of surveys were avoided by taking the following steps:

- The lack-of-depth issue was addressed by consulting various people working in ISD departments, statistics departments and computer science academia, to improve the detail captured in the survey.
- Open questions that allow greater depth in the responses were utilised.
- To address the dishonesty issue that could arise by using questionnaires, participants in organizations were told that the data was anonymous and therefore they had no reason to be dishonest in their responses.
- The questionnaire was also sent to many different people to improve the quality of the data collected.

In this research different organizations in South Africa were contacted from January to July 2011. They were asked to take part in the research by completing a

questionnaire. Organizations were told that they would remain anonymous and that the data would be used to further an understanding of SDMs in South Africa.

According to Oates (2006:96-98), there are two different types of surveys: probabilistic and non-probabilistic. In each of these types there are four different techniques that could be used when conducting a survey.

In this study, the non-probabilistic approach was adopted and two of the techniques were combined to obtain results, that is, purposive sampling and snowball sampling. In purposive sampling, the researcher selects the candidates for participation; in this survey software developers from different companies were selected. The snowball sampling technique was also used and in this technique the researcher finds a person from one of the target populations and after obtaining data from him or her, requests information about other people in the target population. In this research the target population was software developers and respondents were asked for information about other people who could participate in the survey.

In the next section, data generation in the survey is discussed.

3.4 Data generation method

Different methods are employed to generate data. All of these data generation methods have different advantages and disadvantages depending on the research itself. According to Oates (2006:36) and Kaplan and Maxwell (1994:30), there are four data generation methods that could be used in research: interviews, observations, questionnaires and documents.

Oates (2006:36-37) and Kaplan and Maxwell (1994) shortly describe these different data generation methods:

- Interviews

In research, an interview is a conversation held between people where the researcher controls the conversation direction and asks most of the questions. The

researcher then records the responses and in this way data is collected. It is possible to conduct both one-to-one and group interviews. In positivistic research the researcher should have a set of questions that require standard answers to standardise the data collection process.

- Observations

The main focus of observation is to watch what people actually do rather than what they say they do. This usually involves the visual senses, but others such as the audio, olfactory, and gustatory senses could also be involved.

- Questionnaires

Questionnaires are a pre-defined set of questions created by the researcher and in a specific order. They are usually in the form of multiple-choice questions and thus the researcher could analyse and interpret the data.

- Documents

This includes documents that already exist before the research is conducted and documents that are created for the purposes of the research. They could be used in the research and offer another way of collecting data.

This research uses questionnaires for several reasons. Firstly, the research was carried out in different places at the same time. It was therefore not possible for the researcher to be present in all of the organizations at the time that the data was being collected. Thus interviews could not be held.

Secondly, the data needed to be collected from a large number of people in a standardised manner, thus interviews and observations would have taken too long and were not suitable for this research. Another reason for using questionnaires was that they capture quantitative data that could be analysed statistically.

Oates (2006:220) specifies situations in which questionnaires would be best suited, these being situations where the researcher:

- wants to acquire data from a large number of participants;

- wants to obtain short and uncontroversial data from participants;
- wants to receive the data in a standardised manner, by asking the same questions of all participants;
- knows that the participants would be able to read and understand the question and provide answers; and
- has the required funds to distribute the questionnaires and the time to wait for responses.

When these situations are considered in the context of this research, it is evident that they all apply and, therefore, using questionnaires was the right decision.

The next step is to consider the advantages and disadvantages of questionnaires. It is always important to know the strengths and weaknesses of the methods that a researcher is using.

There are a number of advantages that are associated with the use of a questionnaire. Oates (2006:229-230) and Marshall (2005:132) explain some of these advantages:

- Questionnaires are more economical and use less time, money and materials to generate large amounts of data.
- Using multiple-choice questionnaires makes it easier to answer and easier to analyse.
- There are only a few geographical limits for the use of questionnaires, they could be sent by post, e-mail and the Internet.
- Questionnaires require no special social skills of the researcher.
- Most of the respondents know what is expected of them.

The advantages of questionnaires were exploited in this research:

- The time, monetary and material advantages of questionnaires were fully utilised in this research. By sending the questionnaires by e-mail, costs were kept low and time was minimised.

- Being able to deliver the questionnaires to some of the organizations was another advantage of using questionnaires in this research.
- Questionnaires were easy to complete because of the use of multiple-choice questions and they were analysed by using statistical analyses.
- Surveys had to be conducted for many different organizations and the use of questionnaires simplified this task considerably.

Cooper and Schindler (2011:393-402) name 21 different issues that are associated with questionnaires. Oates (2006:230) and Marshall (2005:132) also name a few disadvantages of questionnaires. A few of the most common problems, associated with questionnaires, are listed below:

- The pre-defined answers could be frustrating, because of limited options.
- The pre-defined answers can also cause a bias towards the researcher's opinion.
- The researcher cannot ask participants questions while they are completing the questionnaires and cannot check for truthfulness.
- The researcher cannot explain misunderstood questions, provide further detail or help the participants.
- Questionnaires could cause difficulties when participants have poor literacy skills or are visually handicapped.
- The wording of a question could result in the participant responding in a certain way.
- Questions about sensitive information could cause problems as participants may be unwilling to provide answers.

In order to avoid these disadvantages of questionnaires a pilot survey was launched. A trial questionnaire was sent to 10 people working in the field of IS development and they were each asked to complete it.

After completing the questionnaire the participants were asked to make suggestions for improving the questionnaire. They were also asked if they felt pressured into

answering any question in a certain way. They were also requested to mark any questions that they did not understand.

A number of participants marked a few questions that they did not understand and a few indicated that the questionnaire was too long. It was then simplified and a few questions that were unnecessary were deleted. It was then sent back to the same respondents to see if it was more understandable and easier to use.

After this the questionnaire as presented in Appendix A was completed and used.

Various techniques were used to contact the different organizations. Firstly, the Internet was used to locate the e-mail addresses of different organizations and subsequently the requests were sent to them by e-mail. To obtain more responses, the various organizations were also called and asked if they would take part in the survey. Finally, different organizations around South Africa were visited in order to deliver hard copies of the questionnaire directly to them.

With regards to the response rate, 125 valid questionnaires were collected from the 485 different randomly selected organizations. This meant that the response rate was 26%. The completed questionnaire is now discussed.

3.4.1 The questionnaire

The questionnaire consisted of 19 questions that were used to measure different aspects of the organization and the people completing it. In this section the questionnaire itself is examined and explained. The complete questionnaire appears in Appendix A.

Most of the questions were closed questions; however, a few questions included an option to add an “other” response if none of the options applied to the respondent’s organization. The only open question (Marshall, 2005:132) was question 15, which asked about the use of SDMs in the organization, considering the great number of

different SDMs in use at the moment. Jayarantna (1994) claims that SDMs are numbered in the thousands and Masrek et al. (2008:138) refer to numbers in the hundreds or thousands. Therefore, it would not have made sense to try to list all of these SDMs.

The questions also used the Likert scale (Marshall, 2005:133) to answer questions where the respondent had to decide how strongly they agree or disagree with a statement.

The questionnaire is further designed to measure three different aspects used in this study. The first aspect was the background of the business itself. In this area the questionnaire collected data about the background of the business, the background of the IS department and the respondent's role in this department. Next, the questionnaire focused on culture. Data about both the national and organizational cultures were collected.

The last aspect on which the questionnaire collected data was the use and effectiveness of SDMs. In this area, data was collected on the different SDMs used in organizations and the intensity with which each of them were used.

Considering the criteria addressed in this questionnaire, it should provide a good overview of the business and culture as well as the use and effectiveness of SDMs.

3.4.1.1 The questions in the questionnaire

In this section the questionnaire itself and the reasoning behind the questions used are discussed. Table 3.1 displays the different questions in the questionnaire.

Table 3.1 - Breakdown of the questionnaire

Question number	Number of items	Research variable	Reference
1	1	Core area of the organization	Huisman (2000)
2	1	Period the business has been in operation	Huisman (2000)
3	1	Skill level of IS development employees	Huisman (2000)
4	1	Size of the organization	Huisman (2000)
5	1	Size of the IS department	Huisman (2000)
6	1	Respondent's role in the IS department	Huisman (2000)
7	6	Procurement of organizational software	Huisman (2000)
8	1	Project outcome	
9	1	Project size	
10	9	Success of the process	Huisman (2000)
11	11	Success of the system	Huisman (2000)
12	14	Organizational culture	Quinn and Rohrbaugh (1981, 1983); Iivari and Iivari (2011)
13	8	National culture	
14	13	Reasons for non-use of SDM	Huisman (2000)
15	2	Use of SDM and intensity of use	Huisman and Iivari (2006:44)
16	1	Period of SDM use	Iivari and Huiman (2007:53)
17-18	2	Proportion of people and projects that apply SDM knowledge	Iivari and Huiman (2007:53)
19	1	Strictness of SDM use	Huisman (2000)

Table 3.1 also shows what each question is intended to measure and the number of items in the questionnaire used to measure the research variable. The table also shows references of the questions where appropriate

As displayed in Table 3.1, question 1 was designed to measure the core area of the business of an organization and the results furnished an overview of the types of organizations that responded to the survey.

The objective of question 2 was to measure how old the responding organization is in order to determine if older organizations differ from newer organizations in their responses and also to provide a larger picture of the responding organizations.

Question 3 helps to determine the skills level in an IS department and to further determine if IS departments with more skilled staff use SDMs or if the reverse is true.

Similar to question 2, question 4 helps to gather information about the organization itself, as it measures the size of the organization. Question 5 similarly measures the size of the IS department in this organization.

The purpose of question 6 is to determine the respondent's role in the IS department and thereby establish where the respondent fits into the IS department.

Question 7, as noted in Table 3.1, has six items. This question enquires about the manner in which the organization procures software and because it is possible to do so in various ways, the respondent could mark more than one answer.

The objective of questions 8 and 9 is to determine the size and success of the last project in which the respondent was involved.

Questions 10 and 11 are used to determine the success of the development process and the system, respectively. Question 10 lists nine different items that focus on the success of the development process, including whether the budget and time constraints were met, which help to determine how successful the process was.

Question 11 includes eleven different items all used to determine the success of the product as delivered by the process. The types of questions asked here revolve around whether the quality and the reliability of the developed system are of a high

standard. From these answers the success of the delivered product could be established.

Various aspects of culture are determined in questions 12 and 13. Question 12 used the CVF to determine an organization's orientation to each of the four different culture groups. Respondents chose the level with which they agreed or disagreed for the 14 different statements and their answers helped to determine the organizational culture. The national cultures were then determined by question 12. Similar to the previous question respondents just responded in terms of the level with which they agreed or disagreed for the 8 statements, which helped to determine their orientation towards the different national cultures.

As established before in this study, not all organizations use SDMs and therefore question 14 enquires why an organization does not use SDMs. Only respondents whose IS departments do not use SDMs were asked to complete this question.

The purpose of question 15 is to determine which SDM an organization uses and how intensely it is used. Respondents could fill in a number of different SDMs to indicate how intensely each of these was used. Due to the large number of SDMs available today, the responses to this question were vital to this research.

The next four questions also concerned the use of SDMs. Question 16 enquires about the length of time an SDM has been in use in the IS department. The results determine, for example, if an IS department that has had SDMs in use for a longer period of time is more successful or not. Questions 17 and 18 enquire about the proportion of people and projects for which SDM knowledge is applied. This helps to investigate how widely SDMs are being used in an organization.

The final question, number 19, determines how strictly the IS department uses its SDMs. This could range from a standard SDM for all projects to an adapted SDM on a project by project basis.

3.5 Data analysis

The next step in the research project is to decide how the data will be analysed. There are two different types of data namely quantitative and qualitative data.

Quantitative data is that which is based on numbers (Cooper and Schindler, 2011:144); it could be compared and different mathematical functions could be applied to the data. An example of this is the number of cars that travel at a certain time on a certain road. The main idea of this type of data analysis is to search for patterns in the data and make generalisations to reach conclusions.

Qualitative data includes, according to Oates (2006:266), all non-numeric data; this includes words, images and sounds. It is used to gain insight into a situation and to study it in detail.

According to Oates (2006:245), quantitative data is that which is collected by means of surveys, which this study has used. Another reason for using such data analysis is because the researcher searches for patterns in the data that has been collected.

Different quantitative data generation techniques were used to collect the data for this research. These include: regression, reliability, factor analysis and cluster analyses. The results of these techniques are discussed in chapter 4.

3.6 Summary

In this chapter the research methodology was discussed. The different research paradigms and the reasons for working in the positivist paradigm were described. In addition, the different advantages and disadvantages of using a survey and questionnaires, and ways in which to exploit the advantages and avoid the disadvantages, were described. Subsequently, the data analysis method employed in this research was addressed and it became evident that quantitative data would

be best suited to this research. Finally, the questionnaire and the reasons behind the questions in the questionnaire were discussed.

In the next chapter, the results of the survey and the collected data are considered.

Chapter 4 – Results

4.1 Introduction

In this chapter, the results of the study on the relationship between the use and effectiveness of SDMs and national culture and organizational culture are reported.

Firstly, the different backgrounds of the organizations that completed the questionnaire are discussed. Subsequently, the said IS departments are described by studying the size and skill of the department and the manner in which they acquire software. This is followed by studying the background of the individuals as well as the role they play in the business. Thereafter the use of SDMs and their relationships to culture are discussed.

4.2 Background information

The questionnaire was distributed to many different organizations in South Africa via e-mail as well as hard copies when visiting the organizations. As discussed in Chapter 3, 125 responses were received from the various organizations that received the questionnaire, at a response rate of 26%.

These responses were received from different provinces in South Africa, as the use of technology enabled us to easily contact organizations in different parts of South

Africa. Responses were received from the following provinces: Gauteng, Western Cape, North West and KwaZulu-Natal.

4.2.1 The background of the businesses

The first aspect to consider is the different types of businesses that responded to the survey. As depicted in Figure 4.1, the core business areas of these companies varied, from “software house / software consulting” to education. Most (43%) of the businesses that responded were software houses or carried out software consulting, followed by the transport, storage and communication type of businesses that comprised 23% of all businesses that responded. Of the respondents, 20% indicated that their business area fell into the finance, banking or insurance sectors and 6% in the manufacturing sector. Hence, it is evident that the businesses in this study stem from many different sectors, although most of them represent software houses.

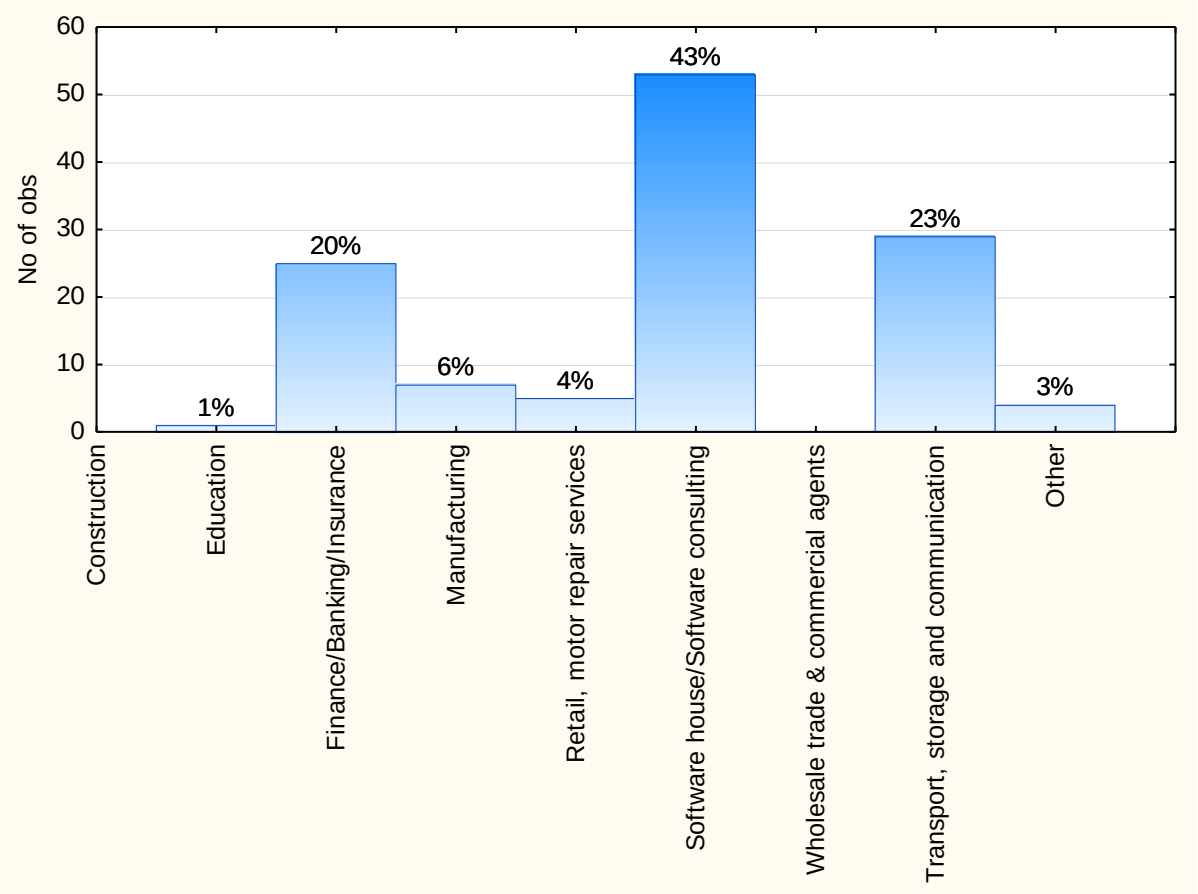

Figure 4.1 – The core business areas

Next, in order to become further acquainted with these organizations, the first question concerns how long these organizations have been in business. As depicted in Figure 4.2, most of the businesses (75%) have been in operation for more than 9 years; however, the data also includes businesses that have been in operation for 3 to 6 years (15%) and 7 to 9 years (3%).

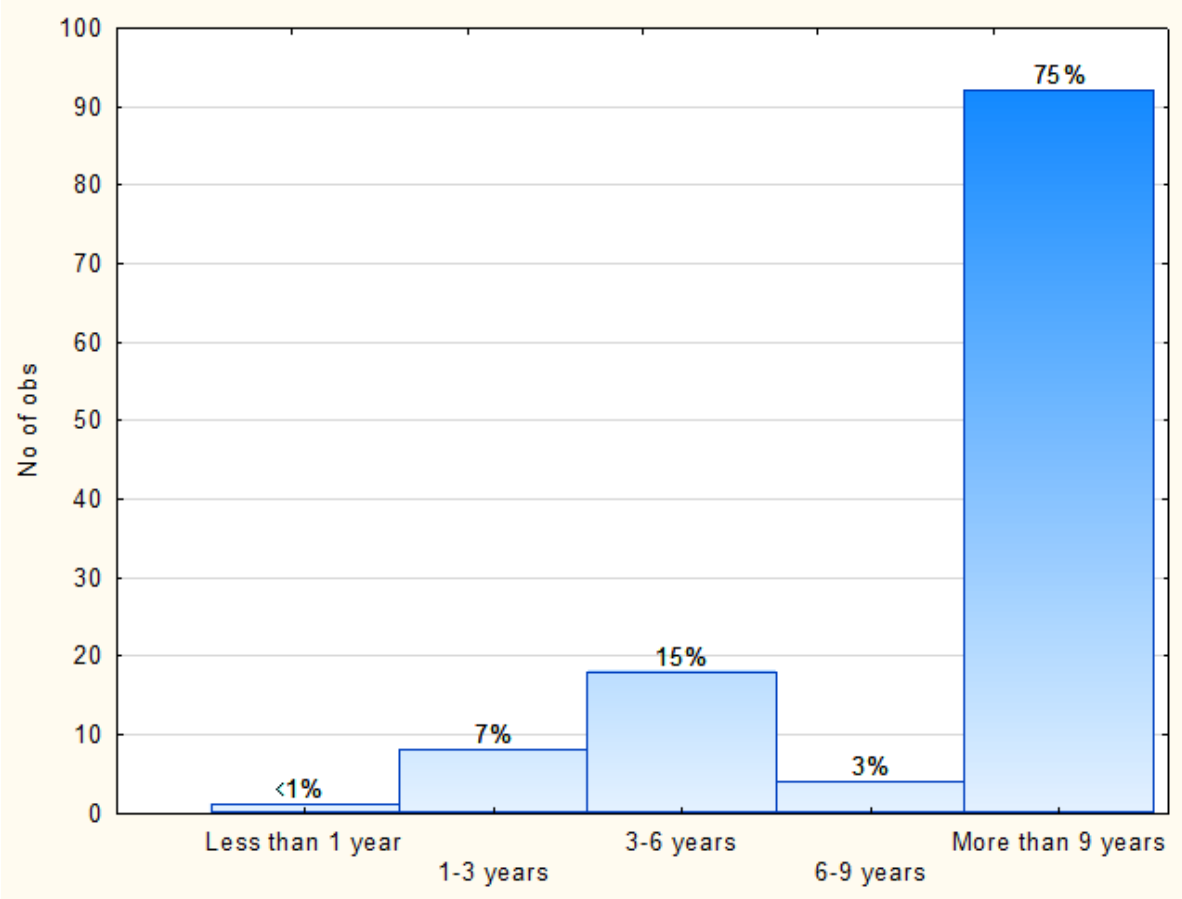

Figure 4.2 – The length of time that the organization has been in operation

The number of people in the organization is also reported in this study. The size of the organization was classified according to the South African Small Business Act 102 of 1996. A micro organization is classified as an organization with 1-5 people, while an organization that is small employs 6-50 people, while a medium one employs 51-100 people, and large one, 101 or more staff.

As illustrated in Figure 4.3, most of the respondents are large organizations (65%), followed by small (24%), medium (7%) and micro (4%) organizations.

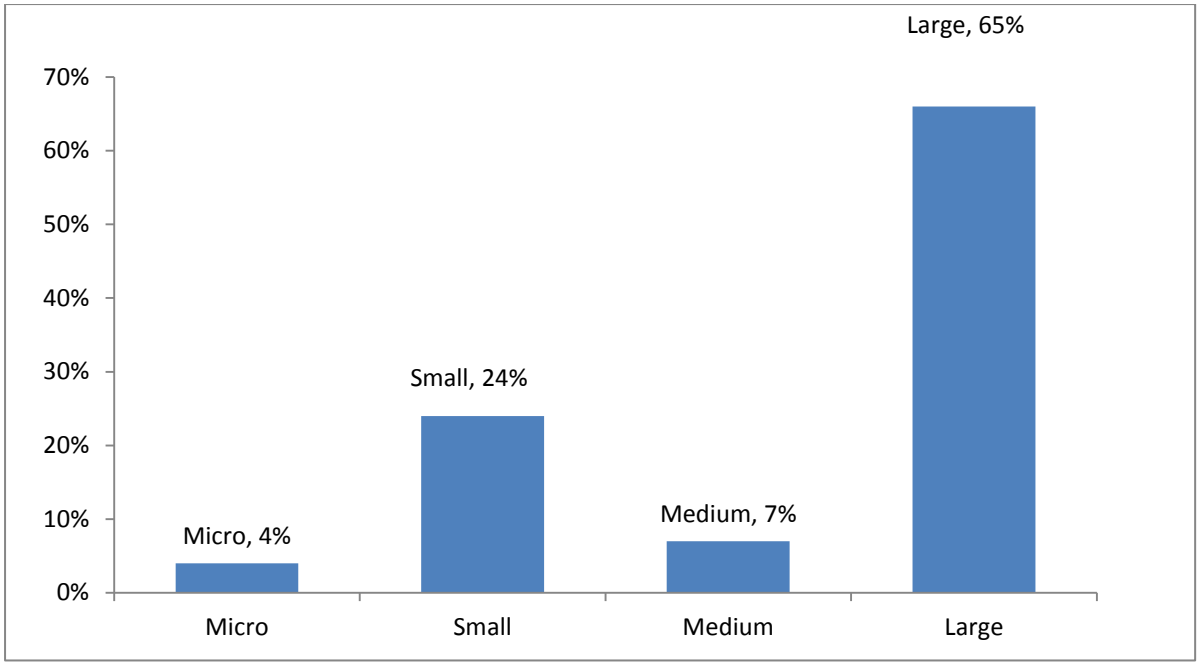

Figure 4.3 – Size of the organization

These statistics furnish a good overview of the different backgrounds of the different organizations that responded to the survey. In the next section, the IS departments of the said organizations are described.

4.2.2 The information system development departments

The IS development departments of these organizations constitute the most important aspect of the data as this is the department on which this study focused.

Firstly, the size of the said IS departments was considered. Figure 4.4 indicates that more than 50 people (30%) are employed in most of the IS departments, while 29% indicated that 11-20 people, and 20% with 21-50 people, were employed in their IS departments. Also smaller IS departments of 1-5 (12%) and 6-10 people (9%) were reported.

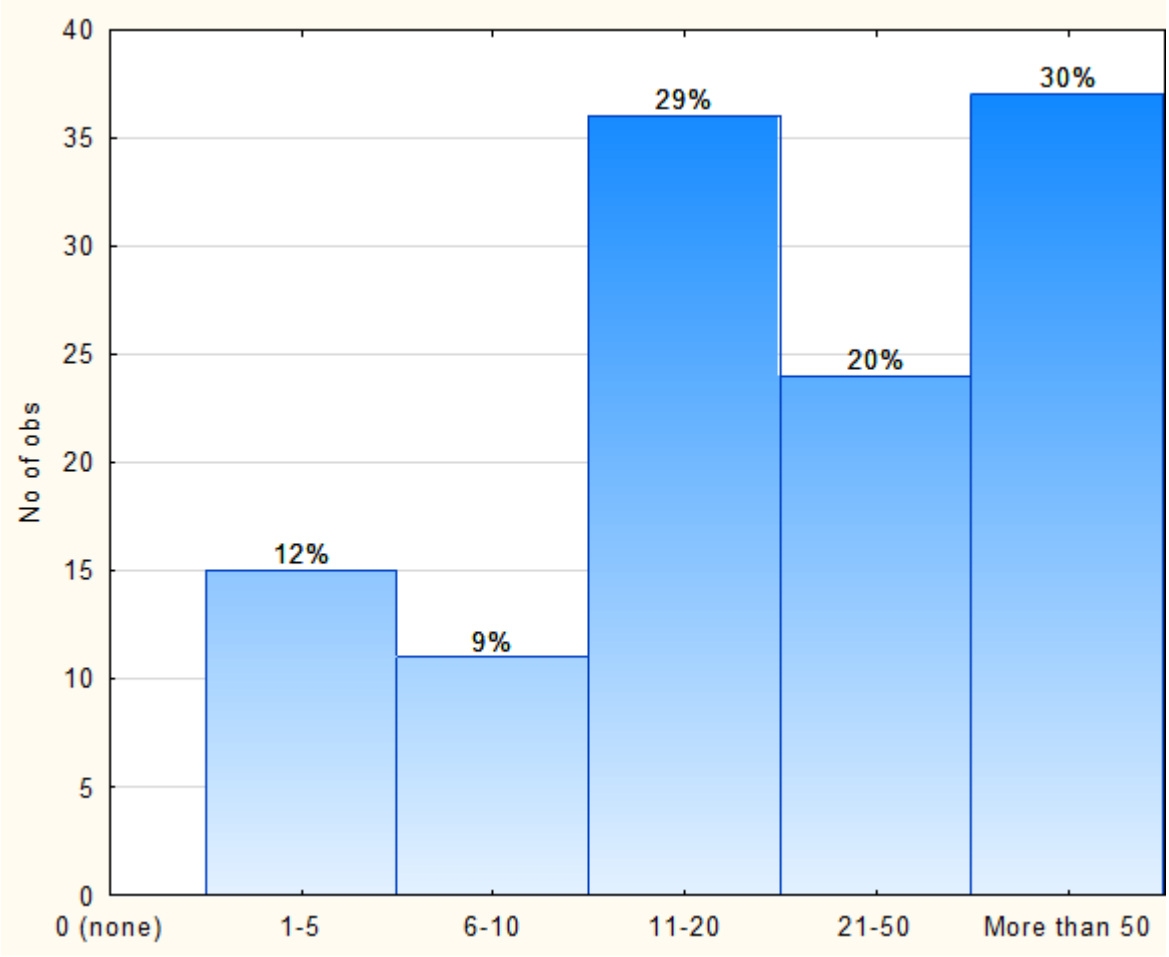

Figure 4.4 – Size of the IS department

Looking more deeply into these departments, the skill level of the people employed and the manner in which these departments procure software are the next aspects to be considered. As illustrated in Figure 4.5, the general opinion (56%) was that the people in these departments were well skilled. However, 27% of the respondents indicated that their department consisted of experts, while 14% believed that the employees were fairly skilled. Only 2% of the respondents felt that the employees possessed limited skills.

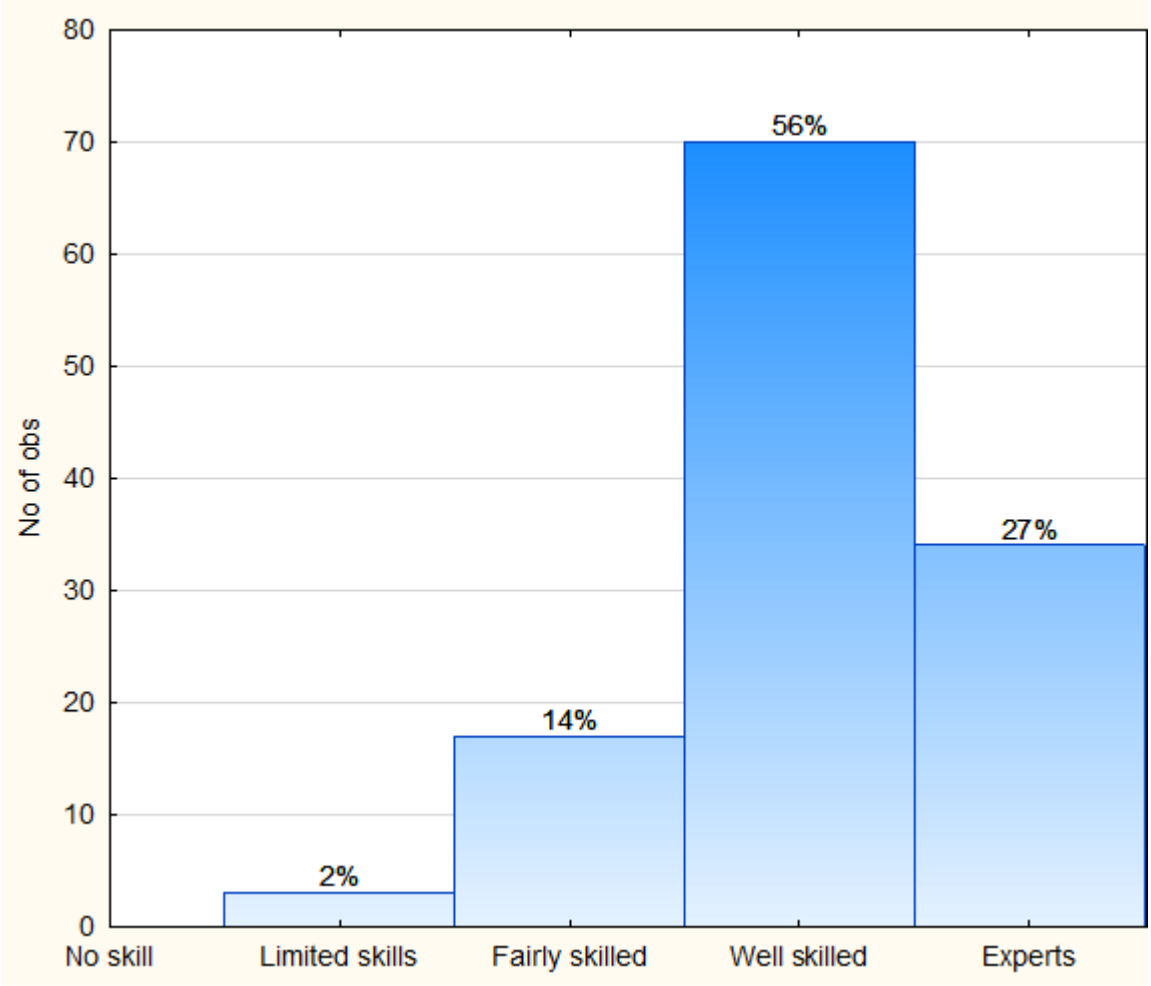

Figure 4.5 General skills of employees in ISD

These organizations procure software in different ways. A company can also utilize more than one way of procuring software and could therefore choose multiple answers. Figure 4.6 shows the percentage of each of the options chosen by the different companies. As depicted in Figure 4.6, 80% of the organizations that participated in this study procured their software by means of in-house development, while 67% use off-shelf software, which they customised to suit their needs. Some companies utilised off-shelf software without customisation (48%) and others used out-sourcing (46%).

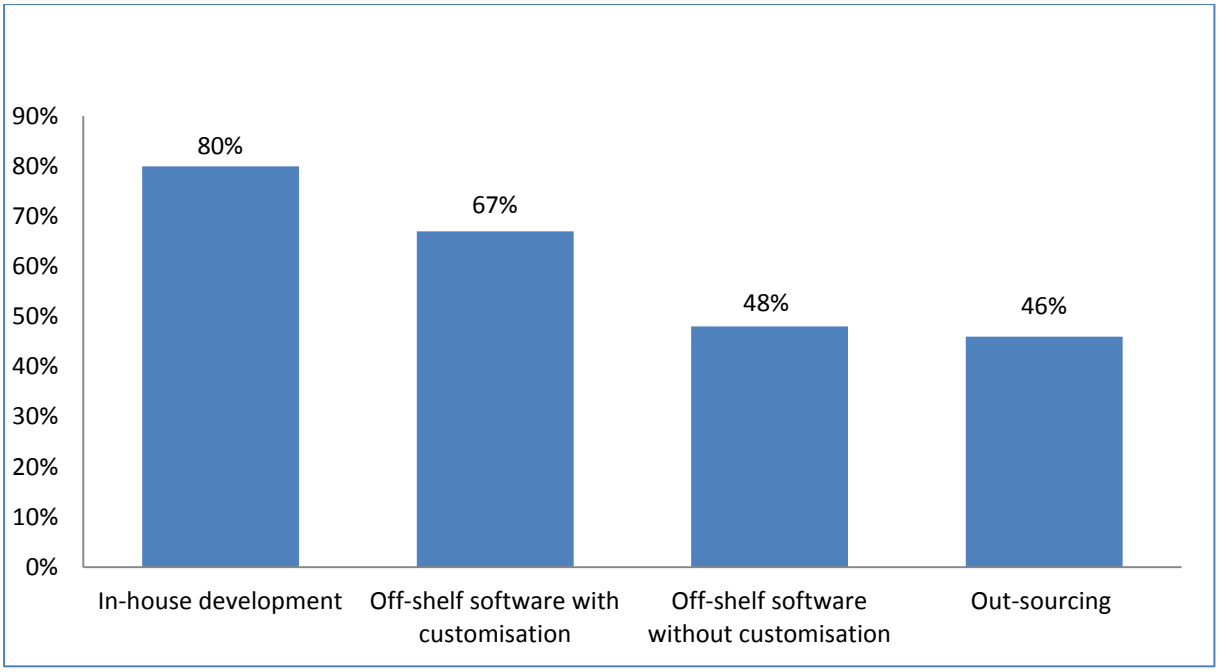

Figure 4.6 – Software procurement

Thus it is evident that the sizes of the IS departments vary, with 79% of respondents indicating that their departments consisted of more than 11 people. Also, most felt that they were good at their jobs, with 83% of the respondents indicating that they were either well skilled or experts.

4.2.3 The background of the individual in the IS development department

In this study, a few questions were designed to determine the role of the individual in the IS department. An individual can play many different roles in an IS department. Most of the respondents in this study were developers (50%), while 20% of the people were project leaders. Of the people who answered the questionnaire, 9% were managers and 6% and 5% were testers and business analysts respectively (as depicted in Figure 4.7).

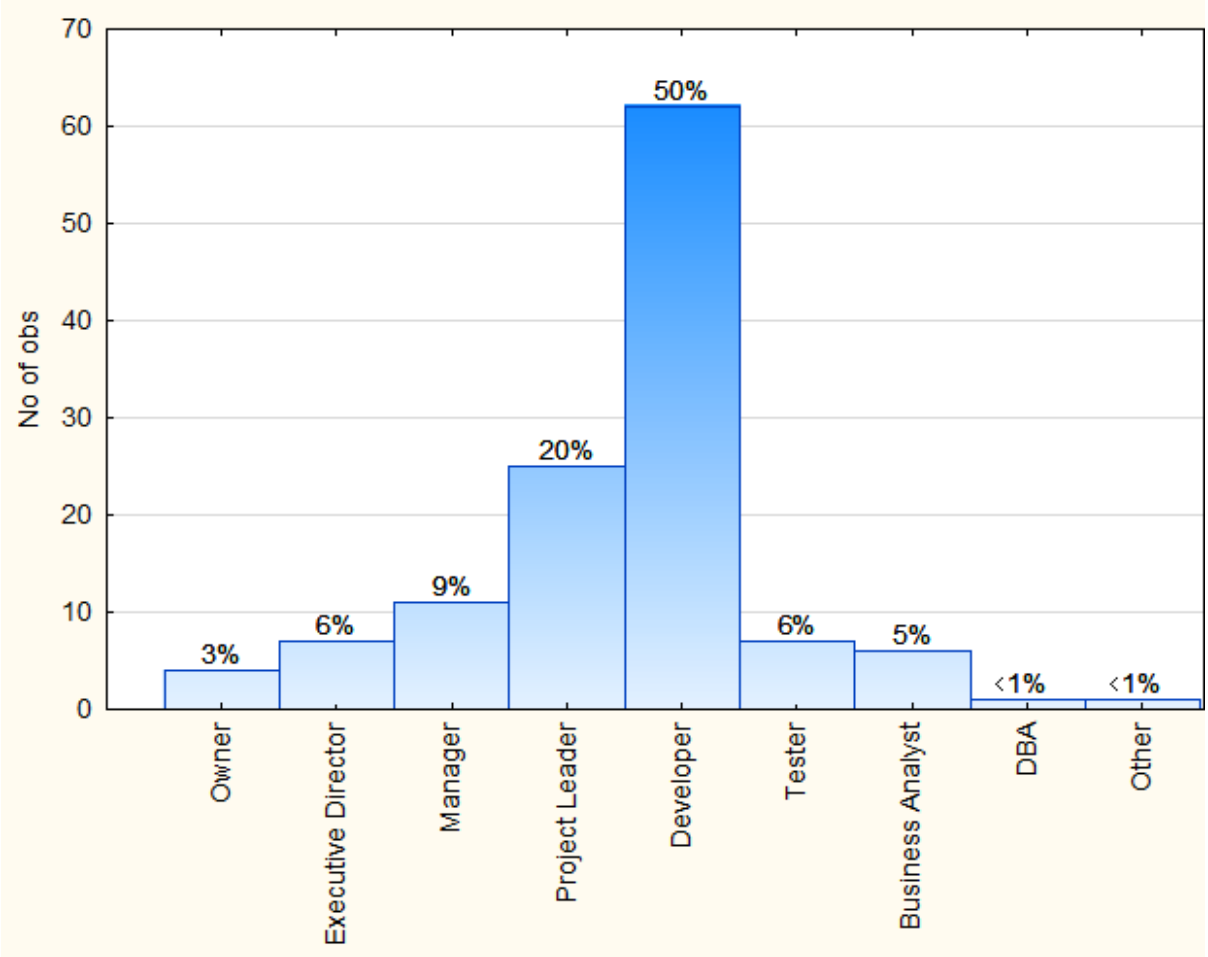

Figure 4.7 – Role in IS department

It is clear that this study included mostly software developers, but there were also a few people who held other positions in the IS departments.

4.2.4 The use of SDMs in organizations

Next, the manner in which SDMs are used in these organizations was analysed. This is one of the main aspects that this study needed to investigate.

The first step was to determine how many of the respondents indicated that they use SDMs. Of the total of 125 questionnaires, 92 indicated that they use SDMs, meaning that SDMs are used by 74%. If the CHAOS report (2009) is correct and only 32% of

all Information System projects succeed, then the question remains: Why do so many IS projects fail when 74% of the organizations use SDMs?

As depicted in Figure 4.8, 25% of the respondents indicated that their SDM has been in use for 5-10 years and 21% said that they did not know how long their SDM had been in use. Of all the responses, 16% indicated that their SDM had been in use for more than 10 years, and further 16%, less than 1 year.

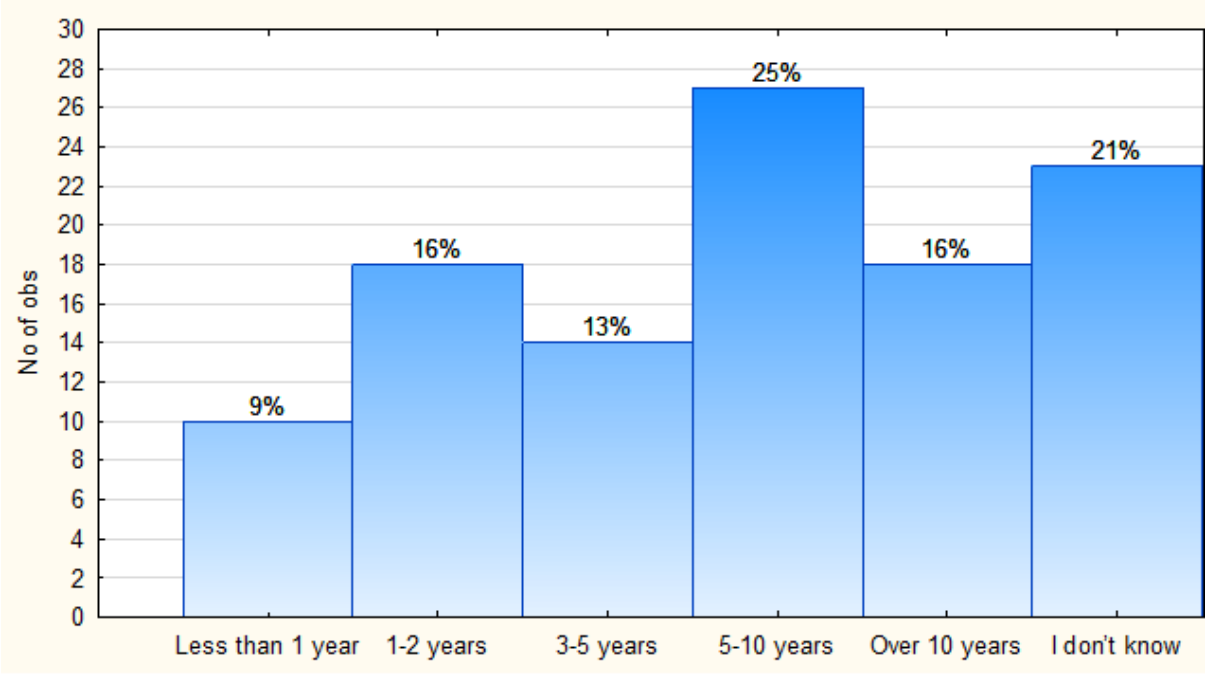

Figure 4.8 – Time that the SDM had been in use

This study looked at the use of SDMs in different ways: their horizontal use, vertical use, strictness, types and non-use.

Horizontal use

The horizontal use refers to the manner in which the methodology is used across the organization, meaning that the proportion of projects that are developed by using SDM knowledge and that the proportion of people that use SDM knowledge when developing projects must be considered. These two items reveal whether the SDM knowledge was applied widely in the organization.

The results of the horizontal use of SDMs, as depicted in Figure 4.9, are considered next. This indicates whether the IS departments applied the knowledge derived from using SDMs for their projects. Most people felt that SDM knowledge was applied to more than 75% of the projects, 27% of people responded that the said knowledge was applied to 51-75% of the projects; and 18%, to only 26-50%; 1-25%, to 10%; and 8% to none of the projects.

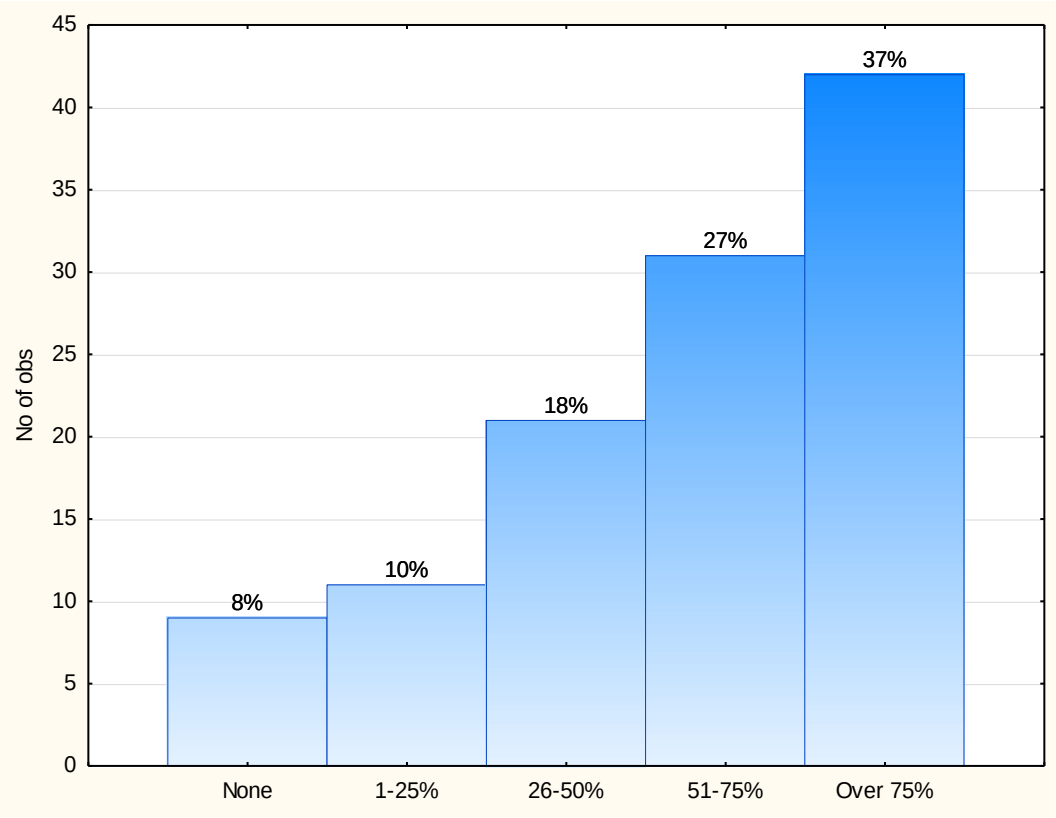

Figure 4.9 - Proportion of projects that apply SDM knowledge

Subsequently, the researcher determined the proportion of people in the IS department who applied SDM knowledge regularly (Figure 4.10). Of the respondents, 30% indicated that 51-75% do so, while 26% revealed that more than 75% of individuals did so. Both 1-25% and 26-50% were counted at 18% of the responses while 8% indicated that no one in their department applied SDM knowledge. In the light of this and the data for the previous question, it is evident that SDMs were being used in most of the IS departments.

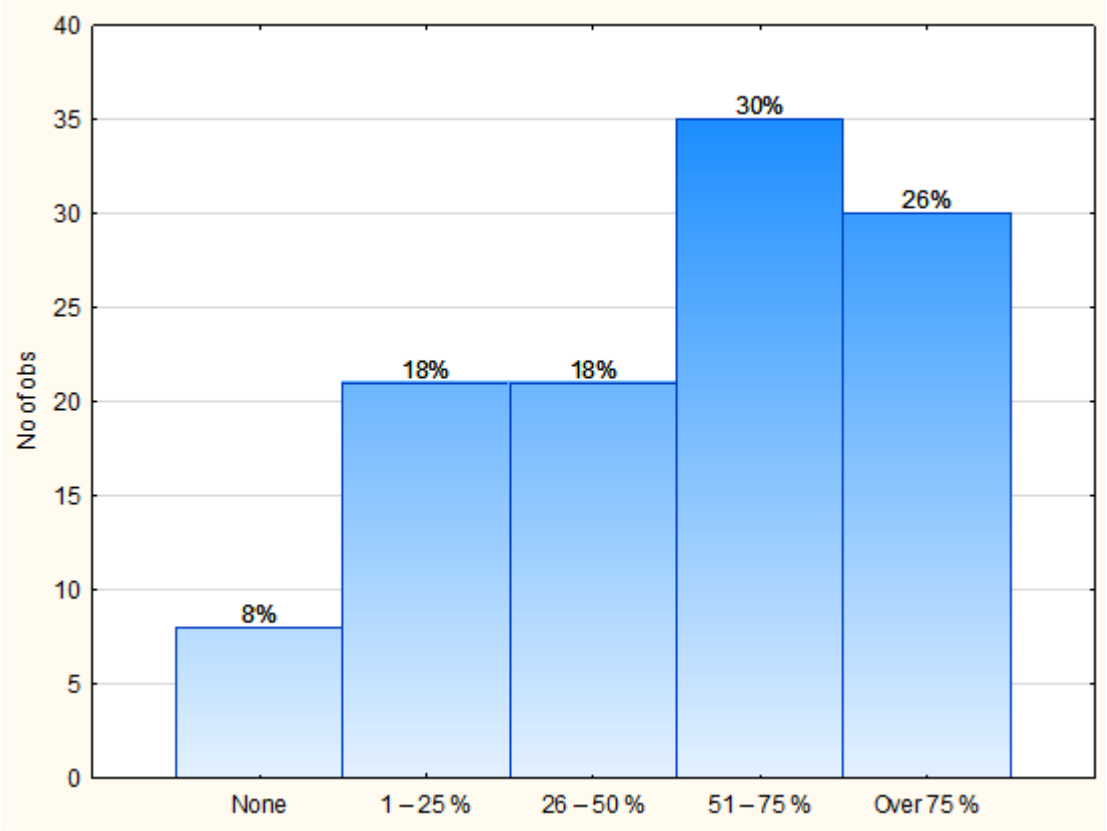

Figure 4.10 – Proportion of people who apply SDM knowledge

As previously mentioned, both of these values refer to the horizontal use of SDM knowledge. Thus horizontal use was calculated by means of the average value for these two variables. A reliability analysis, using the Cronbach alpha method, was subsequently run on these variables to ensure that the value was reliable. The Cronbach alpha is 0.87 for the horizontal use.

The Cronbach alpha was described by Cronbach (1951) and is popular in scientific research, to measure the reliability of several items in a questionnaire. (Christmann and Van Aelst, 2006:1660; Leontitsis and Pagge, 2007:336)

As described by Leontitsis and Pagge (2007:336) the Cronbach alpha is a reliability analysis coefficient that ranges from 0 to 1. Where a value of 1 indicates a very high reliability and 0 indicates not reliable at all. As a rule of thumb, according to Leontitsis and Pagge (2007:336), a Cronbach alpha value of 0.8 and higher is considered very reliable.

Figure 4.11 depicts the horizontal use of SDMs in the organizations that participated in this study. The values for the variable horizontal use range from 1 to 5, with 1 indicating a low horizontal use and 5, a very high horizontal use. In Figure 4.11, it is evident that for most of the organizations, the values for horizontal use fell between 4 and 5 (55%).

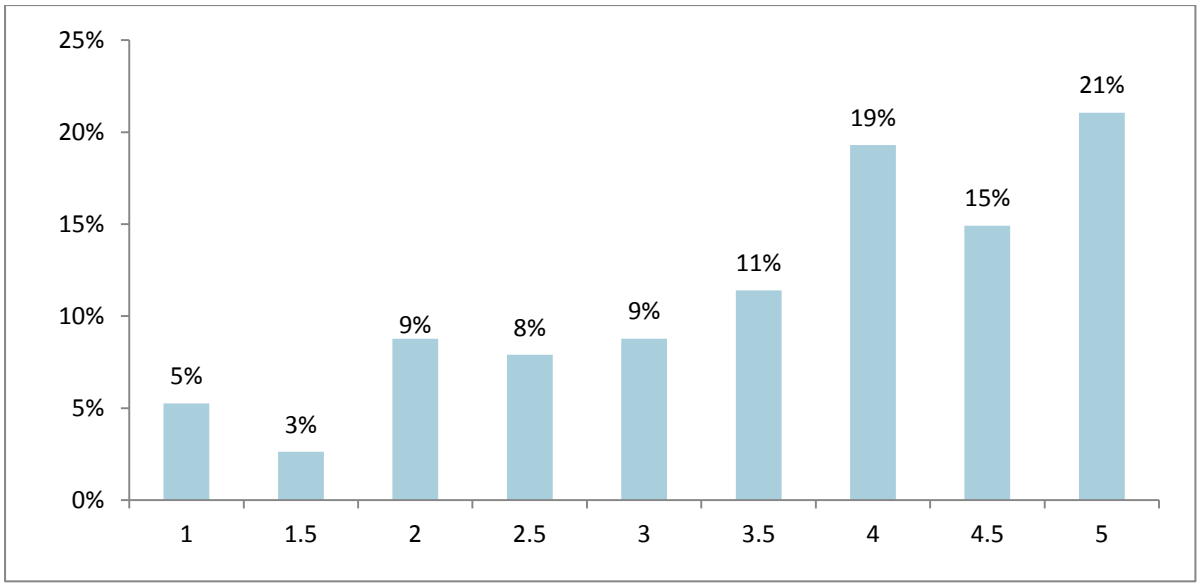

Figure 4.11 – Horizontal use values

Vertical use

SDMs in an organization can also be analysed according to their vertical use. This is defined as the intensity with which SDMs are used in the organization. To measure the vertical use, the respondents were asked to identify the SDMs that their organizations use as well as the intensity with which they are used. The intensity is represented by a numeric value from 1 (used very infrequently) to 5 (used very often). To determine the vertical use of the SDM, the maximum value that was reported in the questionnaire in this regard was utilised because an organization can use more than one SDM; however, the intensity is focussed only on the maximum value with which any of these is used.

The average value for the vertical use of SDMs was 4.174; therefore it is evident that most of the organizations that use SDMs use it with much intensity. Figure 4.12 indicates that 40% of the respondents reported the highest intensity as being 5 while 41% indicated their highest intensity as being 4. Only 4% reported a maximum of 2 and 14%, a maximum of 3. Hence, it is clear that most organizations use their SDMs with a high level of intensity, but that this does vary a little among the different organizations.

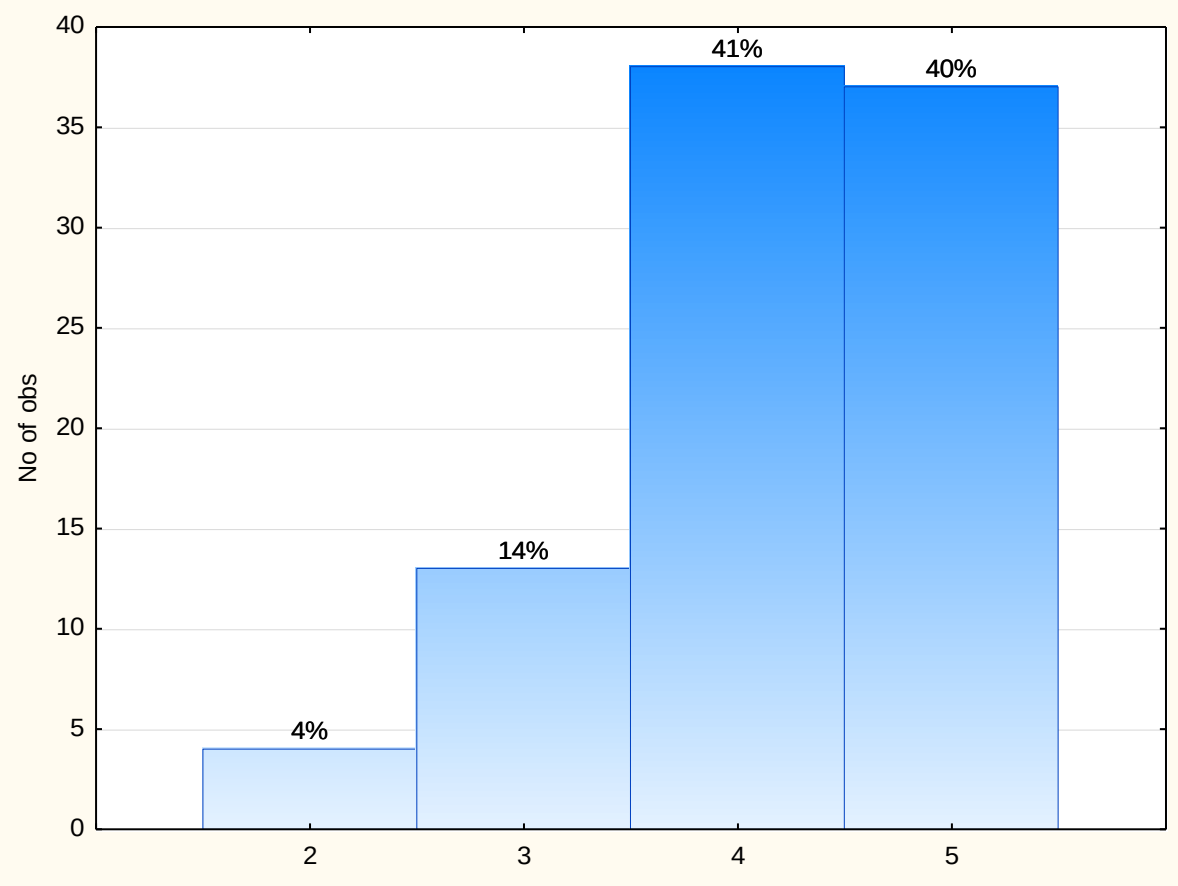

Figure 4.12 Vertical use of SDMs

Now that it has been established that SDMs are being used, it is necessary to determine how strictly the SDM knowledge is applied on the projects, as exhibited in Table 4.1. The findings reveal that 44% of the respondents answered that the SDM knowledge is adapted on a project-to-project basis; 38% indicated that the SDM knowledge is used as a general guideline for all of the projects; and 18% reported that the SDM knowledge is a standard that is rigorously followed for all projects.

Table 4.1 also displays the level of strictness ranged from lenient to very strict use of SDMs as referred to later in this chapter.

Table 4.1 – Strictness of SDM use

A general guideline for all projects	38%
Adapted on a project-to-project basis	44%
A standard which is followed rigorously for all projects	18%

The next step was to determine which of the different SDMs the organizations used. As portrayed in Table 4.2, the SDM that was used most often was the Systems Development Lifecycle (SDLC), but Extreme programming, RAD and Agile SDMs followed the SDLC closely. These three SDMs are also all classified under Agile SDMs and ranked above the SDCL with a usage of 49.6%. Thus it is evident that the newer approach of Agile SDMs was being used by most of the participant organizations.

Table 4.2 – SDM usage

SDM name	**Percentage**
Systems Development Lifecycle	36.00%
Extreme Programming	19.20%
RAD	16.00%
Agile	14.40%
Information Engineering	11.20%
SCRUM	8.00%
STRADIS	5.60%
Prototyping	4.80%
ASAP	4.80%
RUP	4.00%
Solution Chain Value	3.20%
Object Oriented Systems Development	3.20%
XPS	1.60%
SEI-PCMM 2.0	1.60%
SEI-CMMI for DEV 1.2	1.60%
Microsoft Agile MSF	1.60%
Lean Software Development	1.60%
ITIL 2.0	1.60%
Accenture Delivery Methodology	1.60%
YSM	0.80%
Vision Based Methodology	0.80%
V Model	0.80%
UML	0.80%
Test Driven Development	0.80%

SASDM	0.80%
RunSAP	0.80%
PEM - Process Engineering Methodology	0.80%
OpenUP	0.80%
Inhouse SDLC	0.80%
DSDM	0.80%
Crystal clear	0.80%
ASD	0.80%
ARD	0.80%
ADM	0.80%
ABAP	0.80%

As discussed above, 74% of respondents indicated that they use SDM. Subsequently, the researcher looked at why some organizations do not use SDMs. The question in this regard used the Likert-scale to ask participants to what degree they agreed with the relevant statements. Each of these statements represents a reason why an organization would not use SDMs. Table 4.3 displays the average values for each of these reasons.

Table 4.3 – Reasons for non-use of SDMs

Reason	**Average value**
The current system development practice in our IS department is adequate.	3.38
The benefits of systems development methodologies use are long-term, whereas costs incurred are short term.	3.21
The experience of the developers in our IS department reduces the need for systems development methodologies.	2.78
In our IS department there are no clear objectives for adopting systems development methodologies.	2.68
In our IS department there is a lack of management support for the use of systems development methodologies.	2.55
The learning curve for systems development methodologies is very long.	2.55
The financial investment in systems development methodologies is too large.	2.52
In our IS department there is a lot of uncertainty over the benefits of adopting systems development methodologies.	2.51
Our IS department lacks a suitable environment to support systems development methodologies.	2.49
The profile of development projects in our IS department doesn't require the use of system development methodologies.	2.45
There is a lack of experienced staff in our IS department who can effectively use system development methodologies.	2.44

New systems developed with systems development methodologies are not compatible with legacy systems.	2.31
SDMs are too complex or hard to use.	1.96

In Table 4.3, there are only two average values that indicate that the respondents tended to agree with the relevant statements. The Likert-scale uses values 1 through 5, where 1 indicates that they totally disagreed with the statement and 5, they totally agreed with it (Marshall, 2005:133). Thus, by studying Table 4.3, every average value under 3 means that more people disagreed than agreed with that particular statement while only the first two values lie above this mark.

The two reasons why organizations indicated that they do not use SDMs was that the IS departments believed that the practices they use were adequate. This makes sense: why change a winning formula? The other reason was that the benefits of SDMs were viewed as being long term while the costs are short term, and thus SDMs are not used in the organization.

With only two of the averages being above 3 (3.38 and 3.21 respectively), it is evident that the respondents did not agree with many of these reasons for not using SDMs. The organizations have thus made a purposeful decision not to use SDMs.

4.2.5 Organizational culture

The organizational culture of these organizations was determined next. As discussed in Chapter 2, the culture is classified according to the four types of cultures defined in the competing values framework (CVF). As portrayed in Table 4.4, question 12 in the questionnaire was used to determine the nature of the culture of the departments. Three different items in the question were used to determine a department's orientation to each of the four different cultures; the average of these values was subsequently calculated. Items 1, 5 and 9 determine an organization's orientation to group culture, while items 2, 6 and 10 determine the developmental culture. Items 3, 7 and 11 determine the hierarchical orientation, and 4, 8 and 12, an organization's rational culture orientation.

A reliability analysis, using the Cronbach alpha method (as described in this chapter), was subsequently run on the three variables of each of the culture groups. It was found that for a hierarchical culture, the alpha was higher when item number 11 was omitted and for rational culture, the Cronbach alpha is higher when item number 4 was omitted. The resulting Cronbach alpha for all four of these groups can be viewed in Table 4.4.

Table 4.4 – Measurement instruments for organizational culture

Construct	Question numbers (Appendix A)	Reliability
Organizational culture	Question 12	
- Group culture orientation	- numbers 1, 5, 9	0. 715139
- Developmental culture orientation	- numbers 2, 6, 10	0.696390
	- numbers 3, 7	0.788844
- Hierarchical culture orientation	- numbers 8, 12	0.6342636
- Rational culture orientation		

The organizational culture differs from organization to organization. Table 4.5 displays the average value for each of the different types of organizational culture.

Table 4.5 – Organizational culture averages

Group culture	Developmental culture	Hierarchical culture	Rational culture
3.60533333	3.50133333	2.924	3.612

A K-Means cluster analysis was run on the different organizational culture types. Kalyani and Swarup (2011:10841) briefly describes clustering as a process where data is grouped into clusters such that similar patters can be assigned to one of the clusters.

According to Kalyani and Swarup (2011:10841), the K-means algorithm is one of the most widely used and most popular partition clustering method. K-means attempts

to find k-number of clusters, where the sum of the squared distances of each data point to its cluster's centre is minimized.

As a result, group culture, developmental culture and rational culture were grouped together, with hierarchical culture being on its own. When a 3-cluster K-Means cluster analysis was run, group and developmental cultures were grouped together and the hierarchical and rational cultures fell into separate clusters.

This indicates that there is a link between the group and developmental cultures.

4.2.6 National culture

The national culture was measured by the values of 8 different items, each of which is used to measure an aspect of national culture as described in Chapter 2. The average values for each of these items are listed in Table 4.6.

Table 4.6 – National culture averages

Items	National culture dimension	Average	Standard deviation
It is inappropriate for employees to express their disagreements with their managers	Power distance	2.064	1.014
In this country everyone looks after only him or herself and family.	Individualism	2.856	1.029
Values like performance, success and competition are viewed as more important than values like quality of life, service and caring.	Masculinity	3.040	0.987
In this country it is preferred to have rules and procedures in place when approaching a new or unknown	Uncertainty avoidance	3.136	1.0267

situation.			
People in this country prefer to work as a member of a group.	Individualism	2.744	0.897
The people in this country feel threatened by unknown situations.	Uncertainty avoidance	3.500	0.941
Managers make decisions by involving people at lower levels.	Power distance	3.152	1.063
There is a big gap between the number of women and men in managerial positions.	Masculinity	3.112	0.994

4.3 Relationships

In this section, the relationships that were found in the data are considered. These relationships can offer insight into the use and effectiveness of SDMs. Many different relationships were checked while conducting the analysis. In this section, the author discusses the more important relationships that existed or did not exist. Multiple regression was employed to search for relationships in the data.

Acording to Coppi (2008:288) regression analysis is the study of a certain relationship (R) between a dependend variable (Y) and a set of independend variables ($X_1, \ldots, X_p$). Where Y is thought of as a response to variables $X_1, \ldots, X_p$ (the predictive or explanatory variables).

Coppi (2008:288) further explains that the study of R has two objectives:

- To determine the structure of the relationship R
- Using R to accurately predict Y by using variables $X_1, \ldots, X_p$.

In this research the relationship between culture (national and organzational) and the use and effectiveness of SDMs (R) are studied. The variables ($X_1, \ldots, X_p$) in this

research are the elements in culture. These elements have been discussed in Chapter 2 and examples include: Power distance and masculinity in national culture and group culture or developmental culture in organizational culture. The response variable (Y) in this research is the use and effectiveness of SDMs. Regression analysis therefore checks if the relationship R exists between Y and $X_1, \ldots, X_p$. This relationship's strength is indicated by the p-value.

To find a significant relationship between the variable, the p-value should be 0.05 or less.

The different tables in this section report the b* values between the variables. If the b* value is positive, then a positive relationship exists between the variables, if the b* value is negative a negative relationship exists. These relationships are however only significant if the p-value is 0.05 or less, as mentioned. The significance values of the relationships are indicated in Table 4.7.

Table 4.7 – Relationships indicators

Indication	p-value	Significance
‘	≤ 0.10	Noteworthy
*	≤ 0.05	Relationship
**	≤ 0.01	Strong relationship
***	≤ 0.001	Very strong relationship

Figure 4.13 depicts all of the different relationships that were found in this research. All of these relationships are discussed in this chapter.

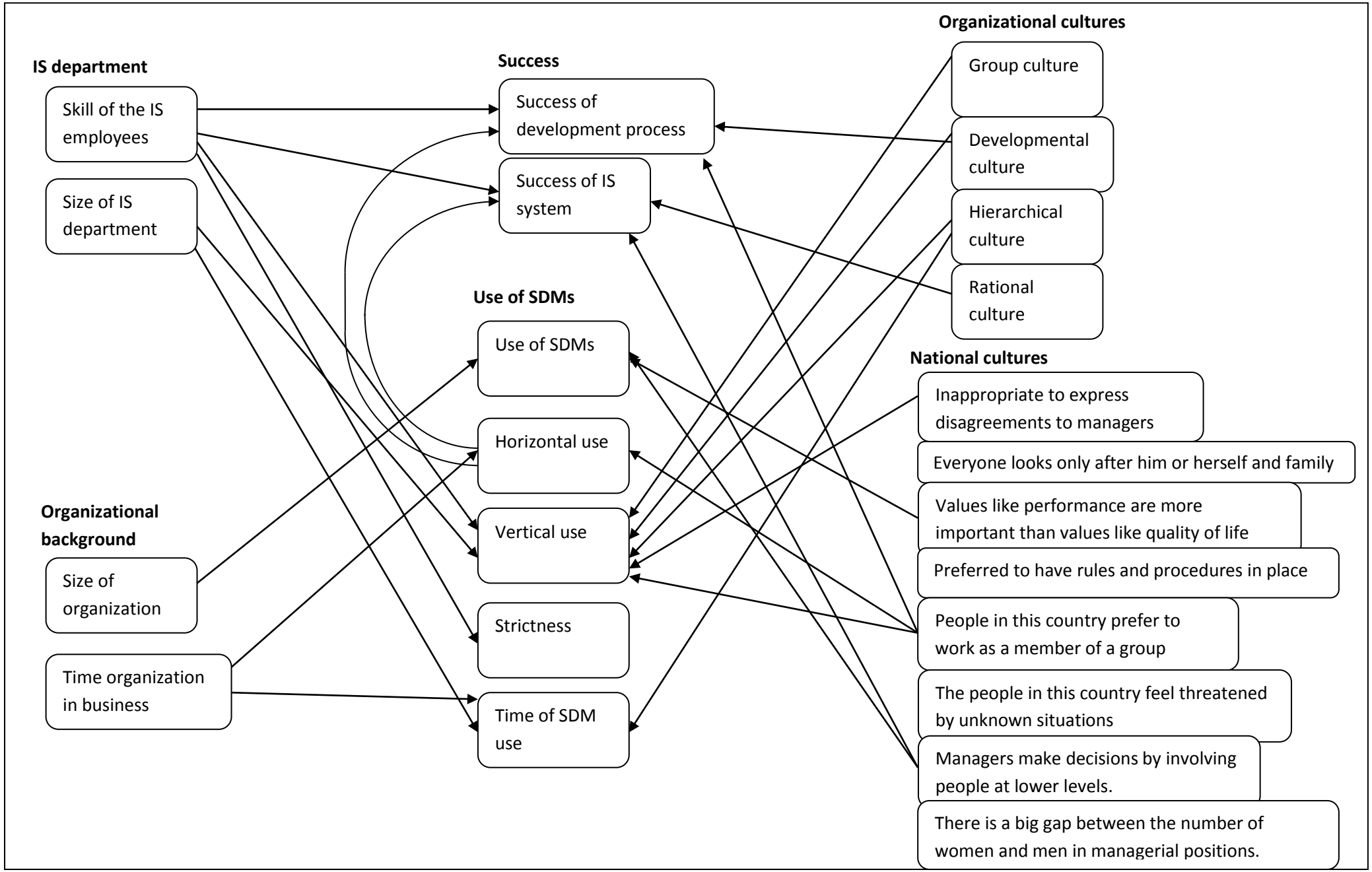

Figure 4.13 - Relationships

4.3.1 Success of the development process and IS product

In this section, the author discusses the success of the development process and the success of the IS system as well as how they were used in the multiple regression analyses. As evident in Table 4.8, the success of the development process was determined by 9 different items and that of the IS product was determined by 11 different items. A reliability analysis was run on both these variables and the resulting Cronbach alpha values are reported in Table 4.8.

Table 4.8 – Success of process and product

Construct	Question numbers (Appendix A)	Reliability
Success of development process	Question 10 - numbers 1-9	0.864832
Success of IS product	Question 11 - numbers 1-11	0. 897917

Factor analyses were also performed for both these variables. The factor analysis regarding the success of the development process indicated that all of the items loaded on one variable and that the value for the explained variance = 4.583 and the proportional total = 0.509. For the success of the IS product, all of the items also loaded on one factor and the value for explained variance = 5.856 and the proportional total = 0.532. Hence, the average of the items can be used to measure the research variables.

A multiple regression analysis was subsequently run on a number of variables with regards to the background of the organization's IS department and its success. The results of this analysis are exhibited in Table 4.9. This is the standard format of the table used in such research to report multiple regression. The first column displays the independent variables. The top row contains the number of valid cases, followed by the independent variables. Each independent variable represents another

multiple regression, the b* value is given in the cells and the R, R^2, Adjusted R^2 and F-values associated with each regression are displayed in the last row.

Table 4.9 – Relationship between background of IS department and success

N = 125	Success of development process	Success of IS product
Total number of people in IS department	0.01	-0.06
Skill level of employees in IS department	0.28**	0.45***
R	0.3	0.44
R^2	0.09	0.19
Adjusted R^2	0.08	0.18
F	5.9**	14.3***

‘p ≤ 0.10 *p ≤ 0.05 **p ≤ 0.01 ***p ≤ 0.001

In Table 4.9, it is clear that a significant relationship exists between the success of the development process and the success of the IS system and the skill level of the employees in the IS department. This suggest that if the success of the development process and the IS product is proportionately related to the skill levels of an organization’s IS department employees.

Next, the relationship between the use of SDMs and success was investigated. Table 4.10 portrays the relationship between the use of the various SDM variables and success.

Table 4.10 – The relationship between the success of the development process and the success of the IS system and SDM use

N = 91	Success of development process	Success of IS product
Horizontal use	0.37**	0.42***
Vertical use	0.01	0.03
Strictness of use	0.07	-0.01
Time SDM has been in use	0.12	0.17
R	0.44	0.50
R^2	0.19	0.26
Adjusted R^2	0.15	0.22
F	5.09	7.26

‘p ≤ 0.10 *p ≤ 0.05 **p ≤ 0.01 ***p ≤ 0.001

A very strong relationship exists between the horizontal use of SDMs and the success of the IS product. This strongly suggests that an IS product will be more successful if an organization uses SDM knowledge for a wider range of people and projects. There is also a strong relationship between the horizontal use of SDMs and the success of the development process: the more people who apply SDM knowledge to projects the more successful the development process would be.

These are two very important relationships. It was revealed that if an organization applies SDM knowledge to a larger proportion of projects and applies SDM knowledge by a larger proportion of people, the success of the project would most likely be greater.

4.3.2 Relationship between organizational characteristics and the use of SDMs

The organization was measured in different ways. The size of the organization, core business area, and the length of time that the organization had been in operation, were the three variables measured. The size of the organization was measured in terms of the number of respondents from all the locations, and who were part of the business.

Firstly, we looked at the use of SDMs and the abovementioned variables of the organization. A variable that determined whether the organization used any SDM at all was created. This variable determined whether an organization had used any SDM or not. A multiple regression analysis was then run to establish whether any relationship existed between these variables.

Table 4.11 – Relationship between organization characteristics and use of SDMs

N=125	Use of SDM
Time in operation	-0.03
Size of the organization	0.26*
R	0.24
R^2	0.06
Adjusted R^2	
F	3.62

‘p ≤ 0.10 *p ≤ 0.05 **p ≤ 0.01 ***p ≤ 0.001

Table 4.11 indicates that there is a significant relationship between the size of the organization and the use of SDMs. The b* value is positive, which means that the larger the business, the more likely it is to use SDMs. There could be various reasons for this. Fitzgerald (1998:317) opines that one of the main reasons that larger organizations use SDMs is the desire to obtain ISO (and other) certifications. It is also noticeable that no relationship exists between the time an organization had been in operation and their use of SDMs.

One of the advantages of SDMs, according to Fitzgerald (1998:317), is that SDMs help with management and control in the development process. Larger organizations employ more people and engage in more projects, thus having an SDM that would help to control and manage these projects and people would be desirable.

As seen in Table 4.12, the b* values for the horizontal use of SDMs, that is, the length of time the SDM has been in use, and the strictness of SDM use, are considered.

Table 4.12 – Relationships between SDM use variables and the organization

N = 91	Horizontal use	Vertical use	Strictness of use	Time SDM has been in use
Time organization has been in operation	0.31*	0.09	0.12	0.42**
Size of the organization	-0.19	0.01	-0.20	-0.07
R	0.23	0.10	0.15	0.38
R^2	0.05	0.01	0.02	0.14
Adjusted R^2	0.03		0.01	0.12
F	2.33	0.46	0.53	7.28

‘p ≤ 0.10 *p ≤ 0.05 **p ≤ 0.01 ***p ≤ 0.001

In Table 4.12, it is evident that a relationship exists between the length of time that an organization has been in operation and the horizontal use of SDMs. This means that an organization that has been in operation for a longer period would use SDM knowledge with more people and on more projects than newer organizations would.

Another relationship exists between the length of time the organization has been in operation and the amount of time that the SDM has been in use. The b* value is

positive, which means that the longer an organization has been in operation the longer the SDMs have been in use.

4.3.3 Relationship between the background of the organizations' IS departments and use and effectiveness of SDMs

At this stage, the researcher searched for relationships between the IS departments and the use of SDMs. A number of variables were used in this regard. The IS departments were measured in two ways: The skill of the employees and the size of the IS department. Table 4.13 exhibits the results of a number of different multiple regressions that were run using these two variables.

Table 4.13 – Relationship between IS department and SDM use

N=91	Use of SDM	Horizontal use	Vertical use	Strictness of use	Time SDM has been in use
Skill of the employees	-0.06	0.09	0.22*	0.20*	-0.12
Size of the IS department	0.16	0.06	0.21*	0.17	0.22*
R	0.16	0.12	0.32	0.23	0.24
R^2	0.02	0.14	0.10	0.05	0.06
Adjusted R^2	0.01		0.08	0.03	0.04
F	1.53	0.62	4.96'	2.94'	2.75

'p ≤ 0.10 *p ≤ 0.05 **p ≤ 0.01 ***p ≤ 0.001

As evident in Table 4.13, the skill of the employees and the size of the IS department both have a relationship with the vertical use; both of these b* values are positive.

This means that higher skilled and larger IS departments would use an SDM more intensely. Another relationship exists between the strictness of SDM use and the skill of the employees in the IS department. The higher the skill level of the employees in an IS department that uses SDMs, the higher the strictness of their use will be.

Lastly, a relationship exists between the amount of time that the SDM has been in use and the size of the IS department. This relationship indicates that organizations with larger IS departments started using SDMs earlier.

4.3.4 Relationship between the success of the development process and the success of the IS system and organizational culture

The next aspect researched is the organizational culture. Various relationships that have not yet been considered emerged from this analysis. Firstly, the relationships between organizational culture, the success of the development process, and the success of the developed system are reported.

Table 4.14 – Relationship between organizational culture and success

N=121	Success of the development process	Success of the developed system
Group Culture	0.16	0.17
Developmental Culture	0.19	0.32**
Hierarchical Culture	0.02	0.09
Rational Culture	0.26**	0.13
R	0.50	0.54
R^2	0.25	0.30
Adjusted R^2	0.22	0.27
F	9.77	12.56

‘p ≤ 0.10 *p ≤ 0.05 **p ≤ 0.01 ***p ≤ 0.001

In Table 4.14, it is clear that a relationship exists between the rational culture and the success of the development process. The rational culture refers to the type of culture where the focus falls on earning profits and setting goals in order to achieve this. According to this data, cultures with a more rational culture will enjoy a better development process.

A further relationship that is evident in Table 4.14 is that between the development culture and the success of the system. If an organization functions with a development culture, then the product that was developed (the IS system) was perceived to be more successful. This is interesting, because the focus of development culture falls on the development of a product. In this culture, a team is quickly assembled when a new project is started and disassembled when the project has been completed.

Table 4.15 portrays other relationships that were found between organizational culture and other variables.

Table 4.15 – Relationships between organizational culture and SDM use

N = 91	Use of SDM (N=125)	Horizontal use	Vertical use	Strictness of use	Time SDM has been in use
Group Culture	-0.10	0.19	0.54**	0.01	0.21
Developmental Culture	0.10	0.03	-0.42**	-0.14	-0.04
Hierarchical Culture	-0.07	-0.06	-0.23*	0.11	0.21*
Rational Culture	0.13	0.23	0.16	0.02	0.04
R	0.14	0.36	0.41	0.17	0.34
R^2	0.02	0.13	0.17	0.03	0.11
Adjusted R^2		0.09	0.13		0.07
F	0.59	3.25*	4.33**	0.83	2.73*

‘p ≤ 0.10 *p ≤ 0.05 **p ≤ 0.01 ***p ≤ 0.001

In the above table, it is evident that various aspects of SDM use and organizational culture do exert an influence on each other. If an organization has a more hierarchical culture, then the SDM would have been in use for longer.

Group culture, developmental culture and hierarchical culture all have a relationship with vertical use. Group culture reveals a positive relationship, while both developmental and hierarchical cultures indicate a negative relationship with the vertical use of SDMs.

If an organization exhibits a group oriented culture, it was more likely to use SDMs more intensely while hierarchical and development cultures would use SDMs less intensely.

4.3.5 Relationships with National Culture

This section covers the relationships that were found between SDM use and effectiveness and national culture. The responses to the questions that were asked about national culture are analysed in order to determine any relationships. Table 4.16 displays the relationships between national culture, the success of the development process, and the success of the system.

Table 4.16 – Relationships between national culture and success

N=123	National culture dimension	Success of the development process	Success of the developed system
It is inappropriate for employees to express their disagreements with their managers.	Power distance	0.09	0.05
In this country everyone looks after him or herself and family only.	Individualism	-0.18’	-0.12
Values like performance, success and competition are viewed as more important than values like quality of life, service and caring.	Masculinity	0.00	-0.08

In this country it is preferred to have rules and procedures in place when approaching a new or unknown situation.	Uncertainty avoidance	0.02	-0.04
People in this country prefer to work as a member of a group.	Individualism	0.20*	0.12
The people in this country feel threatened by unknown situations.	Uncertainty avoidance	0.04	0.09
Managers make decisions by involving people at lower levels.	Power distance	0.15	0.22*
There is a big gap between the number of women and men in managerial positions.	Masculinity	-0.18’	-0.07
R R^2 Adjusted R^2 F		0.35 0.12 0.06 1.98’	0.34 0.11 0.05 1.81’

‘p ≤ 0.10 *p ≤ 0.05 **p ≤ 0.01 ***p ≤ 0.001

Table 4.16 indicates that two relationships were found. Firstly, a relationship exists between managers involving people in the decision making process and the success of the IS system that was developed. This falls in the power distance dimension. When managers involve people at lower levels, the power distance is viewed as being lower.

The value of b* is positive which means that relationship indicates that if managers involve all employees in the decision making process, the IS system is viewed as being more successful.

Another relationship that emerged is that between preferring to work as a member of a group and the success of the development process. Preferring to work as a member of a group falls within the dimension of individualism. When people prefer to work in a group, individualism is considered to be low.

The b* value is also positive, which means that the national cultures with a lower culture of individualism enjoy a more successful development process. This relationship suggests that working as a group would improve the development process.

Table 4.17 below displays the relationships that were found between national culture and SDM use.

Table 4.17 – Relationships between national culture and SDM use

N=91	National culture dimension	Use of SDM (N=125)	Horizontal use	Vertical use	Strictness of use	Time SDM has been in use
It is inappropriate for employees to express their disagreements with their managers.	Power distance	-0.12	-0.03	0.36**	0.01	-0.04
In this country everyone looks after him or herself and family only.	Individualism	-0.08	0.05	-0.00	0.08	0.08
Values like performance, success and competition are viewed as more important than values like quality of life, service and caring.	Masculinity	0.28*	-0.22	-0.23	0.22	-0.28’
In this country it is preferred to have rules and procedures in place when approaching a new or unknown situation.	Uncertainty avoidance	-0.09	-0.07	0.14	-0.04	-0.05
People in this country prefer to work as a member of a group.	Individualism	-0.03	0.25*	0.28*	0.15	0.04
The people in this country feel threatened by unknown situations.	Uncertainty avoidance	0.03	-0.08	-0.01	-0.13	-0.08
Managers make decisions by involving people at lower levels.	Power distance	0.28**	0.11	-0.05	-0.12	0.10
There is a big gap between the number of women and men in managerial positions.	Masculinity	-0.04	-0.14	0.11	-0.17	-0.02
R R^2 Adjusted R^2 F		0.37 0.14 0.08 2.31*	0.41 0.17 0.09 2.06*	0.43 0.19 0.11 2.37*	0.33 0.11 0.04 1.62	0.35 0.12 0.04 1.42

‘p ≤ 0.10 *p ≤ 0.05 **p ≤ 0.01 ***p ≤ 0.001

Further relationships also emerge as reported in Table 4.17. The variable “Values like performance, success and competition are viewed as more important than values like quality of life, service and caring” falls into the masculinity dimension as explained by Hofstede (1994). The first relationship is that between this masculinity and the use of SDMs. Here, the use of SDM is a value that indicates whether or not an organization uses at least one SDM or not. National cultures with a higher masculinity are more likely to employ an SDM.

A strong relationship exists between the use of SDMs and managers involving people in the decision making process. As already discussed, managerial decisions fall into the power distance dimension. The value for b* is positive; therefore in organizations where the managers involve other people in the decision making process, the organization was more likely to use SDMs.

Table 4.17 also portrays a relationship between horizontal use of SDMs and preferring to work as a member of a group (individualism, as explained above). The b* value for this relationship is positive; therefore when people prefer working as a group, SDMs are more likely to be used horizontally in the organization.

The vertical use of SDMs also reveals a few relationships with national culture. There is a strong relationship between vertical use and national cultures where it is inappropriate for employees to express disagreements with managers (Power distance). The b* value is positive, thus the relationship suggests that a higher power distance is accompanied by greater vertical use of SDMs.

An additional relationship emerged between the vertical use of SDMs and preferring to work as a member of a group (individualism). When people prefer to work as a group, the culture is viewed as having a lower level of individualism and the vertical use of SDMs is likely to be greater.

In the light of all these relationships, it is evident that the national culture does exert an influence on the use and effectiveness of SDMs.

4.4 Conclusion

In this chapter, the researcher discussed the organizations that responded to the survey and the persons who responded to the survey. The use of which types of SDMs were used and their non-use were also studied. It was found that 74% of organizations use SDMs and the three most used SDMs are the SDLC, XP and RAD.

The organizational and national cultures of these organizations were also discussed prior to considering various relationships. The use and effectiveness of SDMs were analysed and the author searched for relationships between SDMs and culture. The relationships that were found were discussed. Some relationships of note include the relationship between horizontal use and the success of the IS system and the success of the development process. Another relationship that is worth mentioning is the relationship between people who prefer working in a group and the horizontal use. When people prefer to work as a group it also leads to a more successful development process.

In the next chapter the findings will be discussed further, practical implications of this research are discussed and suggestions for future research regarding culture and SDMs are also discussed.

Chapter 5 – Summary

5.1 Introduction

In this chapter, the results and limitations of this research are summarised and discussed. The contributions made by this research constitute an important topic, which is addressed by answering the questions as asked in Chapter 1 in terms of the research aims and objectives. Since research should lead to practical implementations and various improvements as supported by the data in this study, the author makes various recommendations. Some of the many different topics that could be researched in order to improve knowledge concerning the use of SDMs and effectiveness and culture, are also mentioned.

5.2 Contributions of this research

The questions mentioned in Chapter 1 have been answered and are supported by some the data and information as described in Chapter 4.

1. What is the state of SDM use in South Africa?

The state of SDM use in South Africa is one that is easily described with the data that were collected in this study. According to the data, 74% of organizations in

South Africa use SDMs. These SDMs have been in use for a varying periods ranging from 1 to more than 10 years.

This SDM knowledge is applied to a wide range of projects and people. The data collected reveals that 37% of organizations apply the SDM knowledge to more than 75% of their projects. The vertical use of SDM adds another perspective to the use of SDMs in South Africa. Most organizations (81%) in South Africa apply at least one SDM with a high or very high intensity.

The data also indicates that the three most used SDMs in South Africa are the SDLC, XP and RAD. The two main reasons why organizations do not to use SDMs are also discussed in chapter 4.

Lastly, SDM use in South Africa is also described by the strictness with which organizations apply the SDMs. According to the data, 44 % of organizations adapt SDMs on a project-to-project basis.

2. Does organizational culture have an influence on the use of SDMs?

The data collected indicated that various relationships exist between the different organizational cultures and the use of SDMs.

Three of the different cultures, namely group culture, development culture and hierarchical culture all have an influence on the vertical use of SDMs. Organizations with a more hierarchical culture have been using SDMs longer than other organizational cultures have.

3. Does national culture have an influence on the use of SDMs?

Several of the different elements of national culture that were measured in this study do have an influence on the use of SDMs.

In national cultures where masculine values are viewed as being more important than feminine values (masculinity), SDMs are more likely to be used. This is also true for national cultures where managers involve people at lower levels in the decision making process.

When people prefer to work in a group (low individualism), the SDM knowledge will be used more horizontally in the organization. This is important because the horizontal use of SDMs leads to a more successful development process and a more successful IS system.

In national cultures where it is inappropriate to express disagreements with managers (high power distance), the SDMs will be used with a higher intensity. The same in true for low individualism (as explained above); when working as a group the SDM will have a higher vertical use.

4. Does organizational culture have an influence on the success of the IS product or the success of the process?

The data indicates that organizations with a more developmental culture will have a more successful development system. The more an organization adopts a rational culture the more successful the IS system seems to be.

5. Does national culture have an influence on the success of the IS product or the success of the process?

National culture also exerts an influence on success. In national cultures, where people prefer to work as a group, the development process is viewed as being more successful. This relationship suggests that working as a group will improve the development process.

When managers involve people at lower levels in the organizations in the decision making process, the developed IS system is more successful.

6. Is there any relationship between the use of SDMs and the success of the IS product or the success of the process?

The data reveals two relationships between SDM use and success. As already mentioned, relationships exist between the horizontal use of SDMs and both the success of the development process and the success of the IS system.

This relationship suggests that when the SDM knowledge is employed in a larger proportion of projects and by a greater number of people, then both the development process and the IS system will be more successful.

Iivari and Huisman (2007:42-43) found that the hierarchical culture had a positive relationship with SDM use in an organization and also perceived that SDMs are more beneficial to an organization. In this research these relationships did not exist.

The reason for this is that most organizations are moving more towards using agile SDMs and as mentioned in Iivari and Iivari (2011:517) a hierarchical culture is not suitable for agile SDM use.

The main aim of this research was to answer the question: Is there a relationship between organizational and national culture and the use and effectiveness of systems development methodologies?

The answer, found in this research, is “yes”, relationships do exist between organizational culture and national culture and the use and effectiveness of system development methodologies.

5.3 Practical implications

There are a number of different practical implications that can be found in the data and the results of this research. These recommendations are based upon the data

collected in this research and can help an organization improve the development of IS systems and also improve the IS systems.

The first recommendation, based on the findings that the horizontal use of SDMs leads to a more successful development process and a more successful IS system. Hence, SDM knowledge should be employed for as many projects as possible and by as many IS employees as possible. According to the data, this will lead to a better development process and a better IS system.

In the light of another significant relationship found in this research that when managers involve people in the decision making process the development process is more successful, it is recommended that organizations involve their employees in decisions. This would most likely improve the budget and schedule of the development process.

When people prefer working as a group, it leads to a more successful development process and a higher horizontal use of SDMs. As both these outcomes are desirable, it is important to encourage team work in the organization, which also facilitates the management of projects. Certain SDMs, like XP, also encourage team work and an organization should also consider the use of one of these SDMs.

Lastly, the rational organizational culture leads to a better IS system. In this culture the focus falls outside the organization, for example, earning profit. This culture leads to a better IS system. Thus by not focussing on problems and aspects in the IS organization itself and rather focussing on the reason the IS system is being developed (to earn profits), the system itself will be more successful.

5.4 Limitations and future research

Some of the limitations to this research are discussed in this section. These limitations can contribute to improving future research in this field and will help

academics understand the influence of culture on the use and effectiveness of SDMs.

The first limitation is that only 125 responses were received; by limiting the number of questions or encouraging more organizations involved in this research area more responses could improve the results. By increasing the number of people and businesses that take part in this study, more accurate and valuable relationships could be found. This leads us to the next limitation.

National culture was included in this study, but was carried out in only one country.

Another limitation is that no standard method to measure the national culture was found. A measuring tool similar to the critical values framework, could improve the manner in which research is conducted with regards to national cultures.

There are many different fields and topics that could be adopted for future research. As described by Iivari and Iivari (2011:517) the relationships between agile SDMs and organizational culture are “rich and interesting”. This is also true for national cultures and other SDMs.

One example of future research is that a similar study be carried out in many different countries at the same time. This research would then be able to study the differences in national culture as well as determine if the relationships found in one country could be generalised with regards to different countries. In this research, it was found that lower individualism leads to a better development process, hence it would be interesting to study this relationship in other countries.

The organizational culture should also be studied in different countries. This would enable a comparison of organizations in different locations around the world. It would then be possible to research similar relationships in the different organizations with similar cultures.

5.5 Conclusion

In conclusion it can be seen that there are relationships between national and organizational cultures and the use and effectiveness of SDMs.

When the national culture is less individualistic it leads to a more successful development process and also leads to a higher horizontal and vertical use of SDMs. Another important relationship found is the relationship between power distance and the success of the development process and the success of the developed IS system. If managers involve employees in the decision making process, both the success of the development process and the success of the developed IS system is higher.

The developmental organizational culture leads to a more successful development process and the rational culture leads to a more successful IS system.

These are just a few of the relationships that were found in this research and shows that more research is needed in the area of IS systems and culture.

Appendix A

1. What is the core business area of your organization?	
Agriculture	1
Catering, accommodation and other trade	2
Construction	3
Education	4
Finance/Banking/Insurance	5
Manufacturing	6
Retail, motor repair services	7
Software house/Software consulting	8
Wholesale trade & commercial agents	9
Transport, storage and communication	10
Other, please specify	11

2. How long has this business been in operation?	
Less than 1 year	1
1-3 years	2
3-6 years	3
6-9 years	4
More than 9 years	5

3. What is the general skill of your employees involved in information system development (ISD)?	
No information system development skills	1
Limited skills	2
Fairly skilled	3
Well skilled	4
Experts	5

4. What is the total number of people employed in your business (total from all locations)?	
1-5	1
6-20	2
21-50	3
51-100	4
101-200 (or more)	5

5. What is the total number of people who work in this business' system development department?	
0 (none)	1
1-5	2
6-10	3
11-20	4
21-50	5
More than 50	6

6. What is your role within this business?	
Owner	1
Executive Director	2
Manager	3
Project Leader	4
Developer	5
Other, please specify:	6

7. How does your business procure software? (You may mark more than one)	
We do not procure any software	1
In-house development	2
Off-shelf (no customization)	3
Off-shelf (with customization)	4
Out-sourcing	5
Other, please specify:	6

8. Which one of the following describes the outcome of the last information system development project you were involved with	
I have not partaken in any information system development projects.	1
The project was cancelled/terminated before completion	2
The project was completed but not implemented	3
The project was completed and implemented but not in use any more	4
The project was completed, implemented and is still in use	5

9. What is the size of the last information system development project you were involved with?	
Small	1
Medium	2
Large	3

Very large	4
I have not partaken in any information system development projects	5

10. To what extent do you agree/disagree with the following statements about the last information system development project you were involved with? (1 = totally disagree, 5 = totally agree)

	Totally disagree				Totally agree
10.1) The project was completed on schedule	1	2	3	4	5
10.2) The project was completed within the budget	1	2	3	4	5
10.3) The developed system satisfied all the stated requirements	1	2	3	4	5
10.4) The speed of developing the information system was high	1	2	3	4	5
10.5) The productivity of the developers involved with the project was high	1	2	3	4	5
10.6) The cost of the project is low when compared to the size and complexity of the system developed.	1	2	3	4	5
10.7) The project achieved its goals	1	2	3	4	5
10.8) The project represents excellent work	1	2	3	4	5
10.9) The project was a success	1	2	3	4	5

11. To what extent do you agree/disagree with the following statements about the last information system development project you were involved with? (1 = totally disagree, 5 = totally agree)

	Totally disagree				Totally agree
11.1) The functionality of the developed system is high	1	2	3	4	5
11.2) The reliability of the developed system is high	1	2	3	4	5
11.3) The maintainability of the developed system is high	1	2	3	4	5
11.4) The portability of the of the developed system is high	1	2	3	4	5
11.5) The efficiency of the developed system is high	1	2	3	4	5
11.6) The usability of the developed system is high	1	2	3	4	5
11.7) The developed system meets user needs	1	2	3	4	5

11.8) The documentation of the developed system is good	1	2	3	4	5
11.9) The quality of the developed system is high	1	2	3	4	5
11.10) The users are satisfied with the developed system	1	2	3	4	5
11.11) The developed system is a success	1	2	3	4	5

12. To what extent do you agree or disagree with the following statements? (1 = totally disagree, 5 = totally agree)

Totally disagree Totally agree

12.1) The IS department I work in is a very personal place. It is like an extended family and people seem to share a lot of themselves.	1	2	3	4	5
12.2) The IS department I work in is a very dynamic and entrepreneurial place. People are willing to stick their necks out and take risks.	1	2	3	4	5
12.3) The IS department I work in is a very formal and structured place. People pay attention to bureaucratic procedures to get things done.	1	2	3	4	5
12.4) The IS department I work in is a very production-oriented place. People are concerned with getting the job done and are not very personally involved.	1	2	3	4	5
12.5) The glue that holds the IS department I work in together is loyalty and tradition. Commitment to the IS department I work in runs high.	1	2	3	4	5
12.6) The glue that holds the IS department I work in together is commitment to innovation and development. There is an emphasis on being first with products and services.	1	2	3	4	5
12.7) The glue that holds the IS department I work in together is formal rules and policies. Following rules and maintaining a smooth running institution are important.	1	2	3	4	5
12.8) The glue that holds the IS department I work in together is the emphasis on tasks and goal accomplishment. A production and achievement orientation is commonly used.	1	2	3	4	5
12.9) The IS department I work in emphasizes human resources. High morale is important.	1	2	3	4	5
12.10) The IS department I work in emphasizes growth through acquiring new resources. Acquiring new products/services to meet new	1	2	3	4	5

challenges is important.					
12.11) The IS department I work in emphasizes permanence and stability. Efficient, smooth operations are important.	1	2	3	4	5
12.12) The IS department I work in, emphasizes competitive actions, outcomes and achievement. Accomplishing measurable goals is important	1	2	3	4	5
12.13) The IS department I work in is under threat of being disbanded.	1	2	3	4	5
12.14) The future of the IS department I work in is uncertain.	1	2	3	4	5

13. To what extent do you agree with the following statements? (1 = totally disagree, 5 = totally agree)

	Totally disagree				Totally agree
13.1) In this country it is inappropriate for employees to express their disagreements with their managers when the managers make a decision.	1	2	3	4	5
13.2) In this country everyone looks only after him or herself and also looks after his or her immediate family.	1	2	3	4	5
13.3) In this country values like performance, success and competition are viewed as more important than values like quality of life, service and caring.	1	2	3	4	5
13.4) In this country it is preferred to have rules and procedures in place when approaching a new or unknown situation, rather than having an unstructured approach.	1	2	3	4	5
13.5) People in this country prefer to work as a member of a group, rather than working alone.	1	2	3	4	5
13.6) The people in this country feel threatened when an unknown or uncertain situation approaches.	1	2	3	4	5
13.7) In this country the managers of organizations make decisions by involving people who are at lower levels in the organizations.	1	2	3	4	5
13.8) In this country there is a big gap between the amount of woman and men in managerial positions.	1	2	3	4	5

14. If you are NOT using systems development methodologies please indicate to what extent do you agree/disagree with the following statements about the last information system development project you were involved with? (1 = totally disagree, 5 = totally agree)

	Totally disagree				Totally agree
14.1) The profile of development projects in our IS department doesn't require the use of system development methodologies	1	2	3	4	5
14.2) System development methodologies are too complex or hard to use	1	2	3	4	5
14.3) The current system development practice in our IS department is adequate	1	2	3	4	5
14.4) The experience of the developers in our IS department reduces the need for systems development methodologies	1	2	3	4	5
14.5) The benefits of systems development methodologies use are long-term, whereas cost are incurred short term	1	2	3	4	5
14.6) There is a lack of experienced staff in our IS department who can effectively use system development methodologies	1	2	3	4	5
14.7) New systems developed with systems development methodologies are not compatible with legacy systems	1	2	3	4	5
14.8) Our IS department lacks a suitable environment to support systems development methodologies	1	2	3	4	5
14.9) In our IS department there is a lack of management support for the use of systems development methodologies	1	2	3	4	5
14.10) The learning curve for systems development methodologies are very long	1	2	3	4	5
14.11) The financial investment in systems development methodologies is to large	1	2	3	4	5
14.12) In our IS department there is a lot of uncertainty over the benefits of adopting systems development methodologies.	1	2	3	4	5
14.13) In our IS department there is no clear objectives for adopting systems development methodologies	1	2	3	4	5

15. There are various types of system development methodologies, for example XP (Extreme programming) and IE (Information Engineering). Name the methodologies your organization uses, and indicate how intensively each one is used: (1 = used very infrequently, 5 = used very often)

Name of Methodology	Intensity of use				
	1	2	3	4	5
	1	2	3	4	5
	1	2	3	4	5
	1	2	3	4	5
	1	2	3	4	5
	1	2	3	4	5
	1	2	3	4	5
	1	2	3	4	5
	1	2	3	4	5

16. How long has your systems development methodology been in use in your IS department?	
Less than 1 year	1
1-2 years	2
3-5 years	3
5-10 years	4
Over 10 years	5
I don't know	6

17. What is the proportion of projects that are developed in your IS department by applying systems development methodology knowledge?	
None	1
1 – 25 %	2
26 – 50 %	3
51 – 75 %	4
Over 75 %	5

18. What is the proportion of people in your IS department that apply systems development methodology knowledge regularly?	
None	1
1 – 25 %	2
26 – 50 %	3
51 – 75 %	4
Over 75 %	5

19. Which of the following best describes how your IS department makes use of its systems development methodologies?	
A general guideline for all projects.	1
A standard which is followed rigorously for all projects.	2
Adapted on a project –to-project basis.	3

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