The use of agile systems development methodologies in the telecommunication industry in South Africa

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Dissertation submitted in partial fulfilment of the requirements for the degree of *Master of Science* at the Potchefstroom Campus of the North-West University

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November 2009

ABSTRACT

Over the last decade, systems development professionals have recognised the need to use agile systems development methodologies (ASDMs) in the telecommunication industry. This is partly due to the barriers identified by Mansurov (2000) which suggest that the use of agile methodologies in the telecommunication industry would reduce the ratio of time-to-market. In the South African context, the industry has cemented its position as a major driving force of the economy as a whole. The industry's level of competitiveness is in part informed by the information technology practices that it follows, and hence systems development is deemed to be a crucial and value-adding component of the environment.

This research therefore aims to investigate the systems development practices currently being used in the telecommunication industry of South Africa, as well as the perceived sentiments towards the use of ASDMs. The investigation into the level of applicability of ASDMs in the industry is largely informed by literature from agile proponents which suggest that ASDMs are highly suitable to projects where the user requirements continuously change.

In order to identify the current SD practices followed and the sentiments towards ASDMs in the telecommunication industry, the interpretive paradigm was used. Three prominent organisations were identified and case studies were conducted at each of these companies. The data collection method used was a combination of semi-structured interviews and questionnaires, and the data analysis tools were ATLAS.ti for the semi-structured interviews and SPSS for the questionnaires. Thereafter, the data collected was analysed by using the cross-case analysis method.

The results indicated that the incumbent companies in the telecommunication industry used an SDM that followed the waterfall approach, and the use of ASDMs was informed by a multitude of factors.

OPSOMMING

Gedurende die afgelope dekade het professionele stelselontwikkelaars die behoefte ontdek aan vinnige stelselontwikkelingsmetodologieë (VSOM) in die telekommunikasiebedryf. Dit is deels as gevolg van die hindernisse wat deur Mansurov (2000) geïdentifiseer is wat voorstel dat die gebruik van vinnige metodologieë in die telekommunikasiebedryf die verhouding van tyd-tot-mark sal verminder. Binne die Suid-Afrikaanse konteks het die industrie sy posisie as belangrike dryfkrag vir die ekonomie as geheel versterk. Die industrie se vlak van mededingendheid is deels geïnspireer deur die inligtingstegnologiepraktyke wat dit volg en dus word stelselontwikkeling beskou as 'n belangrike en waardetoevoegende komponent van die milieu.

Die navorsing het gevolglik ten doel om die stelselontwikkelingspraktyke wat tans in die telekommunikasiebedryf gebruik word te ondersoek sowel as die waargenome sentimente ten opsigte van die gebruik van VSOM's. Die ondersoek na die toepaslikheidsvlak van VSOM's in die bedryf word grootliks geïnspireer deur literatuur uit vinnige voorstanders wat voorstel dat VSOM's uiters geskik is vir projekte waar die gebruikersvereistes voortdurend verander.

In 'n poging om die huidige stelselontwikkelingspraktyke wat gevolg word en die sentimente teenoor VSOM's in die telekommunikasiebedryf te identifiseer, is 'n interpretatiewe paradigma gebruik. Drie prominente organisasies is geïdentifiseer en gevallestudies is gedoen by elk van hierdie organisasies. Die data-insamelingsmetode wat gebruik is, was 'n kombinasie van semi-gestruktureerde onderhoude en vraelyste en die data-analisehulpmiddels wat gebruik is, was ATLAS.ti vir die semi-gestruktureerde onderhoude en SPSS vir die vraelyste. Daarna is die ingesamelde data geanaliseer deur gebruik te maak van 'n kruis-geval analisemetode.

Die uitslae het aangedui dat die maatskappye in die telekommunikasiebedryf 'n SOM gebruik het wat van 'n watervalbenadering gebruik maak en dat die gebruik van VSOM's deur 'n hele aantal faktore geïnspireer is.

ACKNOWLEDGEMENTS

First and foremost, I want to give thanks to my Heavenly Father for all the gifts He has given me thus far. You are trustworthy and constant in everything. I know that it is through His Will and Grace that I have gotten this far in life. All glory belongs to Him.

Secondly, I want to thank my parents who have been there for me through the very difficult times. It is because of their love and support that I am able to achieve my goals in life. I also want to thank my sisters who have been a pillar of support in all of the decisions I took. Your sisterly love is an inspiration to me.

A special thank you goes to my supervisor Professor Magda Huisman who has been like a mother to me during my studies. Thank you Prof for all those long chats in your office and thank you for always believing in me and in my work.

I also want to thank my colleagues Willy Shawa and Metages Dessie for their input into this research. We have made it together. I wish to thank my language editor Liezl Potgieter for revising grammar and spelling.

And finally I wish to express a sincere and heartfelt thank you to my wife for all the support and words of encouragement throughout my studies. It is because of you that I am the man I am today. This dissertation is dedicated to our son Jason Mazengera.

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PROBLEM STATEMENT

1.1 INTRODUCTION

The telecommunication industry is a multifaceted industry that affects everyone's life one way or another. In its broadest sense, this industry is diverse with companies ranging from large multinationals to one person owner-managed businesses. In this chapter, the problem facing the telecommunication industry is introduced and the approach through which the researcher aims to address this problem is discussed. According to the Telkom Annual Report (2007), the industry's unprecedented growth has forced companies to continuously review the speed at which they are able to satisfy the market needs. It is for this reason that companies are being exposed to new technologies and new ways in solving complex problems inherent in the telecommunication industry in South Africa. Many authors have suggested that the use of systems development methodologies (SDMs) has the benefit of indirectly affecting a company's competitiveness (Avison & Fitzgerald, 2002; Boehm *et al.*, 2000; Ceschi *et al.*, 2005; Fitzgerald, 1996; Huisman, 2000; Huisman & Iivari, 2006). Therefore, for purposes of this research, focus is placed on SDMs and in particular agile SDMs (ASDMs) in the telecommunication industry.

1.2 PROBLEM STATEMENT

According to Patel (2002), the problem with telecommunication systems is that their needs (reliability and safety, diversity and simplicity, software costs) cannot be addressed by archaic and existing software engineering practises. This problem arose as a result of increased complexity of systems, high expectations from clients and an ever-changing environment faced by systems development professionals in the telecommunication industry (Cockburn & Highsmith, 2001). Patel (2002) goes further to say that telecommunication companies employed their own approaches in dealing with telecommunication development practices, and this led to complicated telecommunication infrastructure which resulted in companies experiencing difficulty in deploying of new technologies. Interestingly enough, the telecommunication industry was not the only industry facing complex systems development practices. In the late 1990's, a consortium called the Agile Alliance was formed that aimed to establish a more people-oriented approach to developing systems. Agile systems development methodologies (ASDMs) were therefore introduced to allow for the seamless development of systems in industries where the requirements were not stable and static.

According to Asproni *et al.* (2004), the term "Agile system development methodologies" refers to those methodologies that share the principles and values as stated in the *Agile Manifesto* (Beck *et al*, 2001). The *Agile Manifesto* was developed by the Agile Alliance and it will be expounded in chapter 2.

The use of ASDMs in the telecommunication industry is not well-documented in the South African context, and therefore an investigation on the use of ASDMs in the telecommunication industry should be conducted. A study by Mansurov (2000) suggests that agile systems development methodologies (ASDMs) are well suited to address the volatility experienced in the telecommunication industry.

Furthermore, studies linking systems development methodologies (SDMs) to the telecommunication industry suggested that there is a need for methodologies that are highly adaptive and flexible (Otto, 2007; Theunissen & Kourie, 2003; Koutsoukos *et al.*, 2001). Therefore in the context of this research, the author wants to investigate the applicability of ASDMs in the telecommunication industry in South Africa. This will be done by identifying the current SDMs being used as well as the current systems development practises followed in three companies in the telecommunication industry.

1.3 RESEARCH CONTRIBUTION

This research draws from the experiences of the studies by Otto (2007) and Theunissen and Kourie (2003) and goes further to investigate the use of ASDMs in the telecommunication industry in South Africa. This research tries to determine the extent to which ASDMs – as a subset of SDMs – can be applied in the telecommunication industry given the complexity in deploying telecommunication systems (Patel, 2002). A study by Koutsoukos *et al.* (2001) found that there was a need for a systems development methodology that is flexible and adaptive in the telecommunication environment. Therefore this research will also investigate the adaptability and flexibility of the current SDMs being used. In respect to the importance of this research, the telecommunication industry is regarded as one of the most important industries in South Africa as it contributes a substantial amount to the Gross Domestic Product (GDP) of South Africa. According to Patel (2002), telecommunication systems have become so complex and expensive that companies are scrambling to find new and better ways of handling their deployment of telecommunication services. Therefore, the importance of this research is that it aims to explore the use of ASDMs in the South African context.

1.4 RESEARCH AIMS AND OBJECTIVES

This section briefly describes the aims and objectives of the research. Taking into consideration the recommendations of the studies identified in the previous section, the author proposes that the research will study the use of ASDMs in the telecommunication industry in South Africa.
The main research questions that will assist in reaching the aims and objectives of this research are:

- *Can agile SDMs be applied in the telecommunication environment?*

In order to answer this research question, the following mini-research questions are used:

  - What SDM is currently being used in the organisation?
  - What are the sentiments of people about ASDMs in the telecommunication industry?
  - If ASDMs are not used, is there a willingness to change to an ASDM?

- *How agile are current SDMs in the telecommunication environment?*

The mini-research questions used to answer this main research question are:

  - Does the current SDM follow a waterfall lifecycle or an incremental one?
  - Does the current SDM adapt well to a changing environment?

These questions have been informed by the studies of Otto (2007), Theunissen and Kourie (2003) and Koutsoukos *et al.* (2001). The findings from these studies indicate a need for an agile methodology in the telecommunication industry because of the benefits that they hold. These studies will be discussed further in chapter 2.

With the current situation facing the telecommunication industry, this research identifies the SDMs used in the industry and ascertains whether or not that methodology – or lack thereof – can address the challenges faced by the industry.

1.5 RESEARCH METHOD

This research is based on the interpretive research paradigm, and the case study method is used as the research method. In each of the three companies identified, semi-structured interviews and questionnaires will be used as the data-collection instruments. In terms of analysing the data collected, ATLAS.ti is used for the interviews and SPSS version 16 is used to analyse the questionnaires. In reporting the findings, the cross-case analysis method will be used so that the three companies' systems development practises are identified. Thereafter, propositions are formulated that encompass the findings from all the companies. Qualitative and quantitative data will be generated from the case study.

The qualitative data will be generated from the semi-structured interviews and quantitative data will be generated from the questionnaires. According to Oates (2006), the use of two or more data-gathering methods is known as method triangulation.

1.6 CHAPTERISATION

Chapter 1: INTRODUCTION

This chapter introduces the focus of this research. The problem statement is highlighted and the research method of investigating the problem is also discussed.

Chapter 2: AGILE SYSTEMS DEVELOPMENT METHODOLOGIES AND THE TELECOMMUNICATION INDUSTRY

In this chapter a background on the telecommunication industry in South Africa is given. The chapter also discusses different types ASDMs and the challenges in the adoption of these methodologies. A comparison between ASDMs and traditional SDMs, and the suitability of ASDMs will be discussed. Previous studies linking SDM's to the telecommunication industry are also discussed.

Chapter 3: RESEARCH METHOD AND DESIGN

This chapter discusses the methods through which this research was executed. Advantages and disadvantages of different research methods are discussed and supporting arguments for the chosen method are given. Diagrammatically, the design of the study is presented in this chapter.

Chapter 4: RESULTS ANALYSIS AND DISCUSSION

This chapter critically analyses the data collected from the three companies during the case studies. Each company's results are discussed individually and thereafter a summary of the company's results are tabulated in each question. Once the questionnaires and the interviews are reported, a cross-case analysis is performed in order to generate propositions that are common between the three companies.

Chapter 5: CONCLUSIONS AND RECOMMENDATIONS

In the final chapter, the study is concluded and recommendations by the author are given. The purpose of the research was to determine whether – or not – agile methodologies are being used in the telecommunication industry in South Africa. This was done by firstly reviewing pre-existing literature on ASDMs and the telecommunication industry, and thereafter identifying the challenges of adopting ASDMs.

Appendix A

This appendix contains the questionnaire used during the data-collection process.

Appendix B

This appendix contains the actual responses from the interviews that were conducted in the companies.

1.7 SUMMARY

This chapter discussed the problem statement which this research aims to address by means of conducting a case study research in three identified companies. In the following chapter, ASDMs and the telecommunication industry in South Africa are discussed.

CHAPTER 2

AGILE SYSTEMS DEVELOPMENT METHODOLOGIES (ASDMs) AND THE TELECOMMUNICATION INDUSTRY

2.1 INTRODUCTION

In this chapter, a brief background is given on the telecommunication industry in South Africa and the challenges it faces. Also, Agile Systems Development Methodologies (ASDMs) are discussed at length with the view of identifying current systems development practises used in the telecommunication industry. A comparison between more traditional systems development methodologies and ASDMs will be given, and the suitability of ASDMs to an industry as volatile and diverse as the telecommunication industry will also be discussed. Studies linking systems development methodologies (SDMs) to the telecommunication industry are also discussed.

2.2 THE TELECOMMUNICATION INDUSTRY

According to Grover and Saeed (2003), the telecommunication industry lies at the core of the digital economy, and the important characteristics include "high sunk costs, rapid technological advances, high obsolescence, and intense competition" (Grover & Saeed, 2003: 119), and the liberalisation or privatisation of this industry will ensure a sustainable and strong growth of the economy over the long-term period (Li & Whalley, 2002). There are different environments or operations serving the telecommunication industry, but all which aim to achieve the same purpose, which is to afford customers or clients a seamless opportunity to communicate. The New Oxford American Dictionary (2005) states that the word telecommunication was adapted from the French word *télécommunication* which means to communicate between far-off points. Therefore, the telecommunication industry's purpose is to allow for communication between two or more distant points in a seamless and effective manner. For the purpose of this study, a broad definition of the telecommunication industry developed by Grover and Saeed (2003: 120) that states, "It is defined to include all suppliers that provide elements (products and services) to networks that carry voice, video, and data", will be used. There are four categories operating within the telecommunication industry namely, network providers, tool providers, transaction and service providers, and internet/content providers.

- Network Providers

  This category can be sub-divided into two parts namely, landline providers and wireless/satellite providers.

In terms of landline providers, these are companies that own and control the network based on physical connections such as telephones and cable networks (Grover & Saeed, 2003). In terms of wireless/satellite providers, these are companies that own and control the network based on a non-physical (virtual) connection such as mobile networks (Grover & Saeed, 2003). These providers are usually seen as the biggest players within the industry because they collect the most profits.

- Tool Providers

  This category can be subdivided into two parts namely, hardware providers and software providers. Hardware providers are those companies that manufacture the hardware necessary for the communication network and software providers are those companies that produce software that is of vital importance to the communication network. Most network providers usually develop their own software and hardware on a small scale. Wireless/satellite providers use base stations that are arranged in a cell-like manner, and these stations are the access points that customers use in order to communicate through hand-held devices. As at 31st March 2007, "The penetration rate for mobile users increased from an estimated 2.4% at 31st March 1997 to an estimated 84%" (Telkom Annual Report, 2007: 11).

- Transaction and Service Providers

  The South African fixed-line communications market boasts with the most advanced market in Africa and one of the leading markets globally (Telkom Annual Report, 2007). Although the telecommunication industry is highly competitive, fixed-line network operators (FLNOs) are experiencing a lot of pressure because clients are migrating towards mobile services. This category can also be subdivided into two groups namely, service providers and transacting service providers. Services providers are those companies that provide a multitude of services such as web-hosting, virtual private network (VPN) services, calling cards and free internet services. Transaction service providers are those companies that "enable buying and selling of goods and services through the internet" (Grover & Saeed, 2003).

- Internet/Content Providers

  In this category, two subdivisions also occur namely, content providers and internet content providers. In terms of content providers, these are companies that produce copyright material distributed through channels outside the internet domain. Internet content providers refer to companies that produce copyright material distributed through the internet.

These previously mentioned providers sum up all the companies that typically operate within the telecommunication industry.

In this research, focus will be placed on the network providers in the telecommunication industry.

In the following section, a discussion on the challenges facing the telecommunication industry is presented.

2.2.1 Challenges facing the telecommunication industry

There are many challenges facing the telecommunication industry. Besides the fact that this industry is highly competitive, all the operators in the industry are faced with a major challenge of restructuring their business model to allow for new technologies and therefore a new way of how their fundamental business operates. In other words, the industry has reached an inflection point where their survival is highly dependant on the speed at which they roll out new technologies. According to Grover and Saeed (2003), long-distance carriers hit with a falling growth rate are diversifying their offering into high-growth and more profitable areas within the industry. According to Guest (2008), their challenges include:

- Reduced tariffs

  The costs of communication in South Africa are rated as one of the highest in the world and customers have come to realise that. The industry is faced with the challenge of reducing the costs substantially without greatly affecting their profits.

- Increased competition

  The industry is faced with increased competition of smaller companies that are taking advantage of the new technologies available. This could force the industry to rethink their business model in line with the current trends of the market.

- Migration from dial-up to ADSL for FLNO's

  When the internet first became available to the general public, most – if not all – customers used a dial-up connection which uses an ordinary modem (internal or external) that had a standard download rate of 56 Kilobits per second (Kbps). Currently, because of the need of faster download rates, service providers are offering high speed download rates ranging between 512 Kbps and 8 Megabits per second (Mbps).

- An introduction of cost-based interconnection.

  The network providers operating in South Africa typically charge a premium on the calls made to outside networks. That is, they charge a premium on the calls outside their particular network.

  In light of this revelation, the enactment of the Telecommunication Act will force the network operators to charge interconnection calls at the cost and not including the premium.

According to Patel (2002), the problem with telecommunication systems is that they have specific needs that cannot be handled properly by existing software engineering tools.

It is therefore vital that the software development teams need to be mindful of the complexities inherent in a telecommunication system. These challenges – highlighted above – can fundamentally change the telecommunication industry landscape in South Africa if they are not addressed in depth by the industry players. Therefore, the sum total of these challenges can greatly affect the telecommunication industry if the business model does not adapt to the imminent fundamental changes on the horizon. With the current situation facing the industry, this research aims to identify the systems development methodologies (SDMs) used in the telecommunication industry, and ascertain whether or not that methodology – or lack thereof – can address the challenges faced by the industry.

2.2.2 New direction of the telecommunication industry

In line with the challenges facing the telecommunication industry, the Electronic Communications Act, which came into effect on July 19 2006, "aims to supplement or replace sector specific legislation and change the market structure from a vertically integrated, infrastructure based, market structure to a horizontal, service based, technology neutral, market structure with a number of separate licences being issued for different areas" (Telkom Annual Report, 2007:11). In other words, the telecommunication industry is also faced with the issue of convergence, which ultimately will benefit the customer. Convergence refers to the bundling of services into one package. For example, a converged product in the telecommunication industry will typically allow customers a variety of ways to communicate such as, fixed-line phones or mobile phones as well as access to the world wide web. A number of technologies that have been released aim to address the convergence issue namely:

- **3G**

  3G is a third generation mobile technology aimed to allow access to data-intensive applications at a faster rate compared to earlier mobile technologies.

- **VoIP** (Voice over Internet Protocol)

  This is a set of facilities – or rules – used to manage the delivery of voice data over the Internet. VoIP services use the internet network to send through the voice data and therefore avoid the charges incurred if an ordinary telephone service is used.

- **IMS** (IP Multimedia Subsystem)

  IMS allows for packet communication of all forms over wireless networks. This is the system that is responsible for allowing communication between different telecommunication platforms.

- **WiMAX** (Worldwide Interoperability for Microwave Access)
  This is an industry collective dedicated to promoting the use of broadband wireless networks.

All these above mentioned technologies aim to create an environment where the customer can choose whichever product best suits their profile, and therefore the systems development methodologies used need to be more flexible and adaptable (Otto, 2007) to change in order to accommodate the multiple choices that the customers have.

2.3 SYSTEMS DEVELOPMENT METHODOLOGIES

In this section, a brief history on the emergence of SDMs is given. Thereafter the definitions of SDMs and ASDMs are presented. Some of the most commonly used ASDMs will be discussed in detail and the effectiveness and challenges in adopting ASDMs is also presented. Once ASDMs are discussed, a comparison between traditional SDMs and ASDMs is given.

2.3.1 The "Software Crisis"

The systems development community identified the need of a structured way of developing information systems. According to Fitzgerald (1996:46) the solution to the dire situation in systems development lies in "increased control and the more widespread adoption of rigorous and formalised systems development methodologies". The term "software crisis" emerged in the late 1960s, and its use referred to the fact that the systems developed took too long to go live, were developed over-budget and the systems did not work well (Fitzgerald, 1996). During this period, an organised way of developing systems was promoted in order to minimise the effect of the software crisis (Fitzgerald, 1996). According to Fitzgerald (1996) a list of conceptual underpinnings that supported the adoption of formalised methodologies was identified namely:

- *Reductionist subdivision of complex development processes*

It was identified that the adoption of phases in the development lifecycle would help in the management of the development process. The purpose of this subdivision was to enable the development team to formulate detailed plans of the system from the onset.

- *Facilitation of project management and control, thus minimising risk and uncertainty*

The advent of SDMs promoted project management techniques that would be used throughout the SD lifecycle.

The focus on project management and control was thought to mitigate the risks involved in a typical SD project. Recent literature indicates that project management and control alone will not suffice in ensuring the success of an SD project.

- *Purposeful framework for application of techniques and resources*

According to Avison and Fitzgerald (2006) companies that are able to adapt to a changing environment will enjoy great success. This is due to the fact that the economic environment in the 21st century forces companies to continuously review their practises in light of the market conditions. Therefore in order to stay abreast of the dynamic environment, companies are encouraged to have tools and techniques that will assist in reducing the risk of a volatile environment.

- *Economic rationale: skill specialisation and division of labour*

Systems development professionals saw that there was a need for specialisation and task delegation. This came about during the pre-methodology era where the programmers were also the project managers of a SD project. The division of labour was therefore thought to be a way in which the development teams' performance could be optimised.

A few methodologies emerged as an answer to the "software crisis". Most were government development standards such as SSADM (UK, Ireland, Malta, Hong Kong, Israel), Dafne (Italy), Merise (France), NIAM (Netherlands) and Department of Defence Std. 2167 (US).

These government development standards aimed to address and propose an organised way of developing systems. According to Herron & Garmus (2000) a United States government study on software development projects revealed that:

- 60% of projects where behind schedule,
- 50% were over cost, and
- 45% of delivered projects were unusable.

According to Cantor (2003), systems development experts have learned that detailed plans are rarely followed. This is because most of the time – especially in larger SD projects – the user requirements change often and therefore result in an unorganised and chaotic systems development process. Table 2.1 shows some of the data contained in the CHAOS report by the Standish Group (2004). As can be seen in the table, more than 50% of SD projects were delivered, but not according to the original plan. This indicates that user requirements change often. Another interesting trend found in the CHAOS report of 2004 was that the percentage of failed SD projects steadily decreased from 1996. This is a clear indication that the management controls are helping to ensure a higher success rate.

Table 2.1: The Chaos Report (2004)

Year	Delivered on time, budget, original content	Delivered, but not according to original plan	Failed to deliver
2004	29%	53%	18%
2000	28%	49%	23%
1998	26%	46%	28%
1996	27%	33%	40%
1994	16%	53%	31%

With specific reference to the telecommunication industry, the system development process needs to be quick but also robust because of the competitive nature of the industry (Theunissen & Kourie, 2003). A discussion on some of the system development methodologies specifically tailored for the industry follows in section 2.3.9. In the following section, the definition of systems development methodologies is given.

2.3.2 Definition of a Systems Development Methodology (SDM)

A systems development methodology (SDM) refers to the framework that is used to structure, plan and control the process of developing an information system (CMS, 2005). In another definition by Avison and Fitzgerald (2006: 24), an information systems development methodology is defined as "a collection of procedures, techniques, tools, and documentation aids which help the systems developers in their efforts to implement a new information system".

Yet another definition by Olerup (1991) states that a methodology can be defined as a strategy, which implies a subdivision of the development process. There is no general definition of what an SDM is, and it is for this reason that there is a lot of confusion when it comes to implementing an SDM in an organisation (Olerup, 1991).

For the purposes of this research, the definition by Huisman and Iivari is used which states that an SDM is a "combination of a systems development approach, a systems development process model, a systems development method and a systems development technique" (Huisman & Iivari, 2006).

A *systems development approach* refers to the philosophical view that the methodology is based on. According to Iivari *et al.* (1998) it is the set of goals, fundamental concepts and beliefs of the systems development process that underpin the inference and actions in systems development.

Some examples of systems development approaches include the object-oriented approach and process-oriented approach (Grey, 2006).

A *systems development process model* is referred to as a representation of the sequence of steps or stages which should be followed during system development (Wynekoop & Russo, 1993). Some examples of a systems development process model include the waterfall model and the incremental model.

A *systems development method* refers to how a systems development project will be executed. According to Wynekoop and Russo (1993), a method is seen as a predetermined and linear approach to conduct a stage or phase of systems development. Also, the systems development method is underpinned by a certain philosophical view of the target system. Some examples of a systems development method include STRADIS, Information Engineering (IE) and Structured Systems Analysis and Design Method (SSADM).

A *systems development technique* refers to the manner and/or style through which the project is executed. It requires the use of tools such as entity relationship diagrams, flowcharts and data flow diagrams.

The prescriptive nature of SDMs aims to ensure the success of the project if it is deployed effectively and with the required skills and experience (Fitzgerald, 1996). Early SDMs mainly relied on unsystematic and random methods (Olerup, 1991, Yeh, 1991) and were influenced by technical and engineering disciplines (Dumdum & Klein, 1986). Also, early methodologies were used in order to improve the track record of information systems development (Avison & Fitzgerald, 2002). Avison & Fitzgerald (2006) identified four era's in the evolution of systems development methodologies namely:

- *Pre-methodology era*

In this era, systems were developed without the use of formal methodologies. System development mainly focussed on programming and technical aspects of the SD project, and this gave rise to problems such as poor control and management. The main characteristic of this era was that there was strong emphasis on systems working properly and not on addressing the needs of the users.

- *Early methodology era*

In this era, there was a strong focus on the identification of phases so that more control could be exercised in SD projects. The main SDM in this era was known as the Systems Development Life Cycle (SDLC) and this methodology was deemed to be sufficient in dealing with static user requirements. The linearity of the SDLC perpetuated the problem of unstable and inflexible systems which resulted in the majority of the projects failing to live up to expectations.

- *Methodology era*

In this era, formalised methodologies were strongly advocated and a number of different approaches to systems development emerged (Avison & Fitzgerald, 2006). The emergence of these different approaches was as a result of the shortcomings of SDLC, and the result was that organisations became more competitive and sustainable.

- *Era of reassessment*

This era – from the late 1990s onwards – is characterised by organisations rethinking the extent to which SDMs benefit their level of success in SD projects. According to Avison and Fitzgerald (2006) most organisations feel that the promises that methodologies hold, such as better management control and the development of high quality systems, have not been achieved. Therefore in this era, organisations have resorted to criticising SDMs and in some instances discontinuing the use of SDMs. There are four directions in which organisations are undertaking in this era, namely (Avison & Fitzgerald, 2006):

  - *Ad hoc development*

  Some organisations have resorted to not using any formalised methodology. This approach is reminiscent of the pre-methodology era, and the development team relies heavily on their past experiences.

  - *Further developments in methodology arena*

  Some organisations have continued to pursue the use of SDMs and this has lead to many contributions being made. There are some that still strongly believe in SDMs and their principles and their argument is that many SD projects fail because the methodologies were either misunderstood or not properly implemented.

  - *Contingency*

  This direction aims to address the static nature of SDMs in a dynamic environment. Most of the formalised methodologies from the previous era where prescriptive and assumed that the environment would be relatively stable. Since the late 1990s, information technology professionals have seen a need for methodologies that are able to capture user requirements well in a highly volatile environment. It was during this period that the Agile Alliance was formed to tackle the issue of evolutionary SDMs. The Agile Alliance developed the Agile Manifesto (see table 2.2) that aims to promote the use of ASDMs especially in highly volatile environments.

- *External development*

  This direction mainly refers to the use of packages (off-the-shelf) and outsourcing. Many organisations have opted to either purchase solutions from information technology vendors or to have third parties develop their systems. Organisations that use external development are usually those that have a negative perception towards methodologies (Avison & Fitzgerald, 2006) and by so doing they feel that the risk of failure should be better managed by those organisations that are experienced in methodologies and their implementation.

There are not many methodologies that were developed specifically for the telecommunication industry (Mansurov, 2000). These methodologies include MODA-TEL, Mansurov's Accelerated Development Methodology and Mobile-D. A discussion on each of these methodologies will follow in section 2.3.9. According to Otto (2007), these methodologies specifically developed for the telecommunication industry are not being used in South Africa.

In the following section, the definition of agile systems development methodologies is given. Agile methodologies emerged in the late 1990s and their aim was to address the issue that methodologies from the methodology era were not well suited in highly volatile and dynamic environments.

2.3.3 Definition of an agile systems development methodology (ASDM)

According to Asproni *et al.* (2004), the term Agile system development methodologies refers to specific methodologies that share the principles and values as stated in the *Agile Manifesto*. The Agile Manifesto developed by Beck *et al.* (2001) highlights twelve principles through which a methodology can be identified to be agile.

In order for a methodology to be deemed as being agile, the most important characteristic is that it needs to be able to adapt quickly to change. This adaptability is achieved through the techniques and tools of the particular methodology.

Fowler (2005) suggests that agile methodologies came about as a result of a need to build systems in an organic way. Also, plan-driven or engineering methodologies where deemed to be highly ineffective and unable to incorporate changes late in the lifecycle. This gave rise to a new way of visualising a system in that there was a need for a more people-oriented methodology. Therefore ASDMs promote closeness among the development team and users, and a more adaptable and evolutionary approach to solving problems in a fast-paced economy. Section 2.3.4

further discusses the history of ASDMs. Table 2.2 highlights the twelve principles that motivate the use of ASDMs. As it can be seen in table 2.2, the principles advocate for an organic and a self-learning approach to systems development. The principles allow the development team to be self-organising so that they are able to adjust quickly to changing requirements and environments.

Table 2.2: The Agile Manifesto (Extracted from Beck *et al.*, 2001)

THE AGILE MANIFESTO

Manifesto for Agile Software Development

The value of the development process should be placed on:

- **Individuals and interactions** over processes and tools (AV 1)[1]
- **Working software** over comprehensive documentation (AV 2)
- **Customer collaboration** over contract negotiation (AV 3)
- **Responding to change** over following a plan (AV 4)

The principles behind the Agile Manifesto

- The highest priority is to satisfy the customer through early and continuous delivery of valuable software. (AP 1)[2]
- Welcome changing requirements, even late in development. Agile processes harness change for the customer's competitive advantage. (AP 2)
- Deliver working software frequently, from a couple of weeks to a couple of months, with a preference to the shorter timescale. (AP 3)
- Business people and developers must work together daily throughout the project. (AP 4)
- Build projects around motivated individuals. Give them the environment and support they need, and trust them to get the job done. (AP 5)
- The most efficient and effective methodology of conveying information to and within a development team is face-to-face conversation. (AP 6)
- Working software is the primary measure of progress (AP 7)
- Agile processes promote sustainable development. The sponsors, developers, and users should be able to maintain a constant pace indefinitely. (AP 8)
- Continuous attention to technical excellence and good design enhances agility. (AP 9)
- Simplicity, which is the art of maximising the amount of work not done, is essential. (AP

[1] AV stands for Agile Value.
[2] AP stands for Agile Principle

10)

- The best architectures, requirements, and designs emerge from self-organising teams. (AP 11)
- At regular intervals, the team reflects on how to become more effective, then tunes and adjusts its behaviour accordingly. (AP 12)

These twelve principles will help guide the development team to maintain a purely agile methodology.

The authors of the *Agile Manifesto* stress the importance of keeping with the principles in order to ensure the successful completion of a systems development project (Beck *et al.*, 2001). According to Livermore (2007) using agile methodologies enables software developers to produce higher quality software more quickly, because they were developed to improve the development process "by removing barriers to accepting business requirement changes during the development process" (p. 32).

2.3.4 The rise of ASDMs

As it has been discussed in section 2.3.1, systems development projects were not well planned and managed. The pre-methodology and methodology era's made systems development professionals and academics conceptualise better ways of handling systems development. This gave rise to a new way of thinking about the development of systems. The birth of agile methodologies – also known as lightweight methodologies – was as a result of many information technology (IT) practitioners discovering that there needed to be a simplified – and humane – way of building systems quickly without compromising the quality (Avison & Fitzgerald, 2006; Beck *et al.*, 1999; Highsmith, 2000; Poppendieck & Poppendieck, 2002; Riehle, 2000). Therefore the fundamental principles of ASDMs are founded on the principle that the humans involved in the project are one of the most crucial components. A discussion on the different types of ASDMs follows in section 2.3.5.

2.3.5 Types of ASDMs

In this section, some of the most commonly used agile methodologies by organisations are discussed.

These most commonly used agile methodologies are *eXtreme Programming (XP), Agile Unified Process (AUP), Adaptive Software Development (ASD), Dynamic System Development Method (DSDM), and Lean Software Development (LSD)*. The definition of systems development methodologies described in section 2.3.2 by Huisman and Iivari (2006) is used to discuss these methodologies. The components used to discuss the ASDMs are:

- *Systems development approach;*
- *Systems development process model;*
- *Systems development method*; and
- *Systems development technique*

2.3.5.1 Extreme programming (XP)

XP was first introduced by Kent Beck in 1996 and it is based on four values namely communication, simplicity, feedback and courage. It advocates constant communication between the customer and the development team by having an on-site customer representative.

XP is generally considered as a "lightweight" development methodology as it only focuses on the most important tasks in the project. The approach, process model, method and techniques of XP are summarised as follows.

- *Systems development approach*

The approach of this methodology is that systems need to be built quickly and this development is driven by tests. Testing is the vital part of XP as it is the first step that needs to be taken before coding (Beck, 1999).

- *Systems development process model*

According to Jeffries (2001), the development follows an iterative and incremental process. XP's measure of success is running software, and that is the goal after iterations.

- *Systems development method*

According to Beck (1999), XP ideally has a short initial development phase that is followed by production support and maintenance until the project is retired because it doesn't meet the new requirements of the business. In an XP project, the functionality of the system is expected to change often and the phases of XP assist in addressing this volatility. A brief summary of these phases in XP follows.

1) Planning

In this phase, user stories are written that help to map out the direction that the project will take. An important point to note is that no two XP projects are the same, and this thinking helps to delineate problems that are specific to the needs of the project.

The project is divided into iterations and the project velocity is measured against the schedule. The members of the team are identified and testing schedules are drawn up in this stage. This stage is crucial in determining the mission-critical requirements of the project.

2) Designing

The use of CRC cards helps give code ownership to the entire development team. The underlying value in this phase is simplicity as it will allow the team to uncover the most efficient system architecture for the project. A systems metaphor is also developed in this stage.

A system metaphor is a story that everyone involved in the project can understand about how the system works.

In this phase – and in the following phases – a crucial term in describing the continuous simplification of the system without changing its behaviour is known as refactoring. This is done whenever and wherever possible throughout the entire project lifecycle.

3) Coding

In this phase, the unit test is coded first before anything else. All code is pair programmed and the customer or customer representative is on-site and always available. This helps to ensure that what is being done is according to the standards agreed upon.

4) Testing

As mentioned in the coding phase previously, all code must have unit tests, and all code must pass all unit tests before it can be released. These unit tests are planned from the start of the SD project. In cases where a bug is found, tests are created so as to have a bug-free code. Acceptance tests are run often and scored against the requirements of the system.

- *Systems development tools and techniques*

The techniques used in XP are test driven development (TDD), pair programming and continuous integration. Each acceptance test is scored, and this score is compared with the requirements of the customer. If the score is unsatisfactory, immediate changes are made to the direction of the project.

2.3.5.2 Agile Unified Process (AUP)

The AUP was borne from the need to simplify the use of the Rational Unified Process (RUP). The use of RUP is very beneficial to an organisation but the learning process is too time-consuming and costly (Ambler, 2005), therefore AUP's aim was to maintain the principles of RUP but use them in a more agile way.

- *Systems development approach*

According to Ambler (2005), AUP is based on five key principles that honour the spirit of the Agile Manifesto. These principles are "Your staff know what they are doing", "Simplicity", "Agility", "Focus on high-value activities", and "Tailor the product to meet the business requirements".

- *Systems development process model*

AUP uses seven disciplines that streamline the system development process namely Model, Implementation, Test, Deployment, Configuration Management, Project Management and Environment. AUP is process-oriented and each of these seven disciplines run throughout the entire project lifecycle but in changing degrees. This continuous adaptation of these disciplines helps to ensure that the system being developed is relevant and consistent with the business requirements.

Like XP, AUP follows an iterative process. There are two types of release iterations in AUP namely Development Release iteration and Production Release iteration. When working code is deployed to a quality assurance area it is known as development release iteration. A production release iteration refers to the deployment to the production area. AUP applies iterative and incremental processes within the lifecycle.

- *Systems development method*

According to Ambler (2005), pure agile methodologies such as XP ignore many important issues which the customers face on a daily basis. Therefore, the use of AUP, as an agile methodology has key processes as mentioned in the process model section but also promotes quick development. A discussion on the stages in AUP follows.

1) Inception

The purpose of this stage is to identify the initial scope of the project, the system architecture and obtaining initial funding. All the initial requirements of the customer are agreed upon in this stage.

2) Elaboration

This stage aims to prove the system architecture proposed during the inception phase. Also, the functional requirements are clarified in this stage. Depending on the changes in the requirements of the system, much iteration is done.

3) Construction

Actual development and testing are done in this phase. All bugs are fixed and the goal here is to regularly build working software after each iteration. At this point the system should meet the highest-needs priorities set out by the customer.

4) Transition

In this phase validation takes place and the system is deployed into the product environment. At this stage the entire project is deemed to be complete but changes to the system can be quickly added on.

- *Systems development tools and techniques*

The techniques include test driven development (TDD), agile model driven development (AMDD), agile change management and database refactoring. All these techniques help improve productivity in the development process and therefore a high quality system is usually the end result.

2.3.5.3 Adaptive Software Development (ASD)

According to Highsmith (2000), ASD grew out of Rapid Application Development (RAD) and its aim is to address the inappropriateness of traditional management in the new economy of increased returns (Riehle, 2000). The pitfalls of the waterfall lifecycle plan-driven[3] approach are evidence enough to advocate for a methodology such as ASD. ASD tends to evolve as the changes of the user requirements become more volatile over time.

- *Systems development approach*

The evolutionary approach helps to ensure that the system being built meets the needs of the customers. Also, comparing it to the waterfall model[4], there is a deeper emphasis on employing a management style suitable in an ever-changing environment.

- *Systems development process model*

ASD is an iterative process and each iteration – called an adaptive cycle – has the following properties (Riehle, 2000):

  - *It is mission driven;*
  - *It is result driven;*
  - *It has a time limit;*
  - *It is risk driven;* and
  - *It is change tolerant.*

- *Systems development method*

The ASD has a lifecycle with repeating series of speculate, collaborate and learn cycles.

1) Speculate

[3]The pitfalls of the plan-driven approach includes inflexibility, requirements inconsistencies, difficulty to respond to change, system testing only when the entire system is built, and costly especially where changes need to be made (CMS, 2005).

[4] The waterfall model is an example of a plan-driven approach.

In this phase, a definition and goals of the system being built is mapped out. This phase also formulates the business requirements of the system. The word speculation is used for this phase because of the underlying principle that no one truly knows what will happen in the future.

2) Collaborate

In this phase, team members collaborate towards a product that includes features that have been suggested from the speculation phase.

3) Learn

Here, this end result is reviewed against the suggestions in the speculation phase. If the result is deemed to be unsatisfactory, the entire ASD lifecycle goes through another iteration until it meets the user requirements.

- *Systems development tools and techniques*

ASD does not promote the use of specific techniques. Rather, the techniques used are chosen solely by the development team. In other words, there are no preset tools and techniques but Highsmith (2000) stresses that the techniques used should promote a learning environment within each iteration. For example, a team using ASD in India can decide to use TDD as a technique and a team in South Africa can decide to use feature driven development (FDD).

2.3.5.4 Dynamic System Development Method (DSDM)

The DSDM was formally defined in 1994 by a consortium that wanted to expand on the Rapid Application Development (RAD) framework (DSDM Consortium, 2003). DSDM is another development methodology, like ASD, that is independent of tools and therefore can be implemented in an environment where structured analysis is the norm. DSDM promotes dynamic development of systems, meaning that systems are developed in a short time span irrespective of the changes made to the user requirements.

- *Systems development approach*

Its underlying principle of being independent of tools and techniques allows the systems development process to be dynamic and highly adaptive in fast-paced environments. Also, active user participation throughout the lifecycle improves the quality of the product.

- *Systems development process model*

DSDM uses incremental prototyping. Code is developed quickly and it is either approved or declined by the client. If it is declined, the lifecycle starts again from the initial phase. This process greatly reduces the project costs.

- *Systems development method*

DSDM has a five-phase lifecycle, namely Feasibility Study, Business Study, Functional Model Iteration, Design and Build Iteration and Implementation.

1) Feasibility Study

The problem statement is defined in this phase and the technical aspect of the required application is verified. The application is checked whether the Rapid Application Development (RAD) methodology can be used for development, and if it can be used, then the development process continues.

2) Business Study

In this phase, the business requirements are specified at an abstract level. Also, the information requirements of the system are identified. Thereafter the system architecture is prepared with the view of ensuring maintainability of the system.

3) Functional Model Iteration

Building the prototype is the main focus in this phase. The prototype is improved through demonstration to the user and the relevant changes to the system are incorporated in this phase.

An important point to note is that this phase is one of the two iterative phases of the entire DSDM lifecycle. The end product of this phase is a functional model consisting of the major functionality of the entire system.

4) Design and Build Iteration

This phase represents the second iterative phase in the lifecycle. The functional model from phase three is further refined to incorporate all the functional requirements of the system.

Once the system has passed all the tests, the system is deemed to be ready for implementation. The main focus in this phase is ensuring that the system is true to the operational environment in which it will operate.

5) Implementation

When the development team is in this phase, the system is deemed to have met all the user requirements. The users are trained and the system is put in the operational environment. If a new functional area needs to be incorporated, the lifecycle goes back to the business study phase until the users are satisfied with the end product. This iterative approach ensures that a high quality and relevant system is developed.

- *Systems development tools and techniques*

Like ASD, DSDM is independent of specific techniques. Depending on the requirements of the project, the development team can decide to use a family of techniques such as change management techniques and model driven development (MDD) along with prototyping.

2.3.5.5 Lean Software Development (LSD)

According to Alexandrou (2009) Lean software development (LSD) focuses on the development of change-tolerant software.

LSD focuses mainly on the project management aspect of the project and only considers the mission-critical requirements of the project. LSD is highly suited to be integrated with other more traditional methodologies (i.e. STRADIS, SDLC and SSADM).

- *Systems development approach*

LSD doesn't have a particular approach per se, but its underlying principles are (Norton, 2007):

- *Eliminate waste*

  Any task that doesn't improve the quality of code and doesn't improve on the time and effort taken is considered as waste. The end result in eliminating waste is to deliver value to the customer.

- *Amplify learning*

  A learning environment is promoted through a combination of tools such as feedback, iterations, synchronisation and set-based development. This learning process greatly benefits the customers in that a high-quality product is developed.

- *Decide as late as possible*

  Deciding late in a project greatly reduces the cost of change and therefore the overall project costs are kept to a minimum. The underlying principle here is that customers know what they want over time and therefore deciding late will help to ensure that the system is of a high quality.

- *Deliver as fast as possible*

  Like all agile methodologies discussed earlier, this is the ultimate goal of LSD. Working code is delivered to the customer as quickly as possible for approval.

- *Empower the team*

  The decisions to be taken should be done by the team members. This principle is fundamental in ensuring that the members are included throughout the lifecycle of the project. If team members have a sense of ownership in the project, then their motivation will increase.

- *Build integrity in*

  Everyone involved in the development process should be held equally responsible for all the decisions taken. Any problem in the project is everyone's problem.

- *See the whole*

  Many failed systems development projects are blamed on the systems developers. The truth is that the entire development team is to blame. Seeing a project in its entirety reduces the risk of failures in the long run.

This in turn boosts the morale of the development team and that translates into an excellent working environment for everyone.

- *Systems development process model*

LSD follows an iterative development process model. This model, like other agile methodologies, ensures that there is an overall high quality system developed and at fast rate.

- *Systems development method*

LSD can not be described in the same way as the previous ASDMs because it doesn't propose a specific set of practices that need to be followed.

Its aim is rather to promote principles described in the Approach section of this methodology. Therefore, LSD doesn't follow a set development lifecycle; it simply can be adopted by an existing methodology being used.

- *Systems development tools and techniques*

Poppendieck and Poppendieck (2002) argue for a need to think out of the box. By allowing flexibility, the authors believe that the end result will be a system of a very high quality. So, the ideology of LSD is to promote a methodology based on its principles and not practices that are cast in stone and should be followed.

All the previously discussed ASDMs are based on the assumption that in coping with high speed and frequent change, traditional management techniques are inadequate. These methodologies aim to promote and facilitate a flexible and adaptable environment where the development team members are regarded as the most important aspects of the development exercise. In the next section, the effectiveness of these methodologies is discussed.

2.3.6 The effectiveness of ASDMs

According to Boehm and Turner (2005), agile methodologies are characterised by development in short iterations, continuous refactoring and its capacity to handle ever-changing business requirements, and according to Mahanti (2006: 199), "common challenges in adopting agile methods are: serial thinking, closed mindedness, office politics, black and white mind-set, fear of change, specialized skills, outdated skills, documentation-heavy mind-set, and do-it-all-at-once attitude". These challenges will be discussed further in section 2.3.7. According to Lindvall *et al.* (2005) agile methodologies are gaining popularity even though they possess a mix of tried-and-tested and controversial software engineering practices. Results from a study conducted by Ceschi *et al.* (2005) suggest that the use of ASDMs improves the management of the development process as well as the customer relationship that the organisation enjoys.

The level of IT manager's satisfaction in terms of project planning was also found to be better when agile methodologies were used. If the principles of ASDMs – as stated in the Agile Manifesto – are adhered to, one of the resulting effects is that the development team begins to enjoy a development environment where decisions are made quicker than in plan-driven development teams (Cohn & Ford, 2003).

The major advantage that agile methods have over other methodologies is that it easily accommodates change due to volatile business requirements (Coram & Bohner, 2005). Four key Agile Ideas, as identified by Fruhling and De Vreede (2006: 60) are:

- People-oriented approach towards systems development;
- Working software is the progress determinant;
- Stakeholder inclusion throughout the entire systems development lifecycle; and
- Adaptation to changing user requirements.

These Agile Ideas were the findings of a study conducted by Fruhling and De Vreede (2006), and it was identified that in order for agile methodologies to be effective in an organisation, the project team needs to adhere to these ideas. Other advantages as suggested by Hayes (2003) include:

- A better return on investment;
- Corrective measures occur early on in the lifecycle of the project;
- Early cancellation of failing projects (if it is determined to be failing);
- Excellent software quality;
- Better control of the project;
- A strong emphasis on team work and increased flexibility.

Nerur *et al.* (2005: 77) argue to say that "[w]hile the opportunities and benefits that agile methodologies afford make them attractive, organisations should be circumspect in embracing them or in integrating them with existing practises". This is because of the challenges discussed by Mahanti (2006) and Schatz and Abdelshafi (2005), and these challenges are discussed in section 2.3.7. Although there are many discussions on the challenges in adopting an agile methodology (Jackson *et al.*, 2004 Kettunen & Laanti, 2007; Livermore, 2008; Asproni *et al.*, 2004; Nerur *et al.*, 2005; Mahanti, 2006), there is not enough research on the effectiveness of ASDMs in the telecommunication industry. The following section discusses the challenges faced in enterprise adoption of agile methodologies.

2.3.7 Challenges in adopting Agile Methodologies

Despite the benefits inherent in using ASDMs, organisations are faced with many challenges in adopting these methodologies. These challenges, identified by Mahanti (2006) and Schatz and Abdelshafi (2005) are:

- *Serial thinking*

  The development process of plan-driven methodologies tends to be linear in the sense that the development team only focuses on the task at hand.

  This thinking is borne of many years of experience in plan-driven methodologies, and changing this approach would pose a challenge.

- *Closed mindedness*

  For many IT professionals, learning a new development approach is very intimidating. This attitude has an effect on the introduction of fresh ideas in the organisation.

- *Office politics*

  Seniority plays a very important role in organisations that use plan-driven methodologies and the introduction of ASDMs, would result in the senior staff feeling left out because of the principles that these methodologies promote. Therefore the adoption of ASDMs would be met with strong resistance especially if the development environment in the organisation is bureaucratic.

- *Fear of change*

  This challenge is usually as a result of inadequate training and education in terms of the proposed change. Organisations need to educate their employees on the benefits that the change will bring. Many people fear what they don't understand, so it is the responsibility of management to gradually introduce the changes.

- *A specialised skills set*

  IT professionals who have been working in a particular industry over a long period, acquire a highly specialised skills set that is very specific to their trade. This specialisation has the negative effect of not being exposed to other philosophical views, and therefore the introduction of change would require a positive attitude from all IT professionals.

- *Documentation-heavy mindset*

  Plan-driven methodologies focus a lot of attention on documentation throughout the development lifecycle. The sudden introduction of a new methodology could result in the development team using plan-driven practises without even knowing it and the result effect could impact the success of the project.

This section highlighted the challenges in adopting ASDMs as identified by Mahanti (2006) and Schatz and Abdelshafi (2005). In the following section (2.3.8), a comparison of traditional systems development methodologies (plan-driven methodologies) and agile systems development methodologies is given.

2.3.8. Comparison of Traditional Systems Development Methodologies (TSDMs) and Agile Systems Development Methodologies (ASDMs)

In this section, a discussion on the differences between traditional systems development methodologies (TSDMs) and agile systems development methodologies (ASDMs) follows. There are various ways to compare SDMs. Bjørn-Andersen (1984) suggested a comparison framework that focused on criteria relating to the values and society of the methodologies being compared and Jayaratna (1994) who developed the Normative Information Model-based System Analysis and Design (NIMSAD) measured a methodology against three criteria namely: the "problem situation", the intended problem solver, and the problem-solving process.

For purposes of this discussion, the comparison framework by Nerur *et al.* (2005) will be used because it is the most recent. This comparison is guided by eleven (11) key attributes that are namely: *Fundamental Assumptions, Control, Management Style, Knowledge Management, Role Assignment, Communication, Customer's Role, Project Cycle, Development Model, Desired Organisational Form/Structure and Technology.*

According to Nerur *et al.* (2005), these attributes highlight the strengths of the methodologies, and therefore an unbiased view is given. In contrast to TSDMs, ASDMs concern themselves with the unpredictable nature of the development process, and by so doing; it relies on the skills of the team (Nerur *et al.*, 2005). Table 2.3 extracted from Nerur *et al.* (2005) contrasts the eleven key attributes of a systems development methodology follows.

Table 2.3: Traditional SDMs and Agile SDMs

	Traditional SDMs	**Agile SDMs**
Fundamental Assumptions	Characterised by predictable and specifiable systems where changes are not seen as normal.	Characterised by software of a very high-quality and very accommodating to change. These methodologies thrive on changes in the user-requirements.
Control	The processes of the methodology dictate how the project will be executed, hence process-centric.	The people involved in the project are the most important stakeholders and they are directly responsible for the success or failure of the project, hence people-centric.

Management Style	Command-and-control. This style can also be seen as a top-down management approach.	Leadership-and-collaboration. This style can be seen as a bottom-up management approach.
Knowledge Management	Explicit	Tacit
Role Assignment	Individual – favours specialisation.	Self-organising teams – encourages role interchangeability
Communication	Formal and rigid	Informal and these methodologies thrive on face-to-face conversations.
Customer's Role	Important	Critical
Project Cycle	Here, these methodologies are guided by the tasks and activities.	Guided by working code and product features.
Development Model	Life-cycle model such as Waterfall, Spiral, etc.	The evolutionary-delivery model.
Desired Organizational Form/Structure	Bureaucratic with high formalisation.	Organic and people-friendly. Thrives on communication and collective effort.
Technology	Can adapt to any technology.	Leans more towards object-oriented technology.

As it can be seen from table 2.3, both methodologies are suitable within specific domains, and their use can increase the success rate of development projects (Fitzgerald, 1996).

TSDMs are more involved with the mechanics of the methodology, whereas ASDMs focus more on the people aspect of the development project (Nerur *et al.*, 2005). Fowler (2005) goes further to say that the main differences between traditional methodologies (i.e. SDLC) and agile methodologies (i.e. XP) are twofold:

- Agile methods represent an adaptive approach rather than a predictive approach. If we visualise methodologies being on a continuum, agile methodologies will be firmly placed in the region where these methodologies have capabilities that allow the development team to introduce changes late in the lifecycle rather than more traditional methodologies that advocate stringent planning from the onset of the project.

- Agile methods are more focused on the human aspect of the project rather than the processes. This key attribute of ASDMs aims to promote an inclusive atmosphere between the members of the team and management. It also aims to shy away from the goal of engineering methods that strive to define a process on its own without appreciating the human aspect of the project.

In terms of the cost of change over time, Boehm *et al.* (2000) found that traditional SDMs, when compared to ASDMs, have difficulties containing these costs especially late in the project life cycle. Although there are a myriad of management tools to reduce these costs (Highsmith, 2000), traditional SDMs cannot compare with ASDMs. Diagrammatically, these differences are shown in figure 2.1 and figure 2.2.

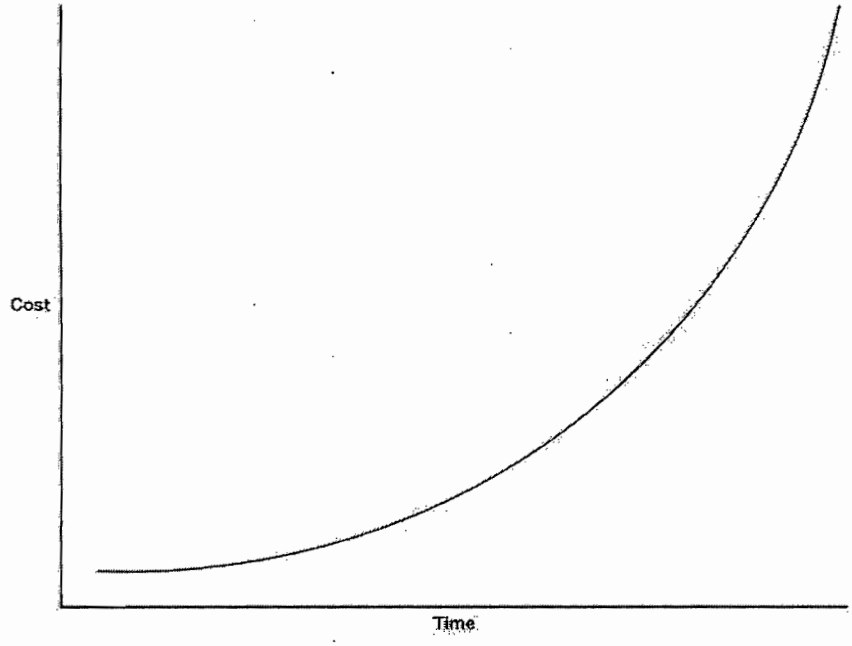


Figure 2.1: Cost of Change Vs Time (Traditional SDMs)

As it can be seen, over time the costs of changing the requirements in a traditional SDM grow exponentially. Whereas in an ASDM (figure 2.2), the costs are substantially lower over time and these costs are kept to an absolute minimum. The x-axis represents the duration on the lifecycle and the y-axis represents the cost of change.

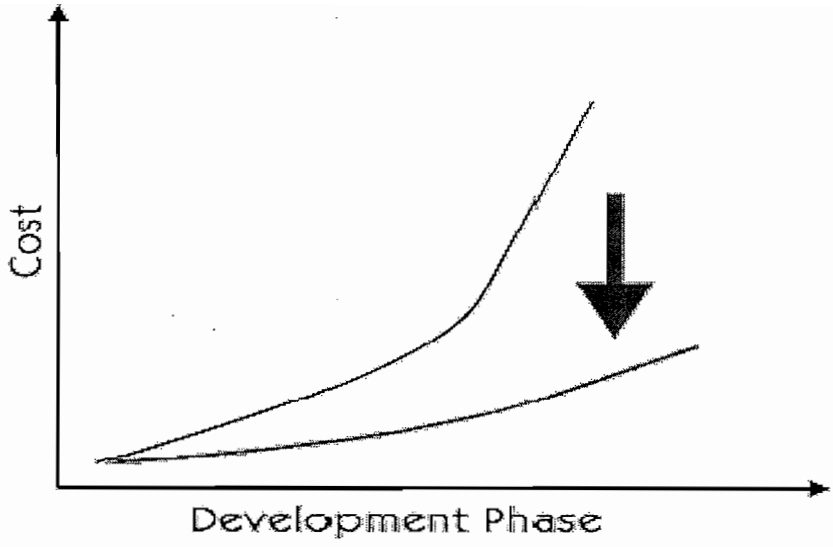


Figure 2.2: Cost of Change Vs Time (ASDMs)

The figures above show a clear indication that as the lifecycle of SD project progresses, the costs of changing the requirements impact on the overall costs of the project. In agile methodologies, the costs involved are better managed than in traditional methodologies (figure 2.2). In the next section, methodologies specifically developed for the telecommunication industry is discussed.

2.3.9 SDMs specifically for the telecommunication industry

There are a handful of methodologies that were developed specifically for the telecommunication industry. The aim of the methodologies is to mitigate the risks of creating systems that do not represent the processes and models found in telecommunication organisations. If a system is found to be inadequate, the repercussions could mean that the business will not be able to compete with organisations effectively and hence, the migration of their clientele to other providers. Therefore a systematic approach needs to be adopted although in practice that is not the case (Avison & Fitzgerald, 2002).

The methodologies that were developed for use in the telecommunication industry are discussed in sections 2.3.9.1 to 2.3.9.3. These methodologies are MODA-TEL, Mansurov's Accelerated Development Methodology and Mobile-D. According to Otto (2007), these methodologies are not being used by the telecommunication industry in South Africa.

2.3.9.1 MODA-TEL

According to Otto (2007), this methodology follows an object-oriented approach because it is based on the Model Driven Architecture (MDA) which has certain object-oriented characteristics. Although it is a methodology, "it does not define a methodology as a body of interrelated methods and rules" (Beluande *et al.*, 2003). There are typically three categories of users namely: 1) Build know-how, 2) Assemble, combine, customise and deploy know-how, and, 3) Apply know-how. These categories are shown diagrammatically in figure 2.3.

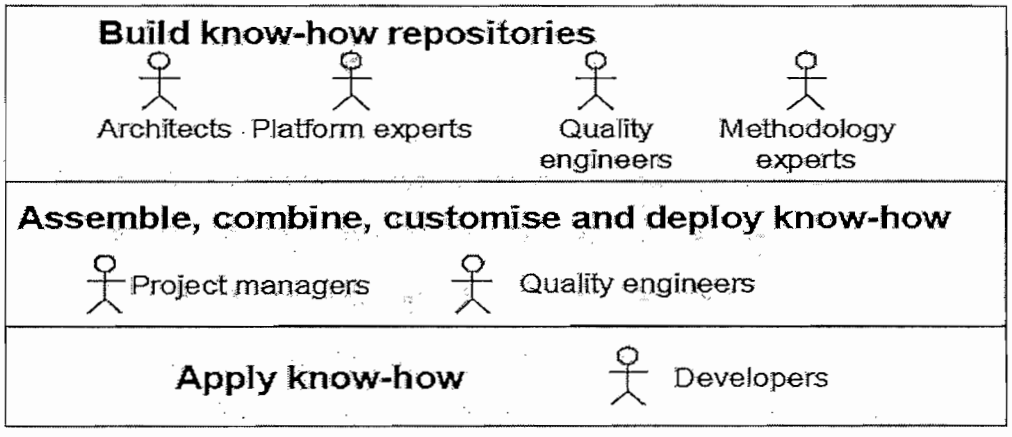


Figure 2.3: Population of MDA users (Extracted from Beluande et al., 2003)

The three categories identified in Figure 2.3 represent the owners of the system being developed. The descriptions of these categories, as identified by Beluande *et al.* (2003) are:

- The first group typically accounts for the expertise required for building the repositories. Typically, this group accounts for approximately 5% of the total MDA users' population.
- The second group is involved with the management aspect of the deployment of MDA technologies. These users ensure that the project meets the requirements set out in the solicitation document. Also, this group amounts to approximately 5% of the total MDA users' population.
- The third group concerns itself with the application of expertise towards the MDA project. Here the composition is estimated at approximately 90% of the total MDA users' population.

The MODA-TEL methodology identifies the following phases (Beluande *et al.*, 2003):

- Project Management

  This phase ensures that the project is within the constraints spelt out in the specification document. This phase runs throughout the entire project lifecycle.

- Preliminary preparation

  The technical aspects of the project are identified in this phase. This is to ensure that the project has tangible goals to achieve.
- Detailed preparation

  This builds on phase 2 but in more detail and is more precise.
- Infrastructure setup

  The selection of the tools that will support the development process is done in this phase.
- Project execution

  This phase concerns itself with the implementation of the project. All the mission-critical functions specified by the customer are included here.

Figure 2.4 shows the phases in the MODA-TEL methodology and how they correspond to the available and required expertise.

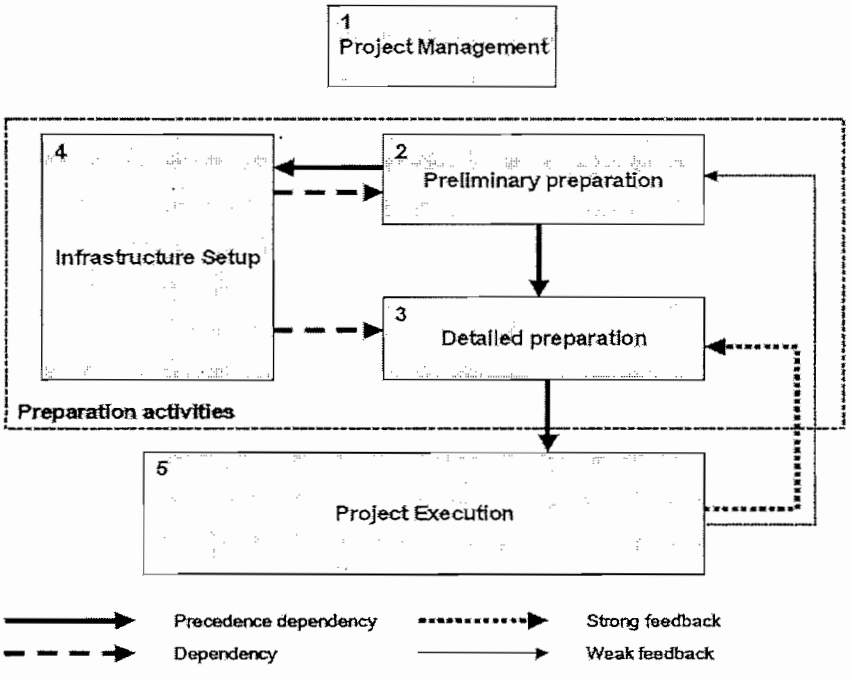
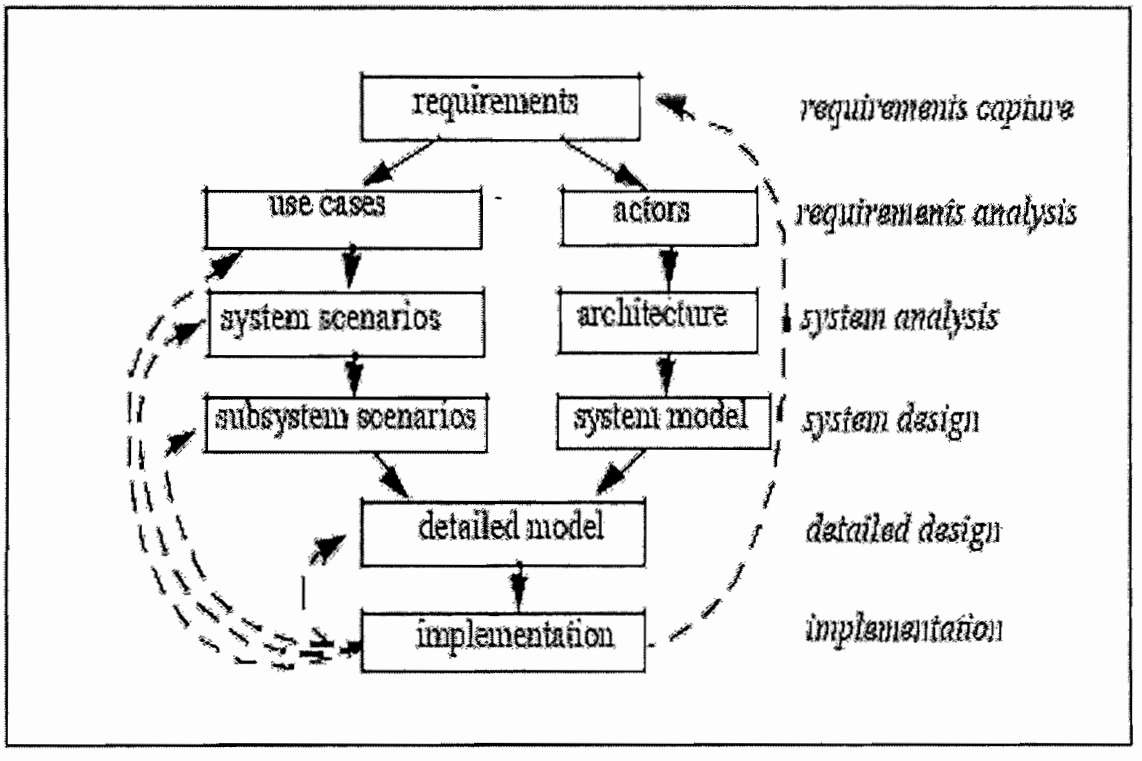


Figure 2.4: Basic phases of the MODA-TEL methodology *Source: Beluande et al. 2003*

Phase 1 corresponds to the second group of expertise (Assemble, combine, customise and deploy know-how), phases 2, 3 and 4 correspond to the first group of expertise (Build know-how repositories), and finally phase 5 corresponds to the third group of expertise (Apply know-how).

2.3.9.2 MANSUROV'S ACCELERATED DEVELOPMENT METHODOLOGY

According to Mansurov (2000), the methodology is "based on extensive use of formal methods and formal languages for the description of the software very early in the development process". Diagrammatically, the methodology follows a classical SDM, but further inspection shows that the methodology is uniquely specific to systems development for telecommunication systems. Figure 2.5 diagrammatically shows the different phases in this methodology. As it can be seen, at each phase a confirmatory step is taken to ensure that the plans and objectives of the previous step are met accordingly. The goal of this methodology is to ensure that the right product is delivered at – or before – the scheduled time, and a strong characteristic of this methodology is that it goes through short iterations.



Source: Mansurov, 2000

Figure 2.5: Stages in Mansurov's accelerated development methodology

Also, the foundation of this methodology is on a use-case based object-oriented development methodology (Otto, 2007), but there is an emphasis on accelerated development (Mansurov, 2000). In other words, this methodology follows ASDM principles.

The methodology uses widely accepted telecommunication formal languages, which are standardised by the International Telecommunications Union (ITU), such as Specification and Descriptive Language (SDL), Message Sequence Charts (MSC) which is like Unified Modelling

Language (UML), a test description language called Tree and Tabular Combined Notation (TTCN), and a data description language called Abstract Syntax Notation (ASN.1).

One of the benefits of the methodology, according to Otto (2007), is that the time-to-market is increased by 20%-30%. This is a phenomenal achievement, given the fact that the telecommunication industry is highly competitive, and hence the speed of development is very important. The phases of the methodology, as seen in figure 2.5 are:

- Requirements capture

  In this phase, the initial requirements are identified. Face to face meetings with the customer are conducted in order to gain insight into the project that the customer envisions.
- Requirements analysis

  A thorough investigation into the requirements of the customer is undertaken. This phase helps the project team map out the entire project from inception to project completion.
- System analysis

  In this phase the product functionality is identified. Also, all the resources needed for the successful completion of the project are identified.
- System design

  This phase concerns itself with the design aspects of the project. Examples include use-case diagrams, state chart diagrams and dataflow diagrams
- Detailed design

  Here, the actual complex software processes are identified and mapped out. In this phase the developers develop complex artefacts.
- Implementation

  In this phase the entire plan of the project is put together with the view of accurately satisfying the needs of the customer. If the project is deemed to be a failure, the project team will back track to see which phases didn't capture the essence of the needs of the customer.

According to Mansurov (2000: 2), there are certain barriers in adoption of formal methods in industry, namely "support of early development phases and existence of legacy software". Therefore, the accelerated development methodology aims to lower these barriers and hence decrease the time-to-market. Throughout the methodology's lifecycle, an important point to note is that there is a "validation" process that takes place before moving to the next phase. This is done to ensure that defects are minimised in the end product (Mansurov, 2000).

2.3.9.3 MOBILE-D

According to the VTT website, Mobile-D is a methodology for agile systems development and it is suitable to various applications. The Mobile-D methodology goes through five phases and within each phase there are tasks that need to be executed before commencing to the next phase. The phases are *Explore, Initialize, Productionize, Stabilize and System test & Fix*. Within the Explore phase, there are three stages that need to be undertaken namely, stakeholder establishment, scope definition and project establishment. According to Salo and Hulkko (2004), this phase involves the planning and establishment of the project. This phase is important because it sets the grounds for properly managing the development process of the project. Moving to the Initialize phase Ihme (2005) states that this pattern classification is essential because this phase concerns itself in dealing with the forthcoming project phases. The goals of this phase are twofold: to gain a deeper understanding of the product to be developed and to prepare all the required human resources – internally and externally – so that they are completely ready for implementation requirements.

Within this phase, there are four stages that need to be undertaken namely, project set-up, planning day in 0 iteration, working day in 0 iteration and release day in 0 iteration. 0 iteration simply means that there have been no iterations yet in that particular stage. The purpose of the project set-up stage is to analyse and determine all the resources required for the project, and also identify project specific ways to communicate with the customer. In the planning day in 0 iteration stage, the tasks involve architecture line planning and initial requirements analysis. In terms of the working day in 0 iterations, this stage concerns itself with setting-up the technical development environment and ensuring that everything is ready for implementation. The release day in 0 iteration is an optional step which depends on the size of the project and environment.

The next phase, Productionize, concerns itself with the functionality that needs to be implemented (Koskela & Kyllönen, 2004), and the goals are to "implement the customer prioritized functionality to the product, and focus on the crucial core functionality" (p 1). In order to move to the next phase, the most important functionality has to be completed. The Stabilize phase, which follows after the Productionize phase, has only one task namely system integration. According to Ihme (2004), the purpose of this phase is to ensure the quality of the project implementation.

Ihme (2004: 1) goes further to say that the goals include "finalizing the implementation of the product, enhancing and ensuring the quality of the product, and finalizing the documentation of the product". The exit criteria of this phase are that one hundred percent of the necessary functionality needs to be working and the requirements of the customer need to be met. In the final phase – System test & fix – the purpose of it is to see if the product accurately meets the requirements of the customers' defined functionality (Jäälinoja *et al.*, 2004). The goals of System Test & Fix are to:

1) Ensure that the system functions in accordance to the project documentation;
2) Undertake a thorough debugging process and report back on any defects found; and
3) Produce a bug-free and flawless product for the customer.

The entry criteria are that the preceding phases needs to be completed, and the deliverables of this phase are a well tested and bug-free system and documentation explaining all the defects found within the system. Figure 2.6 shows the phases and tasks in the Mobile-D methodology.

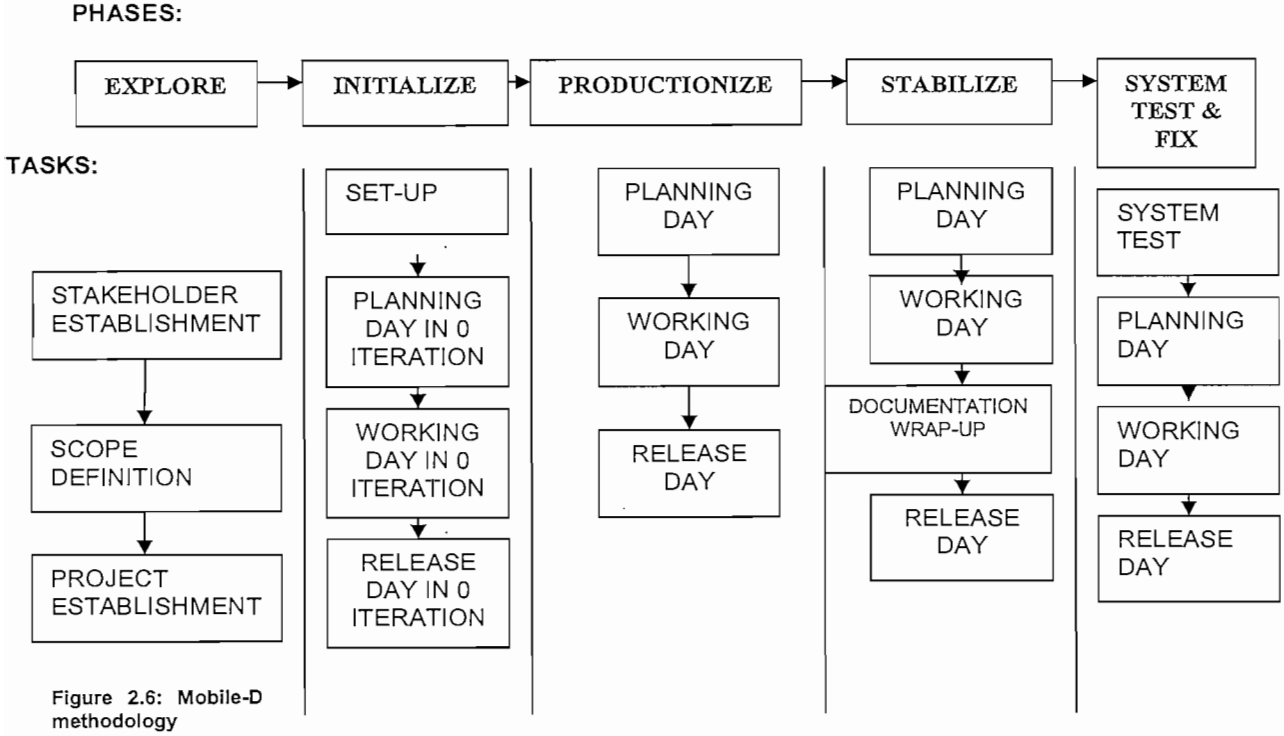


Figure 2.6: Mobile-D methodology

2.3.10. Previous studies linking SDM'S to telecommunication industry

The telecommunication industry, in its broadest sense, is a diverse industry with companies ranging from large multinationals to one person owner-managed businesses. The purpose of these companies, amongst other things, is to stay afloat with the ever-changing nature of the industry.

The industry's unprecedented growth has forced companies to continuously review the speed at which they are able to satisfy the market needs (Kettunen, 2007). It is for this reason that companies are continuously being exposed to new technologies and new ways in solving complex problems inherent in a large industry like telecommunication. Therefore, this section aims to identify previous studies that linked SDMs with the telecommunication industry. More specifically, the studies identified were authored by Otto (2007), Theunissen and Kourie (2003) and Koutsoukos *et al.* (2001) respectively. These studies centred on identifying SDMs used by companies operating in the telecommunication industry and how effective they are in addressing the slippery concept of a project being delivered on time, within budget, and according to the clients' specification. These three constraints (time, budget and user requirements) are pivotal in the determination of project success. A more in-depth discussion on each of these studies follows.

In the study authored by Otto (2007), the results are discussed according to the objectives of the study.

Systems Development Methodology Used

- Of the identified cases, the companies tended to "make use of their own, in-house systems development methodology, because the formal systems development methodologies were believed to be too theoretical and only beneficial to big companies"(p.124)
- Not enough time was spent on requirements analysis due to time constraints.
- Virtually all the cases used formal design techniques, but some elements of system design did present themselves

Key aspects of mobile telecommunication software development

- Companies operating in the telecommunication industry need to be flexible and adaptable in relation to the size of the development teams as well as the product produced.
- Companies had extremely short amounts of time for development. This is because of the competitive nature of the industry.

In the study authored by Theunissen and Kourie (2003), it was identified that the Telkom Development Laboratory (TDL) implements a tailored version of the Rational Unified Process (RUP). Once the requirements of the system are agreed upon, the information is captured and modelled into Ration Rose.

After that an architectural team begins the task of analysing theses requirements and identifies high-risk use cases which are then the first to be implemented in order to reduce their inherent risks involved. Thereafter the system begins to be built using Java and/or C++ depending on the project. Once the software is built, another section within the TDL tests the system to see if it does what it is required to do. If the results of the testing are satisfactory, the software developed is then sent to the client for approval. TDL's use of the RUP had allowed them to enjoy a success rate of close to 100%. A major challenge identified by the researchers was that TDL sometimes experienced the familiar problem of trying to meet changing user-interface specifications.

In the study by Koutsoukos *et al.* (2001), the objective was to propose a contract-based development methodology. The term "contract-based" refers to a connection that is between a group of objects and this group have certain rules and constraints that need to be met (Koutsoukos *et al.*, 2001). Although this methodology has been applied to other application domains, the authors feel that the methodology is more suited for the telecommunication industry. The authors went further to state that object-oriented techniques, which are widely accepted techniques, limit the ability to build systems that "exhibit the agility required by the volatility of business domains" (p. 7).

In all these studies identified above, the common thread is that there is a need for an agile systems development methodology. This is because of an ASDM's ability to absorb changes to the business requirements of a systems development project at any time during the development lifecycle, and hence making it better suited for an industry as diverse and volatile as the telecommunication industry. The studies that were identified will be compared in a tabulated form (see table 2.4) in order to show the different thrusts that they aim to address.

Table 2.4: A comparative summary of the studies

	Study by Otto (2007)	**Study by Theunissen and Kourie (2003)**	**Study by Koutsoukos *et al.* (2001)**
Telecomm Environment	Mobile Telecommunication Environment	Telkom	The entire telecommunication industry
Methodology used	It was identified that most companies used in-house developed methodologies.	A tailored version of RUP, which is an Object-Oriented	Proposes a contract-based development methodology which

		Development Methodology.	aims to address the pitfalls of Object-Oriented techniques.
Pitfalls of methodology used	Otto identified that there was a need for a methodology that was more flexible and agile.	Because of the three barriers identified by Mansurov (2000), there is a need of an agile SDM.	This methodology supports an agile methodology and hence reduces the time-to-market.

Although there are many research reports on either SDMs or the telecommunication industry, there is not enough literature that discusses SDMs within the context of the telecommunication industry. According to Amyot and Eberlein (2003) there is little research that compares different development approaches within the telecommunication domain, and therefore more research discussing the telecommunication in unison with SDMs needs to be promoted.

2.4 SUMMARY

In this chapter, a discussion on agile systems development methodologies (ASDMs) highlighted the most important traits of such a methodology against the backdrop of the telecommunication industry. According to Beck *et al.* (2001), the Agile Manifesto is a guideline to all software professionals wanting to ensure that they maintain agile processes. Its aim is to promote a people-centric environment, and hence reduce the continued failures encountered in the systems development profession, as discussed in the section on the software crisis. Previous studies linking SDMs to the telecommunication industry were discussed and it was concluded that there is a need for an agile SDM for the industry due to its highly competitive and volatile nature. Also, a section on the differences between Traditional SDMs and Agile SDMs was discussed and it was shown that the costs of changing user requirements late in the development lifecycle grew exponentially in TSDMs as compared to ASDMs. This was done to show each of the strengths inherent in the methodologies. In the following chapter, the research design and method of this study is discussed.

CHAPTER 3
RESEARCH METHOD AND DESIGN

3.1 INTRODUCTION

This chapter discusses the research methodology used to answer the main research questions which are:

- *Can ASDMs be applied in the telecommunication industry?*
- *How agile are current SDMs in the telecommunication industry?*

These questions are answered by identifying three companies that are well established in the telecommunication industry. The research is based on the interpretive research paradigm and the research method used is the case study method. Semi-structured interviews and questionnaires were used as the data-collection methods of this research, and the content analysis and cross-case analysis methods were used as the data-analysis methods. According to Yin (1993), studying multiple cases will allow the researcher to generate very robust and consistent findings. The strength of this research also lies in the fact that qualitative and quantitative data is collected by means of semi-structured interviews and questionnaires respectively. In reporting the findings from the questionnaires, descriptive statistics will be used extensively. The actual reporting of the results will be done in chapter 4. In the following section the two different groups of research is introduced.

3.2 WHAT IS RESEARCH?

According to Miller and Tewksbury (2006), research can be categorised into two groups namely, *basic research* and *applied research*. In terms of basic research, it is the study of a particular domain with no particular plan or purpose in mind (Miller & Tewksbury, 2006), whereas applied research refers to those research strategies that facilitate a deeper and meaningful understanding of a particular phenomenon. There are two predominant approaches that occur in applied research. There is the quantitative research approach and the qualitative research approach. Eysenck (2004) argues that in quantitative research, the data gathered is or can be expressed numerically, whereas in qualitative research the data gathered usually draws upon stated experiences of the respondents, and the meaning attached to those experiences can allow the researcher to gain a deeper and richer understanding of the particular phenomena.

Miller and Tewksbury (2006) go further to say that in qualitative research the goals are usually about the attached and personal meanings to the participants of a particular domain and/or phenomena. Also, Seaman (1999) states that qualitative research methodologies allow the researcher greater opportunities to gain depth and breadth of the inherent meaning. Therefore, the qualitative research approach is the grounds on which this research is built, because of the benefits that it holds of gaining a deeper and more thorough understanding of the particular domain or phenomena to be studied.

Within the chosen research approach, there are three prominent research paradigms that exist, although there are others that were discarded or still to be accepted widely by the research fraternity (Taylor, 2006). These three prominent research paradigms are positivist research, critical social research and interpretive research. Guba and Lincoln (1994) suggest that there are four underlying paradigms specifically suited for qualitative research namely, positivism, post-positivism, critical theory and constructivism. A discussion on only the three prominent research paradigms as identified by Taylor (2006) follows in section 3.3.

3.3 RESEARCH PARADIGMS

By the late 1980s, only the positivist and interpretive research paradigms had emerged and been in use extensively (Taylor, 2006). Critical social research only came into existence in the early 1990s and its purpose is to consider other aspects such as social, cultural and political domination (Myers, 1997), and therefore uncover hidden interests and displace ideology with scientific insight (Gephart, 1999). According to Hopkins (2002), a research paradigm refers to those beliefs and methods that researchers use to explain the world around them. Discussions on each of these three paradigms follow.

3.3.1 Positivist research

According to Myers (1997), this paradigm generally attempts to test theories and thereby identify a predictive understanding of a particular phenomenon. Also, Gephart (1999) argues that positivism assumes an objective approach to phenomena, and it often searches for facts borne of certain identifiable and provable variables. Krauss (2005) goes further and states that positivism is "seen as the way to get at truth, to understand the world well enough so that it might be predicted and controlled" (p. 760). Also, according to Belbase (2007), positivism can be seen as objective and dispassionate approach of proving or disproving scientific facts. Its main focus is through objective explanations of controlled conditions (Taylor, 2006), and therefore a hard approach is usually the norm within this paradigm.

3.3.2 Critical social research

According to Belbase (2007), the aim of this paradigm is not only to voice the concerns of the subjects or phenomena studied, but it also promotes a social change to what is being done. Burke (2007) goes further to say that the goal of this paradigm is "to return or give power to those who need it most" (p. 480). The nature of reality in this paradigm according to Voce (2004) is that it is governed by many conflicting and underlying structures such as social, political, cultural, economic, and ethnic and gender issues. Put differently, this simply means that this paradigm concerns itself with the human aspect of the phenomena to be studied, thereby enlightening the respondents in the study about their particular environment (Taylor, 2006). Furthermore, Belbase (2007) argues that the critical paradigm sheds light on human injustices – past or present – but does not aim to address those issues. It simply gives a new dimension to the thought process involved when conducting a research.

3.3.3 Interpretive research

According to Gephart (1999), the key focus or idea of this paradigm is to search for patterns of meaning, and "it seeks to understand social members' definition of a situation" (Schwandt, 1994: 118). The interpretive paradigm allows the researcher to study the behaviour or actions of a subject within a particular environment, and therefore grasp a deeper understanding of a particular phenomenon. According to Voce (2004), there exists multiple realities and there are personal experiences attached to a single phenomenon of which the research needs to identify. Myers (1997) goes further to say that the subjects of the study most likely perceive a phenomenon differently among each other, and it is therefore very important for the researcher to identify those discrepancies and try to explain that phenomenon in a coherent manner.

Therefore, this research has made use of the interpretive research paradigm in order to understand – without any bias – the systems development methodologies used in the telecommunication industry, and to find out if the said methodology can be used to address the challenges faced by the telecommunication industry in South Africa. In the following section, the research methods used in this study are discussed.

3.4 RESEARCH METHODS

According to Myers (1997), a research method refers to a way of gaining insight into a particular phenomenon, and it is informed by the underlying epistemological assumption – either positivist, critical social, or interpretive – as discussed in section 3.3. In this section, a discussion on some research methods associated with the interpretive paradigm is given.

These research methods are: Case study method, Action research method, Ethnography and the Participant-Observation method. Thereafter, a discussion on the research method used for this research is given.

3.4.1. Case study

The case study research method is one of the most commonly used ways to critically study a case (Creswell, 2008; Orlikowski & Baroudi, 1991; Alavi & Carlson, 1992) especially when a specific context or specific individual is being extensively studied (Trochim, 2006). According to Yin (2002), a case study is an empirical inquiry that aims to investigate phenomena within its particular setting so that the context in which the phenomenon is being studied is identifiable and explainable. The case study method helps to gain in-depth and insightful information in a way that the phenomena can be delineated and expressed. According to Myers (1997), the case study research method is highly suitable for information systems research. Therefore, the richness of the data gained from conducting a case study research method has supported its choice in this research. A more detailed discussion on the case study research method follows in section 3.4.5. Other research methods associated with the interpretive paradigm is discussed in sections 3.4.2-3.4.4. These discussions on other research methods are used to present the contrasting principles between them and the case study research method which is the research method used in this research.

3.4.2 Action research

According to Rapoport (1970: 499) action research "aims to contribute both to the practical concerns of people in an immediate problematic situation and to the goals of social science by joint collaboration within a mutually acceptable ethical framework". According to Ferrance (2000) action research is a reflective process that is a collaborative activity among colleagues, and its aim is to search for solutions to problems encountered by individuals on a day to day basis. Borg (1981: 313) goes further to say that "action research emphasizes the involvement of teachers in problems in their own classrooms, and has as its goal the in-service training and development of the teacher rather than the acquisition of general knowledge in the field of education".

Therefore, it can be seen that action research requires the researcher to be intimately involved with the particular domain, and make the required interventions necessary for taking corrective steps in that domain.

3.4.3 Ethnography

A report by AIGA states that ethnography is a research method that is based on observing people within their natural environment rather than in a formal research setting. This enables the researcher to identify traits that are particular to that setting and therefore the researcher is able to make more conclusive assumptions about the phenomenon being studied. A trained ethnographer collects photos, videos, audio and other contextual data, and then uses this data to tell a story about the environment being studied. The steps in ethnographic research include: 1) defining the problem, 2) finding the people who are most likely to shed light on the questions, 3) planning an approach, 4) collecting data by means of identifying attitudes, mannerisms, vocabulary and group dynamics, and finally 5) analysing the data and interpreting opportunities for future research.

3.4.4 Participant-observation

According to Cooper *et al.* (2004) the participant-observation method requires the researcher to become a complete part of the domain being studied in order to record conduct under the widest range of settings. Also, participant-observation covers a wide range of ethical issues that are usually very complex and often unpredictable. There are many ethical issues regarding participant-observation research, and it is the duty of the researcher to identify them and ensure that they follow the guidelines for ethical conduct in participant observation. According to Rankin and Bertrand (2005), this type of research method is historically associated with a method in which the researcher becomes a part of the small community being studied for extended periods of time.

3.4.5 Research method used

A case study basically involves extensive observations of a few individuals. According to Myers (1997), the primary differences between the participant-observation method and the case study method is that the former involves the active participation of the researcher as discussed in section 3.4.4, whereas the case study method simply reports back on what has been observed in the phenomena. According to Abercrombie *et al.* (1984: 34), a case study is defined as "the detailed examination of a single example of a class of phenomena".

Although there have been many authors that have written many articles rejecting this method's ability to add to the body of scientific knowledge (Dogan & Pelassy, 1990; Campbell & Stanley, 1966), many of them have misunderstood the inner workings and strategies used in case study research (Flyvbjerg, 2004).

Flyvbjerg (2004: 422) goes further to say that "the closeness of the case study to real-life situations and its multiple wealth of details are important because it allows for the development of a nuanced view of reality". This simply means that the researcher is able to make his or her assumptions and conclusions without any rigorous restriction of thought. Therefore, it is evident from the discussion above that the case study research method is sufficient when intensively studying multiple cases as is the case in this research. According to Flyvbjerg (2004), if a case is extensively studied, the researcher is more than able to conclude on the particular phenomenon being studied and therefore make scientifically solid conclusions on that particular domain. Soy (1996) identifies six steps that should be followed when using the case study method. Yet another author (Yin, 1994) suggests that the case study method typically follows four stages. For purposes of this study, the researcher has decided to use the steps identified by Soy (1996).

3.4.5.1 Case study steps

- **Step 1: Determine and define the research question**

This is the first – and most crucial – step in applying the case study method, as it helps the researcher establish a strong focus in terms of the phenomena to be studied. The research questions formulated in this step helps the researcher to critique the phenomena in such a way that the problem identified can be adequately addressed.

As it has been identified in chapter one, the focus of this research is to identify whether agile systems development methodologies (ASDMs) are used in the telecommunication industry, and – if not – whether they are applicable in the industry. Not much research has been done on ASDMs in the telecommunication industry in South Africa, and those that exist suggest that ASDMs be used in the telecommunication industry (Otto, 2007; Theunissen & Kourie, 2003). Therefore this step forms the foundation in how the research questions regarding the applicability of ASDMs in the South African context will be answered. With the current situation facing the telecommunication industry, this study also aims to identify the SDMs used and ascertain the degree to which these methodologies address the challenges faced by the industry. The main research questions for this study are:

- *Can agile SDMs be applied in the telecommunication environment?*
- *How agile are current SDMs in the telecommunication environment?*

- **Step 2: Select the cases and determine the data-gathering and analysis techniques**

In this step, the researcher decides on what approaches to use in identifying the multiple real-life cases to be studied (Soy, 1996). Also, the different instruments or techniques should be identified that will help the researcher analyse the data collected.

In this research, the researcher used specific criteria when choosing the cases to study. The criteria included the size of the company, how long it has been in operation and its level of influence in the telecommunication industry. Although there were many companies that passed this criteria test, the researcher only chose to study three such companies namely Company A, Company B and Company C. These companies are well established in the telecommunication industry, and their total revenue exceeds R50 billion. The reason for choosing such large companies was because the researcher felt that these companies followed industry best practice in terms of systems development and therefore they would answer the research questions effectively. A brief description of each company follows.

Company A was founded in 2001 and is 100% owned by 3C Telecommunication. It has more than 5 million customers and it operates in all the provinces of South Africa.

Company B is a leading African communications group providing mobile communications and related services to 39,6 million customers. Its mobile network covers a total population of approximately 182 million people across five countries namely, South Africa, Tanzania, the DRC, Lesotho and Mozambique.

Company C has one of the largest telecommunications networks on the African continent, and recently it has diversified into Middle-East Africa. In South Africa alone it has more than 15 million subscribers connected to its network.

In terms of the data-gathering and analysis techniques, the researcher decided to use questionnaires and semi-structured interviews to gather the data, and ATLAS.ti (see section 3.6.3.1 for a detailed discussion) and SPSS (see section 3.6.3.2 for a detailed discussion) to analyse the data. Most of the questions in the questionnaire (see appendix A) used the Likert scale to measure the extent to which a respondent agreed or disagreed with a statement. The decision to use questionnaires and semi-structured interviews was taken so that a complete picture could be obtained from each case being studied.

- **Step 3: Prepare to collect the data**

In this step, the researcher needs to be well conversed with the data-gathering techniques to be used. The scope of the data needs to be established so that the researcher does not get overwhelmed with the large amounts of data.

In this study, semi-structured interviews and questionnaires were used to collect the data. In preparation to collect the data, the researcher conducted a review on the different methods to be used in the research.

The use of semi-structured interviews as well as questionnaires assisted the researcher in gaining an in-depth view and assessment of what is currently being done in the telecommunication industry in South Africa.

- *The interview questions*

In this section, the questions used in the interview are discussed in a tabulated form. Firstly, general questions about the interviewee's job responsibilities were asked. The motivation for asking these questions was to ascertain whether the interviewee was the right person to gain information from. Table 3.1 gives the actual general questions asked in the interviews.

Table 3.1: General questions used in the interviews

Questions	Motivation
What is your job title and what are your job responsibilities?	This question was used to break the ice between the interviewer and the interviewee. The interviewee also used this question to ease into the rest of the interview without intimidating the interviewee.
Are you involved in information systems development?	This question determined whether the interviewee was a relevant source of information given the direction of this study. The response to this question would allow the researcher to determine the direction which the interview would take.
How many years experience do you have in actual systems development?	This question allowed the researcher to ascertain the possible level of knowledge regarding SDMs the interviewee had. It was assumed by the researcher that the more years of experience, the more knowledgeable the

	interviewee would be.

Table 3.2 gives the questions asked during the interview that aimed to answer the first mini-research question which was "What SDM is currently being used in the organisation?"

Table 3.2: Mini-research Question 1: What SDM is currently being used in the organisation?

Questions	Motivation
What is the name of the systems development methodology you use in the organisation?	The aim of this question was to identify the SDM being used in the organisation. If this question could not be answered, the following questions were used by the researcher to assist in identifying the SDM.
Can you briefly describe the lifecycle of the methodology that you use?	This question will help the researcher identify the different phases in the lifecycle of an SD project.
How long does it take to go through an entire project lifecycle?	This question will help to assess the duration of a typical SD in the organisation.

Table 3.3 gives the questions asked during the interview that aimed to answer the second mini-research question which was "What are the sentiments of ASDMs in the telecommunication industry?"

Table 3.3: Mini-research Question 2: What are the sentiments of ASDMs in the telecommunication industry?

Questions	Motivation
Do you know what ASDMs are?	This question tested the interviewee's level of awareness with regards to ASDMs. A positive response to this question would mean that the interviewee is aware of the advantages and disadvantages of ASDMs.
What do you think the benefits of moving over to an agile methodology are?	This question also tested the interviewee's knowledge with regards to ASDMs.

Table 3.4 gives the questions asked during the interview that aimed to answer the third mini-research question which was "If ASDMs are not used, is there a willingness to change to an ASDM?"

Table 3.4: Mini-research Question 3: If ASDMs are not used, is there a willingness to change to an ASDM?

Questions:	Motivation:
Are you happy with the current methodology being used?	This question tested the level of satisfaction that the interviewee had with regards to the current SDM. A study by Ceschi *et al.* (2005) found that the level of satisfaction played an important role in the success of an SD project.
Do you think the organisation will be willing to change to an ASDM and do you think it will be applicable in the Telecommunication industry?	This question tested the willingness and applicability of ASDMs in the telecommunication industry given the constraints experienced by the interviewee. A positive result would mean that ASDMs are well suited for the telecommunication industry.
Do you think changing the current methodology to ASDM will benefit the organisation?	This question, like the previous one, tested the applicability of ASDMs but specifically for the organisation. The motivation is that the researcher wanted to ascertain whether the organisations interviewed were willing to use ASDMs.

The remaining two mini-research questions were answered by asking a combination of the questions highlighted from table 3.2 – table 3.4. These two mini-research questions were:

- Does the current SDM follow a waterfall lifecycle or an incremental one?
- Does the current SDM adapt to a changing environment well?

- **Step 4: Collect data in the field**

Three large companies (A, B and C) were chosen as valuable sources of information and the interviews were conducted at each company. Before the interviews commenced, the researcher distributed the questionnaires to personnel working in the IT departments of each of these companies. The interviews were recorded using a digital recorder and the informal approach to questioning the interviewees allowed the researcher to understand the context of the particular interviewee.

In Company A, a solutions architect was interviewed. He was contacted by means of an invitation to partake in this study and he agreed to be interviewed in his office. The interview lasted between 30 and 45 minutes.

In Company B, the identified interviewee worked as a senior IT developer and he had been working there for more than three years. He was contacted via email and he was very eager to be a part of this study so arrangements were made to conduct an interview at his office. The interview lasted between 20 and 30 minutes. In Company C, the identified interviewee worked as a core developer and he was introduced to the researcher by the interviewee from Company A. The interview was conducted at the offices of Company C and duration lasted between 15 and 20 minutes.

Once the interviews were concluded, the researcher immediately transcribed them. The researcher also made sure to collect the completed questionnaires once the respondents had finished. In Company A twelve questionnaire were distributed and all were received. In Company B twenty questionnaires were distributed but only thirteen were received, and in Company C all fifteen questionnaire that were distributed were received. In total, forty questionnaires were received from the companies being studied.

- **Step 5: Evaluate and analyse the data collected**

The different research instruments used to collect the data required the researcher to use more than one data-analysis tool. More specifically, the researcher used a qualitative data-analysis tool called ATLAS.ti for the transcribed interviews, and a quantitative data-analysis tool called SPSS version 16 for the collected questionnaires. The main aim of analysing the data collected was to establish patterns in the cases that will help answer the research questions. In order to establish similar patterns between the cases, the researcher chose to use a technique called the cross case analysis method. This method is discussed at length in section 3.5.3.

- **Step 6: Prepare the report**

The final step – as identified by Soy (1996) – is the preparation of the final document. In this step, the patterns established in step 5 are documented in such a manner that a coherent story is told about the cases studied.

In this research, the strategy used will include the formulation of propositions after each company has been analysed. Thereafter, these propositions will be revised after the remaining companies are analysed. This strategy helps in generating propositions that that will encompass the findings from all the companies. These propositions are formulated in such a manner that the research questions are answered. Once the propositions are formulated, a tabulated summary on the measured aspects of this study will be presented.

This summary is intended to give an overview of the SD practices followed in the telecommunication industry in South Africa that conform to the agile values and agile principles highlighted in chapter 2 (see section 2.3.3).

3.4.5.2 Advantages of using the case study method

According to Gummesson (1991) one of the main advantages of using the case study method is that it allows the researcher to gain a general view of a particular phenomenon or event, and therefore enables the researcher to give a detailed account on the particular case being studied. Another advantage – as suggested by Hartley (1994) – is that the case study method is useful in capturing the status quo of the organisation in terms of the culture as well as the direction in which it is heading. This insight, if controlled properly, can result in the researcher adding to the scientific body of knowledge with regards to the phenomena being studied.

Also, rich data generated from the case study method helps the researcher to give a thorough and insightful glimpse on what is being done in the organisation (Burns, 2000). Another crucial argument raised by Yin (1993) was that case studies become more conclusive when more than one case is studied. The researcher chose to use the case study method – based on the advantages mentioned previously – in order to gain insight into the three cases studied. Some disadvantages of use the case study method are discussed in section 3.4.5.3.

3.4.5.3 Disadvantages of using the case study method

The case study method has been criticised as having a lack of scientific rigour and reliability and that it is ineffective in addressing the issue of being too general (Dogan & Pelassy, 1990; Diamond, 1996; Campbell & Stanley, 1966). Some authors also suggest that case study research often reports on findings that are biased (Bryman, 2004; Soy, 1996) and therefore a case study on a single case is discouraged. An observation by Yin (1994) suggested that the researchers are so immersed in the case being studied that they are incapable of removing themselves from the subjects being studied. This is because of the intimate interaction experienced typically in a case study. In conducting this research, the researcher was mindful of these disadvantages inherent in the case study method. In order to minimise the effects of the perceived disadvantages, the researcher studied multiple cases within the telecommunication industry.

3.5 DATA-COLLECTION METHODS

When conducting research, one needs to be mindful of how the data will be collected. This section discusses the different types of data-collection methods used in interpretive research. Although there are many different methods, only three such methods associated with the interpretive research paradigm will be discussed namely interviews, questionnaires and the document review method. Thereafter, the chosen data-collection methods will be discussed in detail.

3.5.1 Interviews

According to Babbie (2004: 300) "a qualitative interview is an interaction between an interviewer and a respondent in which the interviewer has a general plan of inquiry but not a specific set of questions".

This is the case in this research because the researcher aims to let the interview flow in the form of a conversation. In that way the respondent feels free and is able to unpack thoroughly on a particular issue or phenomenon. Babbie (2004) goes further to say that if the interviewing process is correctly executed, in-depth details about a particular phenomenon can be accurately explained. The interview method is a good way to break the ice between the researcher and the respondents, especially if it is used in conjunction with another data-collection method.

3.5.2 Questionnaires

Questionnaires tend to be open-ended, especially in the interpretive research paradigm. This allows the respondents to extensively discuss a particular issue, and therefore this method affords the researcher further insight if it is coupled with the interviewing method. When conducting a case study research, questionnaires can be given to those individuals that haven't been identified for interviewing but work within the same environment. This is known as method triangulation of data and it allows the researcher to have a holistic view of the situation. According to Oates (2006), method triangulation refers to a study which uses two or more data-gathering methods. The data-collection methods used in this study are discussed at length in section 3.5.4.

3.5.3 Document review method

In most instances in research, it is usually the case that particular policies and procedures of a company are written in the form of documents. By reviewing such documents, the researcher is able to get a 'snapshot' of how that environment works. Therefore the document review method can prove to be vitally important in the researchers' endeavours. According to Zamparelli (2001), a document review is a method by which a new or changed document is examined to

ensure that it is technically correct, its intended purpose is suitable, it fulfils the requirements of the previous phases, and it provides an adequate basis for the following phases.
The document review method is usually used to provide the necessary inputs for deciding the next step in the life cycle of the document (Zamparelli, 2001).

3.5.4 Data-collection methods used for this research

A combination of semi-structured interviews and questionnaires will suffice in this research because of the advantages that each of these methods hold.
As stated in section 3.5.2, the use of two or more data-gathering methods is referred to as method triangulation. This strategy will allow the researcher to tell a coherent story about the phenomenon being studied and therefore explain the phenomena being observed in the context of the three companies studied.

3.5.4.1 Using interviews

According to Walsham (1995) the use of interviews when doing an interpretive case study research helps the researcher gain insight into the phenomenon being studied. Interviews become more helpful when the aim of the research is to ascertain the sentiments of a particular event within the context of the organisation being studied. Maree (2008) goes further to say that interviews help to learn about the beliefs and opinions of the interviewee. In this research, semi-structured interviews were used at each of the three companies identified. These semi-structured interviews took place at the offices of the interviewees and the flexibility of the interviews allowed the interviewee to explain further on particular issues that the researcher felt were pertinent to this research. Once the interviews were concluded the researcher immediately transcribed them. ATLAS.ti, which is the qualitative analysis tool used to analyse the interviews, is discussed in section 3.6.3.

3.5.4.1.1 Advantages of Semi-structured interviews

According to Soy (1996), semi-structured interviews have the benefit of generating a large amount of data. This is especially relevant for a study where the researcher wants to have a detailed understanding of the interviewee's setting and context. An unstructured interview also helps to allow the conversation to flow in such a manner that the interviewee is able to elaborate in depth on a particular issue. Some advantages highlighted by Seaman (1999) include:

- Semi-structured interviews allow the researcher to ask probing questions that can lead to further insight;

- Semi-structured interviews are informal and therefore allow the interviewee to feel comfortable;
- Semi-structured interviews are useful for standpoint theory.

3.5.4.1.2 Disadvantages of Semi-structured interviews

However, according to Soy (1996) the main disadvantages of using semi-structured interviews are a lack of reliability because:

- The researcher is only able to interview a few people who might not necessarily represent the sentiments of the entire organisation;
- The researcher does not have complete control of the responses that are solicited; and
- The answers from the interview are very difficult to analyse.

3.5.4.2. Questionnaires

According to Woolfolk (1998) a questionnaire is a formalised and styled interview that enables respondents to answer predefined questions. This research instrument was used in this research, and the questionnaire had both open and close ended questions. The questions were on the aspects of the last systems development project that the respondents were involved in and this enabled the researcher to ascertain the systems development practices followed in the respective organisations. In terms of the open-ended questions, the respondents are afforded an opportunity to elaborate on a particular issue that was pertinent to the study, and therefore the researcher was able to gain an overall picture of the current practises in that organisation (Struwig & Stead, 2001). The questionnaires were hand delivered to the respondents in the companies identified for this research. They were distributed to personnel working in the IT departments and their job titles ranged from junior programmers with less than one year experience to IT managers with more than ten years experience. The decision to distribute the questionnaire across the spectrum of the IT department enabled the researcher to measure the general perceptions and sentiments of agile systems development methodologies in the organisations, and how successful the current methodology being used is in addressing the goals and objectives of the organisations. Once the questionnaires were answered, the researcher collected them and immediately began to analyse the responses with a statistical analysis tool called SPSS version 16 for windows. SPSS version 16 is discussed further in section 3.6.3.

The questionnaire constituted 69 questions that were sub-divided into two sections namely Background information (Section 1) and Project specific information (Section 2).

The types of questions used in the questionnaire were mostly closed-ended questions (Five point Likert scale) and only two open-ended questions. Table 3.1 shows the structure of the questionnaire. The aspects that the researcher aims to evaluate in this study are highlighted as follows.

Given the thrust of this study, the researcher aims to measure the characteristics of SD practices in the identified organisations that are in line with the agile values and agile principles highlighted in the Agile Manifesto (see Table 2.2). The aspects being measured from each company will enable the researcher to perform a cross-case analysis and thereafter establish trends that are applicable to all the cases being studied. The measured aspects in this research are:

- *SDM currently used in the organisation;*
- *How the current SDM is tailored;*
- *Characteristics of the last SD project;*
- *Agile principles followed;*
- *Level of job satisfaction;*
- *Satisfaction with the current SDM;*
- *Effectiveness of current SDM;*
- *Sentiments regarding the use of ASDMs;*
- *SD process quality; and*
- *Quality of last developed system.*

Table 3.5: Structure of questionnaire

Section 1	Question	Section 2	Question
Background information	**Q1 - Q7**	Characteristics of last SD project	**Q1.1-Q1.11**
SDM currently used	**Q8 - Q9**	Agile principles followed	**Q2.1-Q2.13**
		Level of job satisfaction	**Q3.1-Q3.3**
How SDM is tailored	**Q10**	Satisfaction with the current SDM	**Q3.4-Q3.6**
		Effectiveness of current SDM	**Q3.7-Q3.8 & Q3.15-Q3.18**
		Sentiments regarding the use of ASDMs	**Q3.9-Q.14**
		SD process quality	**Q4.1-Q4.9**
		Quality of last developed system	**Q5.1-Q5.8**

3.5.4.2.1. Advantages of questionnaires

The researcher used a questionnaire technique because it has a number of notable advantages namely (Ramajan, 1994):

- A questionnaire is an instrument that enables respondents to answer predefined questions;
- A questionnaire can be completed at a time convenient for the respondents;
- Questionnaires also give a broader spectrum of views because more people can be reached;
- The questionnaire as a method of investigation has the advantage that it is less time consuming;
- A broader sample of people can be reached through the questionnaire data-collection method;
- A questionnaire empowers the respondent and it is confidential for the respondents; and

- Questionnaires are more cost effective because they can be administered in groups or mailed to respondents.

These above mentioned advantages determined the use of questionnaires as a data-collection instrument. Furthermore, the questionnaires allowed for confidentiality of the respondents and that gave them liberty to express their views freely. Even though there are encouraging advantages in using questionnaires as a data-collection method, there are some disadvantages associated with the use of questionnaires. These disadvantages are highlighted below.

3.5.4.2.2. Disadvantages of questionnaires

Some of the main disadvantages of questionnaires as identified by Bell (1993) are:

- Questionnaires are difficult to analyse and quantify, especially if a lot of open-ended questions are asked;
- Questionnaires force the respondents to choose from a list of pre-selected answers that might not reflect their point of view;
- Misinterpretation of questions poses the greatest risk in the data-collection process; and
- The respondents might not answer the questions truthfully and accurately. This could therefore result in the data being inconclusive.

These disadvantages posed a risk to the quality of the data collected in this research. Therefore, in order to minimise the impact of these disadvantages, the researcher had a brief encounter with each of the respondents so that they could understand the main purpose of the research. When some questions were not easily understood, the researcher clarified those questions so that the respondents' answers reflected the current state of affairs in the organisations. Once the questionnaires were completely filled out, the researcher collected them and began to analyse them. The results from the questionnaires will be reported on in chapter 4.

In terms of the validity and reliability of questionnaire, the researcher adopted the questionnaire from a study conducted by Huisman (2000).

Based on the work of Huisman (2000), the questionnaire was found to be highly reliable in measuring the use and effectiveness of SDMs in organisations in South Africa.

3.6 DATA-ANALYSIS METHODS

The nature of this study generated both qualitative data and quantitative data. With regards to the qualitative data, the data analysis refers to those strategies and tools used to understand the data collected using the qualitative research approach (Coolican, 1994). These methods allow the researcher to describe the environment being studied in detail and come to scientifically solid conclusions in a coherent manner.

According to Eysenck (2004), qualitative researchers concern themselves with meanings, attitudes and interpretations found in a particular environment. The qualitative data-analysis method used in this research is discussed in section 3.6.3. In terms of the quantitative data-analysis methods, Trochim (1999) motivated that numerical data have the ability to explain a particular phenomenon within a particular setting if the variables associated with the phenomenon are properly handled. This is especially true when only descriptive statistics are used.

In the following sections, three such data-analysis methods will be discussed namely cross-case analysis, content analysis and statistical analysis. Thereafter the data-analysis methods used in this research will be discussed.

3.6.1 Cross-case analysis method

The cross-case analysis method reveals patterns between similar cases (Freed, 2001), and therefore helps the researcher identify the area in which respondents deem to be problematic or cumbersome. According to Yin (1984) – if there is evidence of patterns in the environment – the results can help a case study to strengthen its internal validity (p. 103). Cross-case analysis usually searches for descriptions of factors which influence change (Freed, 2001). According to Seaman (1999), the cross-case analysis method is an effective way of analysing data from a multiple-case study and eventually generating theory about a particular phenomenon.

3.6.2 Content analysis

According to Eysenck (2004), content analysis started off as a way of analysing messages in the media, newspapers, speeches made by politicians and health records, and it is used when originally qualitative information is reduced to numerical terms.

The first stage in this method is sampling the population from which the researcher would like to study.

Another very important point in this data-analysis method is that the researcher needs to construct coding units through which the data collected may be categorised. Eysenck (2004) goes further to say that this method's greatest strength is its ability in providing a strategy of extracting information from a wealth of real-world situations.

3.6.3 Statistical analysis

According to Eysenck (2004), statistical analysis is applied when relationships between variables need to be investigated. There are mainly two types of statistical analysis methods namely:

- Descriptive statistics; and
- Inferential statistics

Descriptive statistics is usually concerned with the measures of central tendency such as the mean, median and mode, and inferential statistics is usually concerned with the outcomes of statistical tests such that deductions can be made regarding the data collected (UWE, 2006).
The strength of using statistical analysis methods is that they allow the researcher to confirm or find new facts about a particular domain (Trochim, 1999).

3.6.4 Data-analysis methods used in this study

The cross-case analysis method is used in this research, and this is done to ensure that the environment is studied in detail. Instead of using one data-analysis method, it is usually advised to use a combination of any of the methods (Seaman, 1999). For purposes of this research, this method was chosen because of its ability to search for factors that could possibly influence change. The use of the cross-case analysis method helped to continuously review the propositions that were formulated. Furthermore, Eisenhardt (1989) mentioned that the cross-case analysis method helps to formulate theory about the cases being studied. In this research, the cross-case analysis method was used to formulate propositions for each company. In performing the cross-case analysis method, each company was assigned a code and each data source was also assigned a code. For illustrative purposes, suppose a proposition from Company A is supported by the interview and questionnaire data.

The corresponding code for this proposition would then be [AI, AQ]. The letter A represents the source of the data (either Company A, B or C) and the letters Q and I represent the data-collection instruments namely questionnaires and interviews respectively.

Once the propositions were formulated for each company, revised propositions were then formulated such that the theory generated included the data from all the companies.
The codes corresponding to the propositions will be presented in chapter 4. The statistical analysis method used in analysing the questionnaires is descriptive statistics. Frequency distribution tables are used to report the responses from the respondents. In terms of the actual tools used, the ATLAS.ti analysis tool was used for analysing the interviews and SPSS version 16 was used for analysing the questionnaires.

3.6.4.1 ATLAS.ti

ATLAS.ti is a qualitative analysis tool that is used for analysing interviews, field notes and any other data that captures the opinions and perceptions of the respondents. ATLAS.ti especially becomes important when theory for a single case – or multiple cases – is intended to be generated. In this research, three separate interviews were conducted at the respective organisations. Once the interviews were concluded the interviews were immediately transcribed. These transcribed interviews were then stored inside a hermeneutic unit (HU) created in ATLAS.ti. When each of the interviews is stored in the HU, they are known as primary documents (PD). Each of the PD's are then read in order to assign codes to parts of the interview that can be applied to the subsequent PD's. Once the codes are assigned, the corresponding codes are compared in the PD's so that a general view or perception on particular issues can be easily identifiable. In order to perform a cross-case analysis, the researcher used the assigned codes to formulate propositions from Company A's interview. These propositions represented the initial propositions, and they are revised after data from the questionnaires are presented. This iterative process of formulating the propositions is used for all the cases being studied so that the final propositions encompass the results from all the companies. According to Smit (2003) one of the major disadvantages of ATLAS.ti is that it does not assist in establishing the meanings of words or constructs. The onus is therefore on the researcher to interpret the qualitative data in the way it was intended from the respondents. In order to minimise the effect of this disadvantage, the researcher mainly focused on the aims and objectives of the research.

3.6.4.2 SPSS version 16

This quantitative analysis tool was used to analyse the forty questionnaires that were received from all the companies. The main advantage of this analysis tool is that it allows the researcher to use statistical principles and formulae in order to identify patterns and similarities between the cases being studied. Once the questionnaires were collected, the researcher entered the data into Excel.

The questionnaires from each of the companies were stored separately in Excel worksheets. Once they were stored in the worksheets, the data was exported to SPSS for statistical analysis. The data from each of the companies were analysed by using descriptive statistics only. Thereafter, the propositions formulated from the interview data were revised to include the data from the questionnaires.

3.7 SUMMARY

In this section the design of the research is diagrammatically represented. Figure 3.1 is sourced from the discussions in the previous sections.

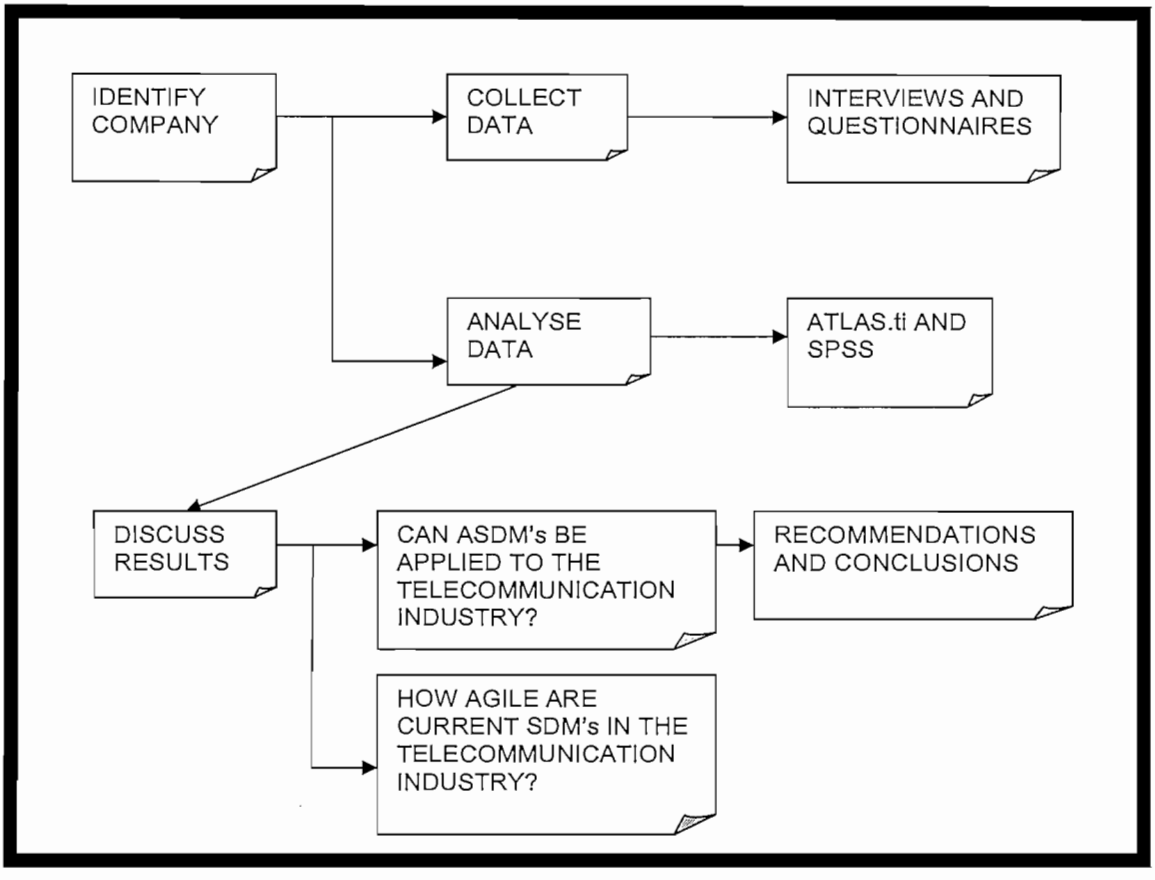


FIGURE 3.1: RESEARCH DESIGN

This chapter looked at the research design and methodology used in this study. The research instruments used in this study were also discussed and the advantages and disadvantages were highlighted. In terms of the strategy used to perform the cross-case analysis, the researcher will formulate initial propositions for Company A's interview data. Thereafter, these propositions will be revised once the questionnaires are analysed.

Once that is done, the same propositions will be revised for companies A and B such that the final propositions encompass the findings from all the companies. The main purpose of this strategy is to enable the researcher to answer the research questions highlighted in figure 3.1. In the following chapter, the results are reported and discussed.

CHAPTER 4
RESULTS AND DISCUSSIONS

4.1 INTRODUCTION

In this chapter the results obtained from the interviews and the questionnaires (Appendix 1) held with three companies are discussed. Each company's results are discussed individually and thereafter a summary of the companies' results are tabulated in each question. Once the questionnaires and the interviews are reported, a cross-case analysis is performed in order to generate propositions that are common between the three companies. This enables the researcher to generate theory on the use of ASDMs in the telecommunication industry in South Africa. ATLAS.ti was used to analyse the interviews and SPSS version 16.0 was used to analyse the questionnaires. In the questionnaire, there were two sections namely background information and project specific information which are discussed separately for each company. In discussing the results of the interviews and the questionnaires, the researcher kept in mind the research aims and objectives. These research aims and objectives are discussed in section 4.2.

4.2 RESEARCH AIMS AND OBJECTIVES

The research aims and objectives were to ascertain whether ASDMs can be applied to the telecommunication industry in South Africa, and if so whether they are currently being used in the industry. The main research questions of the study were:

- 1) *Can ASDMs be applied in the telecommunication industry in South Africa?*

The mini-research questions used to answer this main research question are:

  - What SDM is currently being used in the organisation?
  - What are the sentiments of ASDMs in the telecommunication industry?
  - If ASDMs are not used, is there a willingness to change to an ASDM?

- 2) *How agile are current SDMs in the telecommunication industry in South Africa?*

The mini-research questions used to answer this main research question are:

  - Does the current SDM follow a waterfall lifecycle or an incremental one?
  - Does the current SDM adapt to a changing environment well?

These main research questions were informed by the studies of Otto (2007), Theunissen and Kourie (2003), and Koutsoukos *et al.* (2001), who all identified a need for an agile SDM in the telecommunication industry.

4.3 COMPANY A (INTERVIEW DATA)

4.3.1 Background Information

Company A is a large mobile telecommunications network provider operating in all the nine provinces of South Africa since 2001 and it has more than 5 million customers connected to its network. This company was chosen because of its level of influence and size in the telecommunication industry in South Africa. It is 100 percent owned by 3C telecommunications, which in turn is 60% owned by Oger Telecom South Africa. The interview was done at their offices in Sandhurst, Johannesburg where their IT department is situated. The interviewee had worked in the organisation for approximately a year, and he had more than five years experience in systems development. He was working as a solutions architect in this company and it was felt that the interviewee was in a good position to unpack on all the systems development practises taking place in Company A.

As discussed in Chapter 3, the interviews were unstructured and this had the benefit of allowing the researcher to lead the interviewee to answer questions that were pertinent in this research. The interview lasted between 30 and 45 minutes, and the responses from the interview are organised as follows:

- Firstly, the interviewee's job responsibilities and tasks are discussed;
- Secondly, the systems development methodology used is discussed. This includes the actual methodology used as well as any pitfalls that the interviewee is faced with regarding that methodology; and finally
- The perceived benefits and sentiments of using ASDMs in Company A and in the telecommunication industry as a whole.

Once the interview is discussed, propositions are formulated that can possibly be applied to the other cases (Company B and C). These propositions are strengthened by the results from the questionnaires that were distributed in all the companies.

4.3.2. Job responsibilities (Interviewee 1)

The interviewee worked as a Solution Architect in Company A, and he had been working there for close to a year. On a daily basis, interviewee 1 liaises with the marketing department, which is the client, about the time and number of developers needed in a particular project.

He is also responsible for conceptualising the system architecture for a project, and usually that is done through a plan of action that needs to be approved by the marketing department.

Although interviewee 1 is only exposed to the planning and design phase in the project lifecycle, the onus is on him to ensure that the project is a success. Therefore his responsibilities include budgeting and scheduling of development tasks for the systems development project. He also addresses the technicalities of the system and he also chooses the best way to address a problem by deciding on the development process to use for a particular project.

4.3.3 Systems development methodology used

For large projects (i.e. > R5 million), Company A used a formalised systems development methodology called the Information Systems Development Lifecycle (SDLC), and for smaller projects they used a tailored version of the methodology.

Generally, the interviewee felt that there was no problem with the way they developed systems and this had the effect of him being negative towards changing the current methodology to an agile systems development methodology. The methodology Company A uses follows a waterfall model in that there is a constant linearity between the different phases.

In other words, the development process is informed from the preceding phase, and this has the disadvantage of sometimes making the development team "lose focus" of the project outcomes. Although the interviewee indicated that there was "too much red-tape" when developing systems, the end result was that a high quality system was developed and Company A enjoyed "close to 100% success rate". The interviewee went further to say that the main reason why SDLC is used is because of the overall benefits that it afforded the marketing department. Also, the "use what works" mentality is another reason why Company A chose to use SDLC. In terms of training, the interviewee mentioned that their developers were only trained on what was needed by the organisation, and changing the current mindset could negatively impact Company A. The methodology used in Company A is discussed according to the definition of a systems development methodology, which is described in chapter 2, and comprises of the following (Huisman & Iivari, 2006):

- **Systems development approach**

Company A followed a formal approach for large projects (i.e. > R5 million), and a mixed approach for smaller projects. Company A's system development is driven by the requirements of the client, and the overall success of a project is measured by the return on investment. For the smaller projects, some of the stages such as feasibility studies, planning and design are discarded with the view of rapidly developing a system that is not mission-critical to the organisation.

- **Systems development process model**

As mentioned in the discussion of the SDM used in Company A, the development process follows a linear model and the stages are in a sequential order. Although Company A has generally close to "100% success rate", for the smaller projects Company A tailors it's SDM by removing the planning phase.

- **Systems development method**

1) Feasibility study and system investigation

In this phase the request that is received from the marketing department is initially checked for its viability. Once that is done, the systems architect team develops a conceptual design for the intended system. This phase includes the budgeting and task scheduling as well as resource allocation.

According to the interviewee, this phase is the most important and a considerable amount of time is dedicated to this phase. This is in the view that the project needs to be thoroughly thought through before the system is developed, and therefore reducing the risk of project failure.

2) System analysis and design (Planning and design)

The interviewee identified this phase as the planning and design phase of the project. This phase, according to the interviewee, takes between a week and a month "depending on the urgency of the request" from the marketing department. The interviewee also mentioned to say that this phase is the "most difficult" as it has "too much red-tape", and the reason for this is to ensure that high quality systems are developed. Thereafter, the architectural team would then engage with the IT developers and database administrators to begin the process of developing the system.

3) Implementation, review and maintenance (System build and maintenance)

In this phase, the interviewee's role was to oversee the progress in the development of the system. His responsibilities included ensuring that the system being developed would accurately address the requirements identified in the request form. The interviewee placed a strong emphasis on the fact the systems developed are required to be of the highest quality. An interesting point the interviewee mentioned was that the client was generally happy with the quality of the systems they developed. In terms of maintenance, once a project was complete the entire development project was reviewed and tested to suit the marketing department. This activity can be ascribed to usability testing as well user acceptance. Thereafter, the artefacts generated in a project are stored in a "library" for purposes of reusability.

When asked to give an example of a system that needed to be maintained, the interviewee cited an instance where some of Company A's customers didn't appear in their records and this had the negative effect of rendering the customers inactive members in their network. Although in systems development practice that is seen as a project failure, the interviewee was of the view that the error occurred at the developer level, and that it should not be constituted as a project failure. He was of the view that this error constituted a "system glitch".

Development language

The development language used by Company was Java, C++ or the .NET platform. The choice of which development language to use was dependent on the size of the project, and for their database applications Company A used the Oracle suite. The interviewee also highlighted that in very rare instances, COBOL was used as the preferred programming language.

- **Systems development techniques and tools**

The techniques and tools used by Company A included the use of UML as a design tool and project management techniques such as budgeting and task scheduling. Another technique used by Company A was a constant and continuous interaction with client department but only in the initial phase. As mentioned earlier by the interviewee, this initial face-to-face communication helped to ensure that the systems developed were of a very high quality.

4.3.4 The sentiments of using ASDMs in Company A

As discussed earlier, the interviewee felt that the current methodology that was used was sufficient in meeting their goals and objectives of a particular project. According to the interviewee, Company A enjoyed a success rate of "close to 100%" even though there was "too much red-tape". Accordingly, the interviewee was of the view that changing the methodology to an ASDM would negatively impact the organisation and therefore care should be exercised in that regard. In terms of the applicability of agile methodologies in the organisation, the interviewee felt that they wouldn't work. His attitude towards ASDM was negative and he claimed that its benefits were not realistic given the industry he works in. Even though he noted ASDMs' perceived benefits, the interviewee felt that the principles of ASDMs promised too much. Another crucial point that the interviewee raised was "why change if something works well". In section 4.1.3, it was mentioned that the client department was "happy" with the way that the systems were developed, so the interviewee had the view that changing the current methodology should benefit the client department.

The interviewee admitted that all the decisions were informed by the overall strategy of the organisation, and to change the current methodology would mean to get "buy-in" from the client department.

4.3.5 Propositions

In this section propositions about what is currently being done in Company A are formulated. These propositions are formulated as a way of generating theory about what is happening regarding SDMs in Company A by using only the information gained from the interview.

4.3.5.1 Proposition 1

The SDM currently being used in the telecommunication industry is a formalised methodology following a linear process model. For larger projects, the methodology is used in the way it was intended, and for smaller projects the formalised methodology is tailored by scaling down more time consuming activities such as the feasibility study and the planning and analysis phases. Even though the methodology being used is prone to red-tape, generally the users of the methodology are satisfied with it [**AI**][5].

4.3.5.2 Proposition 2

The first phase is considered to be the most important phase in the project lifecycle, and it is very important that this phase is done with very clear objectives from the client department [**AI**].

4.3.5.3 Proposition 3

Large companies in the telecommunication industry enjoy a very high success rate when developing systems [**AI**].

4.3.5.4 Proposition 4

Agile SDMs are not understood by the development team. These methodologies are viewed as good methodologies only "in theory". Applying agile systems development methodologies in the telecommunication industry will take time and a lot needs to be done to educate the development team [**AI**].

[5] This code shows that the proposition is supported by the findings from the Interview (I) conducted at Company A (A).

4.3.5.5 Proposition 5

Changing the current mindset of the development team will negatively impact the organisation. This is informed by the finding that there is a "why change something if it works" mentality [**AI**].

4.3.5.6 Proposition 6

There needs to be management commitment to the use of a particular SDM in the organisation. Without management commitment, systems development projects could be highly compromised [**AI**].

4.3.5.7 Proposition 7

The use of systems development techniques and tools helps to ensure that the system developed is of a very high quality that meets the requirements of the users [**AI**].

4.4 COMPANY A (QUESTIONNAIRE DATA)

A total of twelve questionnaires were distributed in Company A, and these were analysed using SPSS version 16.0. As mentioned in section 4.1, each question that appears in the questionnaire will be discussed separately, and thereafter revised propositions (from section 4.3.5) will be formulated. There are two sections in the questionnaire namely, background information and project specific information. These sections are discussed separately as follows.

Section 1: Background information

In this section, the researcher wanted to gain a deeper understanding of the respondents' job specific responsibilities and also ascertain their level of knowledge in the systems development process.

4.4.1 Question 1: Which job title best describes your position?

All the individuals to whom the questionnaire was distributed in Company A answered this question. Close to 50 percent (5 out of 12) of those respondents were IT/Business Architects and two respondents (16.7%) were IT/systems developers. Only one respondent was a programmer and two respondents (16.7%) were IT managers.

There was only one IT team leader and only one systems analyst each representing 8.3 percent of the total respondents from Company A. Table 4.1 show the actual results of question 1 in Company A.

Table 4.1: Question 1 (Company A)
Which job title best describes your position?

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	IT/Systems developer	2	16.7	16.7	16.7
	Programmer	1	8.3	8.3	25.0
	IT/Business architect	5	41.7	41.7	66.7
	IT Manager	2	16.7	16.7	83.3
	IT Team leader	1	8.3	8.3	91.7
	Systems analyst	1	8.3	8.3	100.0
	Total	12	100.0	100.0	

4.4.2 Question 2: Are you currently actively involved in information systems development?

All respondents answered positively to this question indicating that they are involved in systems development regardless of their ranking. Table 4.2 shows the result of this question in Company A. This result implies that all the respondents are exposed to the systems development lifecycle.

Table 4.2: Question 2 (Company A)
Are you currently actively involved in information systems development (ISD)?

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	Yes	12	100.0	100.0	100.0

4.4.3 Question 3: How many years of systems development (SD) experience do you have?

Nearly 60 percent of the respondents in Company A had five or more years experience (7 out of 12). Only one respondent had one to two years experience. The rest fell in the "three to four years" category. Table 4.3 shows diagrammatically the breakdown of SD experience in Company A.

Table 4.3: Question 3 (Company A)
How many years of systems development (SD) experience do you have?

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	1-2 year(s)	1	8.3	8.3	8.3
	3-4 years	4	33.3	33.3	41.7
	5 years or more	7	58.3	58.3	100.0
	Total	12	100.0	100.0	

4.4.4 Question 4: Please indicate what percentage of your personal time/work is devoted to the following development activities:

This question had different development activities and the respondents were required to indicate what percentage of their time they were involved in a particular activity.

For each questionnaire filled, the total sum of the percentages of the different activities needed to be one hundred percent (100%).

Breaking down the activities has the benefit of allowing the researcher to have a picture of the day-to-day responsibilities of the respondents. Therefore, for purposes of an in-depth discussion of Company A, each development activity is discussed separately.

- *Systems planning, analysis and design*

Twenty five (25) percent of the respondents in Company A spent between 71 and 80 percent of their time dealing with systems planning, analysis and design activities. A total of 16.7 percent of the respondents (2 out of 12) were not exposed at all to this development activity. Table 4.4 shows the distribution of the time spent on this development activity in Company A.

Table 4.4: Question 4.1 (Company A)

Percentage of time spent working on Systems planning, Analysis & Design

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	0%	2	16.7	16.7	16.7
	1-10%	1	8.3	8.3	25.0
	11-20%	1	8.3	8.3	33.3
	31-40%	1	8.3	8.3	41.7
	71-80%	3	25.0	25.0	66.7
	81-90%	2	16.7	16.7	83.4
	91-100%	2	16.7	16.7	100.0
	Total	12	100.0	100.0	

- *Programming*

The majority of the respondents in Company A (7 out of 12) did not do any programming at work.

This is because the majority of respondents were IT/Business architects as stated in table 4.1 previously. Table 4.5 shows the percentage distribution of the time spent on programming of all the respondents.

Table 4.5: Question 4.2 (Company A)

Percentage of time spent working on programming

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	0%	7	58.3	58.3	58.3
	1-10%	2	16.7	16.7	75.0
	11-20%	1	8.3	8.3	83.3
	31-40%	1	8.3	8.3	91.7
	71-80%	1	8.3	8.3	100.0
	Total	12	100.0	100.0	

- *Testing*

In this development activity, most of the respondents in Company A answered 0 percent (7 out of 12), which represents about 60 percent (58.3%) of the total population of respondents.

Three respondents spent between 1 to 10 percent of their time testing, and a further two respondents spent between 21 and 30 percent of their time testing the systems they developed. Table 4.6 diagrammatically shows the detailed frequency distribution of the testing development activity in Company A.

Table 4.6: Question 4.3 (Company A)

Percentage of time spent working on Testing

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	0%	7	58.3	58.3	58.3
	1-10%	3	25.0	25.0	83.3
	21-30%	2	16.7	16.7	100.0
	Total	12	100.0	100.0	

- *Installation*

In Company A, a large percentage of the respondents (75%) did not spend any time working on installation. The remaining three respondents (25%) at most spent about ten percent of their time installing systems. Table 4.7 shows the breakdown of the percentage of time spent on installing systems in Company A.

Table 4.7: Question 4.4 (Company A)

Percentage of time spent working on Installation

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	0%	9	75.0	75.0	75.0
	1-10%	3	25.0	25.0	100.0
	Total	12	100.0	100.0	

- *User training*

A large percentage of the respondents (75%) in Company A did not perform this development task at all. The remaining twenty five percent of the respondents (3 out of 12) – at most – spent twenty percent of their time performing this development activity. Table 4.8 shows diagrammatically the percentage distribution of the time spent on user training in Company A.

Table 4.8: Question 4.5 (Company A)

Percentage of time spent working on User training

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	0%	9	75.0	75.0	75.0
	1-10%	1	8.3	8.3	83.3
			3		
	11-20%	2	16.7	16.7	100.0
	Total	12	100.0	100.0	

- *Project management*

Exactly half of the respondents (6 out of 12) did not perform any project management activities in Company A.

Three respondents (25%) spent at most ten percent of their time performing project management tasks and two respondents spent at most twenty percent of their time discharging this activity. Only one respondent had a considerable amount of time discharging this activity (71-80%).

Table 4.9 shows the percentage distribution of the time spent on project management by each respondent in Company A.

Table 4.9: Question 4.6 (Company A)

Percentage of time spent working on Project management

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	0%	6	50.0	50.0	50.0
	1-10%	3	25.0	25.0	75.0
	11-20%	2	16.7	16.7	91.7
	71-80%	1	8.3	8.3	100.0
	Total	12	100.0	100.0	

- *"Other" activities*

Although seventy-five percent of the respondents (9 out of twelve) in Company A did not mention any other development activities, the remaining three respondents had interesting responses.

Two of the three respondents said that at most 20 percent of their time was devoted to "systems maintenance" and the remaining respondent said that they were involved in "project budgeting" about ten percent of the time. Table 4.10 shows the frequency distribution of the time spent on "other" development activities in Company A.

Table 4.10: Question 4.7 (Company A)

Percentage of time spent working on other activities

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	0%	9	75.0	75.0	75.0
	1-10%	1	8.3	8.3	83.3
	11-20%	2	16.7	16.7	100.0
	Total	12	100.0	100.0	

4.4.5 Question 5: Approximately how many information systems development (ISD) projects have you completed in the past?

In Company A, exactly fifty percent of the respondents (6 out of 12) have completed between one and ten ISD projects. Twenty-five percent of the respondents (3 out of 12) responded that they had completed between ten and twenty projects in the past.

The remaining three respondents completed more than twenty ISD projects in the past. Table 4.11 shows the frequency distribution of the number of ISD projects all the respondents in Company A have completed.

Table 4.11: Question 5 (Company A)

Approximately how many information systems development (SD) projects have you completed in the past?

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	1-10 projects	6	50.0	50.0	50.0
	10-20 projects	3	25.0	25.0	75.0
	More than 20 projects	3	25.0	25.0	100.0
	Total	12	100.0	100.0	

4.4.6 Question 6: How long have you been working in the organisation?

In Company A, exactly fifty percent of the respondents (6 out of 12) have been working in the organisation for at most a year. About thirty-three percent of the respondents (4 out of 12) had been working for between one and four years, and the remaining two respondents have worked in Company A for five or more years. Table 4.12 shows the frequency distribution of the duration that all respondents have spent in Company A.

Table 4.12: Question 6 (Company A)

How long have you been working in the organisation?

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	0-1 year	6	50.0	50.0	50.0
	1-4 years	4	33.3	33.3	83.3
	5+ years	2	16.7	16.7	100.0
	Total	12	100.0	100.0	

4.4.7 Question 7: Which of the following technologies are you aware of, and please indicate your level of knowledge in a particular technology.

For purposes of this study, the researcher has chosen to analyse three of the seven technologies listed in the questionnaire (see appendix 1). These technologies that are analysed are: Programming languages, UML design and Methodologies.

The reason why the researcher has chosen only these three technologies is because of the fact that these technologies are directly related to the thrust of the research which is systems development methodologies and companies in the telecommunication industry.

- *Programming languages*

In Company A, fifty percent of the respondents (6 out of 12) responded as experts in programming languages. Two respondents (16.7%) responded as skilled personnel and one respondent (8.3%) felt that they were averagely skilled in terms of programming languages.

Two respondents (16.7%) responded as competently skilled and the remaining respondent (8.3%) felt that they had basic knowledge in terms of programming languages.

Table 4.13 shows the frequency distribution of the level of skill in Company A in terms of programming languages.

Table 4.13: Question 7.1 (Company A)

What is your level of knowledge in programming languages (e.g. Java, J2EE, C#, Microsoft.NET, etc)?					
		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	Basic knowledge	1	8.3	8.3	8.3
	Competent	2	16.7	16.7	25.0
	Average	1	8.3	8.3	33.3
	Skilled	2	16.7	16.7	50.0
	Expert	6	50.0	50.0	100.0
	Total	12	100.0	100.0	

- *UML Design*

In Company A, more that thirty-three percent of the respondents (33.3%) responded as having a skilled level in UML design. Twenty-five percent (3 out of 12) responded as being experts, and the remaining five respondents responded as follows: average skilled (16.7%), competent skilled (8.3%) and basic knowledge (16.7%). Table 4.14 shows the frequency distribution of the level of skill in Company A in terms of UML design.

Table 4.14: Question 7.6 (Company A)

What is your level of knowledge in UML Design (Rational Rose, Together, etc)?

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	Basic knowledge	2	16.7	16.7	16.7
	Competent	1	8.3	8.3	25.0
	Average	2	16.7	16.7	41.7
	Skilled	4	33.3	33.3	75.0
	Expert	3	25.0	25.0	100.0
	Total	12	100.0	100.0	

- *Methodologies*

Close to seventy percent of the respondents responded that they were either experts or skilled in methodologies (33.3%) respectively. Only one respondent felt that they were competently skilled and the remaining three respondents representing twenty-five percent of the total respondents felt that they possessed basic knowledge with regards to methodologies. Table 4.15 shows the different levels of knowledge in Company A.

Table 4.15: Question 7.7 (Company A)

What is your level of knowledge in Methodologies (e.g. RUP, PRINCE II, etc)

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	Basic knowledge	3	25.0	25.0	25.0
	Competent	1	8.3	8.3	33.3
	Skilled	4	33.3	33.3	66.7
	Expert	4	33.3	33.3	100.0
	Total	12	100.0	100.0	

4.4.8 Question 9: Is the systems development methodology tailored to suit your organisation?

Only eleven respondents replied to this question and of the eleven, close to 65 percent (7 out of 11) responded positively to the question. The remaining four respondents (36.4%) answered negatively. One respondent failed to answer this question. Table 4.16 shows the result of this question.

Table 4.16: Question 9 (Company A)

Is the systems development methodology tailored to suit your organization?

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	Yes	7	58.3	63.6	63.6
	No	4	33.3	36.4	100.0
	Total	11	91.7	100.0	
Missing	System	1	8.3		
Total		12	100.0		

Section 2: Project specific information

In this section, the researcher wanted to gain a deeper understanding of the respondents' last systems development project they where involved with. This section also helped the researcher identify how agile the company's systems development practices are. This is in direct relation to one of the key aspects of this study, which is to identify whether ASDMs are being used in the telecommunication industry.

4.4.9 Question 1 (Company A)

Eleven questions were asked and the motivation for these questions was to gain an overview of the last systems development project the respondents were involved in. Most of the questions were formulated in such a way that the researcher could accurately understand the intricacies involved when initiating a systems development project (see appendix 1). Table 4.17 shows a summary of the frequency distribution of all the statements in this question.

- *The project was well-defined*

Exactly half of the respondents (6 out of 12) felt that the last systems development project was neutral in terms of the project being well defined. The remaining six respondents (50%) agreed[6] with the statement.

- *Users were aware of their requirements*

Only one respondent disagreed with the statement and five respondents, representing more than 40% of the total respondents, were neutral to this statement (5 out of 12).

A total of 33.3% (4 out of 12) agreed with the statement and 16.7% of the respondents totally agreed with the statement

- *Users requirements changed all the time*

Only one respondent disagreed with this statement. A further 25% of the respondents (3 out of 12) were neutral to this statement, and close to 60% of the respondents (58.3%) agreed with the

[6] The researcher took the responses of "Totally Agree" and "Agree" and grouped them together throughout this study.

statement. The remaining respondent totally agreed with the statement. Therefore, it can be said that eight respondents generally agreed to the statement.

- *User's expectations were realistic*

Five of the twelve respondents (41.7%) disagreed with this statement, and a quarter of the respondents (25%) were neutral to the statement. The remaining four respondents agreed to this statement.

- *Developers understood user's requirements well*

The majority of the respondents (9 out of 12) were neutral to this statement. The remaining three respondents representing 25%, agreed to this statement.

- *The developed system was very complex*

One respondent disagreed with this statement (8.3%) and close to 60% of the respondents felt indifferent to the statement (neutral). The remaining four respondents representing 33.4% of the respondents generally agreed to this statement.

- *Senior management was highly committed to the project*

Six out of the twelve respondents (50%) generally agreed to this statement, and the remaining six respondents were neutral to this statement.

- *Developer's knowledge of the systems development process was good*

Close to 59% of the respondents (7 out of 12) generally agreed to this statement, and the remaining five respondents were neutral to the statement.

- *The installation and adoption of the developed system in user departments were well planned*

Six of the twelve respondents (50%) generally agreed to this statement, and the remaining respondents were indifferent to this statement (neutral).

- *The system was delivered at or before the scheduled time*

Four of the twelve respondents (33.3%) generally disagreed to this statement, and five more respondents (41.6%) generally agreed to the statement. The remaining three respondents were neutral to this statement. The responses to this statement show that there are mixed reactions regarding the last system development project being delivered on time.

- *Status meetings were held weekly*

A large majority of the respondents generally agreed to this statement (75.0%) and only two respondents disagreed to this statement. The remaining respondent was indifferent to this statement.

Generally, the results from this question were positive in Company A, although there were some statements that generated mixed reactions between the respondents. This could be explained from the fact that some of the respondents worked on different projects. The statements that generated mixed reactions were:

- *User's expectations were realistic*

All the five business architects (see table 4.1) were the respondents who disagreed with this statement. This indicates that as the job responsibilities of the respondents' increases, the chances that these respondents will find the user's expectations to be realistic decreases. The mixed reaction comes in because an IT manager (among the three respondents that responded positively) agreed with this statement. After further investigation, it was found that this IT manager was mostly involved with system testing (30% of his time), user training (20% of his time), project management (20% of his time) and maintenance (19% of his time).

- *The system was delivered at or before the scheduled time*

The statements that generally generated a positive response for the respondents are:

- *The project was well defined;*
- *Users were aware of their requirements;*
- *Users requirements changed all the time;* (This result confirms the findings from the literature review which suggests that the user requirements in the telecommunication industry are highly volatile);
- *Developers understood user's requirements well;*
- *The developed system was very complex;*
- *Senior management was highly committed to the project;*
- *Developer's knowledge of the systems development process was good;*
- *The installation and adoption of the developed system in user departments were well planned;* and
- *Status meetings were held weekly*

The positive responses from these statements indicate that systems development is adequately managed in Company A.

Table 4.17: Summary of section 2 (Question 1 Responses)

	Total frequency	The project was well defined		Users were aware of their requirement		Users requirements changed all the time		User's expectations were realistic		Developers understood user's requirements well		The developed system was very complex		Senior management was highly committed to the project		Developer's knowledge of the systems development process was good		The installation and adoption of the developed system in user departments were well planned		The system was delivered at or before the scheduled time		Status meetings were held weekly	
		Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
Totally Disagree	1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	8.3	0	0.0
Disagree	13	0	0.0	1	8.3	1	8.3	5	41.7	0	0.0	1	8.3	0	0.0	0	0.0	0	0.0	3	25.0	2	16.7
Neutral	54	6	50.0	5	41.7	3	25.0	3	25.0	9	75.0	7	58.3	6	50.0	5	41.7	6	50.0	3	25.0	1	8.3
Agree	41	6	50.0	4	33.3	7	58.3	4	33.3	0	0.0	2	16.7	2	16.7	3	25.0	4	33.3	4	33.3	5	41.7
Totally Agree	23	0	0	2	16.7	1	8.3	0	0.0	3	25.0	2	16.7	4	33.3	4	33.3	2	16.7	1	8.3	4	33.3
	Total	12	100.0	12	100.0	12	100.0	12	100.0	12	100.0	12	100.0	12	100.0	12	100.0	12	100.0	12	100.0	12	100.0

4.4.10 Question 2 (Company A)

These statements tested the agility of the last systems development project that the respondents were involved with. As stated in chapter two, ASDMs aim to allow for a flexible approach to developing systems and hence enable an organisation to quickly and effectively change the direction of a systems development project. An overall positive result in these statements would mean that Company A was using the principles of ASDMs on the last systems development project. Table 4.18 and table 4.19 show the summary of the frequency distribution of all the statements in this question.

- *Documentation is very important in the systems development projects we undertake*

Eleven of the twelve respondents (91.6%) generally agreed to this statement, and the remaining respondent was neutral to this statement. Therefore, generally the response to this statement was positive.

- *Generally, building a system takes too much time*

Seven of the twelve respondents (58.4%) generally agreed to this statement and only two respondents (16.7%) disagreed to this statement. The remaining three respondents were neutral to this statement. Therefore, the general response was positive for this statement.

- *Changing user requirements at an advanced level in the project is virtually impossible*

This statement is one of the most important characteristics of an agile systems development methodology. In Company A, four respondents (33.3%) disagreed to this statement and four other respondents (33.3%) generally agreed to this statement. The remaining four respondents were neutral to the statement. The result of the responses of this statement was that it generated a mixed reaction.

- *Adapting to changes in user requirements is very difficult*

This statement is also another very important characteristic of ASDMs. Four respondents (33.3%) disagreed to this statement and three other respondents (25.0%) agreed to this statement. The remaining five respondents (41.7%) were neutral to this statement. Therefore, this statement generally generated a mixed reaction between the respondents.

- *Working software is delivered frequently (weeks rather than months)*

The use of ASDMs allow for the frequent development of working software (see Chapter 2). Therefore this statement directly tested Company A's ability to frequently deliver working software, which is a crucial indicator of ASDMS. Five of the twelve respondents (41.6%) generally disagreed with this statement and only two respondents (16.7%) agreed with the statement. So it can be said that in Company A, working software is not frequently delivered.

- *Late changes in user requirements are welcome*

Exactly 50% of the respondents generally disagreed with this statement and only two respondents (16.7%) agreed to the statement. Therefore, generally Company A does not welcome late changes in the user requirements.

- *There is close and daily cooperation between the developers and the user*

Four of the twelve respondents (33.3%) generally disagreed with this statement, and two respondents (16.7%) generally agreed with the statement. The remaining six respondents were neutral to the statement. Therefore, generally the response to this statement was negative meaning that there is no close and daily cooperation between the developer and the user.

- *The development team is made up of between 3-7 people*

Exactly 75.0% of the respondents (9 out of 12) generally agreed to this statement, and the remaining three respondents were neutral to the statement. Therefore, the general result of the responses was positive meaning that there are indeed between 3 and 7 people in a development team.

- *We continuously re-design the system being developed, even during development*

Close to 60% of the respondents (7 out of 12) agreed with this statement, and only two respondents (16.7%) disagreed. The remaining three respondents were neutral to the statement. Therefore, the general result of the responses was positive meaning that they do continuously re-design the systems, even during development.

- *There is good communication between the members in the development team*

Exactly 50% of the respondents agreed to the statement and the remaining six respondents were neutral to the statement. This result signifies that there is good communication between the members in the development team.

- *As a development team, we are very motivated to achieve the goals set out by management*

More than 75.0% of the respondents (10 out of 12) generally agreed to this statement, and the remaining two respondents were neutral to this statement. Therefore, generally the development team is very motivated to achieve the goals set out by management.

- *Problems relating to SD projects are quickly dealt with*

Seven out of the twelve respondents (58.4%) generally agreed to this statement and only two respondents disagreed to the statement. Therefore, the responses show that problems are quickly dealt with in SD projects in Company A. Table 4.18 and table 4.19 show the frequency distribution of this question in Company A.

Table 4.18: Summary of section 2 (Question 2)

	Total Frequency	Documentation is very important in the SD projects we undertake		Generally, building a system takes too much time		Changing user requirements at an advanced level in the project is virtually impossible		Adapting to changes in user requirements is very difficult		Working software is delivered frequently (weeks rather than months)		Late changes in user requirements are welcome		There is close and daily cooperation between the developers and the users		The development team is made up of between 3-7 people		We continuously re-design the system being developed, even during development		There is good communication between the members in the development team		There is good communication between the development team and the users of the system being developed	
		Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
Totally Disagree	3	0	0.0	0	0.0	0	0.0	0	0.0	1	8.3	1	8.3	1	8.3	0	0.0	0	0.0	0	0.0	0	0.0
Disagree	24	0	0.0	2	16.7	4	33.3	4	33.3	4	33.3	5	41.7	3	25.0	0	0.0	2	16.7	0	0.0	0	0.0
Neutral	46	1	8.3	3	25.0	4	33.3	5	41.7	5	41.7	4	33.3	6	50.0	3	25.0	3	25.0	6	54.5	6	50.0
Agree	43	4	33.3	5	41.7	3	25.0	3	25.0	2	16.7	2	16.7	1	8.3	6	50.0	7	58.3	4	36.4	6	50.0
Totally Agree	15	7	58.3	2	16.7	1	8.3	0	0.0	0	0.0	0	0.0	1	8.3	3	25.0	0	0.0	1	9.1	0	0.0
	Missing system																			1			
	Total	12	100.0	12	100.0	12	100.0	12	100.0	12	100.0	12	100.0	12	100.0	12	100.0	12	100.0	12	100.0	12	100.0

Table 4.19: Summary of section 2 (Question 2 continued)

	Total frequency	As a development team, we are very motivated to achieve the goals set out by management		Problems relating to the systems development project are quickly dealt with	
		Freq	%	Freq	%
Totally Disagree	0	0	0.0	0	0.0
Disagree	2	0	0.0	2	16.7
Neutral	5	2	16.7	3	25.0
Agree	12	7	53.8	5	41.7
Totally Agree	5	3	25.0	2	16.7
	Total	12	100.0	12	100.0

4.4.11 Question 3 (Company A)

These statements went further to test how agile the systems development methodologies are in Company A. Also, the applicability of agile systems development methodologies is tested based on the last systems development project. The first three statements tested the level of satisfaction in terms of systems development projects in Company A. An overall positive result would mean that Company A is generally happy with the systems development projects they undertake and also they are well aware and understand the benefits of using ASDMs. Table 4.20 and table 4.21 show the frequency distribution of the responses to this question.

- *I enjoy working with my colleagues*

Exactly 75.0% of the respondents (9 out of 12) generally agreed to this statement. The remaining three respondents were neutral to the statement. So generally the result of this question is that the respondents enjoy working with each other.

- *I enjoy the way we develop systems*

Two out of the twelve respondents (16.7%) disagreed with this statement and close to 60% of the respondents (7 out of 12) agreed with the statement. The remaining three respondents (25.0%) were indifferent to the statement (neutral). Therefore it can be said that generally the development team enjoys the way they develop systems.

- *I feel proud when we successfully develop a(n) system/application that meets the users requirements*

All twelve respondents agreed to this statement signifying that there is a great sense of pride when a system or application that has been built meets the users' requirements.

- *Changing the current systems development methodology we use will be a good idea*

Seven out of the twelve respondents (58.4%) generally agreed to this statement. The remaining 5 respondents were neutral to the statement. Therefore it can be said that generally the development team feels that changing the current SDM would be a good idea.

- *I see nothing wrong with the current methodology we use*

Seven out of twelve respondents (58.4%) generally disagreed with this statement. Only one respondent agreed with the statement and the remaining four respondents (33.3%) were neutral to the statement. This result signifies that the development team generally felt that there was something wrong with the methodology they used. Based on the open-ended questions in the questionnaire it was identified that Company A used the systems development lifecycle (SDLC).

- *The development team is well conversed with the methodology being used*

More than 30% of the respondents (4 out of 12) disagreed with this statement and the remaining 8 respondents were neutral to the statement. Therefore the result of this statement is that the development team generally is not well conversed with the methodology being used.

- *The current methodology being used adapts to change well*

Exactly 50% of the respondents (6 out of 12) agreed to this statement and only one respondent disagreed to this statement. The remaining five respondents were indifferent (neutral) to this statement. Therefore, generally the development team feels that the methodology being used (SDLC) is well equipped in adapting to change.

- *The methodology being used is linear (i.e. it follows a waterfall model)*

Exactly 50% of the respondents (6 out of 12) agreed with this statement and only one respondent (8.3%) disagreed with the statement. The remaining 5 respondents were neutral to the statement. Therefore, the result of this statement signifies that indeed Company A is using a methodology that follows a linear model, and as identified earlier the company uses the SDLC, which follows a waterfall model.

- *I know what agile systems development methodologies are*

Seven out of twelve respondents (58.3%) generally agreed to this statement and three respondents (25%) disagreed with the statement. Therefore it can be said that the development team in Company A are aware of ASDMs.

- *I have used an agile methodology before*

This statement continues from the previous statement. The results show that there is a mixed reaction as 50% generally disagreed and the remaining 50% generally agreed to the statement.

- *Using an agile methodology will be beneficial to this organisation*

A large majority of the respondents (66.7%) generally agreed to the statement. Therefore it can be said that an ASDM will greatly benefit Company A.

- *One needs to have a lot of experience in agile methodologies before using it*

Three out of the twelve respondents (25%) disagreed with this statement and 41.7% of the respondents (5 out of 12) agreed with the statement. Therefore, generally the development team is not sure whether experience is necessary in using ASDMs because this result shows a mixed reaction between the members of the development team.

- *Agile methodologies are widely used in the telecomm industry*

This statement also generated a mixed reaction between the members of the development team. Three out of the twelve respondents disagreed with this statement and three other respondents

generally agreed to this statement. Therefore it can be said that Company A is undecided about whether ASDMs are widely used in the telecomm industry.

- *The telecomm industry is a fast-paced industry, and companies operating within it requires a systems development methodology that is able to accommodate change*

Seven out of the twelve respondents (58.3%) generally agreed to this statement. Therefore this result shows that there is a need for a flexible and adaptive systems development methodology in the telecommunication industry.

- *Our systems development methodology helps to capture requirements for the systems to be developed*

Seven out of the twelve respondents (58.3%) agreed with the statement and only two respondents (16.7%) disagreed. Therefore, the SDM captures the requirements for a system to be built.

- *Our systems development methodology helps to involve end-users in systems development projects*

Seven out of the twelve respondents (58.3%) agreed with this statement and only one respondent (8.3%) disagreed with this statement. Therefore it can be said that generally Company A's SDM involves end-users in the SD projects.

- *Our systems development methodology helps to build management commitment in our systems development projects*

Exactly 50% of the respondents (6 out of 12) agreed to this statement and the remaining 6 respondents were neutral to this statement. Therefore it can be said that there is a strong commitment of management based on the SDM they use.

- *Our systems development methodology helps to decompose the system to be developed in workable parts*

A large percent of the respondents (58.3%) agreed with the statement only two respondents (16.7%) disagreed with the statement. Therefore it can be said that the SDM used by Company A allows for the development of modules in a systems development project.

The statements from this section that yielded positive responses are:

- *I enjoy working with my colleagues* (This indicates that the respondents in Company A generally satisfied with the working conditions.)
- *I enjoy the way we develop systems* (Same as above)
- *I feel proud when we successfully develop a(n) system/application that meets the users requirements* (Same as above)
- *Changing the current SDM we use will be a good idea;*

- *The current methodology being used adapts to change well;*
- *The methodology being used is linear;*
- *I know what ASDMs are;*
- *Using an agile methodology will be beneficial to the organisation;*
- *The telecomm industry is a fast-paced industry, and companies operating within it requires an SDM that is able to accommodate change quickly;*
- *Our SDM helps to capture requirements for the system to be developed;*
- *Our SDM helps to involve end-users in SD projects;*
- *Our SDM helps to build management commitment in our SD projects; and*
- *Our SDM helps to decompose the system to be developed in workable parts*

Although the respondents from Company A felt that their current SDM was sufficient in meeting their day-to-day needs, the general impression is that the respondents are willing to change the current SDM.

Table 4.20 and table 4.21 show the summary of the frequency distribution of this question in Company A.

Table 4.20: Summary of section 2 (Question 3)

	Total Frequency	I enjoy working with my colleagues		I enjoy the way we develop systems		I feel proud when we successfully develop a(n) system/application that meets the users requirements		Changing the current systems development methodology we use will be a good idea		I see nothing wrong with the current methodology we used		The development team is well conversed with the methodology being used		The current methodology being used adapts to change well		The methodology being used is linear (i.e. it follows a waterfall model)		I know what agile systems development methodologies are		I have used an agile methodology before		Using an agile methodology will be beneficial to this organisation	
		Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
Totally Disagree	10	0	0.0	0	0.0	0	0.0	0	0.0	5	41.7	0	0.0	0	0.0	1	8.3	0	0.0	4	33.3	0	0.0
Disagree	16	0	0.0	2	16.7	0	0.0	0	0.0	2	16.7	4	33.3	2	16.7	0	0.0	3	25.0	2	16.7	1	8.3
Neutral	37	3	25.0	3	25.0	0	0.0	5	41.7	4	33.3	8	66.7	4	33.3	5	41.7	2	16.7	0	0.0	3	25.0
Agree	42	7	58.3	7	58.3	4	33.3	2	16.7	1	8.3	0	0.0	6	50.0	6	50.0	3	25.0	2	16.7	4	33.3
Totally Agree	27	2	16.7	0	0.0	8	66.7	5	41.7	0	0.0	0	0.0	0	0.0	0	0.0	4	33.3	4	33.3	4	33.3
	Total	12	100.0	12	100.0	12	100.0	12	100.0	12	100.0	12	100.0	12	100.0	12	100.0	12	100.0	12	100.0	12	100.0

Table 4.21: Summary of section 2 (Question 3 continued)

	Total Frequency	One needs to have a lot of experience in agile methodologies before using it		Agile methodologies are widely used in the telecomm industry		The telecomm industry is a fast-paced industry, and companies operating within it requires an SDM that is able to accommodate change quickly		Our SDM helps to capture requirements for the system to be developed		Our SDM helps to involve end-users in systems development projects		Our SDM helps to build management commitment in our systems development projects		Our SDM helps to decompose the system to be developed in workable parts	
		Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
Totally Disagree	2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	16.7
Disagree	9	3	25.0	3	25.0	0	0.0	2	16.7	1	8.3	0	0.0	0	0.0
Neutral	31	4	33.3	6	50.0	5	41.7	3	25.0	4	33.3	6	50.0	3	25.0
Agree	36	5	41.7	2	16.7	3	25.0	7	58.3	7	58.3	6	50.0	6	50.0
Totally Agree	6	0	0.0	1	8.3	4	33.3	0	0.0	0	0.0	0	0.0	1	8.3
	Total	12	100.0	12	100.0	12	100.0	12	100.0	12	100.0	12	100.0	12	100.0

4.4.12 Question 4 (Company A)

These statements assessed the successful completion of the last project the respondents were involved with. Also, these statements aimed to assess the overall success of the last project in terms of costs and project deadlines. Table 4.22 shows the summary of the frequency distribution of all the respondents in this question. Each statement's result will be discussed separately as in sections 4.4.9, 4.4.10 and 4.4.11.

- *The project was completed on schedule*

Seven out of the twelve respondents (58.4%) generally agreed to the statement and only two respondents disagreed (16.7%). Therefore this result shows that the last project was generally completed on schedule, and this is a positive result.

- *The project was completed within budget*

Exactly 50% of the respondents (6 out of 12) generally agreed to this statement ands only two other respondents (16.7%) disagreed. Therefore it can be said that generally the last project was indeed completed within budget.

- *The developed system satisfied all the stated requirements*

A large majority of the respondents (58.3%) agreed with the statement, and the remaining 41.7% of the respondents (5 out of 12) were indifferent to the statement. Therefore it can be said that generally the last developed systems satisfied all the stated requirements.

- *The speed of developing the project was high*

Five out of the twelve respondents (41.7%) agreed with the statement and only two respondents (16.7%) disagreed. The remaining five respondents were neutral to the statement. Therefore, this result shows that generally the speed of development was high in the last SD project.

- *The productivity of developers involved with the project was high*

A large percentage of the respondents (58.3%) agreed to this statement signifying that generally productivity levels of the developers were high.

- *The cost of the project was low when compared to the size and complexity of the system developed*

More than 30% of the respondents (4 out of 12) generally agreed with this statement and only one respondent (8.3%) disagreed. The remaining seven respondents were neutral to this statement. Therefore it can be said that even though some of the members in the development team felt that the cost was low with regards to the size and complexity of the system, generally the development team is not aware of the costs associated with the project.

- *The project achieved its goals*

Exactly 75% of the respondents (9 out of 12) generally agreed to this statement. The remaining three respondents were neutral to the statement. Therefore this result shows that the last project generally achieved its goals.

- *Overall, the project represents excellent work*

More than 75% of the respondents (10 out of 12) generally agreed to this statement signifying that the last project that they were involved with represented excellent work.

- *Overall, the project was a success*

This statement also generated a high positive response. Ten out of the twelve respondents (83.3%) generally agreed to this statement signifying that the last project that the respondents were involved with was generally a success.

Generally, the results in this question yielded a positive result meaning that the last project that the respondents were involved with was completed on schedule and within budget. Also, the productivity of the developers was deemed to be of a very high standard, and the costs involved were low compared to the size and complexity of the project. Therefore it can be said that overall the project was successful and it represented excellent work. The level of success of the last project was very high and therefore Company A prides itself in how they develop systems. Table 4.22 shows the results of the summary of the frequency distribution of this question in Company A.

Table 4.22: Summary of section 2 (Question 4)

	Total Frequency	The project was completed on schedule		The project was completed within budget		The developed system satisfied all the stated requirements		The speed of developing the project was high		The productivity of developers involved with the project was high		The cost of the project was low when compared to the size and complexity of the system developed		The project achieved it goals		Overall, the project represents excellent work		Overall, the project was a success	
		Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
Totally Disagree	0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Disagree	7	2	16.7	2	16.7	0	0.0	2	16.7	0	0.0	1	8.3	0	0.0	0	0.0	0	0.0
Neutral	36	3	25.0	4	33.3	5	41.7	5	41.7	5	41.7	7	58.3	3	25.0	2	16.7	2	16.7
Agree	49	5	41.7	4	33.3	7	58.3	5	41.7	7	58.3	1	8.3	6	50.0	7	58.3	7	58.3
Totally Agree	16	2	16.7	2	16.7	0	0.0	0	0.0	0	0.0	3	25.0	3	25.0	3	25.0	3	25.0
	Total	12	100.0	12	100.0	12	100.0	12	100.0	12	100.0	12	100.0	12	100.0	12	100.0	12	100.0

4.4.13 Question 5 (Company A)

These statements assessed the actual system that was developed in terms of functionality, reliability, maintainability and efficiency. The purpose of these statements was to assess the overall quality of the last system developed. As in the previous sections, each statement is discussed separately. Table 4.23 shows results of the summary of this question in Company A.

- *The functionality of the developed system is high*

A large percentage of the respondents (75%) generally agreed with this statement signifying that generally the respondents were of the view that the functionality of the system was high.

- *The reliability of the developed system is high*

Here also 75% of the respondents (9 out of 12) agreed with this statement. Therefore it can be said that the reliability of the last systems the respondents developed was of a very high standard.

- *The maintainability of the developed system is high*

Ten out of the twelve respondents (83.3%) agreed to this statement signifying that generally the respondents felt that the maintainability of the developed system was high.

- *The efficiency of the developed system is high*

In terms of the efficiency of the developed system being high, ten respondents out of twelve generally agreed with the statement signifying that there was a consensus that the system was highly efficient.

- *The developed system meets user needs*

All twelve respondents agreed with this statement. This positive result means that all the respondents felt that the system met all the needs of the users. This result directly contributes to the overall success of the project and as it can be seen in section 4.4.12, generally the respondents felt that the project was a success.

- *Overall, the quality of the developed system is high*

Exactly 75% of the respondents (9 out of 12) generally agreed with the statement. This result shows that generally the quality of the developed system was high.

- *Overall, the users are satisfied with the developed system*

Eleven out of the twelve respondents (91.7%) agreed with the statement signifying that there is a very high user satisfaction in Company A.

- *Overall, the developed system is a success*

All twelve of the respondents agreed to this statement meaning that the last developed system was deemed to be a success.

All the statements from this section yielded a positive response indicating that the respondents felt that the last developed system was of a very high quality.

Table 4.23: Summary of section 2 (Question 5)

	Total Frequency	The functionality of the developed system is high		The reliability of the developed system is high		The maintainability of the developed system is high		The efficiency of the developed system is high		The developed system meets users needs		Overall, the quality of the developed system is high		Overall, the users are satisfied with the developed system		Overall, the developed system is a success	
		Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
Totally Disagree		0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Disagree		0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Neutral		3	25.0	3	25.0	2	16.7	2	16.7	0	0.0	3	25.0	1	8.3	0	0.0
Agree		5	41.7	7	58.3	9	75.0	7	58.3	9	75.0	6	50.0	7	58.3	6	50.0
Totally Agree		4	33.3	2	16.7	1	8.3	3	25.0	3	25.0	3	25.0	4	33.3	6	50.0
	Total	12	100.0	12	100.0	12	100.0	12	100.0	12	100.0	12	100.0	12	100.0	12	100.0

4.4.14 Open-ended section (Company A)

There were only two open-ended questions ("What is the name of the SDM you use?" and "Briefly describe how the SDM is tailored.") in the questionnaire namely question 8 and 10 (see appendix 1). In questions 8 and 10, eleven out of the twelve respondents answered these questions and the results are as follows:

- Ten of the eleven respondents (90.9%) said that SDM used was SDLC for large projects and a tailored version of it for smaller projects;
- Of the seven respondents that answered "yes" to question 9 (see table 4.16), 71.4% (5 out of 7) said that the SDM was tailored by shortening some stages and reducing the time taken in the initial phase.

Therefore it can be said that the current SDM used in Company A was the SDLC and it was used for projects with a cost of R5 million or more. For the smaller projects, this SDM was tailored by shortening the development lifecycle of the project.

4.5 REVISED PROPOSITIONS

In this section, the propositions that were formulated in section 4.3.5 are revised. This is done using the information gained from the questionnaire data in section 4.4. Also, more propositions generated from the questionnaire data will be included.

4.5.1 Proposition 1: [*The SDM currently being used in the telecommunication industry is a formalised methodology following a linear process model. For larger projects, the methodology is used in the way it was intended, and for smaller projects the formalised methodology is tailored by scaling down more time consuming activities such as the feasibility study and the planning and analysis phases. Even though the methodology being used is prone to red-tape, generally the users of the methodology are satisfied with it.*]

Taken from section 4.3.5.1, this proposition does not change at all. This is because the questionnaire data has shown that generally the respondents are satisfied with the methodology they use because of the successes that it brings to the organisation (table 4.22 and table 4.23). Therefore this proposition will remain unchanged **[AI, AQ]**[7].

[7] This code indicates that Proposition 1 is supported by the findings from the interview and questionnaire data from Company A.

4.5.2 Proposition 2: [*The first phase is considered to be the most important phase in the project lifecycle, and it is very important that this phase is done with very clear objectives from the client department.*]

The questionnaire data did not single out the first phase in the project lifecycle. Therefore this proposition will also remain unchanged because not enough information concerning the initial phase was gained from the questionnaire **[AI].**

4.5.3 Proposition 3: [*Large companies in the telecommunication industry enjoy a very high success rate when developing systems.*]

This proposition from section 4.3.5.3 is supported by tables 4.22 and 4.23 which show that generally Company A has a high success rate in systems development projects. Therefore this proposition should be slightly revised to include the data generated from the questionnaires.

4.5.3.1 Revised proposition 3

Generally, large companies in the telecommunication industry enjoy a very high success rate when developing systems and the developed system is generally of a very high standard that effectively meets the requirements of the users.

In terms of the overall project success rate, the system is developed within budget and the costs involved are minimal compared to the benefits that the systems hold for the users. The SDM currently used helps to capture user requirements and it allows for modular development **[AI, AQ]**.

4.5.4 Proposition 4: [*Agile SDMs are not understood by the development team. These methodologies are viewed as good methodologies only "in theory". Applying agile systems development methodologies in the telecommunication industry will take time and a lot needs to be done to educate the development team.*]

Based on the results from the questionnaires in Company A, the fourth proposition in section 4.3.5 needs to be totally revised because of the positive responses gained from the questionnaires, which is contrasting with the initial proposition 4.

4.5.4.1 Revised proposition 4

Although there are some people that don't know what agile SDMs are, the general perception is that agile systems development methodologies can benefit the organisation – and the industry – and one doesn't need to have experience in ASDMs in order to use them. Also, using an ASDM will help the organisation to adapt quickly to a changing environment **[AQ]**[8].

4.5.5 Proposition 5: [*Changing the current mindset of the development team will negatively impact the organisation. This is informed by the finding that there is a "why change something if it works" mentality from the interview.*]

The proposition in section 4.3.5.5 gave the impression that there is a very negative sentiment towards agile systems development methodologies. Based on the results from the questionnaires, it can be said that the opposite is true (see table 4.20 and table 4.21). These results show that there is generally a positive attitude towards the use of an agile systems development methodology. Therefore this proposition needs to be totally revised to include the perceptions of the twelve respondents from the questionnaire data.

4.5.5.1 Revised proposition 5

Although there is a strong resistance of the use of ASDMs from management because of the high success rate that the current SDM affords the organisation, the general mindset is very positive towards ASDMs, and they are generally open to experiencing an agile systems development methodology even though the current methodology they use is very successful in meeting the user requirements **[AQ]**.

4.5.6 Proposition 6: [*There needs to be management commitment to the use of a particular SDM in the organisation. Without management commitment, systems development projects could be highly compromised.*]

This proposition in section 4.3.5.6 was confirmed from the findings in table 4.21 where 50% of the respondents (6 out of 12) agreed with the statement that the current SDM helps to build management commitment in the systems development projects. Therefore proposition 6 remains unchanged **[AI, AQ]**.

[8] This code indicates that proposition 4 is only supported by the questionnaire data from Company A.

4.5.7 Proposition 7: [*The use of systems development techniques and tools helps to ensure that the system developed is of a very high quality that meets the requirements of the users.*]

This proposition in section 4.3.5.7 was confirmed by the findings in table 4.14 which shows that there are a large percentage of respondents (58.3%) that are highly skilled in UML design. The findings in table 4.23 show that the developed system is of a very high quality **[AI, AQ]**.

4.6. SUMMARY OF COMPANY A

In this section, the results from Company A are discussed in terms of the research aims and objectives. As mentioned in section 4.2, the thrust of this research was to ascertain whether ASDMs are used in the telecommunication industry in South Africa and the main research questions were:

- *Can ASDMs be applied in the telecommunication industry in South Africa?*

The findings from the questionnaire alone suggest that there is a good attitude towards ASDMs in the organisation. This is supported by proposition 4 (see section 4.5.4.1) which suggests that ASDMs are applicable in the organisation even though the current SDM helps to maintain a high level of standard in terms of the quality of the systems developed.

- *How agile are current SDMs in the telecommunication industry in South Africa?*

The findings from the interview and questionnaire data indicated that a SDM following a waterfall model was used, but some agile practices such as modular development and good communication between the end-users and the development team are used (see table 4.21). Another ASDM characteristic is that the system is continuously re-designed, even during the development phase. The findings show that 58.3% of the respondents agreed that there was continuous re-design of the system (see table 4.18).

4.7 COMPANY B (INTERVIEW DATA)

4.7.1 Background information

Company B is a leading African communications group providing mobile communications and related services to 39,6 million customers. Its mobile network covers a total population of approximately 182 million people across five countries namely, South Africa, Tanzania, the DRC, Lesotho and Mozambique, and its operations in South Africa is the largest in terms of the number of customers and revenue. The interview at Company B was done at their offices in Midrand, Johannesburg, and the interviewee had been working in the organisation for more than three years. In terms of SD experience, the interviewee had eight years experience and he was a senior IT developer at the time of the interview.

The duration of the interview lasted between 20 and 30 minutes, and the structure of the interview discussion will follow section 4.3. Thereafter propositions for Company B will be formulated. Once that is done, the questionnaire data from Company B will be reported with the view of revising the propositions formulated from the interview data.

4.7.2 Job responsibilities (Interviewee 2)

As mentioned in section 4.7.1, the interviewee was a senior IT developer at Company B and he had been working there for more than three years. On a daily basis the interviewee was responsible with database and software application development for the customer services department in Company B. Over and above software and database development, the interviewee was also responsible for the database testing and usability testing as well as ensuring that the customer services systems are online 24 hours a day. The interviewee's responsibilities centred on the technical aspects of a systems development project.

4.7.3 Systems development methodology used

Company B, according to the interviewee, uses the waterfall approach for very large projects, and for the smaller projects some of the stages are skipped or shortened. The interviewee did not specify the name of the systems development methodology used. This indicates that for the smaller projects, the SDM used is tailored to suit that project and therefore the bureaucratic principles that are followed in larger projects are generally disregarded for smaller projects.
In terms of the success rate of the projects in Company B, the interviewee said that they enjoyed a "very high success rate" and the SDM used was sufficient in capturing the requirements of the user department, which in this interview was identified to be the customer services department. The SDM used by Company B will discussed using the definition of Huisman and Iivari (2006).

- **Systems development approach**

Company B followed a formalised approach for large projects, and a tailored version of that SDM for the smaller projects. Company B's SD is driven by the requirements of an internal client department and the users of the developed system are usually the owners of the system.

- **Systems development process model**

The SDM used follows a sequential model in that it is ordered in such a way that a stage commences once the preceding phase has been completed. If there are any complications during the project lifecycle, the development process is restarted from the beginning, but according to the interviewee these problems were hardly encountered.

- **Systems development method**

1) Analysis phase

In this phase the business analysts engage with the client department. The user requirements are identified and modelled in such a way that the development team is able to understand. Once that is done, the development team begins the process of building the system. Depending on the size of the project, this phase can take between a week and a month.

2) Development and testing phase

This is the phase that the interviewee spent most of his time on. His domain was the customer services department and it was his responsibility to ensure that all the systems in that department were online at all times. Once the system was developed, the interviewee was required to rigorously test the database as well as the software applications in order to ensure integrity between the systems.

It was identified that these tests were done to ensure that the system was of a "very high quality" and also that the system was in line with the overall business strategy of Company B.

3) Implementation and maintenance phase

When a project is deemed to be unsuccessful, a post mortem is done by the development team "to determine exactly what went wrong". Once the problem is identified, other systems linked to that system are then checked for "consistency". Thereafter, the system is reintegrated into the "core network". This represents the maintenance phase and as mentioned by the interviewee, a system failure "rarely happens".

In terms of implementing the developed system, the interviewee mentioned that all the different domains need to be "synchronised" before a system is put online. This practice helps to ensure that the integrity of the entire system is preserved.

Development language

The development language used included the .NET platform as well as Java. In some instances COBOL was used for legacy systems.

The organisation also used Business Process Execution Language (BPEL), which is used as a runtime representation of process logic and helps with system integration.

- **Systems development techniques and tools**

Company B used a combination of brainstorming, stakeholder analysis, and Use-case scenarios for SD techniques and Microsoft Project for SD tools. The use of MS Project helped to ensure that the projects are delivered on time and within budget.

In terms of the SD techniques, they helped to ensure that the SD project captured the user requirements effectively and therefore facilitated an environment where a system of a high quality could be developed.

4.7.4 The sentiments of using ASDMs in Company B

The interviewee felt that ASDMs were not well understood in the organisation and as a result they were never used. In terms of the perceived benefits of ASDMs, the interviewee felt that the use of agile methodologies could lead to "happier developers" and reduce the cycle time of a project. The unpredictability of agile methodologies excited the interviewee to the extent that he was open to experiencing using ASDMs in the organisation. In terms of the applicability of ASDMs in the organisation – and the industry as a whole – the interviewee was of the view that agile methodologies could positively affect the morale of the development team even though the current methodology used helps to achieve close to 100% success rate.

His argument was that the "excitement" of using an agile methodology would create a high productive environment in the organisation. Therefore, the general sentiment of using ASDMs in Company B is that they would greatly improve the development process and therefore result in a more satisfied and "well-rounded" development team.

4.7.5 Propositions

As in section 4.3.5, the following propositions are formulated to generate theory about the SD practises in Company B based on the interview data. In order to include the propositions formulated for Company A, the researcher decided to revise the propositions in section 4.5 so that the interview data from Company B are included. This is the strategy used to perform the cross-case analysis method of the cases being studied.

4.7.5.1 Proposition 1: [*The SDM currently being used in the telecommunication industry is a formalised methodology following a linear process model. For larger projects, the methodology is used in the way it was intended, and for smaller projects the formalised methodology is tailored by scaling down more time consuming activities such as the feasibility study and the planning and analysis phases. Even though the methodology being used is prone to red-tape, generally the users of the methodology are satisfied with it.*]

Proposition 1 from section 4.3.5.1 is supported by the findings from the interview data. As mentioned by the interviewee, SD projects generally follow a waterfall model, which is a formalised methodology following a linear process model.

In terms of tailoring the current methodology, the interviewee mentioned that for smaller projects some stages are skipped and others are shortened. In terms of current SDM satisfaction, the interviewee was generally happy with the methodology. Therefore proposition 1 from section 4.3.5.1 is supported from the interview data findings in Company B and it can be applied to Company B [**AI, AQ, BI**][9].

4.7.5.2 Proposition 2: [*The first phase is considered to be the most important phase in the project lifecycle, and it is very important that this phase is done with very clear objectives from the client department.*]

Not much was said about the first phase in the interview but the interviewee mentioned that Company B "has close 100% success rate". This high success rate could be attributed to many contributing factors but for purposes of this proposition, the researcher has decided to use the first phase to explain the high success rate. It also follows that in most SD projects the users are more exposed to the initial phase of the project. Therefore in revising proposition 2 from section 4.3.5.2 to include the findings from Company B, the researcher decided to revise the proposition as follows.

4.7.5.2.1 Revised proposition 2

The first phase is considered to be one of the most important phases in the project lifecycle. It is very important that this phase is done with very clear objectives from the user department and therefore resulting in a high quality systems development project [**AI, BI**].

4.7.5.3 Proposition 3: [*Generally, large companies in the telecommunication industry enjoy a very high success rate when developing systems and the developed system is generally of a very high standard that effectively meets the requirements of the users.*

In terms of the overall project success rate, the system is developed within budget and the costs involved are minimal compared to the benefits that the systems hold for the users. The SDM currently used helps to capture user requirements and it allows for modular development.]

[9] This code indicates that this proposition is supported by the findings from the interview and questionnaire data from Company A, and the interview data from Company B

As mentioned by the interviewee, Company B enjoys a "close to 100%" success rate but if there are mistakes in any phase then a "post mortem" is performed to determine the origin of the problem.. Therefore proposition 3 from section 4.5.3.1 will change slightly to include the interview data from Company B.

4.7.5.3.1 Revised Proposition 3

Generally, large companies in the telecommunication industry enjoy a very high success rate when developing systems and the developed system is generally of a very high standard that effectively meets the requirements of the users. In terms of the overall project success rate, the organisations in the telecommunication industry develops systems within budget and the costs involved are minimal compared to the benefits that the system hold for the users. The SDM currently used helps to capture user requirements and it allows for modular development so that a quality of standard in maintained. In the rare case of project failure, a post mortem is performed in order to identify the origin of the error and thereafter rectify it such that the entire project is not compromised **[AI, AQ, BI]**.

4.7.5.4 Proposition 4: [*Although there are some people that don't know what agile SDMs are, the general perception is that agile systems development methodologies can benefit the organisation – and the industry – and one doesn't need to have experience in ASDMs in order to use them. Also, using an ASDM will help the organisation to adapt quickly to a changing environment.*]

Proposition 4 from section 4.5.4.1 is supported by the findings from the interview data in Company B. The interviewee mentioned that his knowledge of ASDMs was based on "a lot of reading on methodologies" in his spare time.

Also, the interviewee was of the view that using ASDMs would greatly benefit the organisation – and industry – and therefore lead to "happier people and reduced cycle times". Therefore proposition 4 from section 4.5.4.1 remains unchanged **[AQ, BI]**.

4.7.5.5 Proposition 5: [*Although there is a strong resistance of the use of ASDMs from management because of the high success rate that the current SDM affords the organisation, the general mindset is very positive towards ASDMs, and they are generally open to experiencing an agile systems development methodology even though the current methodology they use is very successful in meeting the user requirements.*]

Proposition 5 from section 4.5.5.1 is supported by the findings from the interview data. There seems to be a positive view of ASDMs from the interviewee but he mentioned that "senior management" would not be willing to change the current SDM because of the high success rate that they enjoy.

Therefore, as is the case in Company A, there is very little or no support from senior level management in terms of changing the current SDM to an agile SDM. This proposition from section 4.5.5.1 will therefore remain unchanged **[AQ, BI]**.

4.7.5.6 Proposition 6: [*There needs to be management commitment to the use of a particular SDM in the organisation. Without management commitment, systems development projects could be highly compromised.*]

It was established that senior management has the final say to which SDM is used. It has also been established that there needs to be senior management commitment in order for the SDM project to succeed. Therefore, this proposition in section 4.3.5.6 will remain unchanged because it has been supported from the interview data findings **[AI, AQ, BI]**.

4.7.5.7 Proposition 7: [*The use of systems development techniques and tools helps to ensure that the system developed is of a very high quality that meets the requirements of the users.*]

Proposition 7 from section 4.3.5.7 is supported by the findings from the interview. As it was established from the interview, the organisation uses a combination of tools and techniques that help in meeting user requirements. The use of these techniques and tools explains the high success rate that the organisation enjoys. Therefore, proposition 8 from section 4.3.5.7 remains unchanged as it also applies to this organisation **[AI, AQ, BI]**.

4.8 COMPANY B (QUESTIONNAIRE DATA)

A total of twenty questionnaires were distributed in the organisation but only thirteen were returned. The analysis of the questionnaires followed the same approach as Company A where a statistical analysis tool was used to analyse the data. Thereafter, the propositions from section 4.7.5 will be revised to include the data generated from the questionnaire data. As mentioned in section 4.4, the questionnaire is sub-divided into two sections and each section will also be discussed separately for Company B.

Section 1: Background information

In this section general questions concerning the respondent's job responsibility were asked. The respondent's level of knowledge in SD processes and technologies were also asked.

In the last part of this section, the researcher asked the respondents about the current SDM being used and whether it is tailored to suit a particular SD project.

4.8.1 Question 1: Which job title best describes your position?

As mentioned in section 4.8, only thirteen out of the twenty distributed questionnaires were returned. Of the thirteen respondents, close to 31% (4 out of 13) of them were IT/Systems developers. There was only one business Analyst and one Programmer each representing 7.7% of the total respondents, and there were two IT/Business Architects and two IT Managers each representing 15.4% of the total respondents. The remaining 23.1% (3 out of 13) of the respondents replied under the category "Other".

Of the three respondents, two (15.4%) of them responded as being Test Analysts and the remaining respondent (7.7%) responded as being a Solutions Architect. Table 4.24 shows the actual results of question 1 in Company B.

Table 4.24: Question 1 Results (Company B)

Which job title best describes your position?

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	I.T/ Systems developer	4	30.8	30.8	30.8
	Business analyst	1	7.7	7.7	38.5
	Programmer	1	7.7	7.7	46.2
	I.T/ Business architect	2	15.4	15.4	61.5
	I.T Manager	2	15.4	15.4	76.9
	Other	3	23.1	23.1	100.0
	Total	13	100.0	100.0	

4.8.2 Question 2: Are you currently actively involved in information systems development?

As was the case in Company A, all the respondents responded positively to this question. Table 4.25 shows the result of this question in the organisation. This result implies that all the respondents were actively involved in SD projects and that was the target audience of this study.

Table 4.25: Question 2 Results (Company B)

Are you currently actively involved in information systems development?

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	YES	13	100.0	100.0	100.0

4.8.3 Question 3: How many years of systems development (SD) experience do you have?

More than 50% of the respondents (7 out of 13) had five or more years experience in SD. The remaining respondents replied as follows:

- Three respondents (23.1%) had 1 to 2 years SD experience,
- And the remaining three respondents (23.1%) had 3 to 4 years experience.

This result shows that generally the IT workforce in Company B is sufficiently experienced in terms of SD. Table 4.26 shows the actual result of this question in the organisation.

Table 4.26: Question 3 Results (Company B)
How many years of systems development (SD) experience do you have?

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	1-2 year(s)	3	23.1	23.1	23.1
	3-4 years	3	23.1	23.1	46.2
	5 years or more	7	53.8	53.8	100.0
	Total	13	100.0	100.0	

4.8.4 Question 4: Please indicate what percentage of your personal time/work is devoted to the following development activities:

The results of this question are discussed in the same order as section 4.4.4. Each of the activities will be discussed and reported separately.

- *Systems planning, analysis and design*

Three respondents (23.1%) spent between 61 and 90 percent of their time discharging this task. A further four respondents (30.8%) spent between 41 and 50 percent of their time in this task, and five respondents (collectively 38.5%) – at most – spent between 1 and 40 percent of their time in this task. Only one respondent was not exposed at all to this task. Table 4.27 shows the frequency distribution of the time spent on this development activity.

Table 4.27: Question 4.1 Results (Company B)
Percentage of time spent working on systems planning, analysis & design

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	0%	1	7.7	7.7	7.7
	1-10%	2	15.4	15.4	23.1
	21-30%	2	15.4	15.4	38.5
	31-40%	1	7.7	7.7	46.2
	41-50%	4	30.8	30.8	76.9
	61-70%	1	7.7	7.7	84.6
	71-80%	1	7.7	7.7	92.3
	81-90%	1	7.7	7.7	100.0
	Total	13	100.0	100.0	

- *Programming*

Of the 13 respondents, seven (53.8%) respondents did not do any programming. Four respondents (30.8%) spent between 11 and 50 percent of their time at work programming and only two respondents (15.4%) spent between 61 and 90 percent of their time programming. Table 4.28 shows the detailed frequency distribution of the time spent working on programming.

Table 4.28: Question 4.2 Results (Company B)
Percentage of time spent working on programming

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	0%	7	53.8	53.8	53.8
	11-20%	1	7.7	7.7	61.5
	21-30%	1	7.7	7.7	69.2
	41-50%	2	15.4	15.4	84.6
	61-70%	1	7.7	7.7	92.3
	81-90%	1	7.7	7.7	100.0
	Total	13	100.0	100.0	

- *Testing*

Three respondents (23.1%) spent no time discharging this development activity. Eight respondents (61.5%) spent between 1 and 20 percent of their time at work dealing with this development activity and the remaining two respondents (15.4%) spent between 41 and 50 percent of their time working on testing.

Even though the interviewee from Company B mentioned that there are many tests that are conducted before a system is released, the results from the questionnaire show that generally the SD team do not spend much time on this development activity. This could be explained by the fact that only a few team members are charged with the task of discharging this development task. Table 4.29 shows the frequency distribution of the time spent on testing.

Table 4.29: Question 4.3 Results (Company B)
Percentage of time spent working on testing

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	0%	3	23.1	23.1	23.1
	1-10%	7	53.8	53.8	76.9
	11-20%	1	7.7	7.7	84.6
	41-50%	2	15.4	15.4	100.0
	Total	13	100.0	100.0	

- *Installation*

Eleven respondents (84.6%) did not spend any time working on installing the systems they developed. The remaining two respondents (15.4%) spent between 1 and 10 percent of their time working on installing systems. Table 4.30 shows the detailed frequency distribution for installation in Company B.

Table 4.30: Question 4.4 Results (Company B)
Percentage of time spent working on installation

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	0%	11	84.6	84.6	84.6
	1-10%	2	15.4	15.4	100.0
	Total	13	100.0	100.0	

- *User training*

Eleven respondents (84.6%) did not spend any time discharging this development activity. The remaining two respondents (15.4%) spent between 1 and 10 percent of their time working on user training in Company B. Table 4.31 shows the detailed frequency distribution of the time spent on user training in Company B.

Table 4.31: Question 4.5 Results (Company B)
Percentage of time spent working on user training

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	0%	11	84.6	84.6	84.6
	1-10%	2	15.4	15.4	100.0
	Total	13	100.0	100.0	

Seven respondents (53.8%) did not discharge any project management activities and the remaining six respondents (46.2%) spent up to 30% of their time at work dealing with project management activities. Table 4.32 shows the frequency distribution of the time spent on project management activities of each respondent.

Table 4.32: Question 4.6 Results (Company B)
Percentage of time spent working on project management

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	0%	7	53.8	53.8	53.8
	1-10%	2	15.4	15.4	69.2
	11-20%	2	15.4	15.4	84.6
	21-30%	2	15.4	15.4	100.0
	Total	13	100.0	100.0	

- *"Other" activities*

Eleven respondents (84.6%) did not spend any time on "other" activities and the remaining two respondents (15.4%) spent between 41 and 60 percent of their time working on "line management" activities. Table 4.33 shows the frequency distribution of the time spent on "other" development activities in Company B.

Table 4.33: Question 4.7 Results (Company B)
Percentage of time spent working on other activities

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	0%	11	84.6	84.6	84.6
	41-50%	1	7.7	7.7	92.3
	51-60%	1	7.7	7.7	100.0
	Total	13	100.0	100.0	

4.8.5 Question 5: Approximately how many information systems development (ISD) projects have you completed in the past?

In Company B, 61.5% of the respondents (8 out of 13) had completed between 1 and 10 SD projects in the past. Three other respondents (23.1%) completed between 10 and 20 SD projects in the past, and the remaining two respondents (15.4%) completed more than 20 SD projects. Table 4.34 shows the actual results of this question in Company B.

Table 4.34: Question 5 Results (Company B)
Approximately how many information systems development (SD) projects have you completed in the past?

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	1-10 projects	8	61.5	61.5	61.5
	10-20 projects	3	23.1	23.1	84.6
	More than 20 projects	2	15.4	15.4	100.0
	Total	13	100.0	100.0	

4.8.6 Question 6: How long have you been working in the organisation?

More than 23% of the respondents (3 out of 13) have at most worked in the organisation for a year and 53.8% of the respondents (7 out of 13) in Company B have worked between 1 and 4 years. The remaining three respondents (23.1%) have worked for more than 5 years.

So it can be generally said that the IT team members' average duration in the organisation is between 1 and 4 years. Table 4.35 shows the actual result of this question.

Table 4.35: Question 6 Results (Company B)
How long have you been working in the organisation?

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	0-1 year	3	23.1	23.1	23.1
	1-4 years	7	53.8	53.8	76.9
	5+ years	3	23.1	23.1	100.0
	Total	13	100.0	100.0	

4.8.7 Question 7: Which of the following technologies are you aware of, and please indicate your level of knowledge in a particular technology.

In this section, the results are reported in the same way as Company A in section 4.4.7. As in Company A, only programming languages, UML design and methodologies are reported based on the responses from Company B.

- *Programming languages*

Only one respondent (7.7%) was competent in programming languages and a further 23.1% (3 out of 13) rated themselves as being average. A large percentage of the respondents (53.8%) rated themselves as being skilled in programming languages and the remaining two respondents (15.4%) rated themselves as being experts. The results show that generally the skill level in programming languages is high in Company B. Table 4.36 shows the actual result of this question.

Table 4.36: Question 7.1 Results (Company B)
What is your level of knowledge in programming languages (e.g. Java, J2EE, C#, Microsoft.NET, etc)?

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	Competent	1	7.7	7.7	7.7
	Average	3	23.1	23.1	30.8
	Skilled	7	53.8	53.8	84.6
	Expert	2	15.4	15.4	100.0
	Total	13	100.0	100.0	

- *UML design*

More than 30.8% of the respondents (4 out of 13) responded as being skilled in UML design, and 38.5% of the respondents (5 out of 13) felt they had an average level skill. The remaining four respondents responded as follows: basic knowledge (15.4%) and competent (15.4%).
This result shows that generally the skill level in UML design is average. Table 4.37 shows the actual result of this question.

Table 4.37: Question 7.2 Results (Company B)
What is your level of knowledge in UML Design (Rational Rose, Together, etc)?

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	Basic knowledge	2	15.4	15.4	15.4
	Competent	2	15.4	15.4	30.8
	Average	5	38.5	38.5	69.2
	Skilled	4	30.8	30.8	100.0
	Total	13	100.0	100.0	

- *Methodologies*

Only twelve of the thirteen respondents answered this question, and of the twelve respondents, two (16.7%) responded as having basic knowledge in methodologies, one (8.3%) responded as being competent and six (50%) responded as having average skills in methodologies. The remaining three respondents (25%) replied as being skilled in methodologies. This result shows that generally the level of skill in terms of methodologies in Company B is average. Table 4.38 shows the actual results of the question.

Table 4.38: Question 7.3 Results (Company B)
What is your level of knowledge in Methodologies (e.g. RUP, PRINCE II, etc)

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	Basic knowledge	2	15.4	16.7	16.7
	Competent	1	7.7	8.3	25.0
	Average	6	46.2	50.0	75.0
	Skilled	3	23.1	25.0	100.0
	Total	12	92.3	100.0	
Missing	System	1	7.7		
Total		13	100.0		

4.8.8 Question 9: Is the systems development methodology tailored to suit your organisation?

More than 60% of the respondents (8 out of 13) responded positively to this question. The remaining five respondents felt that the SDM was not tailored at all. Table 4.39 shows the actual result of this question.

Table 4.39: Question 9 Results (Company B)
Is the systems development methodology tailored to suit your organisation?

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	Yes	8	61.5	61.5	61.5
	No	5	38.5	38.5	100.0
	Total	13	100.0	100.0	

Section 2: Project specific information

In this section, the reporting style is ordered in the same way as in the case of Company A. As discussed earlier, this section aims to ascertain the SD practises followed in the last SD project. Also, the use of ASDMs in the organisation is tested in order to ascertain whether they are used. In the final part of this section, the level of success of the project and the system are tested.

4.8.9 Question 1 (Company B)

As mentioned in section 4.4.9, there were eleven statements that the respondents needed to reply to. The respondent had a choice of five different alternatives ranging from totally disagree to totally agree. The use of this Likert scale helped the researcher ascertain the extent to which the respondents agreed or disagreed with a particular statement. Table 4.40 shows a summary of the frequency distribution of all the statements in this question.

- *The project was well-defined*

More than 50% of the respondents (7 out of 13) agreed with the statement. The remaining six respondents replied in the following way:

Three out of thirteen respondents (23.1%) were neutral to the statement and the remaining three respondents (23.1%) disagreed with the statement. Therefore it can be said that generally the last SDM project was well defined.

- *Users requirements were realistic*

One respondent (7.7%) did not reply to this question. Out of a total of twelve respondents who replied to this statement, exactly 50% generally agreed with the statement and only one respondent (8.3%) disagreed. The remaining five respondents were neutral to the statement.

This result shows that generally the SD team felt that the user requirements were realistic and that they could be met.

- *Users' expectations were realistic*

More than 30% of the respondents (5 out of 13) generally agreed to this statement, and four respondents disagreed with the statement. The remaining respondents were neutral to the statement. As it can be seen, this statement generated mixed reactions within Company B because five respondents agreed and four respondents disagreed with this statement. It can therefore be said that the environment in Company B is somewhat volatile in terms of user expectations in an SD project.

- *Developer's understood user's requirements well*

As it was in the case of Company A, the majority of the respondents (9 out of 13) were neutral to the statement indicating that there was uncertainty in answering this question. More than 20% of the respondents generally agreed with the statement and only one respondent disagreed.

- *The developed system was very complex*

A total of six respondents representing 46.2% of the total respondents agreed with this statement. More than 20% of the respondents (3 out of 13) totally disagreed and the remaining four respondents were neutral towards this statement. This result indicates that although there is a slight majority that feel that the last developed system was very complex, there are some respondents that feel the opposite is true. Those respondents that totally disagreed with the statement are two test analysts and one IT/systems developer.

- *Senior management was highly committed to the project*

A collective percentage of 46.2% (6 out of 13) respondents generally agreed with the statement and only one respondent (7.7%) disagreed. The remaining six respondents (46.2%) were neutral to this statement. This result confirms the findings from the interview which found that there needed to be senior management commitment in order for a project to be successful.

- *Developer's knowledge of the systems development process was good*

More than 50% of the respondents (7 out of 13) generally agreed with the statement and the remaining six respondents were neutral. This result indicates that generally the knowledge of SD processes of the developer's in Company B is generally good.

- *The installation and adoption of the developed system in user departments were well planned*

More than 46% of the respondents (6 out of 13) generally agreed with the statement and the remaining seven respondents were neutral.

Although most of the respondents did not spend any time on installation activities (see table 4.30), this result shows that installation and adoption of developed systems were indeed well planned hence the majority of the respondents agreeing to the statement.

- *The system was delivered at or before scheduled time*

Out of the thirteen respondents, five generally disagreed and four agreed with this statement. The remaining four respondents were neutral to the statement.

This result shows that generally there is a negative sentiment towards to the last SD project being delivered at or before the scheduled time. This result is contradicting the findings from the interview which found that there was a very high project success rate in Company B.

Therefore it can be concluded that the success rate of the SD projects in Company B is marginally lower than the interviewee stated.

- *Status meeting were held weekly*

More than 38% of the respondents (5 out of 13) generally agreed with the statement and only two respondents disagreed. The remaining six respondents representing 46.2% of the total respondents were neutral to the statement. This result shows that the majority of the respondents were not sure about status meetings being held weekly.

In summarising this section, the general result was positive in terms of the reactions that these statements generated. There was only one statement that generated a contradiction with the interview findings. The statement "The system was delivered at or before the scheduled time" generated a negative reaction from the respondents and this is in contradiction with the findings from the interview. The interview data in section 4.6.4 showed that Company B enjoyed close to 100% success rate in their SD projects. Table 4.40 shows the summary of the frequency distribution of all the respondents in all the statements.

Table 4.40: Summary of section 2 (Question 1 Responses)

	Total frequency	The project was well defined		Users were aware of their requirement		Users requirements changed all the time		User's expectations were realistic		Developer's understood user's requirements well		The developed system was very complex		Senior management was highly committed to the project		Developer's knowledge of the systems development process was good		The installation and adoption of the developed system in user departments were well planned		The system was delivered at or before the scheduled time		Status meetings were held weekly	
		Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
Totally Disagree	4	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	3	23.1	0	0.0	0	0.0	0	0.0	1	7.7	0	0.0
Disagree	18	3	23.1	2	15.4	1	8.3	4	30.8	1	7.7	0	0.0	1	7.7	0	0.0	0	0.0	4	30.8	2	15.4
Neutral	61	3	23.1	7	53.8	5	41.7	4	30.8	9	69.2	4	30.8	6	46.2	6	46.2	7	53.8	4	30.8	6	46.2
Agree	51	7	53.8	4	30.8	4	33.3	4	30.8	2	15.4	6	46.2	5	38.5	6	46.2	5	38.5	4	30.8	4	30.8
Totally Agree	8	0	0.0	0	0.0	2	16.7	1	7.7	1	7.7	0	0.0	1	7.7	1	7.7	1	7.7	0	0.0	1	7.7
Missing System	1					1	7.7																
	Total	13	100.0	13	100.0	13	100.0	13	100.0	13	100.0	13	100.0	13	100.0	13	100.0	13	100.0	13	100.0	13	100.0

4.8.10 Question 2 (Company B)

As in section 4.4.10, these statements were used to test how agile the SDM of the last SD project was. Collectively, the responses of these statements allowed the researcher to gain a deeper insight into whether or not ASDMs – or agile practices – were used in the last SD project. If the general response is positive, then the conclusion can be made that there are ASDMs – or agile practices – are being used in the organisation. Table 4.41 and table 4.42 show the summary of the frequency distribution of the statements in this question.

- *Documentation is very important in the systems development projects we undertake*

A large majority of the respondents (69.3%) generally agreed to this statement, and only one respondent representing 7.7% of the total respondents disagreed. The remaining three respondents were neutral to the statement. This result agrees with the findings from the interview that suggests that a formalised SDM is used, and all formalised SDMs stress the importance of documentation.

- *Generally, building a system takes too much time*

More than half of the respondents (7 out of 13) generally agreed to the statement. The remaining six respondents were neutral to the statement. This result, although positive, indicates that generally building a system takes too much time. This time-consuming activity can be explained from the bureaucratic practices that are pervasive in formalised SDMs.

- *Changing user requirements at an advanced level in the project is virtually impossible*

The majority of the respondents (8 out of 13) were neutral to this statement. Out of the five remaining respondents, four generally agreed and only one respondent disagreed with the statement. The results show that there is uncertainty towards this statement in Company B and that can be explained by the fact that the majority of the respondents were IT/systems developers or programmers.

- *Adapting to changes in user requirements is very difficult*

The majority of the respondents (53.8%) were neutral to this statement and the remaining six respondents agreed to the statement. This result shows that although there are a substantial number of respondents that are unsure about the difficulty of adapting to change, there is a large enough number of respondents that feel the statement is a true reflection of their SD practices. This result corresponds with the use of a formalised methodology that is currently being used in Company B.

- *Working software is delivered frequently (weeks rather than months)*

More than 50% of the respondents (7 out of 13) generally disagreed with the statement. Only 3 respondents agreed and the remaining three were neutral to the statement. This statement agrees with the findings from the interview that the SDLC methodology is used. In using the SDLC, the organisation is incapable of delivering software frequently because of the linear model that the SDLC methodology follows.

- *Late changes in the user requirements are welcome*

This statement tested the current SDM level of adaptability. Out of the thirteen respondents, six (46.2%) generally disagreed and five (38.5%) generally agreed. The remaining two respondents (15.4%) were neutral to the statement. As it can be seen, there is a mixed reaction between the respondents and this suggests that there in no consensus when it comes to managing changes in the user requirements.

- *There is close and daily cooperation between the developers and the users*

More than 30% of the respondents (4 out of 13) agreed to the statement and five respondents disagreed. The remaining four respondents were neutral to the statement. This statement, as it can be seen, generated a mixed reaction between the respondents suggesting that there are some members of the team that interact with the users on a daily basis.

- *The development team is made up of between 3-7 people*

Out of the thirteen respondents, six of them generally disagreed with the statement and only two respondents agreed with the statement. The remaining five respondents representing 38.5% of the total respondents were neutral to the statement. It can therefore be concluded that generally the development team is not made up of between 3-7 people.

- *We continuously re-design the system being developed, even during development*

Six out of the thirteen respondents (46.2%) generally disagreed with the statement and only two respondents (15.4%) generally agreed. The remaining five respondents (38.5%) were neutral to the statement. Therefore is can be concluded that generally the system being developed is not continuously re-designed to meet the ever-changing user requirements in an SD project. This can be explained by the current SDM being used which does not accommodate volatile user requirements.

- *There is good communication between the members in the development team*

More than 50% of the respondents (7 out of 13) generally agreed with the statement and only two respondents disagreed. The remaining four respondents were neutral to the statement. This result generally indicates that the communication between the members in the team is healthy.

- *There is good communication between the development team and the users of the system being developed.*

More than 30% of the respondents (4 out of 13) agreed with the statement and 38.5% of the respondents (5 out of 13) disagreed. The remaining respondents were neutral to this statement. This result, as it can be seen, generated a mixed reaction between the respondents. Therefore it can be concluded that the communication channel between the development team and the users of the system is not well managed, hence the mixed reaction among the respondents.

- *As a development team, we are very motivated to achieve the goals set out by management*

More than 50% of the respondents (7 out of 13) generally agreed with the statement and three respondents disagreed. The remaining three respondents were neutral to the statement. Therefore it can be concluded that the motivation of the development team to achieve the goals set out by management is generally high.

- *Problems relating to the systems development project are quickly dealt with*

The results generated from this statement indicate a mixed reaction between the respondents. Of the thirteen respondents, three (23.1%) of them agreed and three (23.1%) others disagreed. The remaining seven respondents were neutral to the statement. Therefore, because of this mixed reaction, it cannot be ascertained whether problems relating to SD project are quickly dealt with.

Generally, the results from this question agreed with the findings from the interview which suggests that a waterfall approach (SDLC) is used. Although there were some statements that generated mixed reactions between the respondents, the general impression of the results confirms the finding that an ASDM – or agile practices – is not often used in Company B. The statements that generated mixed reactions were:

- *Late changes in the user requirements are welcome;*
- *There is close and daily cooperation between the developers and the users;*
- *There is good communication between the development team and the users of the system being developed;*
- *Problems relating to the systems development project are quickly dealt with.*

Table 4.41: Summary of section 2 (Question 2 Responses)

	Total frequency	Documentation is very important in the systems development projects we undertake		Generally, building a system takes too much time		Changing user requirements at an advanced level in the project is virtually impossible		Adapting to changes in the user requirements is very difficult		Working software is delivered frequently (weeks rather than months)		Late changes in user requirements are welcome		There is close and daily cooperation between the developers and the users		The development team is made up of between 3-7 people		We continuously re-design the system being developed, even during development		There is good communication between the members in the development team		There is good communication between the development team and the users of the system being developed	
		Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
Totally Disagree	7	0	0.0	0	0.0	1	7.7	0	0.0	1	7.7	2	15.4	0	0.0	1	7.7	2	15.4	0	0.0	0	0.0
Disagree	32	1	7.7	0	0.0	0	0.0	0	0.0	6	46.2	4	30.8	5	38.5	5	38.5	4	30.8	2	15.4	5	38.5
Neutral	51	3	23.1	6	46.2	8	61.5	7	53.8	3	23.1	2	15.4	4	30.8	5	38.5	5	38.5	4	30.8	4	30.8
Agree	44	6	46.2	6	46.2	3	23.1	6	46.2	3	23.1	3	23.1	4	30.8	2	15.4	1	7.7	6	46.2	4	30.8
Totally Agree	9	3	23.1	1	7.7	1	7.7	0	0.0	0	0.0	2	15.4	0	0.0	0	0.0	1	7.7	1	7.7	0	0.0
	Total	13	100.0	13	100.0	13	100.0	13	100.0	13	100.0	13	100.0	13	100.0	13	100.0	13	100.0	13	100.0	13	100.0

Table 4.42: Summary of section 2 (Question 2 continued)

	Total frequency	As a development team, we are very motivated to achieve the goals set out by management		Problems relating to the systems development project are quickly dealt with	
		Freq	%	Freq	%
Totally Disagree	1	0	0.0	1	7.7
Disagree	5	3	23.1	2	15.4
Neutral	10	3	23.1	7	53.8
Agree	9	6	46.2	3	23.1
Totally Agree	1	1	7.7	0	0.0
	Total	13	100.0	13	100.0

4.8.11 Question 3 (Company B)

The structure of reporting the results of this question will follow section 4.4.11. As mentioned earlier, these statements were asked to ascertain whether ASDMs were understood by the respondents and if they could be applied the organisation. Also, some of the statements tested the current level of satisfaction that the members in the development team enjoy. A general positive result would imply that the development team is open to the use of ASDMs in their organisation. Table 4.43 and table 4.44 show the frequency distribution of all the responses to this question.

- *I enjoy working with my colleagues*

A large majority of the respondents (10 out of 13) generally agreed with this statement. The remaining three respondents (23.1%) were neutral. This result shows that there is a good rapport between the members of the development team.

- *I enjoy the way we develop systems*

Close to 50% of the respondents (6 out of 13) agreed to the statement and only two respondents representing 15.4% of the total respondents disagreed with the statement. The remaining five respondents were neutral to the statement. This result shows that generally the development team enjoys the development process that they use.

- *I feel proud when we successfully develop a(n) system/application that meets the users requirements*

A large majority of the respondents (8 out of 13) generally agreed with the statement. The remaining respondents were neutral. This result shows that there is a sense of pride when a system meets the users' requirements.

- *Changing the current systems development methodology we use will be a good idea*

Only one respondent did not reply to this statement. Out of the twelve respondents that replied, five generally agreed and a further 25% (3 out of 12) of the respondents disagreed with the statement. The remaining four respondents representing 33.3% of the total respondents that replied were neutral to the statement. As it can be seen, this statement has generated a slight mixed reaction between the respondents, indicating that there are some within the development team that are unhappy with the current SDM.

- *I see nothing wrong with the current methodology we use*

One respondent did not reply to this statement. Out of the twelve respondents that replied to this statement, exactly 50% generally disagreed with this statement and only one respondent agreed. The remaining five respondents representing 41.7% of the total respondents that replied to this statement were neutral to this statement.

This result indicates that there is a large majority of the respondents that feel there is something wrong with the current SDM, and this result corresponds with the findings from the preceding statement which suggests that there are some members of the development team that feel that changing the current SDM would be a good idea.

- *The development team is well conversed with the methodology being used*

The majority of the respondents (6 out of 13) were neutral to this statement. Out of the remaining seven respondents, three of them generally disagreed and four others agreed indicating a mixed reaction between the respondents. Therefore it can be concluded that the majority of the development team are unsure about the level of knowledge that they have with regards to the SDM being used.

- *The current methodology being used adapts to change well*

More than 60% of the respondents (8 out of 13) were neutral to this statement. Out of the remaining respondents, four of them agreed and only one disagreed. This result shows that generally the development team is unsure whether the current SDM adapts to change well. This result also agrees with the results from section 4.7.10 (see table 4.41) which suggests that the adaptation capabilities of the current SDM are inadequate to suit a volatile environment.

- *The methodology being used is linear (i.e. it follows a waterfall model)*

More than 60% of the respondents (8 out of 13) agreed with this statement and four respondents (30.8%) generally disagreed with the statement. The remaining respondent was neutral to the statement. This result shows that generally the current methodology follows a waterfall model. This is in agreement with the findings from the interview.

- *I know what agile systems development methodologies are*

More than 70% of the respondents (10 out of 13) generally agreed with the statement and only respondent disagreed with the statement. The remaining two respondents were neutral to the statement. This result shows that there is good level of awareness when it comes to ASDMs.

- *I have used an agile methodology before*

Out of the thirteen respondents, five (38.5%) of them generally agreed and six (46.2%) others generally disagreed with the statement. The remaining respondents were neutral to the statement. This result shows that there is a mixed reaction towards the statement among the development team indicating that there are some that have never used an agile methodology.

- *Using an agile methodology will be beneficial to this organisation*

Based on the findings from the interview, it was expected that a large majority of the respondents would generally agree with this statement. Out of the thirteen respondents, five (38.5%) of them agreed and three (23.1%) of them generally disagreed with the statement.

This result shows that there is an indication that some members of the development team are not entirely convinced of the benefits that an agile methodology would have on the organisation. This result could be explained from the fact that their SD projects enjoy a very high success rate and therefore a change in the current methodology would not be justifiable.

- *One needs to have a lot of experience in agile methodologies before using it*

One respondent did not reply to this statement. This statement generated a mixed reaction among the respondents. Three respondents (25%) agreed and three (25%) others disagreed with the statement. The remaining six respondents (50%) were neutral to the statement. This result shows that there is uncertainty among the development team regarding having experience in ASDMs when it is decided to be used.

- *Agile methodologies are widely used in the telecomm industry*

The results of this statement agree with the findings from the interview which suggests that the current SDM is sufficient in meeting the objectives of the organisation. A large majority of the respondents (8 out of 12) disagreed with the statement and only one respondent (8.3%) agreed with this statement. Out of the twelve respondents that replied to this statement, the remaining three (25%) respondents were neutral.

- *The telecomm industry is a fast-paced industry, and companies operating within it requires a systems development methodology that is able to accommodate change*

More than 75% of the respondents (10 out of 13) agreed with the statement, and the remaining three respondents (23.1%) were neutral. This result shows that there is a need for a highly adaptive SDM for companies operating in the telecommunication industry. Also, this result agrees with the findings from section 4.7.10 (see table 4.41).

- *Our systems development methodology helps to capture requirements for the system to be developed*

Close to 50% of the respondents (6 out of 13) agreed with the statement. Only one respondent disagreed and the remaining six respondents (46.2%) were neutral to the statement. This result shows that the SDM being used is generally sufficient in capturing user requirements.

- *Our systems development methodology helps to involve end-users in the systems development projects*

This statement generated a mixed reaction amongst the respondents. Out of the thirteen respondents, three (23.1%) disagreed and a further three (23.1%) agreed with the statement. Therefore, it cannot be concluded that the current SDM helps to involve the end-users in the SD projects.

- *Our systems development methodology helps to build management commitment in our systems development projects*

This statement generated a slight mixed reaction. Three respondents (23.1%) disagreed and five respondents (38.5%) agreed with the statement. This result contradicts the finding from the interview that suggests that management is happy with the successes that the current SDM affords the organisation.

- *Our systems development methodology helps to decompose the system to be developed in workable parts*

More than 50% of the respondents (7 out of 13) agreed with the statement and only two respondents (15.4%) disagreed with the statement. The remaining four respondents were neutral to the statement. This result shows that generally the organisation uses a modular development approach when developing a system even though the SDM follows a waterfall model.

The results from this question suggest that the development team is well aware of the benefits that an ASDM would have on the organisation. Even though management would not be willing to change the current methodology, the results from this question show that ASDMs are applicable in the telecommunication industry. The statements that generated mixed reactions were:

- *Changing the current systems development methodology we use will be a good idea;*
- *The development team is well conversed with the methodology being used;*
- *I have used an agile methodology before;*
- *One needs to have a lot of experience in agile methodologies before using it;* and
- *Our systems development methodology helps to involve end-users in the systems development projects.*

Table 4.43 and table 4.44 show the summary of the frequency distribution of this question in Company B.

Table 4.43: Summary of section 2 (Question 3 Responses)

	Total Frequency	I enjoy working with my colleagues		I enjoy the way we develop systems		I feel proud when we successfully develop a(n) system/application that meets the users requirements		Changing the current systems development methodology we use will be a good idea		I see nothing wrong with the current methodology we use		The development team is well conversed with the methodology being used		The current methodology being used adapts to change well		The methodology being used is linear (i.e. it follows a waterfall model)		I know what agile systems development methodologies are		I have used an agile methodology before		Using an agile methodology will be beneficial to this organisation	
		Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
Totally Disagree	9	0	0.0	0	0.0	0	0.0	0	0.0	2	16.7	1	7.7	0	0.0	3	23.1	0	0.0	2	15.4	1	7.7
Disagree	20	0	0.0	2	15.4	0	0.0	3	25.0	4	33.3	2	15.4	1	7.7	1	7.7	1	7.7	4	30.8	2	15.4
Neutral	46	3	23.1	5	38.5	5	38.5	4	33.3	5	41.7	6	46.2	8	61.5	1	7.7	2	15.4	2	15.4	5	38.5
Agree	55	7	53.8	6	46.2	6	46.2	3	25.0	1	8.3	4	30.8	4	30.8	8	61.5	8	61.5	3	23.1	5	38.5
Totally Agree	11	3	23.1	0	0.0	2	15.4	2	16.7	0	0.0	0	0.0	0	0.0	0	0.0	2	15.4	2	15.4	0	0.0
	Missing System							1		1													
	Total	13	100.0	13	100.0	13	100.0	13	100.0	13	100.0	13	100.0	13	100.0	13	100.0	13	100.0	13	100.0	13	100.0

Table 4.44: Summary of section 2 (Question 3 continued)

	Total Frequency	One needs to have a lot of experience in agile methodologies before using it		Agile methodologies are widely used in the Telecomm industry		The Telecomm industry is a fast-paced industry, and companies operating within it requires an SDM that is able to accommodate change quickly		Our SDM helps to capture requirements for the system to be developed		Our SDM helps to involve end-users in systems development projects		Our SDM helps to build management commitment in our systems development projects		Our SDM helps to decompose the system to be developed in workable parts	
		Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
Totally Disagree	1	1	8.3	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Disagree	19	2	16.7	8	66.7	0	0.0	1	7.7	3	23.1	3	23.1	2	15.4
Neutral	34	6	50	3	25.0	3	23.1	6	46.2	7	53.8	5	38.5	4	30.8
Agree	29	3	25.0	1	8.3	4	30.8	6	46.2	3	23.1	5	38.5	7	53.8
Totally Agree	6	0	0.0	0	0.0	6	46.2	0	0.0	0	0.0	0	0.0	0	0.0
	Missing system	1		1											
	Total	13	100.0	13	100.0	13	100.0	13	100.0	13	100.0	13	100.0	13	100.0

4.8.12 Question 4 (Company B)

As mentioned in section 4.4.12, these statements assessed the level of success of the last project undertaken. Even though the interviewee mentioned that the success rate is generally very high, the respondents from Company B have a different view. Once the results are reported, table 4.45 shows the summary of the frequency distribution of all the respondents in this question.

- *The project was completed on schedule*

This statement generated a mixed reaction among the respondents. Five respondents (38.5%) generally disagreed with the statement and five (38.5%) others agreed. The remaining respondents were neutral to the statement. This result is inconsistent with the findings from the interview which suggests that the success rate is very high.

- *The project was completed within budget*

This statement also generated a mixed reaction among the respondents. Six of the respondents representing 46.2% agreed and five other respondents (38.5%) generally disagreed with the statement. The remaining respondents were neutral to the statement. Again, this result shows inconsistency with the findings from the interview.

- *The developed system satisfied all the stated requirements*

More than 60% of the respondents (8 out of 13) generally agreed with the statement and only two other respondents disagreed. The remaining three respondents were neutral to the statement. This result shows that the developed system generally captured and satisfied all the user requirements. Satisfying the user requirements could be a critical success factor in the organisation and maybe this is used to assess the level of success of an SD project.

- *The speed of developing the project was high*

Four out of the thirteen respondents (30.8%) agreed with the statement and four others disagreed indicating a mixed reaction among the respondents. The remaining five respondents (38.5%) were neutral to the statement.

- *The productivity of developers involved with the project was high*

More than 50% of the respondents (7 out of 13) generally agreed with the statement and the remaining respondents were neutral. This result shows that generally the productivity level of the developers is high and hence an impressive project success rate.

- *The cost of the project was low when compared to the size and complexity of the system developed*

More than 50% of the respondents (7 out of 13) agreed with the statement and the remaining six respondents were neutral to the statement. This result indicates that generally the cost of the SD project was low when compared to the complexity and size of the system.

- *The project achieved its goals*

More than 45% of the respondents (6 out of 13) generally agreed with the statement and only two respondents disagreed. The remaining five respondents were neutral to the statement. This result – although positive – indicates that the level of success of the SD projects in the organisation is not as high as the interviewee suggested.

- *Overall, the project represents excellent work*

More than 50% of the respondents (7 out of 13) generally agreed with the statement and a further two respondents disagreed. The remaining five respondents were neutral to the statement. This result generally shows that the last SD project represented excellent work.

- *Overall, the project was a success*

No respondents disagreed with this statement. Out of the thirteen respondents, seven (53.9%) generally agreed and the remaining six respondents (46.2%) were neutral to the statement. This result shows that generally the project was a success but there are some members of the development team that are unsure whether the project was successful or not.

The results from this question generally yielded positive responses indicating that the last SD project was successful. Some statements yielded a mixed reaction among the respondents indicating that the level of success of the SD projects is not as high as the interviewee suggested. The statements that generated mixed reactions were:

- *The project was completed on schedule;*
- *The project was completed within budget; and*
- *The speed of developing the project was high.*

Table 4.45 shows the results of the summary of the frequency distribution of this question in Company B.

Table 4.45: Summary of section 2 (Question 4 Responses)

	Total Frequency	The project was completed on schedule		The project was completed within budget		The developed system satisfied all the stated requirements		The speed of developing the project was high		The productivity of developers involved with the project was high		The cost of the project was low when compared to the size and complexity of the system developed		The project achieved it goals		Overall, the project represents excellent work		Overall, the project was a success	
		Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
Totally Disagree	7	3	23.1	2	15.4	0	0.0	2	15.4	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Disagree	13	2	15.4	3	23.1	2	15.4	2	15.4	0	0.0	0	0.0	2	15.4	2	15.4	0	0.0
Neutral	40	3	23.1	2	15.4	3	23.1	5	38.5	6	46.2	6	46.2	5	38.5	4	30.8	6	46.2
Agree	50	5	38.5	6	46.2	7	53.8	4	30.8	6	46.2	7	53.8	5	38.5	5	38.5	5	38.5
Totally Agree	7	0	0.0	0	0.0	1	7.7	0	0.0	1	7.7	0	0.0	1	7.7	2	15.4	2	15.4
	Total	13	100.0	13	100.0	13	100.0	13	100.0	13	100.0	13	100.0	13	100.0	13	100.0	13	100.0

4.8.13 Question 5 (Company B)

In this section, the structure of reporting the results of this question will follow section 4.4.13. The motivation of these statements is that the researcher wanted to assess the actual system in terms of functionality, reliability, maintainability and efficiency. A positive result in these statements will indicate a system of a very high quality. Table 4.46 shows the summary of the frequency distribution of all the respondents in this question.

- *The functionality of the developed system is high*

Seven out of the thirteen respondents (53.9%) generally agreed with the statement and only two respondents (15.4%) disagreed. The remaining four respondents (30.8%) were neutral to the statement. This result indicates that generally the functionality of the system was high.

- *The reliability of the developed system is high*

More than 50% of the respondents (7 out of 13) generally agreed with the statement. Only two respondents (15.4%) disagreed with the statement. This result indicates that the reliability of the developed system is generally high.

- *The maintainability of the developed system is high*

This statement also had 53.9% of the respondents agreeing with it, and only two respondents (15.4%) disagreed with the statement. This result indicates that there is a general perception that the developed system is highly maintainable.

- *The efficiency of the developed system is high*

Seven out of the thirteen respondents (53.9%) generally agreed with the statement and only two respondents disagreed. This result indicates that the efficiency of the developed system is generally thought to be high in Company B.

- *The developed system meets user needs*

More than 50% of the respondents (7 out of 13) agreed with the statement indicating that generally the developed system met the user needs. Although the result is positive, it was expected that a larger percentage would agree to the statement based on the results from the previous sections.

- *Overall, the quality of the developed system is high*

The general view of the respondents was that the quality of the developed system was high. This is because more than 50% of the respondents (7 out of 13) generally agreed with the statement and the remaining six respondents were neutral.

- *Overall, the users are satisfied with the developed system*

The majority of the respondents (53.9%) generally agreed with the statement and only two respondents disagreed. This result indicates that the development team generally felt that the users were satisfied with the developed system. Although the result is positive, it was expected that a larger percentage of respondents would agree with the statement based on the findings from the previous sections.

- *Overall, the developed system is a success*

This statement was also expected to generate a large percentage of the respondents that agreed. The results show that more than 50% of the respondents (7 out of 13) generally agreed and only two other respondents disagreed with the statement.

Generally, the results show a positive response towards the overall quality of the developed system. Based on the results from the previous sections, it was expected that a larger percentage of the respondents would generally agree with the statements. The overall impression of these results indicates that the quality of the developed system is not as high as it was previously thought to be. Table 4.46 shows the summary of the frequency distribution of all the respondents in Company B.

Table 4.46: Summary of section 2 (Question 5 Responses)

	Total Frequency	The functionality of the developed system is high		The reliability of the developed system is high		The maintainability of the developed system is high		The efficiency of the developed system is high		The developed system meets users needs		Overall, the quality of the developed system is high		Overall, the users are satisfied with the developed system		Overall, the developed system is a success	
		Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
Totally Disagree	0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Disagree	14	2	15.4	2	15.4	2	15.4	2	15.4	2	15.4	0	0.0	2	15.4	2	15.4
Neutral	34	4	30.8	4	30.8	4	30.8	4	30.8	4	30.8	6	46.2	4	30.8	4	30.8
Agree	37	5	38.5	5	38.5	3	23.1	3	23.1	5	38.5	6	46.2	5	38.5	5	38.5
Totally Agree	19	2	15.4	2	15.4	4	30.8	4	30.8	2	15.4	1	7.7	2	15.4	2	15.4
	Total	13	100.0	13	100.0	13	100.0	13	100.0	13	100.0	13	100.0	13	100.0	13	100.0

4.8.14 Open-ended section (Company B)

The motivation of the open-ended section was to gain a deeper understanding into what the current SDM was and how the development team tailored that methodology. The structure in reporting the results from these questions will follow section 4.4.14. Out of the thirteen respondents, nine respondents (69.2%) said that the current SDM was SDLC, one respondent (7.7%) said that the current SDM was Extreme programming (XP) and one other respondent (7.7%) said that the current SDM was the Rational Unified Process (RUP). The remaining two respondents (15.4%) did not know what SDM was being used. Eight of the respondents (61.5%) felt that the SDM was tailored to suit the organisation (see table 4.39) and the remaining five respondents did not think the SDM was tailored to suit the organisation. All of the eight respondents that said the SDM was tailored to suit the organisation mentioned that the tailoring process was done by combining some of the stages, especially for projects that cost less than R1 million.

Therefore, it can be concluded that the current SDM used in Company B is also the SDLC and it is tailored in projects where the cost are less than R1 million. Another observation is that the development team in Company B is generally aware of the SDM that is used and this awareness helps in ensuring that a system of good quality is built.

4.9 REVISED PROPOSITIONS

In this section, the propositions from section 4.7.5 are revised to include the findings from the questionnaires. The revision of the proposition will allow the researcher to generate theory on the SD practices in both Company A and Company B. Once these propositions are formulated, the results of Company C will be reported with the view of formulating final propositions that encompass the data from all the companies.

4.9.1 Proposition 1: [*The SDM currently being used in the telecommunication industry is a formalised methodology following a linear process model. For larger projects, the methodology is used in the way it was intended, and for smaller projects the formalised methodology is tailored by scaling down more time consuming activities such as the feasibility study and the planning and analysis phases. Even though the methodology being used is prone to red-tape, generally the users of the methodology are satisfied with it.*]

The results from the open-ended section of the questionnaire (see section 4.8.14) show that the SDLC is used as the methodology of choice in Company B.

Also, it was identified that for smaller projects the SDLC was tailored by scaling down on some of the time consuming activities. Therefore this proposition remains unchanged because it includes the findings from the questionnaires **[AI, AQ, BI, BQ]**[10].

4.9.2 Proposition 2: [*The first phase is considered to be one of the most important phases in the project lifecycle. It is very important that this phase is done with very clear objectives from the user department and therefore resulting in a high quality systems development project.*]

The results from the questionnaires did not single out the first phase as the most important phase. Therefore this proposition from section 4.3.5.2 will remain unchanged **[AI, BI]**.

4.9.3 Proposition 3: [*Generally, large companies in the telecommunication industry enjoy a very high success rate when developing systems and the developed system is generally of a very high standard that effectively meets the requirements of the users. In terms of the overall project success rate, the organisations in the telecommunication industry develops systems within budget and the costs involved are minimal compared to the benefits that the system hold for the users. The SDM currently used helps to capture user requirements and it allows for modular development such that a quality of standard in maintained. In the rare case of project failure, a post mortem is performed in order to identify the origin of the error and thereafter rectify it such that the entire project is not compromised.*]

The results from the questionnaire indicate that there needs to be a slight revision of this proposition from section 4.5.3.1. This decision is informed from the fact that the success rate was not as high as interviewee 2 mentioned.

4.9.3.1 Revised proposition 3

Generally, large companies in the telecommunication industry enjoy a moderate to high success rate when developing systems and the developed system is generally of a very high standard that effectively meets the requirements of the users. In terms of the overall project success rate, the organisations develop systems within budget and the costs involved are low when compared to the benefits that the systems hold for the users. The SDM currently being used helps to capture the user requirements and it allows for modular development **[AI, AQ, BI, BQ]**.

[10] This code indicates that this proposition is supported by the findings from the interview and questionnaire data Company A, and the findings from the interview and questionnaire data from Company B.

4.9.4 Proposition 4: [*Although there are some people that don't know what agile SDMs are, the general perception is that agile systems development methodologies can benefit the organisation – and the industry – and one doesn't need to have experience in ASDMs in order to use them. Also, using an ASDM will help the organisation to adapt quickly to a changing environment.*]

The results from the questionnaire section indicate that this proposition also applies to Company B. Therefore this proposition remains unchanged [**AQ, BI, BQ**].

4.9.5 Proposition 5: [*Although there is a strong resistance of the use of ASDMs from management because of the high success rate that the current SDM affords the organisation, the general mindset is very positive towards ASDMs, and they are generally open to experiencing an agile systems development methodology even though the current methodology they use is very successful in meeting the user requirements.*]

Again, the results from the questionnaires indicate that there is a positive attitude towards ASDMs. It was also identified that there needs to be management commitment on the SDM that is used, therefore the proposition from section 4.5.5.1 remains unchanged [**AQ, BI, BQ**].

4.9.6 Proposition 6: [*There needs to be management commitment to the use of a particular SDM in the organisation. Without management commitment, systems development projects could be highly compromised.*]

The results from the questionnaire show that there was a slight mixed reaction in terms of management commitment of the SDM used (see table 4.43). There was a substantial amount of respondents (5 out of 13) that were neutral to the statement. Therefore proposition 6 from section 4.3.5.6 needs to be revised to include the findings from the questionnaires.

4.9.6.1 Revised proposition 6

There needs to be management commitment to the use of a particular SDM in the organisation. In most instances, the level of management commitment indirectly affects the success of the SD project [**AI, AQ, BI, BQ**].

4.9.7 Proposition 7: [*The use of systems development techniques and tools helps to ensure that the system developed is of a very high quality that meets the requirements of the users.*]

The interview conducted in Company A was held with a solutions architect (see section 4.3). The role of a solutions architect encompasses the management perspective of the SD project. The solutions architect is exposed to the entire development lifecycle and it is for this reason that the solutions architect is placed in a better position to assess the critical success factors of the project. This proposition was formulated from the results of Company A. In terms of Company B, the interviewee was an IT developer and he was mostly exposed to the actual development of the system. Therefore, based on the different levels that the interviewees were involved in, it can be concluded that proposition 7 (see section 4.3.5.7) also applies to Company B because of the fact that an IT developer is primarily concerned with the development of the system **[AI, AQ, BI]**.

4.10 SUMMARY OF COMPANY B

In this section, the results from Company B are discussed in terms of the research aims and objectives. As mentioned in section 4.2, the thrust of this research was to ascertain whether ASDMs are used in the telecommunication industry in South Africa and the main research questions were:

- *Can ASDMs be applied in the telecommunication industry in South Africa?*

The results from Company B show that there is an open attitude towards using ASDMs in the telecommunication industry. Even though the current SDM is well equipped to capture the requirements from the user, there is a keen appreciation for the perceived benefits that ASDMs have for the organisation. The determining factor of which SDM to use was identified as the current success that it brings to the organisation, and therefore it can be concluded that ASDMs are highly applicable in Company B on condition that management are committed to the use of those methodologies.

- *How agile are current SDMs in the telecommunication industry in South Africa?*

The results from the interview and questionnaire data suggest that ASDMs are currently not being used in the organisation but agile practices are frequently employed. The agile practices that are used often include shortening the duration of some of the stages and sometimes completely avoiding the initial stages in a development project. In terms of adapting to change, the SDM used was found to be moderate.

Only four respondents out of thirteen agreed that the SDM adapted to change well (see table 4.43). The major flaw that the current SDM had was its perceived inability to change user requirements late in the development lifecycle (see table 4.41). This result shows that the SDM is inadequate in being sufficient in a volatile environment.

4.11 COMPANY C (INTERVIEW DATA)

4.11.1 Background information

Company C has one of the largest telecommunications network on the African continent, and it is a market leader in South Africa with more than 15 million customers subscribed to its network. The organisation's operation spans the entire continent of Africa, and it recently acquired a stake in a leading Middle-East African telecommunications service provider. The interview at Company C was held at their offices in Rivonia, Johannesburg. The interviewee was working as a core developer at the time of the interview and he was identified as a potential source of information with regards to the SD practices in Company C. The duration of the interview lasted between 15 and 20 minutes, and the structure of the interview discussion will follow section 4.3. Once the interview data from the organisation is reported, the propositions from section 4.8 will be revised to include this interview data.

4.11.2 Job responsibilities (Interviewee 3)

As mentioned in section 4.10.1, the interviewee was working as a core developer at the time of the interview. He mentioned that he was actively involved in systems development and his responsibilities included systems development and maintenance of mission critical applications for the user departments. It was identified later on that the user departments were the different divisions within the organisation. The interviewee also mentioned that he was working with a team of ten developers.

4.11.3 Systems development methodology used

According to the interviewee, there was not a specific SDM the company followed and after further questioning it was determined that the interviewee was unclear on SDMs and the benefits that they hold.

This finding was deduced from the interviewee's inability to name the SDM being used in the organisation even though it was apparent that a formalised SDM was being used. In terms of the systems development lifecycle, the SDM followed a waterfall model, and the duration of a typical SD project took between 6 months and 2 years.

The duration of a typical SD project clearly indicates that the SDM is extremely bureaucratic and a lot of time is spent on the planning and analysis phases. The interviewee also mentioned that there were some systems that get outsourced from third parties and it was his responsibility to ensure that the internal system worked in tandem with the outsourced systems. When asked about using a single SDM, the interviewee was of the view that it would not be flexible and therefore – as it was the case in Company C – a variety of SDMs should be used depending on the project requirements. The SDM currently being used in the organisation is now defined using the definition of SDMs by Huisman and Iivari (2006).

- **Systems development approach**

The interviewee mentioned that different SDMs were used and the choice of a particular SDM depended on the project and client preferences. Regardless of the type of project, it was determined from the interview that the organisation followed a formalised development approach for all their projects. In terms of tailoring the SDM to suit a particular project, the interviewee mentioned that in most instances a tailored version of the SDM was used so that it could accommodate different group projects.

- **Systems development process model**

It was determined from the interview that the SDM currently being used followed a linear model. This result was apparent because each phase only commenced if the preceding phase had been completed. This could be the reason why a typical SD project took such a long time to complete. If problems were to arise during the project lifecycle, the interviewee mentioned that the entire project would be put on hold until that problem had been addressed, but such problems hardly came about.

- **Systems development method**

The interviewee identified four phases that a typical SD project usually has. Throughout the development lifecycle there was a strong emphasis on modular and systems testing to ensure that the entire system accurately captured the user requirements.

1) Analysis and planning phase

This phase included requirements analysis and prototype design. Initially the user requirements are gathered by the business analysts and once the users agree on the initial user requirements, a prototype design is developed. The prototype design is then tested by the user in order to assess whether the requirements have been accurately captured. If the prototype is accepted by the user department, then this phase is deemed to be complete.

2) Development phase

In this phase, additional functionality is added to the prototype. The full development of the system commences at this stage and each module is tested to ensure that it is working correctly.

3) Implementation phase

All the modules that have been developed in the previous phase are first tested separately and then implemented as a whole system. At this stage the users are able to use the system and if the project reaches this stage, it is generally a success.

4) Maintenance phase

There is a team dedicated to the maintenance of the developed system. In most instances this phase includes continuously ensuring that the system is working in the way that it should. If minor problems are identified here, the system is sent back to the development team to correct that problem.

- **Systems development techniques and tools**

Company C uses a combination of tools and techniques such as prototyping and testing. As it was mentioned previously, prototyping is used to ensure that the user department is satisfied with the system that is to be developed. The different types of tests help to ensure that the system executes in the manner that it should. The interviewee also mentioned that the development team used modular development as a technique to ensure that the systems were of a high quality.

4.11.4 The sentiments of using ASDMs in Company C

The feeling towards ASDMs of the interviewee suggested that a lot still needs to be done to educate the industry on these methodologies. The interviewee admitted that ASDMs would benefit the organisation – and industry – but was not too positive when asked if the organisation would be willing to change their current SDM. According to the interviewee, the choice of a particular SDM is heavily dependent on the scope of the project, therefore applying only one SDM – and in this instance an agile methodology – would result in a development environment that is not flexible at all.

4.12 PROPOSITIONS

In this section, the propositions formulated in section 4.9 are revised in order to include the findings from the interview data. So far, the propositions in section 4.9 have captured the SD practices and ASDM sentiments from Company's A and B.

By revising these propositions from section 4.9, the researcher's intention is to include the findings gained from the interview conducted in Company C.

4.12.1 Proposition 1: [*The SDM currently being used in the telecommunication industry is a formalised methodology following a linear process model. For larger projects, the methodology is used in the way it was intended, and for smaller projects the formalised methodology is tailored by scaling down more time consuming activities such as the feasibility study and the planning and analysis phases. Even though the methodology being used is prone to red-tape, generally the users of the methodology are satisfied with it.*]

It was identified from the interview that a formalised SDM was used in the organisation. This SDM followed a linear process model similar to SDLC, and the SDM was tailored to suit a particular project depending on the scope. Therefore this proposition from section 4.3.5.1 remains unchanged because it is supported by findings from the interview [**AI, AQ, BI, BQ, CI**].

4.12.2 Proposition 2: [*The first phase is considered to be one of the most important phases in the project lifecycle. It is very important that this phase is done with very clear objectives from the user department and therefore resulting in a high quality systems development project.*]

The duration of the SD projects in Company C indicates that a lot of time is spent on the initial phases in the systems development lifecycle. The fact that prototyping is done in the planning and analysis phase also indicates that the initial phase is regarded as a very important phase. Therefore the proposition from section 4.3.5.2 will remain unchanged [**AI, BI, CI**].

4.12.3 Proposition 3: [*Generally, large companies in the telecommunication industry enjoy a moderate to high success rate when developing systems and the developed system is generally of a very high standard that effectively meets the requirements of the users. In terms of the overall project success rate, the organisations develop systems within budget and the costs involved are low when compared to the benefits that the systems hold for the users. The SDM currently being used helps to capture the user requirements and it allows for modular development.*]

During the interview, it was identified that Company C enjoyed a very good project success rate. It was also identified that the current SDM helped to capture user requirements well and the development team used modular development as a technique to ensure that the system being developed was of a high quality. Therefore proposition 3 from section 4.9.3.1 will remain unchanged **[AI, AQ, BI, BQ, CI]**.

4.12.4 Proposition 4: [*Although there are some people that don't know what agile SDMs are, the general perception is that agile systems development methodologies can benefit the organisation –and the industry- and one doesn't need to have experience in ASDMs in order to use them. Also, using an ASDM will help the organisation to adapt quickly to a changing environment.*]

The proposition from section 4.5.4.1 needs to be revised to include the finding from the interview that suggests that the scope of a particular project will determine the kind of SDM to be used.

4.12.4.1 Revised proposition 4

Although a lot still needs to be done in terms of educating people about ASDMs, the general perception is that the use of agile methodologies can benefit the organisation – and the industry – and one doesn't need to have experience in ASDMs in order to use them.
The use of ASDMs will help the organisation adapt quickly to a changing environment, and the choice of using such a methodology should be informed by the scope of the SD project **[AQ, BI, BQ, CI]**.

4.12.5 Proposition 5: [*Although there is a strong resistance of the use of ASDMs from management because of the high success rate that the current SDM affords the organisation, the general mindset is very positive towards ASDMs, and they are generally open to experiencing an agile systems development methodology even though the current methodology they use is very successful in meeting the user requirements.*]

The results from the interview show that proposition 5 from section 4.5.5.1 is applicable to Company C. Therefore proposition 5 will remain unchanged. **[AQ, BI, BQ, CI]**

4.12.6 Proposition 6: [*There needs to be management commitment to the use of a particular SDM in the organisation. In most instances, the level of management commitment indirectly affects the success of the SD project.*]

Proposition 6 from section 4.9.6.1 suggests that there needs to be management commitment to the use of a particular SDM. The findings from the interview show that indeed management has a final say on the SDM used. Therefore this proposition will remain unchanged because it includes the findings from the interview **[AI, AQ, BI, BQ, CI]**.

4.12.7 Proposition 7: [*The use of systems development techniques and tools helps to ensure that the system developed is of a very high quality that meets the requirements of the users.*]

The techniques and tools identified in the interview included prototype design, testing and modular development. These techniques helped to ensure that the developed systems were of a high quality. In terms of project failure, the interviewee mentioned that problems hardly arose concerning the developed system therefore implying that Company C enjoy a healthy project success rate. Therefore proposition 7 from section 4.3.5.7 also applies to Company C **[AI, AQ, BI, CI]**.

4.13 COMPANY C (QUESTIONNAIRE DATA)

A total of fifteen questionnaires were distributed in the organisation and all of them were returned. The analysis of the questionnaires followed the same approach as Company A where a statistical analysis tool was used to analyse the data. Thereafter, the propositions from section 4.12 will be revised to include the data generated from the questionnaire data. As mentioned in section 4.4, the questionnaire is subdivided into two sections and each section will also be discussed separately for Company C.

Section 1: Background information

4.13.1 Question 1: Which job title best describes your position?

All respondents replied to this question. Five out of the fifteen respondents (33.3%) were actively involved with the actual development of the system. Two respondents out of the five that were involved wit the development of the system were IT/systems developers and the remaining three respondents out of the five were programmers. Four other respondents (26.7%) were identified to be more involved with the management of the SD projects.

Out of these four respondents, three of them were IT/business architects and the remaining respondent was an IT team leader. In terms of the analysis of the requirements of the systems, there were five respondents (33.3%) that were mostly involved in this task. Two of them were identified to be systems analysts and the remaining three respondents were business analysts. The remaining respondent said that he was involved in systems support.

The results from this question show that the questionnaires were well spread among the development team, and this would help the researcher to gain a holistic picture into the SD practices that are currently undertaken in Company C. Table 4.47 shows the actual result of this question.

Table 4.47: Question 1 (Company C)
Which job title best describes your position?

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	I.T/ Systems developer	2	13.3	13.3	13.3
	Business analyst	3	20.0	20.0	33.3
	Programmer	3	20.0	20.0	53.3
	I.T/ Business architect	3	20.0	20.0	73.3
	I.T Team leader	1	6.7	6.7	80.0
	Systems analyst	2	13.3	13.3	93.3
	Other	1	6.7	6.7	100.0
	Total	15	100.0	100.0	

4.13.2 Question 2: Are you currently actively involved in information systems development?

All the respondents answered positively to this question indicating that they are involved in SD projects regardless of their ranking. Table 4.48 shows the actual result of this question.

Table 4.48: Question 2 (Company C)
Are you currently actively involved in information systems development?

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	YES	15	100.0	100.0	100.0

4.13.3 Question 3: How many years of systems development (SD) experience do you have?

Close to 34 percent of the respondents (5 out of 15) had five years or more experience in SD. Twenty percent of the respondents (3 out of 15) had between three and four years experience and about 27% of the respondents (4 out of 15) had between one and two years SD experience. Three respondents had less than one year SD experience representing exactly 20% of the total respondents.

Table 4.49 shows the frequency distribution of the years of experience in SD in Company C.

Table 4.49: Question 3 (Company C)
How many years of systems development (SD) experience do you have?

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	Less than 1 year	3	20.0	20.0	20.0
	1-2 year(s)	4	26.7	26.7	46.7
	3-4 years	3	20.0	20.0	66.7
	5 years or more	5	33.3	33.3	100.0
	Total	15	100.0	100.0	

4.13.4 Question 4: Please indicate what percentage of your personal time/work is devoted to the following development activities:

- *Systems planning, analysis and design*

A total of nine respondents (60.1%) spent between 51 and 90 percent of their time discharging this activity. The remaining six respondents spent between 1 and 40 percent of their time spent at work discharging this development activity. Interestingly enough, all the respondents in Company C were exposed to this development task. Table 4.50 shows the detailed frequency distribution of the time spent on systems planning, analysis and design.

Table 4.50: Question 4.1 (Company C)
Percentage of time spent working on systems planning, analysis and design

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	1-10%	2	13.3	13.3	13.3
	11-20%	1	6.7	6.7	20.0
	21-30%	1	6.7	6.7	26.7
	31-40%	2	13.3	13.3	40.0
	51-60%	1	6.7	6.7	46.7
	61-70%	3	20.0	20.0	66.7
	71-80%	4	26.7	26.7	93.3
	81-90%	1	6.7	6.7	100.0
	Total	15	100.0	100.0	

- *Programming*

Exactly forty percent of the respondents (6 out of 15) were not at all exposed to programming while at work. Eight respondents (53.4%) spent between 11 and 50 percent of their time working on programming, and only one respondent (6.7%) spent between 71 and 80 percent of their time at work programming. Table 4.51 shows a detailed frequency distribution of the total time spent working on programming in Company C.

Table 4.51: Question 4.2 (Company C)
Percentage of time spent working on programming

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	0%	6	40.0	40.0	40.0
	11-20%	4	26.7	26.7	66.7
	21-30%	2	13.3	13.3	80.0
	31-40%	1	6.7	6.7	86.7
	41-50%	1	6.7	6.7	93.3
	71-80%	1	6.7	6.7	100.0
	Total	15	100.0	100.0	

- *Testing*

Eight respondents (53.3%) were not involved in testing at all. The remaining seven respondents (46.7%) spent between 1 and 40 percent of their time working on testing. Table 4.52 shows the detailed frequency distribution of the time spent on testing.

Table 4.52: Question 4.3 (Company C)
Percentage of time spent working on testing

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	0%	8	53.3	53.3	53.3
	1-10%	4	26.7	26.7	80.0
	21-30%	2	13.3	13.3	93.3
	31-40%	1	6.7	6.7	100.0
	Total	15	100.0	100.0	

- ***Installation***

Close to 67 percent of the respondents (10 out of 15) did not deal with installation at work. The remaining five respondents (33.3%) spent between 1 and 10 percent of their time working on installations in Company C. Table 4.53 shows the detailed frequency distribution of the time spent working on installation.

Table 4.53: Question 4.4 (Company C)
Percentage of time spent working on installation

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	0%	10	66.7	66.7	66.7
	1-10%	5	33.3	33.3	100.0
	Total	15	100.0	100.0	

- *User training*

Nine of the respondents (60%) did not work on user training at all, and the remaining six respondents (40%) spent between 1 and 30 percent of their time working on user training in Company C. Table 4.54 shows the detailed frequency distribution of the time spent working on user training.

Table 4.54: Question 4.5 (Company C)
Percentage of time spent working on User training

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	0%	9	60.0	60.0	60.0
	1-10%	4	26.7	26.7	86.7
	11-20%	1	6.7	6.7	93.3
	21-30%	1	6.7	6.7	100.0
	Total	15	100.0	100.0	

- *Project management*

More than 50 percent of the respondents (8 out of 15) did not spend any time on project management activities. The remaining seven respondents (46.7%) spent up to 20 percent of their time discharging project management activities. Table 4.55 shows the frequency distribution of the time spent on project management activities by each respondent.

Table 4.55: Question 4.6 (Company C)
Percentage of time spent working on project management

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	0%	8	53.3	53.3	53.3
	1-10%	6	40.0	40.0	93.3
	11-20%	1	6.7	6.7	100.0
	Total	15	100.0	100.0	

- *"Other" activities*

A total of twelve respondents representing 80% did not spent time at all on "other" activities. The remaining three respondents (20%) spent up to 20 percent of their time working on "other" activities. These activities were classified as project budgeting for the three respondents. Table 4.56 shows the frequency distribution of the time spent on "other" development activities in Company C.

Table 4.56: Question 4.7 (Company C)

Percentage of time spent working on other activities

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	0%	12	80.0	80.0	80.0
	1-10%	2	13.3	13.3	93.3
	11-20%	1	6.7	6.7	100.0
	Total	15	100.0	100.0	

4.13.5 Question 5: Approximately how many information systems development (SD) projects have you completed in the past?

Only one respondent (6.7%) had completed more than 20 SD projects. The remaining 93.3% of the respondents (14 out of 15) completed between 1 and 10 SD projects in the past.

Table 4.57: Question 5 (Company C)

Approximately how many information systems development (SD) projects have you completed in the past?

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	1-10 projects	14	93.3	93.3	93.3
	More than 20 projects	1	6.7	6.7	100.0
	Total	15	100.0	100.0	

4.13.6 Question 6: How long have you been working in the organisation?

Exactly 60 percent of the respondents (9 out of 15) had worked between 1 and 4 years in Company C. Only one respondent (6.7%) had been at the organisation for more than 5 years and the remaining five respondents (33.3%) had spent at most 1 year in Company C. Table 4.58 shows the actual results of this question.

Table 4.58: Question 6 (Company C)

How long have you been working in the organisation?

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	0-1 year	5	33.3	33.3	33.3
	1-4 years	9	60.0	60.0	93.3
	5+ years	1	6.7	6.7	100.0
	Total	15	100.0	100.0	

4.13.7 Question 7: Which of the following technologies are you aware of, and please indicate your level of knowledge in a particular technology.

The structure of reporting the results of this question will follow section 4.4.7. As previously mentioned, the three technologies that are analysed are programming languages, UML design and methodologies.

- *Programming languages*

Only one respondent (6.7%) had basic knowledge in programming languages. Three respondents rated themselves as being competent and four other respondents (26.7) felt they were average in terms of programming languages. The remaining seven respondents (46.6%) categorised themselves as being skilled (5 out of 15) and expert (2 out of 15). Table 4.59 shows the detailed frequency distribution of the level of skill in terms of programming languages.

Table 4.59: Question 7.1 (Company C)
What is your level of knowledge in programming languages (e.g. Java, J2EE, C#, Microsoft.NET, etc)?

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	Basic knowledge	1	6.7	6.7	6.7
	Competent	3	20.0	20.0	26.7
	Average	4	26.7	26.7	53.3
	Skilled	5	33.3	33.3	86.7
	Expert	2	13.3	13.3	100.0
	Total	15	100.0	100.0	

- *UML Design*

Only one respondent (6.7%) failed to answer this question. The remaining 93.3% of the respondents responded as follows: basic knowledge (13.3%), competent (6.7%), average (20.0%), skilled (26.7%) and expert (26.7%).

Therefore it can be concluded that more than 70% of the respondents are well skilled in terms of UML design. Table 4.60 shows the actual result of this question in Company C.

Table 4.60: Question 7.6 (Company C)
What is your level of knowledge in UML Design (Rational Rose, Together, etc)?

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	Basic knowledge	2	13.3	14.3	14.3
	Competent	1	6.7	7.1	21.4
	Average	3	20.0	21.4	42.9
	Skilled	4	26.7	28.6	71.4
	Expert	4	26.7	28.6	100.0
	Total	14	93.3	100.0	
Missing	System	1	6.7		
Total		15	100.0		

- *Methodologies*

One respondent also did not reply to this question. Out of the remaining fourteen respondents 21.4% had basic knowledge, 14.3% were competent, 21.4% were average, 14.3% were skilled and 28.6% were experts.

This result shows that the level of knowledge in terms of methodologies is healthy in Company C. Table 4.61 shows the detailed frequency distribution of how the respondents replied to this question.

Table 4.61: Question 7.7 (Company C)

What is your level of knowledge in Methodologies (e.g. RUP, PRINCE II, etc)

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	Basic knowledge	3	20.0	21.4	21.4
	Competent	2	13.3	14.3	35.7
	Average	3	20.0	21.4	57.1
	Skilled	2	13.3	14.3	71.4
	Expert	4	26.7	28.6	100.0
	Total	14	93.3	100.0	
Missing	System	1	6.7		
Total		15	100.0		

4.13.8 Question 9: Is the systems development methodology tailored to suit your organisation?

Only fourteen respondents replied to this question, and the results show that out of the fourteen respondents nine said yes to the SDM being tailored and the remaining five respondents said no. After further investigation of this result, it was identified that the five respondents that said no to this question were either IT/systems developers or programmers. The interpretation of this result suggests that junior level personnel are of the opinion that their SDM is at times tailored to suit the organisation. Table 4.62 shows the actual result of this question.

Table 4.62: Question 9 (Company C)

Is the systems development methodology tailored to suit your organisation?

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	Yes	9	60.0	64.3	64.3
	No	5	33.3	35.7	100.0
	Total	14	93.3	100.0	
Missing	System	1	6.7		
Total		15	100.0		

Section 2: Project specific information

The structure of reporting the results will follow sections 4.4.9 to 4.4.13. In each question, the statements generating mixed reactions or negative reactions will be further discussed with the view of gaining an in-depth understanding of the SD practices in Company C. Once the results are reported, a summary of SD practices and ASDM sentiments is given in line with the research aims and objectives of the study.

4.13.9 Question 1 (Company C)

As in section 4.4.9, eleven statements were put forward to the respondents and each respondent had to reply to these statements using a Likert scale ranging from totally disagree to totally agree. The motivation of these statements is that they would allow the researcher to assess the perceptions of the development team regarding the planning and analysis phase.

The results from the statements are reported below and table 4.63 shows a summary of the frequency distribution of all the statements from all the respondents in this question.

- *The project was well-defined*

A large percentage of the respondents (73.3%) generally agreed with the statement and the remaining 26.7% of the respondents were neutral to this statement. This result overwhelmingly shows that the last SD project was generally well-defined.

- *Users were aware of their requirements*

Ten out of the fifteen respondents (66.7%) generally agreed with this statement and only two respondents (13.3%) disagreed. The remaining 20% of the respondents were neutral to the statement. This result indicates that the users were generally well aware of their requirements.

- *Users requirements changed all the time*

More than 70% of the respondents (11 out of 15) generally agreed with the statement and two other respondents disagreed. The remaining two respondents were neutral to the statement. This result indicates that the requirements of the users were very volatile and a typical SD project was met with continuous changes to the user requirements.

- *User's expectations were realistic*

Seven out of the thirteen respondents that replied to this statement (53.9%) generally agreed with the statement and four other respondents (30.8%) disagreed. The remaining two respondents were neutral to the statement. This result indicates that generally the expectations of the users were realistic although there is a substantial amount of respondents that felt the opposite is true. Therefore in order to accurately represent the results from this statement, it can be concluded that this statement has generated a slight mixed reaction among the respondents.

- *Developers understood user's requirements well*

More than 50% of the respondents (8 out of 15) were neutral to this statement. Five of the remaining respondents generally agreed with the statement and only two respondents disagreed. This result shows that there is a large majority of the respondents that are unsure about whether the developers understood user's requirements well.

- *The developed systems was very complex*

Five out of the fifteen respondents agreed with the statement and only two respondents disagreed. The remaining respondents (8 out of 15) were neutral indicating that there was uncertainty about the level of complexity of the developed system.

- *Senior management was highly committed to the project*

More than 25% of the respondents generally agreed with the statement and only one respondent disagreed. The remaining ten respondents (66.7%) were neutral to the statement.

This result indicates that generally there is uncertainty in the development team about how committed to a project senior management is.

- *Developer's knowledge of the systems development process was good*

More than 40% of the respondents generally agreed with the statement and the remaining respondents were neutral. This result indicates that generally the developer's knowledge of the SD process was good.

- *The installation and adoption of the developed system in user departments were well planned*

Ten out of the fifteen respondents (66.7%) generally agreed with the statement indicating that the implementation of the system was well executed.

- *The system was delivered at or before the scheduled time*

The results from this statement indicate that there is a mixed reaction between the respondents. Six out of the fifteen respondents disagreed and seven other respondents agreed with the statement. The remaining two respondents were neutral to the statement. This result, as mentioned earlier, indicates a mixed reaction among the members in the development team.

- *Status meetings were held weekly*

Exactly 60% of the respondents (9 out of 15) generally agreed with the statement and four other respondents disagreed. The remaining two respondents were neutral to the statement. This result shows that there is a majority of respondents that attend status meetings on a weekly basis.

Out of the eleven statements in this question, six of them generated positive responses among the respondents. The results of the remaining statements are as follows:

- Two statements generated mixed reactions among the respondents.

The statements that generated mixed reactions were:

  - *User's expectations were realistic;* and
  - *The system was delivered at or before the scheduled time.*

  Based on the results from the interview in Company C, it was expected that this statement would generally yield a positive result.

- Two statements generated uncertainty among the respondents

The statements that generated uncertainty among the respondents were:

  - *Developers understood user's requirements well;* and
  - *Senior management was highly committed to the project.*

Table 4.63: Summary of section 2 (Question 1 Responses)

	Total frequency	The project was well defined		Users were aware of their requirement		User's requirements changed all the time		User's expectations were realistic		Developers understood user's requirements well		The developed system was very complex		Senior management was highly committed to the project		Developer's knowledge of the systems development process was good		The installation and adoption of the developed system in user departments were well planned		The system was delivered at or before the scheduled time		Status meetings were held weekly	
		Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
Totally Disagree	0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	13.3	0	0.0	0	0.0	0	0.0	2	13.3	0	0.0
Disagree	19	0	0.0	2	13.3	2	13.3	4	30.8	2	13.3	0	0.0	1	6.7	0	0.0	0	0.0	4	26.7	4	26.7
Neutral	54	4	26.7	3	20.0	2	13.3	2	15.4	8	53.3	8	53.3	10	66.7	8	53.3	5	33.3	2	13.3	2	13.3
Agree	60	8	53.3	9	60.0	8	53.3	3	23.1	3	20.0	5	33.3	1	6.7	5	33.3	9	60.0	7	46.7	2	13.3
Totally Agree	26	3	20.0	1	6.7	3	20.0	4	30.8	2	13.3	0	0.0	3	20.0	2	13.3	1	6.7	0	0.0	7	46.7
Missing System								2	13.3														
	Total	15	100.0	15	100.0	15	100.0	15	100.0	15	100.0	15	100.0	15	100.0	15	100.0	15	100.0	15	100.0	15	100.0

4.13.10. Question 2 (Company C)

The structure of reporting the results in this section will follow section 4.4.10. This question had thirteen statements and the motivation of these statements was to test how agile the current SDM was. Once the results of each statement are reported, a tabulated summary (see Tables 4.64 and 4.65) of all the responses from the respondents is presented.

- *Documentation is very important in the systems development projects we undertake*

A total of 14 respondents agreed with this statement and only one respondent disagreed. This result clearly indicates that documentation is very important in the SD projects they undertake. This result agrees with the finding that the waterfall model (SDLC) is used as the SDM of choice.

- *Generally, building a system takes too much time*

More than 65% of the respondents (10 out of 15) agreed with the statement and only two respondents disagreed. The remaining two respondents were neutral to the statement. This result shows that there is a general perception that the systems take too long to develop. The findings from the interview indicated that a system took between 6 months and 2 years to develop. Therefore the result from this statement agrees with the findings from the interview.

- *Changing user requirements at an advanced level in the project is virtually impossible*

Eight respondents (53.3%) disagreed with the statement and only one respondent agreed. This result implies that changing the user requirements at any stage in a SD project is possible. It can therefore be concluded that agile practices – and not the ASDMs – are used in Company C. The next statement assesses the level of difficulty in adapting to changes in user requirements.

- *Adapting to changes in user requirements is very difficult*

The majority of the respondents (60%) in this statement were neutral to the statement. Three other respondents agreed with the statement and the remaining three respondents disagreed. This result shows that although there is a mixed reaction among the respondents, generally the development team is unsure about whether the adaptation to changes in user requirements is difficult.

- *Working software is delivered frequently (weeks rather than months)*

It was identified from the interview discussion that Company C used modular development as a technique. Seven respondents generally disagreed with the statement and six other respondents agreed. This result shows a mixed reaction among the respondents.

After further investigation, it was determined that the respondents that agreed with the statement were not actively involved with the actual programming of the systems. The results from table 4.51 show that six respondents are not actively involved in programming.

- *Late changes in user requirements are welcome*

Close to 50% of the respondents (7 out of 15) were neutral to the statement and only two respondents agreed. The remaining six respondents generally disagreed with the statement. This result shows that although a majority of the respondents are unsure about whether late changes in user requirements are welcome, there are a considerable amount of people within the development team that are strongly against last changes in user requirements.

- *There is close and daily cooperation between the developers and the users*

Five respondents generally disagreed with the statement, and only three respondents agreed. The remaining seven respondents were neutral to the statement. Therefore the result from this statement indicates that there is generally no close and daily cooperation between the developer and the user. This result agrees with the finding that a waterfall model is used in the organisation because one of the characteristics of the waterfall model is that different development activities are centralised according to the expertise needed for a particular activity.

- *The development team is made up of between 3-7 people*

Four respondents (26.7%) generally disagreed and seven others (46,7%) generally agreed with the statement. This result indicates that there are generally 3 to 7 people in a development team in Company C. In terms of the interview conducted in Company C, the interviewee mentioned that he was currently on a team of ten developers. Therefore the result from this statement contradicts the finding from the interview.

- *We continuously re-design the system being developed, even during development*

The result from this statement shows that there is a slight mixed reaction between the respondents. Five respondents (33.3%) generally agreed with the statement and three other respondents disagreed. The remaining seven respondents (46.7%) were neutral to the statement.

- *There is good communication between the members in the development team*

More than 65% of the respondents (10 out of 15) generally agreed with the statement. The remaining respondents were neutral to the statement. Therefore this result indicates that there is good communication between the members in the development team.

- *There is good communication between the development team and the users of the systems being developed*

A total of eight respondents (53.3%) agreed with the statement, and the remaining seven respondents were neutral to the statement. This result shows that there is a good communication channel between the development team and the users of the system being developed.

- *As a development team, we are very motivated to achieve the goals set out by management*

Eleven out of the fifteen respondents (73.4%) generally agreed with the statement. This result shows that the development team is highly motivated to achieve the goals set out by management.

- *Problems relating to the systems development projects are quickly dealt with*

The results from this statement show that there is a slight mixed reaction between the respondents. Four respondents (26.7%) generally disagreed with the statement and six other respondents (40%) generally agreed.

The results from this section generally agreed with the findings from the interview. The main findings from this section are:

- *Documentation is very important in the SD projects;*
- *Building a system takes too much time;*
- *Late changes in user requirements are not welcome;* and
- *There is no close cooperation between the developers and the users.*

These findings are some of the characteristics of using the waterfall model (SDLC). Other statements that generated mixed reactions between the respondents are:

- *Working software is delivered frequently (weeks rather than months);*
- *We continuously re-design the system being developed, even during development;* and
- *Problems relating to the systems development projects are quickly dealt with.*

Table 4.64 and table 4.65 show the frequency distribution of this question in Company C.

Table 4.64: Summary of section 2 (Question 2)

	Total frequency	Documentation is very important in the systems development projects we undertake		Generally, building a system takes too much time		Changing user requirements at an advanced level in the project is virtually impossible		Adapting to changes in the user requirements is very difficult		Working software is delivered frequently (weeks rather than months)		Late changes in user requirements are welcome		There is close and daily cooperation between the developers and the users		The development team is made up of between 3-7 people		We continuously re-design the system being developed, even during development		There is good communication between the members in the development team		There is good communication between the development team and the users of the system being developed	
		Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
Totally Disagree	16	0	0.0	2	13.3	4	26.7	2	13.3	5	33.3	1	6.7	1	6.7	2	13.3	1	6.7	0	0.0	0	0.0
Disagree	20	0	0.0	0	0.0	4	26.7	1	6.7	2	13.3	5	33.3	4	26.7	2	13.3	2	13.3	0	0.0	0	0.0
Neutral	58	1	6.7	3	20.0	6	40.0	9	60.0	2	13.3	7	46.7	7	46.7	4	26.7	7	46.7	5	33.3	7	46.7
Agree	40	1	6.7	8	53.3	1	6.7	2	13.3	5	33.3	0	0.0	3	20.0	3	20.0	3	20.0	6	40.0	8	53.3
Totally Agree	29	13	86.7	2	13.3	0	0.0	1	6.7	1	6.7	2	13.3	0	0.0	4	26.7	2	13.3	4	26.7	0	0.0
	Total	15	100.0	15	100.0	15	100.0	15	100.0	15	100.0	15	100.0	15	100.0	15	100.0	15	100.0	15	100.0	15	100.0

Table 4.65: Summary of section 2 (Question 2 continued)

	Total frequency	As a development team, we are very motivated to achieve the goals set out by management		Problems relating to the systems development project are quickly dealt with	
		Freq	%	Freq	%
Totally Disagree	2	0	0.0	2	13.3
Disagree	2	0	0.0	2	13.3
Neutral	9	4	26.7	5	33.3
Agree	10	7	46.7	3	20.0
Totally Agree	7	4	26.7	3	20.0
	Total	15	100.0	15	100.0

4.13.11 Question 3 (Company C)

The structure of reporting the results in this question will follow section 4.4.11. These statements went further to test the agility of the current SDM being used. The level of applicability of ASDMs in the telecommunication industry as well as the level of satisfaction regarding the current SDM is also tested in this question. A general positive result would indicate that the respondents are happy with the current SDM and they are generally open to experiencing an ASDM. Table 4.66 and table 4.67 show the frequency distribution of the responses from the respondents.

- *I enjoy working with my colleagues*

More than 85% of the respondents (13 out of 15) generally agreed with this statement. This result indicates that the respondents enjoy working with their colleagues.

- *I enjoy the way we develop systems*

Exactly 60% of the respondents (9 out of 15) generally agreed with the statement. The remaining six respondents were neutral to the statement. This result indicates that the development team generally enjoys the way they develop systems.

- *I feel proud when we successfully develop a(n) system/application that meets the users requirements*

More than 85% of the respondents (13 out of 15) agreed with the statement. This result shows that there is a sense of pride among the members of the development team in terms of successfully meeting the requirements of the users.

- *Changing the current systems development methodology we use will be a good idea*

The results from this statement indicate that there is a general view that changing the current SDM would be a good idea. This result contradicts the findings from the interview which suggests that a change of the SDM should be informed by the scope of the SD project.

- *I see nothing wrong with the current methodology we use*

More than 50% of the respondents (8 out of 15) generally disagreed with the statement. This result shows that there is a general view that there is something wrong with the current SDM. This can be explained from the fact that it takes too long to develop a system.

- *The development team is well conversed with the methodology being used*

The result from this statement shows that the majority of the respondents are unsure about the level of knowledge that the development team has regarding the SDM currently being used. This result agrees with the findings from the interview that suggest that the development team is not sufficiently knowledgeable about the SDM that is being used.

- *The current methodology being used adapts to change well*

The results from section 4.12.10 indicated that the current SDM did not allow for late changes in the user requirements. The results from this statement indicate that the respondents are generally unsure about the current SDM's adaptability in a volatile environment. Five other respondents (33.3%) generally agreed with the statement and only two respondents disagreed. This result therefore indicates that the current SDM adapts well to change only if those changes are introduced early in the development lifecycle of the project. This is a clear indication that the SDLC methodology is the current SDM being used in the organisation.

- *The methodology being used is linear (i.e. it follows a waterfall model)*

The result from this question agreed with the findings from the interview which suggested that the current SDM followed a waterfall model. Even though the results from this statement showed that a majority of the respondents agreed with the statement, there was a substantial amount of respondents that generally disagreed (4 out of 15). This result therefore shows that indeed not only one SDM is used in the organisation.

- *I know what agile systems development methodologies are*

Exactly 60% of the respondents generally agreed with the statement. This result indicates that there is a good level of awareness in terms of ASDMs in the organisation.

- *I have used an agile methodology before*

Close to 50% of the respondents had not used an agile methodology before. This result agrees with the finding from the interview that suggested that the development team was not exposed to ASDMs and the benefits that they hold.

- *Using an agile methodology will be beneficial to this organisation*

Even though the development team had not experienced an agile methodology, the results from this statement indicate that the development team appreciates the benefits of using an ASDM.

- *One needs to have a lot of experience in agile methodologies before using it*

Exactly 40% of the respondents (6 out of 15) agreed with the statement, and four respondents (26.7%) disagreed. Therefore this result shows that generally the respondents feel that one needs to be experienced in ASDMs before using them.

- *Agile methodologies are widely used in the telecomm industry*

Seven out of the fifteen respondents (46.7%) generally disagreed with this statement, and only three respondents (20.0%) disagreed. This result indicates that the respondents from Company C generally feel that ASDMs are not widely used in the industry.

- *Our systems development methodology helps to capture requirements for the system to be developed*

Seven out of the fifteen respondents (46.7%) generally agreed with this statement and the remaining respondents were neutral. This result, although positive, indicates that there are many people within the development team that are unsure whether the SDM helps to capture the user requirements.

- *Our system development methodology helps to involve end-users in systems development projects*

The result from this statement indicated a slight mixed reaction between the respondents. Three of the respondents (20%) disagreed with the statement and five other respondents (33.3%) agreed. The majority of the respondents (7 out 15) were not sure whether the SDM helped to involve the end-users.

- *Our systems development methodology helps build management commitment in our systems development projects.*

The result from this statement indicated that the SDM helped to build management commitment in the SD projects. This result agrees with the findings from the interview that suggested that management played a crucial role in the success of an SD project.

- *Our systems development methodology helps to decompose the system to be developed in workable parts*

The findings from the interview showed that Company C develops a system in modules. The results from this statement agree with the findings from the interview. Close to 70% of the respondents (10 out of 15) generally agreed with the statement and the remaining five respondents were neutral.

- *The telecomm industry is a fast-paced industry, and companies operating within it requires a systems development methodology that is able to accommodate change quickly*

The result from this statement indicates that there is an overwhelming majority (80%) that understands the volatility of the telecommunication industry, and there is a need for an SDM that can accommodate change anywhere in the development lifecycle.

The results from this section showed that there was a need for an SDM that could accommodate a volatile environment. In terms of the level of satisfaction, the respondents generally answered positively and the results showed that there was a good development environment. The respondents were also of the view that changing the current SDM would benefit the organisation because the current SDM could not adapt to change well especially at an advanced level in the lifecycle. Some of the interesting findings from this section are highlighted below.

- *Changing the current SDM would be a good idea;*
- *There is something wrong with the current SDM;*
- *The development team is not entirely proficient in the SDM they use;*
- *The SDM used does not adapt well to change (especially at an advanced level in the development lifecycle);*
- *Most of the members in the development team have not used an agile methodology before;* and
- *ASDMs are not widely used in the telecommunication industry*

These highlighted findings indicate that the use of an agile systems development methodology would benefit the organisation even though they are not widely used in the telecommunication industry. In terms of the applicability of ASDMs in the organisation, the results from this section indicate that the respondents are open to experiencing ASDMs and their use could help with ensuring that systems are developed in a shorter time frame. Table 4.66 and table 4.67 show the summary of the frequency distribution of these statements in Company C.

Table 4.66: Summary of section 2 (Question 3 Responses)

	Total Frequency	I enjoy working with my colleagues		I enjoy the way we develop systems		I feel proud when we successfully develop a(n) system/application that meets the users requirements		Changing the current systems development methodology we use will be a good idea		I see nothing wrong with the current methodology we used		The development team is well conversed with the methodology being used		The current methodology being used adapts to change well		The methodology being used is linear (i.e. it follows a waterfall model)		I know what agile systems development methodologies are		I have used an agile methodology before		Using an agile methodology will be beneficial to this organisation	
		Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
Totally Disagree	18	0	0.0	0	0.0	0	0.0	2	13.3	4	26.7	3	20.0	0	0.0	2	13.3	0	0.0	7	15.4	0	0.0
Disagree	10	0	0.0	0	0.0	0	0.0	1	6.7	4	26.7	1	6.7	2	13.3	2	13.3	0	0.0	0	0.0	0	0.0
Neutral	51	2	13.3	6	40.0	2	13.3	4	26.7	5	33.3	9	60.0	8	53.3	4	26.7	6	20.0	3	20.0	4	26.7
Agree	43	5	33.3	8	53.3	3	20.0	2	13.3	2	**13.3**	2	13.3	3	20.0	7	46.7	6	40.0	2	13.3	3	20.0
Totally Agree	41	8	53.3	1	6.7	10	66.7	6	40.0	0	0.0	0	0.0	2	13.3	0	0.0	3	20.0	3	20.0	8	53.3
	Missing System																						
	Total	**15**	**100.0**	**15**	**100.0**	**15**	**100.0**	**15**	**100.0**	**15**	**100.0**	**15**	**100.0**	**15**	**100.0**	**15**	**100.0**	**15**	**100.0**	**15**	**100.0**	**15**	**100.0**

Table 4.67: Summary of section 2 (Question 3 continued)

	Total Frequency	One needs to have a lot of experience in agile methodologies before using it		Agile methodologies are widely used in the Telecomm industry		The Telecomm industry is a fast-paced industry, and companies operating within it requires an SDM that is able to accommodate change quickly		Our SDM helps to capture requirements for the system to be developed		Our SDM helps to involve end-users in systems development projects		Our SDM helps to build management commitment in our systems development projects		Our SDM helps to decompose the system to be developed in workable parts	
		Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
Totally Disagree	6	3	20.0	3	20.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Disagree	11	1	6.7	4	26.7	1	6.7	0	0.0	3	20.0	2	13.3	0	0.0
Neutral	41	5	33.3	5	33.3	3	20.0	8	53.3	7	46.7	8	53.3	5	33.3
Agree	30	3	20.0	3	20.0	0	30.8	5	33.3	5	33.3	5	33.3	9	60.0
Totally Agree	18	3	20.0	0	0.0	12	80.0	2	13.3	0	0.0	0	0.0	1	6.7
	Missing system														
	Total	15	100.0	15	100.0	15	100.0	15	100.0	15	100.0	15	100.0	15	100.0

4.13.12 Question 4 (Company C)

The reporting of the results from these statements will follow section 4.4.12. These statements assessed the level of success of the last SD project that was undertaken in Company C. Table 4.68 shows the summary of the frequency distribution of the responses of all the respondents in this question.

- *The project was completed on schedule*

The results of this statement indicate a slight mixed reaction among the respondents. Eight respondents generally agreed and six others disagreed.

- *The project was completed within budget*

More than 50% of the respondents (8 out of 15) generally agreed with this statement. This result indicates that last project was generally perceived to have been completed within budget.

- *The developed system satisfied all the stated requirements*

More than 85% of the respondents generally agreed with the statement. This result shows that the system generally satisfied all the stated requirements.

- *The speed of developing the project was high*

The majority of the respondents (53.3%) were not sure whether the speed of the developed system was high. This result indicates that the respondents are generally used to the systems being developed according to the requirements of the project. It was expected that this statement would generate a negative reaction because of the findings from the interview.

- *The productivity of developers involved with the project was high*

This statement yielded a positive result. Close to 67% of the respondents agreed with the statement indicating that the productivity levels of the developers was generally high.

- *The cost of the project was low when compared to the size and complexity of the system developed.*

Exactly 60% of the respondents were neutral to the statement indicating that most of the respondents were not exposed to the management aspect of the project. Five other respondents agreed with this statement and after further investigation it was identified that all these respondents were either IT/business architects or business analysts.

- *The project achieved its goals*

An overwhelming majority (93.3%) agreed with this statement indicating that the project achieved its goals.

- *Overall, the project represents excellent work*

Again, a large majority (93.3%) agreed with this statement. This result indicates that the project represented excellent work.

- *Overall, the project was a success*

More than 85% of the respondents (13 out of 15) generally agreed with this statement. Therefore it can be concluded that the last SD project was a resounding success.

The results from these statements from section 4.12.12 generally show that the last SD project was successful. Some of the interesting findings from this section are highlighted below.

- *There is uncertainty about whether the project was completed on schedule;*
- *The project was completed within budget;*
- *The last SD project was a success.*

These findings indicate that Company C generally enjoys a high success rate in their SD projects. Table 4.68 shows the summary of the frequency distribution of the responses from the respondents.

Table 4.68: Summary of section 2 (Question 4 Responses)

	Total Frequency	The project was completed on schedule		The project was completed within budget		The developed system satisfied all the stated requirements		The speed of developing the project was high		The productivity of developers involved with the project was high		The cost of the project was low when compared to the size and complexity of the system developed		The project achieved it goals		Overall, the project represents excellent work		Overall, the project was a success	
		Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
Totally Disagree	3	3	20.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Disagree	12	3	20.0	5	33.3	0	0.0	3	20.0	0	0.0	1	6.7	0	0.0	0	0.0	0	0.0
Neutral	31	1	6.7	2	13.3	2	13.3	8	53.3	5	33.3	9	60.0	1	6.7	1	6.7	2	13.3
Agree	59	6	40.0	5	33.3	8	53.3	2	13.3	5	33.3	3	20.0	11	73.3	10	66.7	9	60.0
Totally Agree	30	2	13.3	3	20.0	5	33.3	2	13.3	5	33.3	2	13.3	3	20.0	4	26.7	4	26.7
	Total	15	100.0	15	100.0	15	100.0	15	100.0	15	100.0	15	100.0	15	100.0	15	100.0	15	100.0

4.13.13 Question 5 (Company C)

The structure of reporting the results from this section will follow section 4.4.13. As mentioned earlier, these statements assessed the functionality, reliability, maintainability and efficiency of the last system that was developed. Table 4.69 shows a summary of the frequency distribution of the responses of these statements.

- *The functionality of the developed system is high*

A large majority of the respondents (13 out of 15) generally believed that the functionality of the system was high.

- *The reliability of the developed system is high*

Based on the results from this statement, the general view was that the developed system was reliable.

- *The maintainability of the developed system is high*

The responses from this statement show that the developed system was highly maintainable. More than 85% of the respondents generally agreed with the statement.

- *The efficiency of the developed system is high*

The responses from this statement show that the developed system was highly efficient. More than 90% of the respondents agreed with the statement.

- *The developed system meets user needs*

More than 90% of the respondents (14 out of 15) generally agreed with this statement. This result agrees with the findings from section 4.12.11 which suggests that the user requirements were met.

- *Overall, the quality of the developed system is high*

More than 85% of the respondents (13 out of 15) generally agreed with the statement indicating that the overall quality of the developed system was high.

- *Overall, the users are satisfied with the developed system*

The responses from this statement indicate that the users were satisfied with the developed system. Exactly 80% of the respondents agreed with the statement. This result agrees with the finding from section 4.12.11 which suggests that the user requirement were captured well.

- *Overall, the developed system is a success*

An overwhelming majority agreed with the statement indicating that the system was deemed to be successful by the organisation.

The overall result from this section indicates that the developed system was of a very high quality and the actual system was deemed to be highly successful. Even though the duration of developing a system is too long the SDM helps to ensure that a high quality system that meets the user requirements is developed. The drawback with regards to the SDM is that late changes in the user requirements are very difficult to capture. Some of the interesting findings from this section are highlighted below.

- *The functionality of the developed system is high;*
- *The developed system is highly reliable;*
- *The developed system is highly maintainable;*
- *The system meets the user needs;* and
- *The developed system was a success.*

Table 4.69 shows the actual responses from the respondents.

Table 4.69: Summary of section 2 (Question 5 Responses)

	Total Frequency	The functionality of the developed system is high		The reliability of the developed system is high		The maintainability of the developed system is high		The efficiency of the developed system is high		The developed system meets users needs		Overall, the quality of the developed system is high		Overall, the users are satisfied with the developed system		Overall, the developed system is a success	
		Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
Totally Disagree	0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Disagree	0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Neutral	14	2	13.3	2	13.3	2	13.3	1	6.7	1	13.3	2	13.3	3	20.0	1	13.3
Agree	65	6	40.0	8	53.3	9	60.0	8	53.3	10	66.7	8	53.3	8	53.3	8	53.3
Totally Agree	41	7	46.7	5	33.3	4	26.7	6	40.0	4	26.7	5	33.3	4	26.7	6	40.0
	Total	15	100.0	15	100.0	15	100.0	15	100.0	15	100.0	15	100.0	15	100.0	15	100.0

4.13.14 Open-ended section (Company C)

The reporting of the results from this section will follow the same structure in section 4.4.14.

Question 8 (Section 1): What is the name of the SDM currently being used?

Eight out of the fifteen respondents (53.3%) said that the current SDM was SDLC and four other respondents said that the current SDM was an agile methodology. After further investigation, it was determined that these four respondents misrepresented the current SDM because none of them had used an agile methodology before. The remaining three respondents did not answer to this question. Therefore out of the twelve respondents that answered this question, four of them were invalid answers and were not considered in the results. The final result of this question is therefore in agreement with the findings from the interview which suggests that an SDLC is the current SDM being used in the organisation.

Question 10 (Section 1): Describe how the SDM is tailored if your answer to question 9 was yes.

This question was linked to question 9 in the questionnaire. The results of question 9 shows that out of the fourteen respondents that answered this question, nine of them agreed and the remaining five respondents disagreed to the question (see table 4.62). Eight respondents out of the nine who said the SDM was tailored mentioned that the tailoring of the SDM was done by scaling down on the planning and analysis phases. The respondents also mentioned that the tailoring of the SDM was dependent on the size and scope of the project.

Therefore it can be concluded that the current SDM being used in Company C is the SDLC, and this methodology is tailored in smaller projects by scaling down on the initial phase.

4.14. REVISED PROPOSITIONS

In this section, the propositions from section 4.12 are revised in order to include to findings from the questionnaire. Once these propositions are formulated, they will represent the SD practices and ASDM sentiments that are being followed in the telecommunication industry in South Africa.

4.14.1 Proposition 1: [*The SDM currently being used in the telecommunication industry is a formalised methodology following a linear process model. For larger projects, the methodology is used in the way it was intended, and for smaller projects the formalised methodology is tailored by scaling down more time consuming activities such as the feasibility study and the planning and analysis phases. Even though the methodology being used is prone to red-tape, generally the users of the methodology are satisfied with it.*]

The results from the questionnaire data indicate that this proposition will remain unchanged because it is supported from the findings. It was identified that the SDLC was the current SDM being used and the tailoring process depended on the size and scope of the project **[AI, AQ, BI, BQ, CI, CQ]**[11].

4.14.2 Proposition 2: [*The first phase is considered to be one of the most important phases in the project lifecycle. It is very important that this phase is done with very clear objectives from the user department and therefore resulting in a high quality systems development project.*]

Not enough information regarding the initial phase was generated from the questionnaires. In terms of documentation and user requirements – which are usually in the initial phase of an SDLC project – it was established from the results of the questionnaire that these activities helped to ensure that a developed system was of a very high quality. Therefore this proposition from section 4.3.5.2 will remain unchanged **[AI, BI, CI]**.

4.14.3 Proposition 3: [*Generally, large companies in the telecommunication industry enjoy a moderate to high success rate when developing systems and the developed system is generally of a very high standard that effectively meets the requirements of the users. In terms of the overall project success rate, the organisations develop systems within budget and the costs involved are low when compared to the benefits that the systems hold for the users. The SDM currently being used helps to capture the user requirements and it allows for modular development.*]

The results from the questionnaire data show that the current SDM helped to ensure that the system is developed in workable parts (see table 4.67). The project success rate was also generally deemed to be high (see table 4.69). Therefore this proposition from section 4.3.5.3 will remain unchanged **[AI, AQ, BI, BQ, CI, CQ]**.

[11] This code indicates that this proposition is supported by the interview and questionnaire data from all the companies.

4.14.4 Proposition 4: [*Although a lot still needs to be done in terms of educating people about ASDMs, the general perception is that the use of agile methodologies can benefit the organisation – and the industry – and one doesn't need to have experience in ASDMs in order to use them. The use of ASDMs will help the organisation adapt quickly to a changing environment, and the choice of using such a methodology should be informed by the scope of the SD project.*]

The results from the questionnaire data agree with proposition 4 in section 4.12.4.1. Therefore this proposition will remain unchanged **[AQ, BI, BQ, CI, CQ]**.

4.14.5 Proposition 5: [*Although there is a strong resistance of the use of ASDMs from management because of the high success rate that the current SDM affords the organisation, the general mindset is very positive towards ASDMs, and they are generally open to experiencing an agile systems development methodology even though the current methodology they use is very successful in meeting the user requirements.*]

The results from the questionnaire data agree with proposition 5 in section 4.5.5.1. Therefore this proposition will also remain unchanged **[AQ, BI, BQ, CI, CQ]**.

4.14.6 Proposition 6: [*There needs to be management commitment to the use of a particular SDM in the organisation. In most instances, the level of management commitment indirectly affects the success of the SD project.*]

The results from the questionnaire data indicated that the current SDM marginally helped to commit management to the SD projects. Therefore this proposition remains unchanged as it can also be applied to Company C **[AI, AQ, BI, BQ, CI, CQ]**.

4.14.7 Proposition 7: [*The use of systems development techniques and tools help to ensure that the system developed is of a very high quality that meets the requirements of the users.*]

The results from the questionnaire data indicated that the developed systems were generally of a very high quality. In terms of using tools and techniques in order to ensure the quality of the system, not much data from the questionnaire section was generated. Therefore this proposition from section 4.3.5.7 is also applicable to Company C **[AI, AQ, BI, CI]**.

4.15. SUMMARY OF COMPANY C

The results of Company C are now summarised in terms of the research aims and objectives of this study. As mentioned in section 4.2, the main research questions aimed to ascertain the applicability of ASDMs in the telecommunication industry and also the agility of the current SDMs used in the telecommunication industry.

The findings from these statements indicated a level of uncertainty (or mixed reactions) among the members of the development team:

- *Developer's understood user's requirements well;*
- *Senior management was highly committed to the project;*
- *User's expectations were realistic;* and
- *The system was delivered at or before the scheduled time.*

The findings from these statements agreed with finding that the SDLC is the current SDM being used:

- *Documentation is very important in the SD projects;*
- *Building a system takes too much time;*
- *Late changes in user requirements are not welcome;* and
- *There is no close cooperation between the developers and the users.*

The findings from these statements suggested that ASDMs are well suited for the telecommunication industry:

- *Changing the current SDM would be a good idea;*
- *There is something wrong with the current SDM;*
- *The development team are not entirely proficient in the SDM they use;* and
- *The SDM used does not adapt well to change (especially at an advanced level in the development lifecycle);*

In terms of the main research questions, the results from Company C indicate that ASDMs are highly applicable. The results of Company C are summarised as follows:

- *Can ASDMs be applied in the telecommunication industry in South Africa?*

The results from Company C indicated that ASDMs are applicable in the telecommunication industry. This is because of the findings that suggested that changing the current SDM would be a good idea because it did not adapt well to change.

Even though most of the members in the development team had not used an agile methodology before, the results indicate that there is openness towards experiencing the use of ASDMs. This attitude towards ASDMs is further strengthened by the respondents' belief that ASDMs are not widely used in the telecommunication industry. Therefore, there is a strong belief in Company C that agile methodologies are applicable in the telecommunication industry in South Africa.

- *How agile are current SDMs in the telecommunication industry in South Africa?*

It was found that Company C tailored their SDM according to the scope of the SD project. The tailoring process was done by scaling down on tasks and activities that were deemed to be time consuming such as planning and analysis. Even though the results show that the first phase is considered to be very important, tailoring of the current SDM is done when the development team is constrained by time and budget.

4.16 SUMMARY OF CHAPTER

This chapter reported the findings from the interviews conducted in the organisations as well as the questionnaires that were distributed. As previously mentioned, the interviews were held at the respective offices, and a total of forty questionnaires were returned to the researcher. Because of the nature of this study, the researcher reported the interviews and questionnaires separately. Each company was looked at separately and the interview data was the first to be reported. Once the interview was reported initial propositions were formulated in order to generate theory about what is happening in the particular organisation.

Thereafter, the questionnaire data was reported with the view of revising the initial propositions. This process was done for each company but the same propositions were used for all the companies. If it was determined that the proposition did not include data from a particular company, that proposition was revised so that the company could be represented. This strategy proved to be very successful in developing propositions for the SD practices that are currently being followed in the telecommunication industry of South Africa. In the following chapter, the concluding remarks and recommendations based on this study are highlighted.

CHAPTER 5
CONCLUSIONS AND RECOMMENDATIONS

5.1 INTRODUCTION

This study looked at the applicability of ASDMs in the telecommunication industry in South Africa. The purpose of the research was to determine whether – or not – agile methodologies are being used in the telecommunication industry in South Africa. This was done by firstly reviewing pre-existing literature on ASDMs and the telecommunication industry, and thereafter identifying the challenges of adopting ASDMs. Once the literature was reviewed, case studies were conducted at three prominent telecommunication companies in South Africa. The results from the case study were used to ascertain the level of use – and possible applicability – of ASDMs in the telecommunication industry in South Africa. Therefore this chapter summarises the results obtained from the case studies conducted. The results indicated that there was generally a positive attitude towards the use of ASDMs in the telecommunication industry, and the current SDMs being used did not accommodate late changes in user requirements very well. In summarising the results the researcher will remain cognisant of the research questions and objectives discussed in Chapter 1.

5.2 CONTRIBUTION OF THE RESEARCH

The telecommunication industry in South Africa is a fast paced industry that has unique requirements that need to be met continuously. In terms of this research, the main purpose was to identify the current SDMs being used and to ascertain whether ASDMs or agile practices are being applied in the industry. According to studies conducted by Otto (2007), Theunissen and Kourie (2003) and Koutsoukos *et al.* (2001), it was found that there is a need for a systems development methodology that is flexible and adaptive to the ever-changing requirements that are common in the telecommunication industry. Therefore in order to address the main purpose of the research, the researcher identified three research aims and objectives that would help establish the use of ASDMs in the telecommunication industry in South Africa. The aims and objectives of the research were to:

- Identify highly influential companies operating in the telecommunication industry so that the industry "best"[12] practices may be identified;
- Investigate the sentiments towards using ASDMs and the applicability of these methodologies in the telecommunication industry; and

[12] The phrase "best" practices should not be construed to mean the most effective way of doing things but rather to indicate what is currently considered as the industry norm.

- Determine the current SDMs being used in the telecommunication industry.

The main research questions that were used to address these aims and objectives were:

- *Can agile SDMs be applied in the telecommunication industry?*

The mini-research questions used to answer this question were:

  - What SDM is currently being used in the organisation?
  - What are the sentiments of ASDMs in the telecommunication industry?
  - If ASDMs are not used, is there a willingness to change to an ASDM?

The motivation of these mini-research questions was that the researcher wanted to determine whether ASDMs are suitable to the telecommunication industry in South African. Previous research (Otto, 2007; Theunissen & Kourie, 2003) found that ASDMs are not being used, and their recommendations were that they should be used. Therefore, this research aimed to take the studies of the previous authors further by determining the use of ASDMs in the telecommunication industry, and whether or not they are applicable in the industry.

- *How agile are current SDMs in the telecommunication industry?*

The mini-research questions used to answer this question were:

  - Does the current SDM follow a waterfall lifecycle or an incremental one?
  - Does the current SDM adapt to a changing environment well?

The motivation of these mini-research questions was that the researcher wanted to determine the current SDMs' response rate to changing user requirements. In an industry as volatile as the telecommunication industry, previous studies (Koutsoukos *et al.*, 2001; Mansurov, 2000) found that SDMs needed to be adaptive and evolutionary so that the organisations remain competitive. Contrarily, this study found that the telecommunication industry in South Africa did not make use of ASDMs.

In answering these main research questions as stated above, the definition of SDMs by Huisman and Iivari (2006) which states that an SDM is comprised of a combination of a systems development approach, a systems development process model, a systems development method and systems development tools and techniques was used. With regards to ASDMs, the *Agile Manifesto* (Beck *et al.*, 2001) highlighted the principles that needed to be adhered to in order to achieve flexible and adaptive systems development practises.

5.3 RESULTS OF THE STUDY

In this section, the findings are discussed according to the aims and objectives of the research. Initially, the propositions regarding the current SDMs being used are discussed. Thereafter the propositions regarding the sentiments of ASDMs in the telecommunication industry are discussed. Once the propositions have been discussed, the main research questions are answered.

5.3.1 Current SDMs being used in the telecommunication industry

It was found that large organisations used the SDLC as their methodology of choice. In some instances, the methodology was tailored by scaling down on activities such as planning and analysis. This tailoring was done as a result of the scope of the project. The scope of the project was referred to as the time and budget constraints of the project. In terms of the process model, the SDM followed a waterfall approach and it was identified that in some instances the SDM was not adequate in adapting to late changes in the user requirements.

The propositions that were directly related to the current SDMs being used in the telecommunication industry are discussed below.

- **Proposition 1**

The SDM currently being used is a formalised methodology following a linear process model. For larger projects, the methodology is used in the way it was intended, and for smaller projects (< R5 million) the formalised methodology is tailored by scaling down on more time consuming activities such as the feasibility study and the planning and analysis phases. Even though the methodology being used is prone to red-tape, generally the users of the methodology are satisfied with it **[AI, AQ, BI, BQ, CI, CQ]**.

- **Proposition 2**

The first phase is considered to be one of the most important phases in the project lifecycle. It is very important that this phase is done with very clear objectives from the user department and therefore resulting in a high quality systems development project **[AI, BI, CI]**.

- **Proposition 3**

Generally, large companies in the telecommunication industry enjoy a moderate to high success rate when developing systems and the developed system is generally of a very high standard that effectively meets the requirements of the users. In terms of the overall project success rate, the organisations develop systems within budget and the costs involved are low when compared to the benefits that the systems hold for the users. The SDM currently being used helps to capture the user requirements and it allows for modular development **[AI, AQ, BI, BQ, CI, CQ]**.

- **Proposition 4**

The use of systems development techniques and tools helps to ensure that the developed system is of a very high quality that meets the requirements of the users **[AQ, BI, BQ, CI, CQ]**.

5.3.2 The sentiments of ASDMs in the telecommunication industry in South Africa

In this section the attitudes towards ASDMs are assessed. The results from the interviews and questionnaires indicate that there is a positive attitude towards using ASDMs even though not many members are experienced in these methodologies. The general impression is that the members of the IT departments feel that using ASDMs would benefit the organisations and the industry as a whole but management have the final say in which methodology to be used. The propositions that addressed the issue of ASDMs in the telecommunication industry are highlighted below.

- **Proposition 5**

Although a lot still needs to be done in terms of educating people about ASDMs, the general perception is that the use of agile methodologies can benefit the organisation – and the industry – and one doesn't need to have experience in ASDMs in order to use them.

The use of ASDMs will help the organisation adapt quickly to a changing environment, and the choice of using such a methodology should be informed by the scope of the project **[AQ, BI, BQ, CI, CQ]**.

- **Proposition 6**

There needs to be management commitment to the use of a particular SDM in the organisation. In most instances, the level of management commitment indirectly affects the success – or failure – of the SD project **[AI, AQ, BI, BQ, CI, CQ]**.

- **Proposition 7**

Although there is a strong resistance of the use of ASDMs from management because of the high success rate that the current SDM affords the organisations, the general mindset is very positive towards ASDMs and generally IT department team members are open to experiencing ASDMs even though the current methodology is very successful in meeting the user requirements **[AI, AQ, BI, CI]**.

The results of the study are now discussed according to the main research questions which were highlighted in chapter 1.

- *Can agile SDMs be applied in the telecommunication environment?*

The results indicated that ASDMs can be applied to the telecommunication industry but the determining factor for the successful adoption of these methodologies would greatly depend on the level of management commitment. The current SDM helped to capture the user requirements but was insufficient in accommodating changes late in the project lifecycle. In a fast paced industry like the telecommunication industry, there is a need of a highly adaptive and flexible SDM. ASDMs were identified to be the most appropriate in addressing the SD challenges faced by the organisations.

- *How agile are current SDMs in the telecommunication environment?*

In assessing the agility of the current SDM, the principles highlighted in the *Agile Manifesto* were used. These included good and constant communication between the development team and the users and continuous attention to technical excellence and good design practices. Even though an ASDM was not being used, some practises that were more common in ASDMs were actively used in the industry. These practises include building a system in parts (modular development), teams that are self-organising[13], and the current SDM's are tailored to suit a particular SD project. Table 5.1 shows the complete summary of the measured aspects in this study. This was used to perform the cross-case analysis so that the SD practices in the telecommunication industry of South Africa could be identified. The column titled 'Codes' is used to represent the corresponding Agile Value (AV) or Agile Principle (AP). These measured aspects include:

- *SDM currently used in the organisation;*
- *How the current SDM is tailored;*
- *Characteristics of the last SD project;*
- *Agile principles followed;*
- *Level of job satisfaction;*
- *Satisfaction with the current SDM;*
- *Effectiveness of current SDM;*
- *Sentiments regarding the use of ASDMs;*
- *SD Process quality; and*
- *Quality of last developed system*

The agile values and agile principles have been adapted from the Agile Manifesto (see section 2.3.3).

[13] The results showed that the respondents were self-organising, and that corresponds to the eleventh agile principle (see Table 2.2)

Table 5.1: Summary of measured aspects

Codes	Measured Aspects	COMPANY A		COMPANY B		COMPANY C	
		Interview	Questionnaires (12 Respondents)	Interview	Questionnaires (13 Respondents)	Interview	Questionnaires (15 Respondents)
	SDM currently used in organisation	SDLC for large projects (i.e. >R5million) Smaller projects, SDM is tailored	90.9% of respondents said SDLC is used for large projects	Used the waterfall approach (i.e. linear process model)	69.2% SDLC 7.7% XP 7.7% RUP 15.4% DNK[Φ]	Current SDM followed a waterfall approach A variety of SDMs are used depending on the project requirements	53.3% SDLC 20% DNK 26.7% Said ASDM but it was found to be a misrepresentation
	How the current SDM is tallored	Some stages discarded	Some phases are shortened	Tailored version of SDM for smaller projects	61% mentioned that SDM was tailored by combining some stages (Project < R1million)	SDM was tailored to suit different group projects	64% Agreed and said that SDM was tailored by scaling down on the planning and analysis phases. Tailoring depended on the size and scope of project
AP2	**Characteristics of the Last Project** **1. User requirements changed all the time** **2. User expectations were realistic** **3. The developed system was very complex**	1. DNM* 2. DNM 3. DNM	1. 58.3% Agreed 2. 33.3% Agreed & 41.7% Disagreed (Slight Mixed Reaction) 3. 33.3% Agreed	1. DNM 2. DNM 3. DNM	1. 50% Agreed & 8.3% disagreed 2. 38.5% Agreed & 31% Disagreed (Mixed Reaction) 3. 46.2% Agreed & 23% Disagreed	1. DNM 2. DNM 3. DNM	1. 73.3% Agreed 2. 53.9% Agreed 3. 33.3% Agreed

[Φ] DNK : Did not Know
* DNM : Did not Mention

Table 5.1: Summary of measured aspects (cont)

	Agile Principles followed						
AV2	1. **Documentation is very important**	1. Interviewee agreed	1. 91.6% Agreed	1. DNM	1. 69.3% Agreed & 7.7% Disagreed	1. Documentation was found to be very important	1. 93.4% Agreed
	2. **Building a system takes too long**	2. DNM	2. 58.4% Agreed & 16.7% Disagreed	2. DNM	2. 53.9% Agreed	2. Group project took 6months to 2 years	2. 66.6% Agreed
AP2	3. **Changing user requirements at advanced level is virtually impossible**	3. DNM	3. 33.3% Agreed & 33.3% Disagreed (Mixed Reaction)	3. DNM	3. 30.8% Agreed & 7.7% Disagreed	3. DNM	3. 6.7% Agreed & 53.3% Disagreed
	4. **Adapting to user requirements is very difficult**	4. Interviewee only mentioned that adaptation is necessary	4. 33.3% Disagreed & 25% Agreed	4. Re-engineering is done so that those requirements are included	4. 46.2% Agreed & 53.8% Neutral	4. DNM	4. 20% Agreed & 20% Disagreed (Mixed Reaction)
	5. **Late changes are welcome**	5. DNM	5. 50% Disagreed & 16.7% Agreed	5. DNM	5. 38.5% Agreed & 46.2% Disagreed	5. DNM	5. 13.3% Agreed & 40% Disagreed
	6. **Continuously re-design during development**	6. DNM	6. 58.3% Agreed &16.7% Disagreed	6. Interviewee Agreed	6. 15.4% Agreed & 38.5% Disagreed	6. DNM	6. 33.3% Agreed & 20% Disagreed
AP1/3	7. **Working software delivered frequently**	7. DNM	7. 41.7% Disagreed & 16.7% Agreed	7. DNM	7. 23.1% Agreed & 53.9% Agreed	7. Not at all	7. 40% Agreed & 46.7% Disagreed
AP4	8. **Close and daily cooperation between developers and users**	8. Interviewee mentioned that there was a close relationship with the user department	8. 16.7% Agreed & 33.3% Disagreed	8. By inference, the interviewee agreed	8. 30.8% Agreed & 38.5% Disagreed (Slight Mixed Reaction)	8. Interviewee agreed	8. 20% Agreed & 33.3% Disagreed
	9. **Good communication between members in development team**	9. By inference, there is good communication because they enjoy a very high success rate	9. 50% Agreed & 50% Neutral	9. By inference, the interviewee agreed	9. 53.9% Agreed & 15.4% Disagreed	9. Interviewee agreed	9. 66.7% Agreed
AP5	10. **Development team is motivated**	10. Interviewee agreed	10. 75% Agreed	10. DNM	10. 53.9% Agreed & 23.1% Disagreed	10. DNM	10. 73.4% Agreed

Table 5.1: Summary of measured aspects (cont)

AP11	**Agile Principles followed (cont)** 11. **Problems are dealt with quickly**	11. Based on the responses, the interviewee disagreed with this statement	11. 58.4% Agreed & 16.7% Disagreed	11. Interviewee agreed	11. 23.1% Agreed & 23.1% Disagreed (Mixed Reaction)	11. DNM	11. 40% Agreed & 26.7% Disagreed
	Level of Job Satisfaction 1. **Enjoy working with colleagues** 2. **Enjoy way we develop systems** 3. **I feel proud when we successfully develop a system**	1. DNM 2. Interviewee mentioned that he didn't have a problem with it 3. Interviewee mentioned that he is proud when a project is successful	1. 75% Agreed 2. 58.3% Agreed & 16.7% Disagreed 3. 100% Agreed	1. DNM 2. DNM 3. DNM	1. 76.9% Agreed 2. 46.2% Agreed & 15.4% Disagreed 3. 61.6% Agreed	1. DNM 2. DNM 3. DNM	1. 86.7% Agreed 2. 60% Agreed 3. 86.7% Agreed
	Satisfaction with the current SDM 1. **Changing current SDM will be a good idea** 2. **I see nothing wrong with current SDM** 3. **Development team is well conversed with current SDM**	1. Interviewee was sceptical 2. Interviewee didn't have a problem with current SDM 3. By inference, interviewee agreed	1. 58.4% Agreed 2. 58.4% Disagreed & 8.3% Agreed 3. 33.3% Disagreed & 66.7% Neutral	1. DNM 2. DNM 3. By inference, interviewee agreed	1. 41.7% Agreed & 25% Disagreed 2. 8.3% Agreed & 50% Agreed 3. 30.8% Agreed & 23.1% Disagreed	1. Forced to use SDM by management 2. DNM 3. Interviewee agreed	1. 53.3% Agreed 2. 13.3% Agreed & 53.3% Disagreed 3. 13.3% Agreed & 26.7% Disagreed

Table 5.1: Summary of measured aspects (cont)

AP2 AP1 AP3 AP1	**Effectiveness of current SDM** **1. Current SDM adapts to change well** **2. Process follows linear model** **3. Current SDM helps to capture requirements** **4. Current SDM helps to involve end-users** **5. Current SDM helps to build management commitment** **6. Current SDM helps to decompose system into workable parts**	1. Interviewee mentioned that SDM was sufficient 2. Interviewee agreed 3. DNM 4. DNM 5. Interviewee agreed 6. DNM	1. 50% Agreed & 16.7% Disagreed 2. 50% Agreed & 8.3% Disagreed 3. 58.3% Agreed & 16.7% Disagreed 4. 58.3% Agreed & 8.3% Disagreed 5. 50% Agreed 6. 58.3% Agreed & 16.7% Disagreed	1. DNM 2. Interviewee agreed 3. DNM 4. DNM 5. DNM 6. DNM	1. 30.8% Agreed & 7.7% Disagreed 2. 61.5% Agreed 3. 46.2% Agreed & 7.7% Disagreed 4. 23.1% Agreed & 23.1% Disagreed (Mixed Reaction) 5. 38.5% Agreed & 23.1% Disagreed 6. 53.8% Agreed & 15.4% Disagreed	1. DNM 2. Interviewee agreed 3. Interviewee agreed 4. Interviewee agreed 5. DNM 6. By inference, interviewee agreed	1. 33.3% Agreed & 13.3% Disagreed 2. 46.7% Agreed & 26.7 Disagreed 3. 46.7% Agreed & 53.3% Neutral 4. 33.3% Agreed & 20% Disagreed 5. 33.3% Agreed & 13.3% Disagreed 6. 66.7% Agreed
	Sentiments regarding the use of ASDMs **1. I know what ASDMs are** **2. I have used ASDMs before** **3. Using an ASDM will benefit the organisation** **4. Needs lots of experience to use ASDMs** **5. ASDMs are widely used in the Telecomm industry** **6. Telecomm industry needs SDM able to accommodate change**	1. Interviewee knew ASDMs 2. DNM 3. Interviewee disagreed 4. Interviewee felt that development team needed to be trained 5. DNM 6. Interviewee agreed	1. 58.3% Agreed & 25% Disagreed 2. 50% Agreed & 50% Disagreed (Mixed Reaction) 3. 66.7% Agreed 4. 41.7% Agreed & 25% Disagreed 5. 25% Agreed & 25% Disagreed (Mixed Reaction) 6. 58.3% Agreed	1. Interviewee knew ASDMs 2. DNM 3. Mentioned that current SDM was good enough 4. Interviewee mentioned that development team must be trained on ASDMs first 5. DNM 6. DNM	1. 76.9% Agreed & 7.7% Disagreed 2. 38.5% Agreed & 46.2% Disagreed (Slight mixed reaction) 3. 38.5% Agreed & 23.1% Disagreed 4. 25% Agreed & 25% Disagreed (Mixed Reaction) 5. 66.7% Disagreed 6. 77% Agreed	1. Interviewee agreed 2. DNM 3. Interviewee agreed 4. DNM 5. DNM 6. DNM	1. 60% Agreed 2. 33.3% Agreed & 46.7% Disagreed 3. 73.3% Agreed 4. 40% Agreed & 26.7% Disagreed 5. 20% Agreed & 26.7% Disagreed (Mixed Reaction) 6. 80% Agreed

Table 5.1: Summary of measured aspects (cont)

	SD Process quality						
	1. **Project was completed on schedule**	1. DNM	1. 58.3% Agreed & 16.7% Disagreed	1. DNM	1. 38.5% Agreed & 38.5% Disagreed (Mixed Reaction)	1. DNM	1. 53.3% Agreed & 40% Disagreed
	2. **Project was completed within budget**	2. DNM	2. 50% Agreed & 16.7% Disagreed	2. DNM	2. 46.2% Agreed & 38.5% Disagreed (Slight Mixed Reaction)	2. DNM	2. 53.3% Agreed & 33.3% Disagreed
	3. **Developed system satisfied stated requirements**	3. Interviewee Agreed	3. 58.3% Agreed	3. DNM	3. 61.5% Agreed	3. Interviewee agreed	3. 86.7% Agreed
	4. **Speed of developing the project was high**	4. DNM	4. 41.7% Agreed & 16.7% Disagreed	4. DNM	4. 30.8% Agreed & 30.8% Disagreed (Mixed Reaction)	4. Not at all (It took 6month to 2 years)	4. 26.7% Agreed & 20% Disagreed (Mixed Reaction)
	5. **Productivity of developers was high**	5. Interviewee Agreed	5. 58.3% Agreed	5. DNM	5. 53.8% Agreed	5. DNM	5. 66.7% Agreed
	6. **Cost of SD project low compared to size & complexity of system**	6. DNM	6. 33.3% Agreed & 8.3% Disagreed	6. DNM	6. 53.8% Agreed	6. DNM	6. 33.3% Agreed & 6.7% Disagreed
	7. **Project achieved goals**	7. Interviewee Agreed	7. 75% Agreed	7. Interviewee mentioned that systems rarely fail	7. 46.2% Agreed & 15.4% Disagreed	7. DNM	7. 93.3% Agreed
	8. **Project represents excellent work**	8. Interviewee Agreed	8. 83.3% Agreed	8. DNM	8. 53.8% Agreed & 15.4% Disagreed	8. DNM	8. 93.3% Agreed
	9. **Overall, project was a success**	9. Interviewee Agreed	9. 83.3% Agreed	9. DNM	9. 53.8% Agreed	9. DNM	9. 86.7% Agreed
	Quality of last developed system						
	1. **Functionality of system is high**	1. DNM	1. 75% Agreed	1. DNM	1. 53.8% Agreed	1. DNM	1. 86.7% Agreed
	2. **Reliability of system is high**	2. Interviewee agreed	2. 75% Agreed 3. 83.3% Agreed 4. 83.3% Agreed	2. By inference, the interviewee agreed with the statement	2. 53.8% Agreed	2. DNM	2. 86.7% Agreed

Table 5.1: Summary of measured aspects (cont)

	3. **Maintainability of system is high** 4. **Efficiency of system is high** 5. **System meets users needs** 6. **Overall, the quality of the system is high** 7. **Overall, the users are satisfied** 8. **Overall, the developed system is a success**	3. DNM 4. DNM 5. Interviewee Agreed 6. DNM 7. DNM 8. Interviewee Agreed	5. 100% Agreed 6. 75% Agreed 7. 91.6% Agreed 8. 100% Agreed	3. DNM 4. DNM 5. DNM 6. DNM 7. Interviewee agreed 8. Interviewee agreed	3. 53.8% Agreed 4. 53.8% Agreed 5. 53.8% Agreed 6. 53.8% Agreed 7. 53.8% Agreed 8. 53.8% Agreed	3. DNM 4. DNM 5. DNM 6. DNM 7. DNM 8. Interviewee agreed	3. 86.7% Agreed 4. 93.3% Agreed 5. 93.3% Agreed 6. 86.7% Agreed 7. 80% Agreed 8. 93.3% Agreed

5.4 RECOMMENDATIONS

In this section the recommendations from the researcher are highlighted. These recommendations are informed from the findings of this research discussed in section 5.3.

- *ASDM exposure and training*

Many people in the telecommunication industry have not experienced ASDMs and this is directly attributed to management's resistance to introduce them. The resistance stems from the success that the current SDM affords the organisations. Therefore management needs to expose the development team to new ways of addressing problems. The choice of a systems development methodology should be informed by the requirements of the industry and not the successes that the current SDM gives the organisation.

- *More people-oriented and less process-oriented*

The results indicated that decisions taken on the SDM to be used was based on the scope of the project. This is a clear indication that the telecommunication industry values their clients more than their work force.

Therefore, one of the main recommendations of this research is that large companies in the telecommunication industry should value their work force in the same way they value their clients. This approach could greatly increase the development team's level of satisfaction, which in turn could result in a highly motivated and self-driven development team.

- *Iterative process model rather than a linear process model*

It was identified from the interviews that the SDLC followed a waterfall model. This explains the fact that late changes are difficult to capture. Therefore an iterative process model should be employed so that the user requirements can be captured at any stage in the project lifecycle.

5.5 LIMITATIONS AND FUTURE WORK

The number of cases studied where not enough but this effect was minimised by studying three of the largest telecommunication operators in South Africa. The decision to study these large companies was motivated by the quest to identify industry "best" practice, which was assumed to be taking place at these companies. Also, in order to minimise the negative effect of studying a small number of cases, the researcher used semi-structured interviews and questionnaires as the data-collection methods. This helped to triangulate the data (see Oates, 2006) and therefore made the findings more conclusive. In terms of future work, the researcher is of the view that an action research method on the use of ASDMs in the telecommunication industry should be conducted.

If properly executed this action research could have the benefit of showing senior management in the organisations the extent to which ASDMs could impact on the morale of the development team and therefore the company's competitiveness in an industry as volatile as the telecommunication industry.

5.6 SUMMARY

This chapter presented the findings from the case study research conducted at three prominent companies in the telecommunication industry in South Africa. In conclusion, the results indicate that there are some agile principles and values that are being followed by the organisations even though a formalised agile SDM is not being used. This finding suggests that ASDMs are indeed suitable and applicable in the telecommunication industry of South Africa.

BIBLIOGRAPHY

ABERCROMBIE, N., HILL, S. AND TURNER, B.S. 1984. Dictionary of Sociology. Harmondsworth: Penguin.

AIGA. An Ethnography Primer. http://www.aiga.org. Date of access: 15th April 2009.

ALAVI, M. AND CARLSON, P. 1992. A review of MIS research and disciplinary development. *Journal of Management Information Systems*. 8(4): 45-62.

ALEXANDROU, M. 2009. Lean Development (LD) Methodology. Mariosalexandrou.com. http://www.mariosalexandrou.com/methodologies/lean-development.asp. Date of access: 13th July 2009.

AMBLER, S.W. 2005. The Agile Unified Process (AUP). Ambysoft. http://www.ambysoft.com/unifiedprocess/agileUP.html. Date of access: 13th July 2009

AMYOT, D. AND EBERLEIN, A. 2003. An Evaluation of Scenario Notations and Construction Approaches for Telecommunication Systems Development. *Telecommunication Systems*. 24(1): 61-94.

ASPRONI, G., FEDOTOV, A. AND FERNANDEZ, R. 2004. An Experience Report on Implementing a Custom Agile Methodology on a C++/Python Project. *Overload*. Issue 64. Association of C & C++ Users.

AVISON, D. AND FITZGERALD, G. 2002. Reflections on Information Systems Development.

AVISON, D. AND FITZGERALD, G. 2003. Where to now for development methodologies? *Communication of the ACM*. 46(1): 79-82.

AVISON, D. AND FITZGERALD, G. 2006. Information Systems Development: Methodologies, Techniques and Tools. 4th Edition. United Kingdom: McGraw-Hill Education.

BABBIE, E. 2004. The Practice of Social Research (10th ed). Wadsworth: Chapman University.

BECK, K. 1999. Extreme Programming Explained: Embrace Change. 1st Edition.

BECK, K., *et al.* 2001. Manifesto for Agile Software Development. http://www.agilemanifesto.org. Date of access: 9th February 2009.

BELBASE, S. 2007. Research Paradigms Politics of Research. http://www.tesionline/intl/indepth.jsp?id=1124. Date of access: 24th February 2009.

BELL, H. 1993. Research Methodology in Education. Washington: McGraw-Hill Education.

BELUANDE, M., STEINHAU, R., ALMEIDA, J.P. AND GAVRAS, A. 2003. MODA-TEL Model-Driven Methodology, MODA-TEL (Deliverable D3.add1), *Information Society Technologies.*

BJØRN-ANDERSEN, N. 1984. Challenge to Certainty. In: Bemelmans, T.M.A. (Ed.) *Beyond Productivity: Information Systems Development for Organizational Effectiveness.* Amsterdam: North Holland.

BOEHM, B., *et al.* 2000. Software cost estimation with COCOMO II. Englewood Cliffs. NJ: Prentice-Hall

BOEHM, B. AND TURNER, R. 2005. Management challenges to implement agile processes in traditional development organizations. *IEEE Software.* 22(5): 30-40.

BORG, W. 1981. Applying education research: A practical guide for teachers. New York: Longman.

BRYMAN, A. 2004. Qualitative research on leadership: A critical but appreciative review. *The Leadership Quarterly.* 15: 721-891.

BURKE, M.E. 2007. Making choices: Research paradigms and information management. *Practical applications of philosophy in IM research. Emerald.* 56(6): 476-484.

BURNS, R. 2000. Introduction to research methods. London: SAGE Publication.

CAMPBELL, D.T. AND STANLEY, J.C. 1966. Experimental & Quasi-experimental Designs for research. Chicago.

CANTOR, M. 2003. Leading Modern Systems Development. *The Rational Edge: e-Zine for the rational community*. Rational Software Corporation. http://www.therationaledge.com/content/jan_03/fmodernSystemsDevelopment_mc.jsp. Date of access: 6th March 2008.

CESCHI, M., SILLITTI, A., SUCCI, G. AND PANFILIS, S. D. 2005. Project Management in Plan-Based and Agile companies. *IEEE Software*. 22(3): 21-27.

COCKBURN, A. AND HIGHSMITH, J. 2001. Agile software development: the people factor, *IEEE Computer*. 34(11): 131-133.

CMS: CENTERS FOR MEDICARE & MEDICAID SERVICES. 2005. *Selecting a development Approach*. http://www.cms.hhs.gov/SystemLifecycleFramework/Downloads/SelectingDevelopmentApproach.pdf. Date of Access: 17th March 2008

COHN, M. AND FORD, D. 2003. Introducing an agile process to an organization. *IEEE Computer*. 36 (6): 74-78.

COOLICAN, H. 1994. Research methods and statistics in psychology. 2nd ed. London: Hodder & Stoughton.

COOPER, J., LEWIS, R. AND URQUHART, C. 2004. Using participant or non-participant observation to explain information behaviour. *Information Research Journal*. 9(4).

CORAM, M. AND BOHNER, S. 2005. The impact of agile methods on software project management. *Engineering of Computer-Based systems, 2005. ECBS '05. 12th IEEE International Conference and Workshops on the*. 4-7 April 2005: 363-370.

CRESWELL, J.W. 2008. Qualitative inquiry and research design: Choosing among five approaches (3rd Ed). Thousand Oaks, CA: SAGE Publications.

DIAMOND, J. 1996. The roots of Radicalism. *The New York Review of books.* 14 November. 4-6.

DOGAN, M. AND PELASSY, D. 1990. How to Compare Nations: Strategies in Comparative Politics (2nd ed). London: Chatham House.

DUMDUM, U. AND KLEIN, H. 1986. The need for organisational requirements analysis. In: Nissen, H. & Sandstrom, G. (Eds) *Quality of work versus Quality of Information Systems.* Sweden: Lund University: 393-420.

DSDM CONSORTIUM. 2003. DSDM and Data Warehousing: Synopsis. Date of access: 15th August 2009

EISENHARDT, K.M. 1989. Building Theories from Case Study Research. *Academy of Management Review.* 12: 532-550.

EYSENCK, M. 2004. Research Methods: Data Analysis. Psychology Press Ltd.

FERRANCE, E. 2000. Action Research: Themes in Education. Northeast and Islands Regional Educational Laboratory. Brown University.

FITZGERALD, B. 1996. Formalised Systems Development Methodologies: A Critical Perspective. *Information Systems Journal.* 6(1): 3-23.

FLYVBJERG, B. 2004. Five Misunderstandings about Case-Study Research. In: Seale, c., Gobo, G., Gubrium, J.F. & Silverman, D. (Eds). *Qualitative Research Practice.* London and Thousand Oaks, CA: SAGE PUBLICATIONS, 2004: 420-434.

FOWLER, M. 2005. The New Methodology. Martinfowler.com. http://www.martinfowler/articles/newmethodology.html. Date of access: 10 July 2008

FREED, S. 2001. http://www.andrews.edu/~freed/diss/shirley6.html. Date of access: 5th March 2009.

FRUHLING, A. AND DE VREEDE, G. 2006. Field Experiences with Extreme Programming. *Journal of Management Information Systems*. 22(4): 39-68.

GEPHART, R. 1999. Paradigms and Research Methods. *Research Methods Forum Division*. 4. Academy of Management. http://division.aomonline.org/rm/1999_RMD_Forum_Paradigms_and_Research_Methods.html. Date of access: 4th August 2008.

GREY, J. 2006. An investigation of the suitability of agile system development methodologies for the development of data warehouses. MSc Dissertation. Potchefstroom, North West University.

GROVER, V AND SAEED, K. 2003. The Telecommunication Industry Revisited: The changing pattern of partnerships. *Communications of the ACM*. 46(7): 119-125.

GUBA, E.G. AND LINCOLN, Y.S. 1994. Competing Paradigms in Qualitative Research. In: Denzin, N.K. and Lincoln, Y.S. (Eds.). *Handbook of Qualitative Research*. Thousand Oaks, CA: Sage Publications: 105-117.

GUEST, K. 2008. Telkom Profits Under Pressure. *ITWEB*. http://www.itweb.co.za/sections/business/2008/08013011.asp?S=financial&A=fin&O=frgn Date of access: 20 February 2008.

GUMMESSON, E. 1991. Qualitative Methods in Management Research. CA: Sage Publications.

HARTLEY, J. 1994. Case Studies in Organisational Research. In: Casell, C.M. and Symon, G. (Eds.). *Qualitative Methods in Organisational Research*. London: Sage Publications: 208-229.

HAYES, S. 2003. Why use Agile Methods? *ZDNet Australia Article*. http:///www.builderau.com.au/program/development/0,39024626,20275975,00.htm. Date of Access: 4th January 2009.

HERRON, D. AND GARMUS, D. 2000. Functional Point Analysis: Measurement Practices for Successful Software Projects. Addison-Wesley Professional.

HIGHSMITH, J.A. 2000. Adaptive Software Development: A Collaborative Approach to Managing Complex systems. New York: Dorset House.

HUISMAN, H.M. 2000. The Deployment of Systems Development Methodologies: A South African Experience. PhD Thesis. Potchefstroom: North West University.

HUISMAN, H.M. AND IIVARI, J. 2006. Deployment of systems development methods: Perceptual congruence between IS managers and system developers. *Information & Management.* 43: 29-49.

HOPKINS, W.G. 2002. Dimensions of Research. *Sportscience.* http://www.sportsci.org/jour/0201/wghdim.htm. Date of access: 4th August 2008.

IHME, T. 2004. *Mobile-D/Stabilize phase.* http://virtual.vtt.fi/virtual/agile/mobile-d_docs/stabilize/mobiledpattern_stabilize.pdf. Date of access: 1st March 2009.

IHME, T. 2005. *Mobile-D/Initialize phase.* http://virtual.vtt.fi/virtual/agile/mobile-d_docs/initialize/mobiledpattern_initialize.pdf. [Date of access: 1st March 2009].

IIVARI, J., HIRSCHEIM, R. AND KLEIN, H.K. 1998. A paradigmatic analysis contrasting information system development approaches and methodologies. *Information System Research.* 9(2): 164-193.

JÄÄLINOJA, J., HANHINEVA, A. AND KOSKELA, J. 2004. *Mobile-D/System Test & Fix.* http://virtual.vtt.fi/virtual/agile/mobile-d_docs/systemtest&fix/mobiledpattern_systemtest&fix.pdf. Date of access: 1st March 2009.

JACKSON, A., TSANG, S.L., GRAY, A., DRIVER, C. AND CLARKE, S. 2004. Behind the Rules: XP Experiences. *Agile Development Conference 2004: Agile Challenges (XR2).* Experience Report. http://agile2004.agilealliance.org/files/XR2-1.pdf. Date of access: 20th February 2009.

JAYARATNA, N. 1994. Understanding and Evaluating Methodologies, NIMSAD: A Systemic Framework. Maidenhead: McGraw-Hill.

JEFFRIES, R. 2001. Extreme programming installed. Harlow: Pearson Education

KETTUNEN, P. 2007. From Hype towards Real-World Agility-in-the-Large: Nokia Siemens Networks Perspectives. *Flexi Newsletter.* January 2007 issue: 6-7.

KETTUNEN, P. AND LAANTI, M. 2007. Combining Agile Software Projects and Large-scale Organizational Agility. *Software Process Improvement and Practise.* 13: 183-193.

KOSKELA, J. AND KYLLÖNEN, M. 2004. *Mobile-D/Release Project Process/Productionize.* http://virtual.vtt.fi/virtual/agile/mobile-_docs/productionize/mobiledpattern_productionize.pdf Date of access: 1st March 2009.

KOUTSOUKOS, G., GOUVEIA, J., ANDRADE, L. AND FIADEIRO, J.L. 2001. *Managing Evolution in Telecommunication Systems.* http://www.fiaderio.org/jose/papers/daais.pdf. Date of access: 16th March 2008.

KRAUSS, S.E. 2005. Research Paradigms and Meaning Making: A Primer. *The Qualitative Report.* 10(4): 758-770.

LI, F. AND WHALLEY, J. 2002. Deconstruction of the Telecommunication Industry: From Value Chains to Value Networks. *Management Science: Theory, Method & Practice.* Strathclyde Business School. http://cosmic.rrz.uni-hamburg.de/webcat/hwwa/edok02/f10354g/WP0202.pdf. Date of access: 25th February 2009.

LINDVALL, M., BASILI, V., BOEHM, B., COSTA, P., DANGLE, SHULL, F., TESORIERO, R., WILLIAMS, L. AND ZELKOWITZ, M. 2005. *Empirical Findings in Agile Methods.* http://www.cs.umd.edu/~mvz/pub/agile.pdf. Date of Access: 1st March 2009.

LIVERMORE, J.A. 2007. Factors that significantly Impact the Implementation of an Agile Software Development Methodology. *Journal of Software.* 3(4): 31-36.

MAHANTI, A. 2006. Challenges in Enterprise Adoption of Agile Methods – A Survey. *Journal of Computing and Information Technology.* 14(3): 197-206.

MANSUROV, N. 2000. Formal methods for accelerated development of telecommunications software.
http://www.ispras.ru/groups/case/downloads/methodology.pdf. Date of access: 31st March 2008.

MAREE, K. 2008. First steps in research. Pretoria: Van Schaik Publishers

MILLER, J. AND TEWKSBURY, R. 2006. Research Methods: A Qualitative Reader. Upper Saddle River, NJ: Pearson, Prentice Hall.

MYERS, M.D. 1997. Qualitative Research in Information Systems. *MIS Quarterly*. 21(2): 241-242. http://www.misq.org/discovery/MISQD_isworld/. Date of access: 4th August 2008.

NERUR, S., MAHAPATRA, R. AND MANGALARAJ, G. 2005. Challenges of Migrating to Agile Methodologies. *Communications of the ACM*. 48 (5): 73-78.

NEW OXFORD AMERICA DICTIONARY. (2nd edition) 2005. "Telecommunication", "tele" and "communication". 2005.

NORTON, D. 2007. Lean Software Development Overview. Darrel Norton's Blog [MVP]. *CodeBetter.com*. http://codebetter.com/blogs/darrell.norton/articles/50341.aspx. Date of access: 15th July 2009.

OATES, B.J. 2006. Researching Information Systems and Computing. Thousand Oaks, CA: Sage Publications.

OLERUP, A. 1991. Design Approaches: A comprehensive study of Information Systems and architectural design. *The Computer Journal*. 34 (3).

ORLIKOWSKI, W.J. AND BAROUDI, J.J. 1991. Studying Information Technology in Organisations: Research Approaches and Assumptions. *Information Systems Research*. 2: 1-28.

OTTO, C.H. 2007. The Use of Systems Development Methodologies in the Mobile telecommunication software development in South Africa. MSc Dissertation. Potchefstroom: North-West University.

PATEL, A. 2002. Current status and future directions of software architecture for telecommunication. *Computer Communications*. 25(2): 121-132.

POPPENDIECK, M. AND POPPENDIECK, T. 2002. Lean Software Development: An Agile Toolkit. *Poppendieck.LLC*: 20-24.

RAMAJAN, A.G. 1994. The effects of management styles on teachers in India Education. Pretoria: University of Pretoria.

RANKIN, K. AND BERTRAND, J. 2005. *Guidelines for Ethical conduct in Participant Observation.* Social Sciences & Humanities Research Ethics Board (SSH REB). University of Toronto.

RAPOPORT, R.N. 1970. Three Dilemmas in Action Research. *Human Relations*. 23(6): 499-513.

RIEHLE, D. 2000. A Comparison of the Value Systems of Adaptive Software Development and Extreme Programming: How Methodologies May Learn from Each Other. In: Succi, G. and Marchesi, M. (Eds). *eXtreme Programming Examined.* Addison-Wesley: 35-50.

SALO, O. AND HULKKO, H. 2004. *Mobile-D/Release Project Process/Explore.* http://virtual.vtt.fi/virtual/agile/mobile-d_docs/explore/mobiledpattern_explore.pdf. Date of access: 1st March 2009.

SCHATZ, B. AND ABDELSHAFI, I. 2005. Primavera gets agile: a successful transition to agile development. *IEEE Software*. 22(3): 36-42.

SCHWANDT, T.A. 1994. Constructivist, Interpretivist approaches to human. In: Denzin, N.K and Y.S. Lincoln. (Eds.). Handbook of Qualitative Research. Newbury Park, California: 118-137.

SEAMAN, C.B. 1999. Qualitative Methods in Empirical Studies of Software Engineering. *IEEE Transactions on Software Engineering*. 25(4): 557-572.

SMIT, B. 2003. Atlas.ti for quality in qualitative research: A CAQDAS project. *Education as Change.* 6(1): 130-145.

SOY, S.K. 1996. *The Case Study as a Research Method.* http://www.ischool.utexas.edu/~ssoy/usesusers/l391d1b.htm. Date of access: 22nd July 2009

STRUWIG, W. F. AND STEAD, G. B. 2001. Planning Designing and Reporting Research. London: Masker Miller Longman.

TAYLOR, P.C. 2006. Major Research Paradigms for Science and Mathematics Educators. Curtin University of Technology. Australia

TELKOM SA .LIMITED ANNUAL REPORT 2007. https://secure1.telkom.co.za/ir/financial/pdf/telkom_ar_2007.pdf Date of access: 18 February 2008

THE STANDISH GROUP. 2004. *The CHAOS Report 2004.* http://www.cs.nmt.edu/~cs328/reading/Standish.pdf. Date of Access: 17th March 2008.

THEUNISSEN, W.H.M AND KOURIE, D.G. 2003. *A Case Study of software development processes in the Telecommunication industry.* Research Paper submitted for the SATNAC proceeds in 2003. http://www.cs.up.ac.za/cs/mtheunis/work/SATNAC2003_Theunissen.pdf. Date of access: 11th March 2008

TROCHIM, W.M.K. 1999. *Survey Research.* http://www.trochim.human.cornell.edu/kb/survey.htm. Date of access: 1st March 2009.

TROCHIM, W.M.K. 2006. *Qualitative Methods.* http://www.socialresearchmethods.net/kb/qualmeth.php. Date of access: 10th March 2009.

UWE (UNIVERSITY OF WEST ENGLAND). 2006. *Qualitative Analysis – What It Is.* http://hsc.uwe.ac.uk/dataanalysis/quantWhat.asp. Date of access: 10th September 2009.

VOCE, A. 2004. *Introduction to Research Paradigms. Handout for the Qualitative Research Module.* http://familymedicine.ukzn.ac.za/Uploads/131e81cf-f876-4e8d-9016-69ec7d6598b8/Introduction%20to%20research%20paradigms.doc. Date of access: 3rd March 2009.

VTT. 2006. *Agile software technologies research programme.* http://virtual.vtt.fi/virtual/agile/mobiled.html. Date of access: 23rd February 2009.

WALSHAM, G. 1995. Interpretive case studies in IS research: nature and method. *European Journal of information systems,* 4: 74-81.

WOOLFOLK, A. 1998. *Education Psychology.* New York: Macmillan

WYNEKOOP, J.L. & RUSSO, N.L. 1993. Systems development methodologies: unanswered questions and the research-practice gap. In: DeGross, J.I. (Eds.). *Proceedings of the Fourteenth International Conference of Information Systems.* Orlando, Florida: 181-190

YEH, R. 1991. Systems development as a wicked problem. *International Journal of Software Engineering and Knowledge Engineering.* 1(2).

YIN, R.K. 1984. Case Study Research: Design & Methods (1ST ed). Beverly Hills, CA: Sage Publications: 11-15.

YIN, R.K. 1993. Application of Case Study Research. CA: Sage Publishing: 33-35.

YIN, R.K. 1994. Case Study Research: Design & Methods (2nd ed). Thousand Oaks, CA: Sage Publications.

YIN, R.K. 2002. Case Study Research, Design and Methods (3rd ed). Newbury Park: Sage Publications.

ZAMPARELLI, M. 2001. *ALMA Software Document Review Procedure. Atacama Large Millimeter Array (ALMA).* http://www.alma.nrao.edu/development/computing/docs/joint/draft/ADRP.pdf. Date of access: 1st March 2009.

APPENDIX A (QUESTIONNAIRE)

NORTH-WEST UNIVERSITY
YUNIBESITI YA BOKONE-BOPHIRIMA
NOORDWES-UNIVERSITEIT
POTCHEFSTROOM CAMPUS

Dear Sir/ Madam

RE: Invitation to complete a questionnaire relating to Systems development methodologies

My name is Bruce Mazengera and I am currently a Masters student at North West University (Potchefstroom campus). I am currently conducting research within the Telecommunication industry, and I have identified your organisation as a source of information for research purposes. The focus of my research is investigation of the applicability of Agile systems development methodologies in the Telecommunication industry. Therefore, I would like to extend an invitation to fill out the questionnaire that is attached. Kindly distribute it to all personnel directly related to systems/software development.

Thank you once again for the assistance in this regard and I look forward to hearing from you.

Kind regards

Bruce Mazengera
Email: 16859383@nwu.ac.za

Prof. M. Huisman
Supervisor
Email: Magda.Huisman@nwu.ac.za

QUESTIONNAIRE

SECTION 1: BACKGROUND INFORMATION

1) Which job title best describes your position?

I.T/Systems developer	
Business analyst	
Programmer	
I.T/ Business architect	
I.T Manager	
I.T Team leader	
Systems analyst	
Other, please specify	

2) Are you currently actively involved in information systems development?

Yes	
No	

3) How many years of systems development experience do you have?

Less than 1 year	
1-2 year(s)	
3-4 years	
5 years or more	
None	

4) Please indicate what percentage of your personal time/work is devoted to the following development activities:

Systems planning, analysis and design	%
Programming	%
Testing	%
Installation	%
User training	%
Project management	%
Other, please specify	%

5) Approximately how many information systems development (SD) projects have you completed in the past?

None	
1-10 projects	
10-20 projects	
More than 20 projects	

6)How long have you been working in the organisation?

0-1 Year	
1-4 Years	
5+ Years	

7)Which of the following technologies are you aware of, and please indicate your level of knowledge in a particular technology with an X:

	Basic Knowledge	Competent	Average	Skilled	Expert
Programming languages (e.g. Java, J2EE, C#, Microsoft.NET, etc.)					
Database administration (e.g. SQL)					
Enterprise applications (e.g. SAP, Siebel, etc.)					
Web application servers (e.g. WebLogic, WebSphere, etc)					
Testing tools (e.g. TestDirector, WinRunner, LoadRunner, etc)					
UML Design (e.g. Rational Rose, Together, etc)					
Methodologies (e.g. RUP, PRINCE II, etc)					

8) What is the name of the systems development methodology you use when developing an application/system? (if any)

9) Is the systems development methodology tailored to suit your organisation?

Yes	
No	

10)If the answer to question 10 is yes, briefly describe how the systems development methodology is tailored.

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.....
.....

SECTION 2: PROJECT SPECIFIC INFORMATION

1) To what extent do you agree or disagree with the following statements as valid descriptions of the last systems development project you were involved with? (mark only the relevant one with an X) :

Totally disagree Totally agree

1.1) The project was well-defined	1	2	3	4	5
1.2) Users were aware of their requirement	1	2	3	4	5
1.3) Users requirements changed all the time	1	2	3	4	5
1.4) User's expectations were realistic	1	2	3	4	5
1.5) Developer's understood user's requirements well	1	2	3	4	5
1.6) The developed system was very complex	1	2	3	4	5
1.7) Senior management was highly committed to the project	1	2	3	4	5
1.8) Developer's knowledge of the systems development process was good	1	2	3	4	5
1.9) The installation and adoption of the developed system in user departments were well planned	1	2	3	4	5
1.10) The system was delivered at or before the scheduled time	1	2	3	4	5
1.11) Status meeting were held weekly	1	2	3	4	5

2)To what extent do you agree or disagree with the following statements:

	Totally disagree				Totally agree
2.1) Documentation is very important in the systems development projects we undertake	1	2	3	4	5
2.2) Generally, building a system takes too much time	1	2	3	4	5
2.3) Changing user requirements at an advanced level in the project is virtually impossible	1	2	3	4	5
2.4) Adapting to changes in user requirements is very difficult	1	2	3	4	5
2.5) Working software is delivered frequently (weeks rather than months)	1	2	3	4	5
2.6) Late changes in user requirements are welcome	1	2	3	4	5
2.7) There is close and daily cooperation between the developers and the users	1	2	3	4	5
2.8) The development team is made up of between 3-7 people	1	2	3	4	5
2.9) We continuously re-design the system being developed, even during development	1	2	3	4	5
2.10) There is good communication between the member in the development team	1	2	3	4	5
2.11) There is good communication between the development team and the users of the system being developed	1	2	3	4	5
2.12) As a development team, we are very motivated to achieve the goals set out by management	1	2	3	4	5
2.13) Problems relating to the systems development project are quickly dealt with	1	2	3	4	5

3) To what extent do you agree or disagree with the following statements:

	Totally disagree				Totally agree
3.1) I enjoy working with my colleagues	1	2	3	4	5

3.2) I enjoy the way we develop systems	1	2	3	4	5
3.3) I feel proud when we successfully develop a(n) system/application that meets the users requirements	1	2	3	4	5
3.4) Changing the current systems development methodology we use will be a good idea	1	2	3	4	5
3.5) I see nothing wrong with the current methodology we used.	1	2	3	4	5
3.6) The development team is well conversed with the methodology being used	1	2	3	4	5
3.7) The current methodology being used adapts to change well	1	2	3	4	5
3.8) The methodology being used is linear (i.e. it follows a waterfall model)	1	2	3	4	5
3.9) I know what Agile systems development methodologies are	1	2	3	4	5
3.10) I have used an agile methodology before	1	2	3	4	5
3.11) Using an agile methodology will be beneficial to this organisation	1	2	3	4	5
3.12) One needs to have a lot of experience in agile methodologies before using it	1	2	3	4	5
3.13) Agile methodologies are widely used in the Telecomm industry	1	2	3	4	5
3.14) The Telecomm industry is a fast-paced industry, and companies operating within it requires a systems development methodology that is able to accommodate change quickly	1	2	3	4	5
3.15) Our systems development methodology helps to capture requirements for the system to be developed	1	2	3	4	5
3.16) Our systems development methodology helps to involve end-users in systems development projects	1	2	3	4	5
3.17) Our systems development methodology helps to build management commitment in our systems development projects	1	2	3	4	5
3.18) Our systems development methodology helps to decompose the system to be developed in workable parts	1	2	3	4	5

4) To what extent do you agree or disagree with the following statements about the last project you were involved with?

	Totally disagree				Totally agree
4.1) The project was completed on schedule	1	2	3	4	5
4.2) The project was completed within budget	1	2	3	4	5
4.3) The developed system satisfied all the stated requirements	1	2	3	4	5
4.4) The speed of developing the project was high	1	2	3	4	5
4.5) The productivity of developers involved with the project was high	1	2	3	4	5
4.6) The cost of the project was low when compared to the size and complexity of the system developed	1	2	3	4	5

4.7) The project achieved its goals	1	2	3	4	5
4.8) Overall, the project represents excellent work	1	2	3	4	5
4.9) Overall, the project was a success	1	2	3	4	5

5) To what extent do you agree with the following statements about the last project you were involved with?

	Totally disagree				Totally agree
5.1) The functionality of the developed system is high	1	2	3	4	5
5.2) The reliability of the developed system is high	1	2	3	4	5
5.3) The maintainability of the developed system is high	1	2	3	4	5
5.4) The efficiency of the developed system is high	1	2	3	4	5
5.5) The developed system meets user needs	1	2	3	4	5
5.6) Overall, the quality of the developed system is high	1	2	3	4	5
5.7) Overall, the users are satisfied with the developed system	1	2	3	4	5
5.8) Overall, the developed system is a success	1	2	3	4	5

THANK YOU FOR YOUR COOPERATION