

**An interpretive study of the contingent use of systems
development methodologies in the telecommunications
industry**

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Abstract

The telecommunication industry is dominating the world. Most recently there have been technological advancements made in mobile telecommunication. There are currently a few telecommunication organizations in South Africa. These organizations each have their own unique approach to service delivery. The strong competitive nature of the telecommunication industry is taking telecommunications in South Africa to greater heights. All these advancements necessitate the need for better security and controls of the telecommunications networks. RICA legislation was brought into effect to accomplish just this. The research focuses on the contingent use of systems development methodologies in the telecommunication industry in South Africa.

The study determines how these telecommunication organizations choose a systems development methodology when developing systems. This study looks at how these organizations are currently implementing system development methodologies to keep up with the changes and competition within the industry. An interpretive approach was used to conduct the research. Four of the leading telecommunication organizations in South Africa were studied by using case studies. Each case study focused on a single telecommunication organization to gain in depth data regarding the use of systems development methodologies. The case studies were conducted by using structured interviews to gain data from multiple sources within the organizations. The data was analyzed using ATLAS.ti and a cross case analysis was done to answer the research questions. The results indicate that there is a contingent use of systems development methodologies within telecommunication organizations. The telecommunication organizations each use criteria to determine which systems development methodology to use. The results of the study indicate that there are different levels of contingency, and it examines how this is accomplished by each organization individually. Each of the organizations has a unique approach when selecting systems development methodologies. The systems development methodologies that are used by the telecommunication organizations are also tailored in some cases.

Keywords: Telecommunication, system, development, methodology, contingency, waterfall model, silver bullet, best fit, interpretive, questionnaire.

Opsomming

Die telekommunikasie industrie is tans besig om die wêreld te domineer. Verskeie tegnologiese vooruitgange is onlangs gemaak in mobiele telekommunikasie. Daar is huidiglik 'n paar telekommunikasie organisasies in Suid-Afrika. Die organisasies het elk hulle eie unieke benadering tot dienslewering. Die sterk mededingende natuur van die telekommunikasie industrie is besig om Suid-Afrika tot nuwe hoogtes te neem. Die vooruitgange skep die noodsaak vir beter sekuriteit en kontrole van die telekommunikasie netwerke. RICA wetgewing is in werking gebring om dit te bereik. Die navorsing fokus op die voorwaardelike gebruik van stelsel ontwikkelingsmetodologieë in die telekommunikasie industrie van Suid-Afrika.

Die studie bepaal hoe die telekommunikasie organisasies 'n stelsel ontwikkelingsmetodologie kies wanneer hulle stelsels ontwikkel. Die studie kyk na hoe die organisasies stelsel ontwikkelingsmetodologieë huidiglik implementeer om by te hou met die veranderinge en mededinging binne die industrie. 'n Interpretatiewe benadering was gebruik om die navorsing uit te voer. Vier van die toonaangewende telekommunikasie organisasies in Suid-Afrika was bestudeer deur gebruik te maak van gevallestudies. Elke gevallestudie het op 'n enkele telekommunikasie organisasie gefokus om in diepte data rakende die gebruik van stelsel ontwikkelingsmetodologieë te verkry. Die gevallestudies is uitgevoer deur om gestruktureerde onderhoude te gebruik om data vanaf verskeie bronne binne die organisasies te verkry. Die data was geanaliseer deur gebruik te maak van ATLAS.ti en 'n kruisgeval analise is uitgevoer om die navorsings vrae te beantwoord. Die resultate toon dat daar wel 'n voorwaardelike gebruik is van stelsel ontwikkelings metodologieë binne telekommunikasie organisasies. Telekommunikasie organisasies gebruik elk kriteria om te bepaal watter stelsel ontwikkelingsmetodologie om te gebruik. Die resultate van die studie toon aan dat daar verskillende vlakke van voorwaardelikheid is en dit dui ook aan hoe dit onderskeidelik bereik word deur elke organisasie. Elkeen van die organisasies het 'n unieke benadering om stelsel ontwikkelingsmetodologieë te selekteer. In sommige gevalle word die stelsel ontwikkelingsmetodologieë aangepas.

Sleutelwoorde: Telekommunikasie, stelsel, ontwikkeling, metodologie, voorwaardelikheid, waterval model, silver bullet, best fit, interpretasie, vraelys.

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CHAPTER 1

PROBLEM STATEMENT

1. Research introduction

This chapter delivers an overview of the research to be conducted. This chapter provides a brief summary of the research questions and the research approach. It includes a discussion on the contingent use of systems development methodologies, which consists of a definition and how contingent use is achieved. The first section of this chapter contains the introduction which contains the problem statement, and the importance of the research is also indicated. In the second section the research aims and objectives will be addressed. The research paradigm and method will be discussed in section three, and in the fourth section the chapters and their contents are summarized.

1.1. Introduction

The telecommunication industry in South Africa is growing at a rapid rate. This growth leads to the need for systems that are efficient and of high quality. In 2010 there have been a number of problems that faced the telecommunication industry. The main problems are the Regulation of Interception and Communication Act (RICA). RICA recently imposed by the government, necessitates all South African citizens to register all existing and new cellphone numbers (MTN, 2010). The second problem that the telecommunication industry faced was the worldwide recession which took its toll on all the industries (Uys, 2010).

The third problem and certainly one of the biggest problems is that of rates. The strong competitive nature of the telecommunication industry encourages the telecommunication service providers towards cutting costs in order to compete with the other role players in the industry. These problems and the regulatory changes are forcing the telecommunication organizations to adapt.

Previous lines of differentiation that divided mobile, fixed-line and information technology ("IT") services are slowly vanishing (Uys, 2010). Currently the telecommunication industry in South Africa is moving towards faster and cheaper services.

The correct use of systems development methodologies allow these organizations to adapt to frequent changes and also to overcome the problems they may be facing. It is important to determine the contingent use of systems development methodologies within these organizations.

In doing so the research can determine how these organizations use systems development methodologies contingently and what effect this may have on systems development within these organizations. The research will also determine if contingent use of systems development methodologies is achieved within these telecommunication organizations.

The research will build on previous research conducted by Otto (2007) and Mazengera (2009), which focused on the use of systems development methodologies in telecommunication organizations in South Africa. Otto's (2007) research focused on the use of systems development methodologies in mobile telecommunication software development in South Africa. Otto's research found that systems development methodologies are in fact used in telecommunication systems development and that most telecommunication organizations used in-house developed methodologies.

Mazengera's research focused on the identification of agile systems development methodologies used in the telecommunication industry in South Africa. The research was conducted within the South African telecommunication industry. Mazengera (2009) found that a tailored version of RUP was used when developing systems.

This research will focus on the contingent use of systems development methodologies in the telecommunication industry in South Africa. It will also attempt to identify how such organizations choose these system development methodologies and how contingency is applied when using these systems development methodologies. There are two levels of contingency which this research will focus on, namely first level, which is applied when selecting a systems development methodology and the second level which is used when tailoring an existing systems development methodology.

The telecommunication organizations will be examined to determine which levels of contingency they implement. Contingency is best defined by Wiktionary as "a conditional response plan made in preparation for various future circumstances including the unanticipated" (Wiktionary, 2010).

Contingent use of systems methodologies can be seen as the use of systems development methodologies in such a manner that provision is made for future systems development projects that are of the same nature. Contingency also applies to the tailoring of existing systems development methodologies.

In the literature there are numerous authors who refer to the "contingent use" or "contingency approach" to systems development. It is imperative to note that contingency is not only used in selection of systems development methodologies, but also in the tailoring of systems development methodologies. Contingency is achieved by using criteria or guidelines to select a systems development methodology. The research will attempt to identify the contingency criteria currently used by telecommunication organizations in South Africa.

The decision of choosing the “best fit” systems development methodology can be a difficult task (Ketunnen and Laanti, 2005:589). The “best fit” is also referred to as the “contingency approach”. It is difficult in selecting systems development methodologies in such a manner that they will suffice for future systems development projects.

There are a number of authors who suggest guidelines for selecting systems development methodologies so that they may be used contingently. These guidelines will be discussed below, indicating how each of these guidelines operate and should be implemented.

Davis (1982:28) proposed a contingency approach to selecting a systems development methodology by looking at different levels of uncertainty. This model was based on the premise that there are two levels of requirements that need to be identified. These levels of requirements are:

- Organizational information requirements used to define an overall information system structure and to specify a portfolio of applications and databases.
- Detailed information requirements for an application.

Davis (1982:12) lists four strategies to determine information requirements, namely:

- Asking, which include closed questions, open questions, brainstorming, guided brainstorming and group consensus.
- Deriving requirements from existing information systems.
- Synthesizing requirements from characteristics of the utilizing system.
- Discovering requirements from experimentation with an evolving information system.

Mathiassen *et al.* stated that software design situations can be characterized by the complexity of the system as well as the uncertainty that accompanies the development of that system (Mathiassen, Seewaldt, Stage, 1995:182).

A contingency approach was also recommended by Gremillion and Pyburn (1983:135). This approach suggests that systems development projects be evaluated according to the criteria of commonality, impact and structure before choosing a systems development methodology (Fitzgerald, Russo and Stolterman, 2002:148, Gremillion and Pyburn 1983:135).

This differs from Davis (1982) by placing focus on criteria of commonality, impact and structure, rather than uncertainty. By taking this approach, commonalities are identified in systems development projects and criteria are used to select the proper systems development methodology. The extent to which other organizations may use the system is referred to as commonality.

Impact is determined by the degree in which the system will affect the organization (Gremillion and Pyburn, 1983:136). Structure refers to how well the problem is understood and its probable solution organization (Gremillion and Pyburn, 1983:136). Table 1.1 Indicates how this approach works.

The project is characterized by its properties and the properties then determine which approach to use. For example an uncommon project that has a broad impact with a high structure will utilize the traditional systems development methodology. This model can be implemented by organizations to determine which solution will best suit the requirements of their projects.

Selecting a systems development method			
Properties of a project			Suggested method
Commonality	Impact	Structure	
<i>Common</i>	<i>Broad</i>	<i>High</i>	<i>Package</i>
<i>Uncommon</i>	<i>Broad</i>	<i>High</i>	<i>Traditional</i>
<i>Uncommon</i>	<i>Broad</i>	<i>Low</i>	<i>Prototype</i>
<i>Common</i>	<i>Limited</i>	<i>High</i>	<i>Package</i>
<i>Uncommon</i>	<i>Limited</i>	<i>High</i>	<i>User-developed</i>
<i>Uncommon</i>	<i>Limited</i>	<i>Low</i>	<i>User-developed</i>

Table 1.1 A contingency model proposed by Gremillion and Pyburn (1983:132).

An Application Approach Worksheet is suggested by Shomenta *et al.* (1983:1). The worksheet attempts to assist developers in choosing the correct systems development methodology by departing from a one systems development methodology approach to using a variety of systems development methodologies and tools (Fitzgerald, Russo and Stolterman, 2002:149). This Application Approach Worksheet can be adopted for the contingent use of systems development methodologies.

The Application Approach Worksheet is used by determining which criteria best describe the current project. An example of the criteria is shown in Table 1.2. There are a total of eighteen criteria. The worksheet is used as follows (Shomenta, 1982:6):

- The developer considers each criterion and chooses the criteria that best fit the proposed system. The letter A, B or C is circled; these letters correspond to the application approach it should be used for. Repeated eighteen times.

- The developer goes back to the beginning and for each option chosen in the previous step, assigns a numerical weight or N/A for all three the development approaches. Repeated eighteen times.
- The developer then adds the column totals together.
- For each column a note is made of all N/A's for each column.
- The column totals are compared to determine the highest. The highest column total is deemed the best approach.
- If the approach with the highest total has one or more N/A's, that approach cannot be used. In such an instance the developer discusses alternative solutions with the project manager to determine how to proceed.

Criteria Definition							
Category	Definition	Application Approach A	Weight	Application Approach B	Weight	Application Approach C	Weight
Number of Concurrent Users	The number of people using the system at one time, either entering data or inquiring into the system.	A		B		C	
Number of Locations	The number of geographical locations or building sites. Three separate offices in the same building are considered one location.	A		B		C	
...	...	A		B		C	
Processing Access Requirements	A measure of how the system is to be used. Some systems may be required to be accessible immediately to users at all times. Others may only need the system sporadically and may not need immediate access.	A		B		C	
...	...	A		B		C	
System Complexity	A measure of how difficult the system will be to develop based on an assessment of its complexity.	A		B		C	

Table 1.2 Application Approach Worksheet (Shomonta, 1983:4)

A “single toolkit” approach was proposed by Benyon and Skidmore (1982) which combines the necessary characteristics of a range of methodologies which were suggested to be complementary (Benyon and Skidmore, 1982:7).

Various information systems development methodologies were reviewed by Avison and Wood-Harper (1988:379). They concluded that no single systems development methodology could be used in all development circumstances (Avison and Wood-Harper, 1988:379), which makes contingent use difficult.

They proposed a contingency framework named Multiview, which could be used to select a systems development methodology for a specific development project (Avison and Fitzgerald, 2006:545). Multiview is a framework that provides guidance to analysts. The framework assists analysts in choosing techniques and tools for any problem situation. Multiview also recommends documentation and other standards for specific situations. Multiview consists of five phases (Avison and Taylor, 1999:77), these phases are:

- Analyze human activity system
- Analyze the information
- Analyze and design socio-technical system
- Design human-computer interface
- Design technical aspects.

All of the above mentioned methods that were proposed for systems development methodology selection could be used to implement systems development methodologies contingently. A “best-fit” systems development methodology can then be chosen by selecting a proper approach from a list of systems development methodologies used within a specific organization. In this approach an organization should have a range of methods readily available (Fitzgerald, Russo and Stolterman, 2002:148).

All the above mentioned contingency approaches are discussed in more detail in chapter 2 and are summarized graphically. The contingency approach is however criticized by Kumar and Welke (1992: 59). They argue that existing methods for selecting systems development methodologies do not sufficiently cover all the essential contingencies. They propose method engineering as a solution (Fitzgerald, Russo and Stolterman, 2002:149). They suggest that design methods should be designed by using a meta-method (Fitzgerald, Russo and Stolterman, 2002:149).

The research will attempt to identify whether or not system development methodologies are used contingently in the telecommunication industry and at which levels contingency is used.

The research will determine the method the telecommunication organizations use when selecting a systems development methodology and how they use them contingently.

The methods used by the South Africa telecommunication organizations will be compared to existing contingency approaches suggested by the various authors to determine if they are used in practice.

The telecommunication industry and contingency was discussed in this section. The next section will describe the research aims and objectives of the study. It will also indicate the research questions that were posed.

1.2. Research aims and objectives

In this section the aims and objectives of the research will be discussed briefly. The research will attempt to answer the research questions by conducting case studies on four of the leading telecommunication organizations in South Africa. In order to study the contingent use of systems development methodologies a few research questions have been posed and will be addressed. These research questions are:

- *Do telecommunication organizations in South Africa use system development methodologies when developing telecommunication systems?*

This question requires an analysis of the telecommunication industry and seeks to identify the use of systems development methodologies during systems development. The study will aim to identify the systems development methodologies that are currently being used by the telecommunication organizations.

- *How do the telecommunication organizations in South Africa decide on a system development methodology and what criteria do they use?*

The contingent use of systems development methodologies within the organizations will be identified by analyzing how they select systems development methodologies and which criteria they use in doing so. The criteria will be identified to determine which criteria are applied when selecting a systems development methodology.

- *Are the criteria used for systems development methodology selection controlled?*

The control of the criteria will be analyzed to determine whether or not such criteria are controlled by management or managed by someone within the organization. The study will also attempt to identify whether the organizations control these criteria in a comparative manner.

These questions will be used to explore the contingent use of system development methodologies. The main aim of this research is to interpret the contingent use of systems development methodologies in the telecommunication industry.

This will be accomplished by an analysis of specific situations within their context to determine how each organization manages its own approach. The contingent use of system development methodologies is aimed at finding the so called “silver bullet” approach to systems development (Schwaber, 2002:2). By finding the so called “silver bullet” it allows the organization to use the systems development methodology contingently. The “silver bullet” is considered the ideal systems development methodology that can be used in all situations.

By studying the telecommunication organizations in South Africa, the study will attempt to determine if such an approach exists in the South African telecommunication industry. The contingency decisions telecommunication organizations make can deliver valuable information as to their use of systems development methodologies in telecommunication.

The research aims and objectives were discussed in this section. The next section will discuss the research paradigm used in the research and the methods that were used for data collection.

1.3. Research paradigm and method

This section will discuss the research paradigm used in the research. The data generation methods are also identified. The research paradigm that will be used to conduct this research is the interpretive paradigm.

The interpretive paradigm aims to understand the social context of a system within its natural surroundings within an organization (Oates, 2006:292). The interpretive paradigm has numerous research methods. The method best suited to this analysis is case studies.

The case studies will be conducted in real world settings, by analyzing each telecommunication organization within its natural environment. Yin (2003), notes that it is imperative that multiple sources of evidence should be used when conducting case studies (Yin, 2003:14).

The multiple sources of evidence for this research are interviews that were conducted with multiple personnel within telecommunication organizations and documentation gained from the organizations.

In this instance, case studies will be conducted with four of the leading telecommunication organizations in South Africa, to permit the gathering of multiple sources of evidence in order to allow comparative analysis.

Each organization will be studied separately by conducting interviews with representatives from each organization. Structured interviews will be used as the data collection method and each representative will be asked exactly the same questions as guidelines. The representatives will however be allowed to deviate from the questions as to gain more insight into the organizations' operations and the views of the representative.

Interviews are used due to the notion that they are excellent at dealing with subjects in detail (Oates, 2006:198). Interviews are easier to adapt to specific situations and permit better interaction between the researcher and the organization subject to the case study. After the interviews are conducted they will be transcribed in order to find discernable patterns and trends within the research data.

In order to draw conclusions from the data, the interviews will be analyzed with ATLAS.ti by setting up codes and quotations. This method permits meaningful conclusions and propositions to be made by analysis of data gathered and for the researcher to better understand all the information that has been gathered. The use of structured interviews will deliver qualitative data permitting positive results and to draw conclusions.

The research paradigm and the data gathering method were discussed in this section. The next section contains a summary of the chapters of the research and how they are set out.

1.4. Summary of chapters

This section shows how the chapters will be arranged and what the content of each chapter will be.

Chapter 1: Problem Statement

Chapter one is a brief summary of the research questions and the research approach. It provides an introduction to the content of the research.

Chapter 2: Literature study

This chapter contains information gathered from the literature study conducted. It looks at the telecommunication industry, system development methodologies designed specifically for the telecommunication industry and the contingent use of system development methodologies.

Chapter 3: Research design

This chapter focuses on the research paradigm that will be used when conducting the research. This chapter includes all the various possible research methods and data gathering methods used within the research paradigm. The interview questions are also included in this chapter.

Chapter 4: Results of the research conducted

Chapter 4 includes the results of each case study. An in-depth analysis of the gathered data is provided in this chapter. It also includes a brief description of each organization. In this chapter propositions and solutions are discussed in respect to each of the telecommunication organizations by using content analysis. Cross case analysis between the four case studies are also conducted to find patterns within the data.

Chapter 5: Research summary and conclusions

This chapter includes the answers to the research questions posed in this study. The limitations of this study and the contributions made by the study are included in this chapter. A short summary is provided and future work and research is proposed.

The arrangement of the chapters was discussed in this section. The next section contains the conclusion of the first chapter. A brief overview is given of the discussed content.

1.5. Conclusion

A short introduction regarding the research was given in this chapter, which included a brief summary of the telecommunication industry in South Africa. Contingency was briefly discussed in this chapter to indicate its scope and method.

The research questions were provided to indicate the focus of this study. A short summary regarding the research approach has been provided, including the data gathering method that will be used to gather information. Finally the chapters were also summarized to show how information and content of each chapter has been organized and laid out.

The next chapter contains the literature study regarding systems development methodologies, the telecommunication industry and the contingent use of systems development methodologies.

CHAPTER 2

SYSTEM DEVELOPMENT METHODOLOGIES AND TELECOMMUNICATIONS

2. Literature study

This chapter is built on three topics that are each discussed in turn; these topics are shown in Figure 2.1. The telecommunication industry, which is one of the primary focuses of the study, is covered. Systems development methodologies are discussed by focusing on the definition, the history of systems development methodologies and the selection processes. .

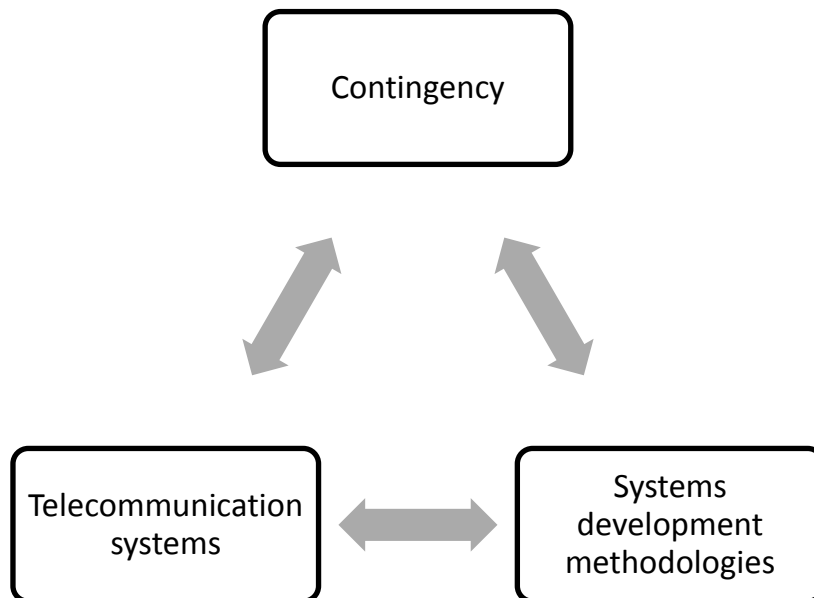


Figure 2.1 Graphical representation of the research focus

Contingency will then be addressed by posing probable solutions from various authors. The combination of these three topics make up the focus of the study, which is the contingent use of systems development methodologies in the telecommunication industry.

2.1. Introduction

Contingency in information systems development means the adoption of a specific methodology used to undertake a specific project (systems development). This specifies that certain methodologies are used under certain circumstances, by determining which methodology (solution) works best for the specific problem. Kettunen and Laanti state that “In general, there is a wide range of software development project types ranging from large contract-driven IT/IS systems to small in-house developments” (Kettunen & Laanti, 2005:587). These projects are either approached using systems development methodologies or by using an amethodical approach.

Amethodical Approach

The term Amethodical is a negative construct that is used to describe a set of attributes that are not methodical (Baskerville, 1999:2). It does not imply chaos or anarchy but it does reject the basic form of structure. This approach implies that a system is developed without predefined sequences and control. Amethodical development is so unpredictable and unique for each system development project that the criteria for contingent methods of development are irrelevant (Baskerville, 1999:2).

An introduction into Chapter 2 was given by looking at some of the topics that will be discussed. In the next section the telecommunication industry and systems development within the telecommunication industry will be discussed.

2.2. The telecommunication industry

In this section an overview of telecommunication will be provided. Telecommunication will be defined in this section. Focus will be placed on how the telecommunication industry differs from other industries where systems development methodologies are frequently used. The different layers in which systems development can be done within the telecommunication industry are discussed. Challenges within the telecommunication industry are also listed.

2.2.1. Definition of telecommunication

This section provides a definition of telecommunications. Telecommunication can be seen as a transmission between two points that is specified by a user.

The information that is transmitted is of the user's choosing and there should not be a change in the form or content of the information when it is being sent or received (Manthey, 2001). Therefore project management in telecommunication should adhere to this definition. The system development methodologies used should ensure that these projects deliver the best and quickest way to develop quality software.

A definition of telecommunication was provided in this section. The next section will look at the differences between the telecommunication industry and that of other industries.

2.2.2. Telecommunication industry versus other industries

The telecommunication industry tends to differ from other industries in software development, in the sense that it is ever changing and the software is required to be developed quickly and effectively. The differences between these industries will be provided in this section. Telecommunication systems development often involves large proprietary systems as well as subsequent maintenance for extended time periods (Kalyanasundaram, Ponnambalam, Singh, Stacey, Munikoti, 1998:715). The large systems used by the telecommunication industry tend to evolve over time (Kalyanasundaram, Ponnambalam, Singh, Stacey, Munikoti, 1998:715). The system designers and architects need strategic information in order to control this evolution so that they can track changes in the telecommunication system's properties (Kalyanasundaram, Ponnambalam, Singh, Stacey, Munikoti, 1998:715).

There are several properties that distinguish the telecommunications industry from normal software as listed by Otto (2007:1):

- Telecommunication software services are of a distributed nature, stretching across wide geographical areas (Eddington, 2005).
- Telecommunication networks tend to grow exponentially in size.
- The telecommunication industry is ever changing and introduces new services and products constantly (Eddington, 2005).
- The complexity of telecommunication systems exceeds that of other systems.
- The requirements imposed on telecommunication systems are increasing in ambition and complexity.
- The time frame available for the development of these systems seems to be decreasing.
- Utilization of frequently emerging technologies (Eddington, 2005)

It is noted that telecommunication projects tend to differ from other comparable projects. These projects also differ from each other within the telecommunication industry in terms of requirements, size, goals, services, complexity, time, sustainability and in what area of telecommunication the system will be used.

There are different types of systems used in the telecommunication industry, each of which has a different purpose and design for the various components within the industry. There is a constant demand to provide enhanced customer services within telecommunication organizations. This places the information technology departments under pressure (Eddington, 2005).

A clear understanding of networking is unique to the telecommunication industry. When deploying new systems, implementing upgrades or purchasing new licenses for purchased systems, a clear understanding of the complete current network is necessary. If not it could lead to a waste of resources. The network elements should be identified, where they are located, their configuration information and hardware and software versions should be acknowledged to name but a few. This should be done across the entire network (Beyaz, 2009:2).

The telecommunication is expanding on a regular basis. This leads to systems that grow in complexity. There still exists a need for formal ways of verifications and benchmarking of telecommunication systems. The differences between telecommunication and other industries were listed in this section. Aspects that are specific to telecommunications were also highlighted. The next section will look at the different layers of the telecommunication industry.

2.2.3. *Telecommunication layers*

Telecommunication consists of different layers. Systems can be developed for each of these layers. An examination of the layers is done in this section. There are three layers in which systems can be used. Patel (2002:122) depicts these layers graphically as can be seen in Figure 2.2. Firstly there is the Telecommunication Infrastructure layer. This layer is used to transmit data through the networks provided by telecommunications.

Secondly there is the Service Provider layer. The service provider serves as a link between the user applications and the infrastructure of the telecommunications. Lastly there is the Telecommunication Users layer. This layer consists of the user applications.

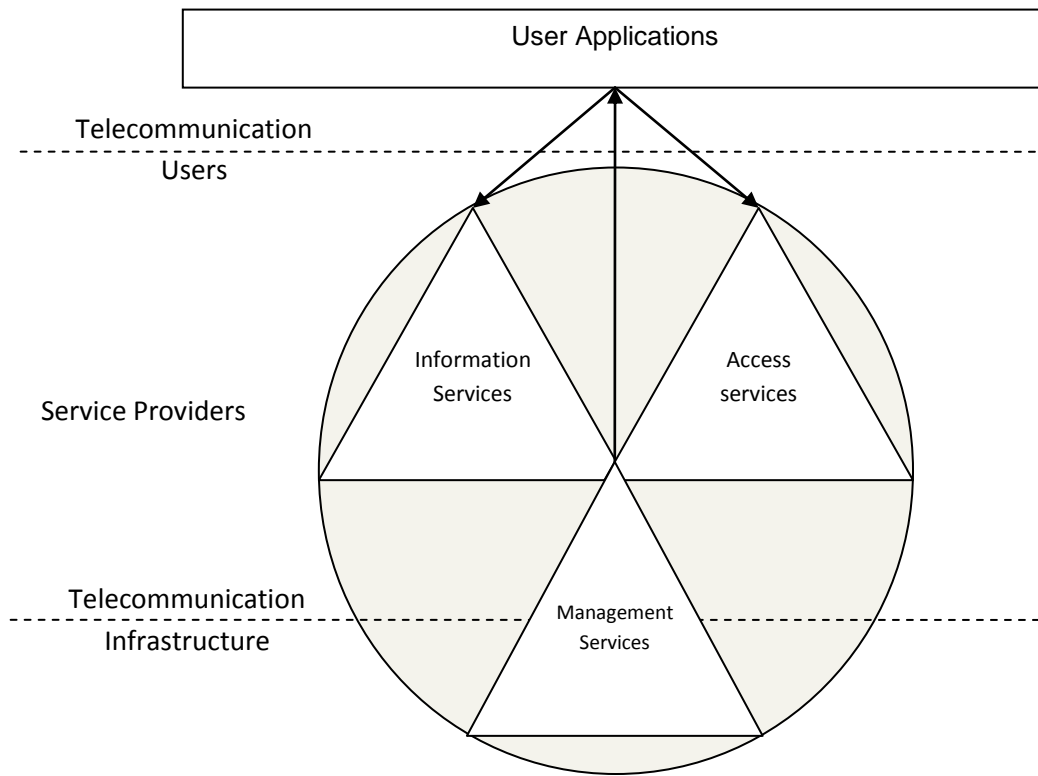


Figure 2.2.

Service model of telecommunication systems (Patel, 2002:122).

As noted by Otto (2007:3), the model incorporates several services. The Information Services is delivered by the service provider layer. It offers information services for networking that provides users with high level information.

The services referred to in the model include information hosting services and delivery services that support users in delivering information over the network. As indicated in Figure 2.2. Access Services delivered by the service provider layer enable users to access data transmission and management functions. On the other hand management services are concerned with managing telecommunication hardware and software.

In telecommunications there are four operating categories of providers, namely tool providers, network providers, transaction and service providers, and internet providers. These aforementioned providers include all the companies and organizations that operate within and around the telecommunication industry. Due to the fact the network providers each strive to deliver unique services to their clients, it is clear that most of the system development takes place within these network providers. This is also one of the areas where the most change and technological advancements take place.

The project team involved in software development projects should therefore determine if and when to use methodologies to successfully complete the projects. Mansurov (2000:2) suggests that the use of agile methodologies in the telecommunication industry would reduce the ratio of time to market. System developers tend to use the Extreme Programming (“XP”) approach in some cases (Wolak, 2001:2). Telecommunications’ system development requirements tend to change more often than others. XP in its nature of being agile and easy to adapt to changes makes it a suitable fit for telecommunication projects (Wolak, 2001:6).

The three different layers within telecommunication were discussed in this section. The next section will examine the challenges that the telecommunication industry face.

2.2.4. Challenges facing the telecommunication industry

Focus needs to be placed on the challenges that telecommunications face before looking at the different methodologies that are currently used to develop systems in telecommunications. This section identifies the challenges that the telecommunication industry face. Guest (2008) lists some of these challenges:

- **Reducing tariffs**
South Africa is currently listed as one of the most expensive countries in terms of internet usage and telecommunication services. The telecommunication companies are faced with the challenge of decreasing costs whilst delivering a high quality service and without loss of profit. South African legislation is poised to regulate this aspect of the industry in this regard, however, no such regulation have been formally implemented to date.
- **Increase in competition**
There is increased competition, especially regarding wireless technologies in telecommunication. As regards fixed lines, Telkom has until recently managed to retain a monopoly. A few new companies have started to settle within South Africa in the past decade. Each of these companies is continuously developing newer technologies to deliver better and more reliable services.
- **Migration from different technologies**
South Africa has been overwhelmed by the variety of technologies which have become available at the same time. For years South Africa has been using Dial-Up lines, but currently there are several new technologies, most recently the introduction of fiber-optic cables. Many

subscribers still use the older technologies unaware or unaffected by new technology and this poses threats for further development. Telkom listed the migration from dial-up to ADSL services as one of the major problems they face, as set out in their 2007 annual report (Guest, 2008).

- The introduction of cost-based interconnection

Network providers in South Africa have been charging a premium for making calls to other networks. These premiums are charged on all calls made outside the specific domestic network. The Telecommunications Act will force the network operators to charge all calls, regardless of the network used, at the same rates. Vodacom is one of the first and have started to implement this by cutting their interconnection rates to other network providers. These problems were all highlighted in the 2007 annual report from Telkom. These problems include reduced tariffs, increased competition and the introduction of cost-based interconnection (Guest, 2008).

Challenges faced by the telecommunication industry have been discussed in this section. It is apparent that there are numerous challenges which need to be addressed. The next section discusses the new technological advances in telecommunications.

2.2.5. New technological advances in the telecommunication industry

There have been a number of large technological developments over the past few years, which are briefly discussed in this section. Digital broadcasting is one of the latest features developed for telecommunications. It delivers access in the form of 2Mb, 34Mb and 155Mb interfaces.

These services are available in both permanent and temporary options. Other technological advancements that were recently developed was the Vehicle Tracking SIM Card, according to Communiqué de Presse (2006) Vodacom have launched a tracking service in cooperation with Sierra Wireless and Tracker. The technology will be used to track stolen vehicles and assist with vehicle recovery.

The Tracker service is provided by Vodacom's network services. It makes use of the inSIM embedded SIM component which was designed and developed by Wavecom. Wavecom is now part of Sierra Wireless which is a leading provider of wireless solutions.

The new technology will be deployed by Vodacom for use by Tracker (Communiqué de Presse, 2006)

There have also been technological advances in wireless technology with the development of HSDPA/ HSUPA and 3G that requires new systems and system upgrades more frequently than in the past. South Africa lacks broadband access and provides an ideal market for the launching of HSUPA and WiMAX (FAN, 2008:8). HSUPA is the mobile equivalent of WiMAX and although it is more difficult to implement it is more reliable (FAN, 2008:9).

HSDA 7.2Mbps has been launched in 2008 and is one of the latest advancements in mobile internet connection. Since 2008 HSUPA and WiMAX has been implemented by Vodacom (SUS Report. 2009:7).

The development of such systems should be done quickly and effectively to ensure optimal systems availability in the shortest amount of time. There has also recently been an addition to the services of fixed lines. Internet Protocol Television (IPTV) service will deliver to the public the same technology as that of television stations. This service also delivers fast interactive networking. IPTV delivers voice, internet and video with a single connection, although the availability of the service is likely to be delayed.

Although many difficulties prevail, the Independent Communications Authority of South Africa (“ICASA”) maintains that it will meet the November 2011 deadline (Manners, 2010). The MultiChoice IPTV solution will be rolled out in gated communities. It uses standard DSts satellite streams which it then converts into an Internet Protocol (IP) based service which is then sent to users over a high speed network (Manners, 2010). Other changes that can be expected in the near future are an IP-Based 4G environment. The technical evolution of the telecommunication environment places a lot of pressure on IT systems that are used to integrate these new technologies (Mehra, 2005:3).

These new technological advances create new opportunities in telecommunication systems development. These can either be positive or negative opportunities in systems development. The contingent use of systems development methodologies can be used to address these opportunities.

New technological advances were discussed in this section. The advances were briefly discussed. Systems development methodologies will be discussed in the next section.

2.3. System development methodologies

There are several definitions for Systems Development Methodologies (“SDM”) that are used either to describe what a SDM is, or, in most cases what a SDM consists of. This section will discuss systems development methodologies by looking at a proper definition, the history, selection processes and methodologies used. This section will also look at the different types of systems development methodologies designed specifically for the telecommunication industry.

2.3.1. Definition of a systems development methodology

A proper definition for a systems development methodology will be identified in this section. Avison and Fitzgerald (2006:24) describe a systems development methodology as “a collection of procedures, techniques, tools, and documentation aids which help the system developers in their efforts to implement a new information system”. Another definition by Huisman and Iivari states that a systems development methodology (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, 2006:32). The definition proposed by Huisman and Iivari is graphically depicted in Figure 2.3.

The aforementioned definition states that each systems development methodology can be classified as a combination of characteristics. This definition will be used throughout the research when referring to systems development methodologies.

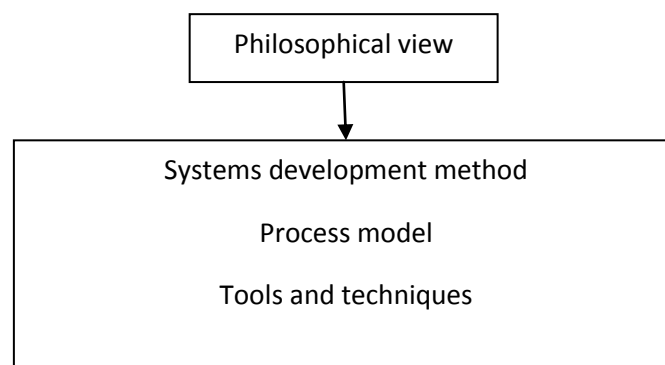


Figure 2.3 A graphical representation of a systems development methodology

- Systems development approach

This approach refers to the philosophical view on which the methodology is based. According to Iivari *et al.*(1998:166) this is “a set of goals, fundamental concepts and beliefs of the systems development process that underpin the inference and actions in systems development”, as illustrated in Figure 2.3. The philosophical approach of the systems development lifecycle (“SDLC”) for example is, to develop a tailor made computer system from scratch that meets the requirements of each individual.
- Systems development process model

This is can be seen as a sequence of steps or stages which need to be followed during the development of the system (Wynekoop & Russo, 1995) , as illustrated in Figure 2.3. The process model assumed by the SDLC for example is, to attempt to improve the manner in which business processes are carried out. It assumes a step-by-step top-down development process.
- Systems development method

This indicates how system development will be executed. Wynekoop & Russo (1995) state that “a method can be seen as a predetermined and linear approach to conduct a stage or phase of systems development”, as illustrated in Figure 2.3. The systems development method used by the SDLC for example is:

 - Feasibility study
 - System investigation
 - System analysis
 - System design
 - Implementation
 - Review and maintenance
- Systems development technique

Iivari *et al.* states that “A technique or method, in this context, consists of a well-defined sequence of elementary operations which permits the achievement of certain outcomes if executed correctly” (Iivari, Hirschheim and Klein, 1998:165). The SDLC for example recommends a number of documentation aids to ensure that the investigation is thorough.

A definition was identified that will be used throughout the study in this section. The definition is that of Huisman and Iivari (2006:32). The next section will provide a discussion on the history of systems development methodologies.

2.3.2. The history of systems development methodologies

Systems development methodologies each deliver a unique approach to assist in development of systems. Over the years the use of methodologies have evolved and in some cases the traditional models have been changed so much that they are no longer of any use and unsuitable for their initial intended use (Kettunen & Laanti, 2005:588).

The history of systems development methodologies can be summed up into four eras (Avison and Fitzgerald, 2003:79) and will be discussed in this section.

The eras are the pre-methodology era, early-methodology era, the methodology era and the post-methodology era. These eras will each be discussed in turn by referring to the literature of Avison and Fitzgerald (2006: 577).

The pre-methodology era

Early applications of computers were largely implemented without the aid of an explicit information systems development methodology until the 1960's. This era was known as the pre-methodology era. During this era programming and solving various technical problems was the emphasis of computer applications development.

This emphasis focused on maintaining operational systems, to get them working properly, rather than on the development of new systems and responding to the needs of users. The rather limited hardware at the time led to many problems in the technical arena.

The individualistic approach programmers took to development depended on the experience and skills of the programmer (Avison and Fitzgerald, 2003:79). The approach was based on a simple rule of thumb and resulted in the poor control and management of objects (Avison and Fitzgerald, 2003:79). The demand for computer based business systems were gradually escalating despite these problems. Management demanded more appropriate systems. There were a number of changes in the last few years of this era, namely:

- Recognition that analysis and design required different people with different skills rather than only using programmers. Systems analysts thus gained a key role in systems development.
- The growing need for common standards and a more disciplined approach for developing information systems within organizations. This led to the establishment of the first systems development methodologies.

The early-methodology era

In the 1970's computers were used for the first time by a wider variety of users. This led to the reduction of computer prices. This era was known as the early-methodology era. More affordable computers meant more and more people started to use computers for different functions. Computer specialists in the early 1970's started to use engineering approaches to assist in the development of software. Since software development is similar to other engineering applications the life cycle approach was adopted for systems development.

This era was characterized by a new approach being used for building computer based applications. This approach focused on the identification of phases and stages. It was thought to help control and improve the management of systems development (Avison and Fitzgerald, 2003:79).

This approach came to be known as the Systems Development Life Cycle (SDLC) or more commonly the 'waterfall model'. It consisted of several stages of development that needed to be followed in sequential order. A number of variations of the SDLC existed but generally the key stages were:

- Feasibility study
- System investigation
- Analysis
- Design
- Development
- Implementation
- Maintenance

A single phase needed to be completed before the next phase could begin.

Each phase had a set of defined outputs or deliverables that needed to be produced prior to such phase being deemed as complete. This approach was tried and tested, and, in many cases well proven. There are however a number of weaknesses or limitations to this approach. It also includes limitations in its use.

The methodology era

In the 1980's till the mid 1990's a range of methodologies emerged, specifically designed for aiding systems development and software engineering. This era was known as the methodology era. It was in this era that the term methodology was used for the first time to describe the different approaches. During this period methodologies flourished. These methodologies emerged from one of two main sources:

- The methodologies developed from practice.
- The methodologies developed from theory.

Methodologies that fall into the first category have typically evolved from being used in an organization to become a commercial product. The second category consists of methodologies that have been developed at universities or research institutions. Commercial methodologies that evolve from application and practice proved to be the most popular. The early methodologies predominantly relied on one technique, or a series of closely linked techniques, as the foundation of the methodology. Ultimately the majority of organizations that had a possible methodology product grasped the nettle and invested resources in the development of the methodology as a commercial product.

The large investment in methodologies resulted in a number of outcomes:

- The realization that most of the methodologies contained inherent gaps or defects. In some cases these were not complete gaps but some areas that were treated in less detail than others. These gaps required filling. Most of the information systems methodologies underwent a process of filling the gaps and rectification of weaknesses. This ensured that those methodologies were more complete.
- Expanding the scope of methodologies was another process required to perfect the methodologies in use at the time. This occurred as a result of methodologies not addressing the whole systems development lifecycle. The implementation phase was

frequently left out, which some omitted from design and others even abandoned analysis. Methodologies thus expanded into the areas of strategy and planning.

- The developing management assumed that the information system could not only make the operation of the organization simpler and more efficient, but that these information systems could enhance the position of the organization in relation to its competitors. This was yet another reason for addressing information systems strategy at a high level in an organization.
- For most of the commercial methodologies the process of expanding scope and ‘filling the gap’ has persisted. Subsequent to the introduction of strategic and business planning phases and tasks, the next development was to integrate new and evolving techniques and approaches. This included techniques and approaches such as object-oriented techniques and the introduction of support tools into the methodology package.

The post-methodology era

It is noted by many authors that since the early 1990’s a shift was made away from rigid methodologies towards the post methodology era. Avison and Fitzgerald (2006) refer to this era as the era of methodology reassessment (Avison and Fitzgerald, 2006:582). This era was characterized by a serious reassessment of the concepts and practicalities of the methodologies of the methodology era. This led to the previous rigid approaches being replaced by more contingent, flexible approaches.

The result of this was that some organizations have moved to other different methodologies and approaches and in some cases others have completely abandoned their use of methodologies (Avison and Fitzgerald, 2003:80).

During the start of the post methodology era, rapid development of new practices for software development also started to increase.

Current trends in systems development indicate that development is leaning towards a more adaptable and flexible approach to development that is more “tailorable” to each project’s individual needs, and moving away from the traditional rigid processes that have been followed in the past (Kettunen & Laanti, 2005:588). It is therefore important to select the best systems development methodology that is available or tailor an existing one to best fit the needs of the project. The development team should be aware of the different alternatives that are available and be aware of how the methodology works under certain conditions in the industry.

The current era is the post-methodology era. The research that will be conducted will examine at how telecommunication organizations use “tailorable” systems development methodologies contingently. The study will also attempt to identify whether there are different alternatives available to the project team when developing systems.

The eras of systems development methodologies were discussed in this section. It was determined that the current era is the post-methodology era. The next section will examine contingency.

2.4. Contingency

This section discusses the contingent use of systems development methodologies. Contingency is discussed by identifying a proper definition, identifying methods for implementing contingency and the use of systems development methodologies.

2.4.1. Definition of contingency

Contingency was defined in Chapter 1 as a conditional response plan that is made in preparation for various future circumstances including unanticipated events. The contingent use of systems development methodologies is achieved by identifying a suitable systems development methodology that will be adequate for assisting in future systems development. Contingency is not only applicable to the selection of systems development methodologies, but can also be achieved by tailoring.

There are many methodologies available, each with their own unique characteristics. It is difficult to use systems development methodologies contingently. Choosing the correct and best fit is difficult and as stated by Kettunen and Laanti, “There are no standardized solutions for this” (Kettunen and Laanti, 2005:589). There is a confusing array of systems development methodologies currently available and Wood-Haper suggests that “the approaches are not simple alternatives, but they seek to do different things...” (Fitzgerald and Wood-Harper, 1982:12).

Contingency was defined in this section. The next section will examine the contingent use of systems development methodologies.

2.4.2. Contingent use of systems development methodologies

Deciding which methodologies to use can be difficult and sometimes misleading. This section discusses the selection of systems development methodologies and the contingent use of systems development methodologies. Different approaches from numerous authors are discussed in this section. The problem for most developers is which systems development methodology to choose or if a combination of systems development methodologies should be used (Avison, Taylor, 1997:73).

Kettunen and Laanti (2005) suggest a software process model selection matrix that provides alternative ways of managing large embedded software projects (Kettunen & Laanti, 2005:589). The software process model that Kettunen and Laanti refer to can also be called a systems development methodology. This solution is not the only one, nor the best method to select a systems development methodology, as there is no one methodology that can be applied to all projects. The basic structure of the process model selection matrix is shown in Table 2.1. It is used by weighing the project against each of the possible systems development methodologies and determining the best fit for the project.

Table 2.1 is a short layout of the systems development methodology selection matrix. A detailed discussion will follow in the next few pages of exactly how the table is applied for the selection of systems development methodologies.

<i>Systems development methodology selection matrix</i>	
	<i>Systems development methodology</i>
<i>Project problem, risk, failure factor</i>	<i>How does this Systems development methodology prevent that particular problem from happening, or helps mitigating it (in the context of large embedded software projects)?</i>

Table 2.1. Software process model selection matrix (Kettunen & Laanti, 2005)

There are no standardized solutions for selecting the correct systems development methodology for every project. Kettunen and Laanti (2005:589) have composed a systems development methodology selection matrix to assist in the selection of the correct systems development methodologies for large embedded systems development projects.

This matrix is a comparative analysis of different systems development methodologies. One of the most notable features that Kettunen and Laanti (2005:589) have added to the matrix is that the comparison of the systems development methodologies can be done based on how well each systems development methodology addresses problems typical of large embedded system development projects.

Table 2.2 gives an example of how the selection matrix will look when data has been entered. The project problems and failure factors are listed in the leftmost corner of the table. The systems development methodologies are listed and discussed under each of the project problems and failure factors to determine the best systems development methodology to use. The ellipsis in the table indicates that any data could be contained in the cell. The cells that contain values are simply examples used to illustrate the use of the selection matrix.

Additionally the model contains a key point of selection of each systems development methodology's home ground, their drawbacks and characteristic pitfalls. The systems development methodology selection matrix can be used in two basic ways by a project manager:

- By using the columns: Selecting the systems development methodology by comparison of basic alternatives for the anticipated problem situation. The problem areas that the systems development methodology addresses can be compared to the current project's problem areas thus selecting the system development methodology that best supports it. (Kettunen and Laanti, 2005:589)
- By using the columns: Evaluating different system development methodology alternatives to determine how they can tackle certain problem situations. Ratings can be used to evaluate the different system development methodologies to assist in making analytical decisions (Kettunen and Laanti, 2005:289).

<i>Systems development methodology selection matrix</i>			
Project problems, failure factors	Systems development methodologies		
	Plan/specification-driven methodologies		
	Waterfall (serial development)	Incremental development methodologies	Evolutionary methodologies Spiral model(risk-driven iteration)
<i>Project initiation Unclear project objectives (lack of a project mission)</i>	Waterfall model does not tackle especially this problem. You should stay on the specification phase, until your project objectives are clarified.	Can start working on the known increments, and clarify the rest later. Note! May arise other problems later, if project is not well defined or if the definition changes much later	...
<i>Overplanning/ underplanning (e.g. 'glass case' plan)</i>	If you can do the planning reasonably well up-front, there is less overhead than with the iterative/incremental models. However, in the case of major uncertainties.
<i>Lack of resources (people)</i>

Table 2.2 Systems development methodology selection matrix

Table 2.2 shows an example of how the systems development methodology selection matrix works. Information systems development can be applied by using either a methodology or by using an amethodical approach. It is hard to determine when to use a specific methodology to develop an information system. Given the vast amount of methodologies it is argued that there are no considerable differences among the methodologies. The assumption that system development

methodologies are universally applicable fails to acknowledge contingency factors and the distinctiveness of each development situation.

The use of methodologies can also pose a considerable threat to development. Developers can be too focused on following the guidelines of the methodology that they can overlook the original goal of the project (DeGrace & Stahl, 1990:10). Methodologies are sometimes promoted as the only way for project development (Benyon & Skidmore, 1987:2).

In most cases the methodology is decided upon by some *a priori* process that is determined by the organizational culture or by the methodologies used for the development of previous systems of the same type (Durham, 1993:22).

There is however no methodology that is so perfect that it can be applied to all situations. The effectiveness of a methodology depends mainly on its intended application (Durham, 1993:22).

In the recent years there have been various studies into determining how to decide on a methodology that will be the 'Best-Fit' for developing an information system. The contingency theory is used as a means of explaining the observed differences in organizational structure (Reid and Smith, 2000:428). It suggests that there is no single way of structuring an organization so that it will perform perfectly under all given circumstances. The agency theory on the other hand is based on a behavioural premise that suggests that people act of their own accord and in their own interest.

A contingency model was first introduced by Alter (1978) which claimed that such model would aid in the development of decision support software (Alter, 1978:26). A few years after Alter's contingency model, McFarlan (1982) then suggested that the development of software should take place by internal integration of users, as well as an external integration between the users and the developers (McFarlan, 1982:142).

Davis (1982:21) placed his focus on the development of requirements by looking at the level of risk that an organization might be subject to, and he then integrated the obtained knowledge into a contingency model that could be used to select the proper systems development methodology. Fazlollahi and Tanniru (1991:293) later revised the model suggested by Davis (1982) and extended it so that it had a narrower focus on requirements (Davis, 1982:21). The 'ideal type', as discussed by Avison and Fitzgerald (2006) should adhere to a large list of criteria to find the appropriate methodology for developing systems (Avison and Fitzgerald, 2006:591).

The various methods suggested by the literature are summarized in Figure 2.4. The contingency model introduced by Alter (1978) was later revised by McFarlan (1982). Davis (1982) also

proposed a contingency model by placing the focus on uncertainty, which was later revised by Fazlollahi and Tanniru (1991). Fazlollahi and Tanniru (1991) extended the model so that it should have a narrower focus on requirements. Gemillion and Pyburn's (1983) contingency model focused on commonality, impact and structure. Shomenta (1983) proposed an Application Approach Worksheet that could be used to select systems development methodologies.

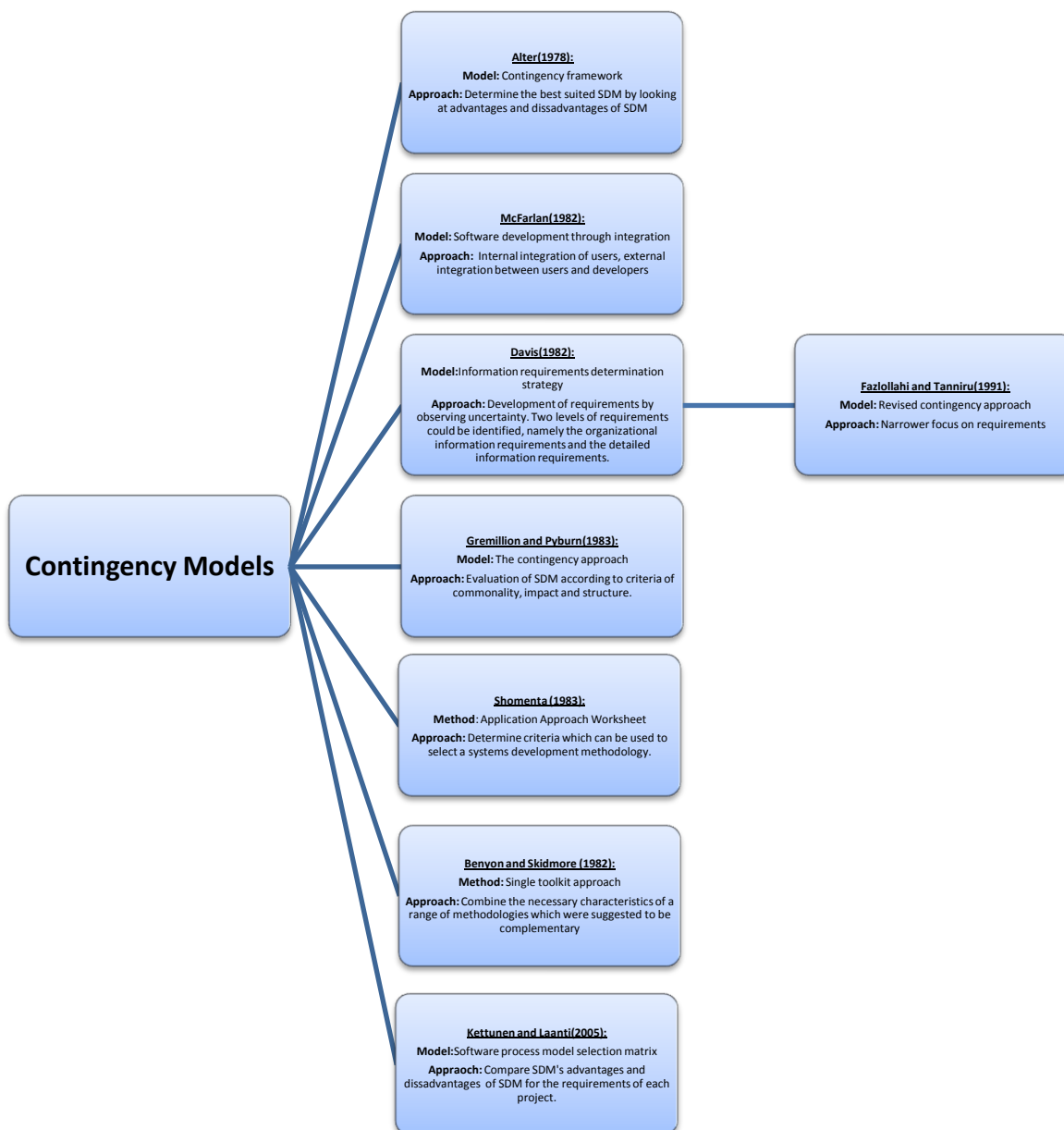


Figure 2.4 Graphical representation of contingency models

Avison and Wood-Harper (1988) developed Multiview, which could be used to select systems development methodologies. Shomenta (1983) suggested a model that identifies criteria when selecting a systems development methodology. Benyon and Skidmore (1982) proposed a single toolkit approach that could be used to combine different elements of systems development methodologies to suit the project.

The latest model is the software process model selection matrix suggested by Kettunen and Laanti (2005) which evaluates systems development methodologies in order to determine the best fit for the systems development project. The approach by Davis (1982) and the approach by Fazlollahi and Tanniru (1991) both determine uncertainty and requirements, although the revised model focuses more narrowly on requirements. The other approaches all differ from each other, even though they aim to achieve the same goal.

Contingency was discussed in this section and different methods were identified. The next section will look at the systems development methodologies developed specifically for the telecommunication industry.

2.5. System development methodologies for telecommunication systems

There are a number of systems development methodologies that were developed solely for telecommunications, which will be discussed in this section. These methodologies are MODA-TEL which is based on the Model Driven Architecture (“MDA”), Mansurov’s Accelerated Development Methodology, MOBILE-D and ODAC. Mazengera (2009) has found in a recent study that although there are methodologies specifically designed for telecommunications they were not used in the three organizations subject to this study.

MODA-TEL, MOBILE-D and Mansurov’s Accelerated Development Methodology are all agile systems development methodologies, which are able to adapt quickly to changes. Each agile methodology delivers a different way of adapting to changes. In telecommunication there are frequent changes and developments which cause systems to be developed or updated within a limited time frame.

In a recent study, methodologies used in the South African telecommunication industry were identified. The systems development methodologies identified were the Information Systems Development Lifecycle (SDLC) and the traditional Waterfall model (Mazengera, 2009:179). There are indications of tailored systems development within all these companies. They use a specific methodology which they then tailor given the specific requirements of the project and the complexity of the project.

The systems development methodologies that were developed for telecommunication each have different approaches to problem solving and solution implementation. They are all based on different systems development techniques.

The systems development methodologies will be briefly discussed by using the definition proposed by Huisman and Iivari (2006:32).

- MODA-TEL

MODA-TEL is based on a MDA (Model Driven Approach), and is an approach rather than a methodology (Gavras, Benaunde, Ferreira, Paulo, and Almeida, 2004:71). Otto (2007:26) states, that this methodology has an object-oriented approach. This approach is targeted mainly at distributed applications. This makes it a prime representative for the development of telecommunication software systems.

MODA-TEL provides support for project management and quality assurance, it does however not support risk management. It provides a great level of adaptability (Asadi & Ramsin, 2008).

- Software development method (Parviainen, Takalo and Tepolla , 2009:14)
 - Preliminary preparation phase: Platform identification, Modeling language identification, Transformation identification and Traceability strategy.
 - Detailed preparation phase: Specification of modelling languages and Specification of transformations.
 - Infrastructure set-up: Tools selection and Metadata management
 - Project execution: Requirements analysis, Modeling, Verification and validation, Transformations, Coding and testing, Integration deployment and Operation maintenance.
 - Project management: Software Development Process (“SDP”) selection, Project organization and Quality management.
- Philosophical approach
Object-oriented approach based on Model Driven Architecture.
- Process model
Object oriented iterative process model
- Techniques
 - The user chooses the model
 - UML is suggested

- MOBILE-D

MOBILE-D used an agile approach for developing systems and is suitable for a wide variety of applications. It makes use of a number of phases to implement the development of

telecommunication systems. Each phase is made up of a number of tasks that need to be completed before moving onto the next phase (Mazengera, 2009:36).

- Software development method
 - Explore phase
 - Initialize phase
 - Productionize
 - Stabilize
 - System test and fix
- Philosophical approach
 - Blended systems development methodology, created for agility but also focuses on object oriented development.
- Process model
 - Iterative Model
 - Models and documentation created as development progresses
- Techniques
 - Project Management techniques
 - Test-driven development
 - Pair programming
 - Continuous integration
- Mansurov's Accelerated Development Methodology
 - Mansurov's Accelerated Development Methodology resembles a classical systems development methodology in some way. It is however uniquely specific to the development of systems for telecommunication systems (Mansurov, 2000). Mansurov's methodology makes use of widely accepted formal telecommunication languages and it places emphasis on accelerated development (Mansurov, 2000).
- Software development method (Mansurov and Propert, 2000:8)
 - Capture and validate Primary Scenarios Message Sequence Charts (use case success paths based on primary user functions).
 - Synthesize initial Specification and Description Language requirements models from these primary validated Message Sequence Charts.
 - Derive High-Yield Secondary Scenario Message Sequence Charts by strategically executing the Specification and Description Language

requirements model. During this process automatically generate corresponding high-yield Tree and Tabular Combined Notation functional test cases in parallel as the Specification and the Description Language requirements model is executed.

- Refine the Specification and Description Language Requirements Model to derive the Specification and Description Language Design Model.
 - Automatically generate code for a specific target environment for example C, C++, JAVA including the appropriate middleware.
 - Employ subsequent steps to derive Specification and Description Language Requirements Models and Specification and Description Language Design Models.
- Philosophical approach
Based on an object oriented systems development methodology.
 - Process model
Specification and Description Language
 - Techniques
 - ITU standardized specification languages
 - CASE tools
 - Specification and Description Language
 - Message Sequence Charts
 - Tree and Tabular Combined Notation
 - UML sequence diagrams

- ODAC (RM-ODP)

RM-ODP (Open Distributed Processing – Reference Model) was developed by the International Telecommunications Union – Telecommunication Standardization Sector (ITU-T) and The International Standardization Organization (ISO). It defines a set of concepts that can be used to develop distributed systems (ISO IS, 1995). The RM-ODP delivers a set of useful modeling and conceptual tools. It does however lack the provision of guidelines or rules that explain how it can be used to develop systems (Gervais, 2002:1).

RM-ODP does not deliver a methodology but ODAC utilizes the concepts of RM-OPD and forms a methodology that has clearly defined steps and guidelines for systems development. According to Gervias (2002:2), “ODAC, which is based on the RM-ODP has the potential to be an MDA-oriented methodology”.

ODAC uses the concepts of RM-ODP, it clearly defines steps, processes for these steps and utilizes UML notation (Gervias, 2002:2).

The ODAC methodology can be used for a wide variety of applications. ODAC makes use of three viewpoints to develop the system namely, Enterprise, Information and Engineering, and Technology (Gervias, 2002:2).

- Software development method
 - Analysis phase
 - Design
 - Implementation
 - ODP Viewpoints
 - Enterprise viewpoint
 - Information and Engineering viewpoint
 - Technology viewpoint

- Philosophical approach

ODAC is a methodology compliant with the Model Driven Architecture principles. It is grounded in the object- oriented approach.

- Process model

Makes use of the Open Distributed Processing viewpoints.

- Techniques

- UML
- PIM Modeler

Comparing methodologies can be a difficult and time consuming task. Avison and Fitzgerald (2006) suggest a framework for comparing systems development methodologies (Avison and Fitzgerald, 2006:597). This framework does however not encompass every single aspect of the systems development methodologies. The above mentioned telecommunication systems development methodologies will be compared according to the framework designed by Avison and Fitzgerald (Avison and Fitzgerald, 2006:597).

A number of additional comparative features may be added for specific purposes such as (Avison and Fitzgerald, 2006:597):

- The speed of systems development

- The quantity of produced specifications and documentation
- The modification potential that users may devise to suit their own situation

The basic structure of the framework contains seven main headings under which the systems development methodologies should be discussed. These seven elements are (Avison and Fitzgerald, 2006:598):

- *Philosophy*: This distinguishes more than any other criteria a methodology from a method. This can be regarded as a set of principles upon which the systems development methodology is based (Avison and Fitzgerald, 2006:598).
 - a. *Paradigm*: The two main paradigms of importance are the science paradigm and the systems paradigm. The science paradigm has branded scientific developments in recent times. The second is the systems paradigm which is branded by a holistic approach (Avison and Fitzgerald, 2006:597).
 - b. *Objectives*: Each systems development methodology has its own objectives. This can be to develop a computerized system or to determine if there is a need for a computerized system (Avison and Fitzgerald, 2006:601).
 - c. *Domain*: Each systems development methodology is designed to solve a specific problem. The domain states which problems this methodology is prone to solve (Avison and Fitzgerald, 2006:602).
 - d. *Target*: This focuses on the applicability of the systems development methodology (Avison and Fitzgerald, 2006:602).
- *Model*: The second element of the framework is concerned with the analysis of the model the methodology uses. The model is the basis of the methodologies paradigm. Avison and Fitzgerald(2006) state that there are four categories of models, namely (Avison and Fitzgerald, 2006:602) namely:
 - Verbal
 - Analytic/Mathematical
 - Iconic/Pictorial/Schematic
 - Simulation

The models that are used in the information systems methodologies are mainly of the third type. Information systems methodologies are thus part of the iconic, pictorial or schematic category (Avison and Fitzgerald, 2006:602).

- *Techniques and tools*: This includes the identification of the tools and techniques used in the systems development methodology (Avison and Fitzgerald, 2006:603).
- *Scope*: This indicates which stages of the life cycle which is covered by the systems development methodology (Avison and Fitzgerald, 2006:603).
- *Outputs*: Here the deliverables of the systems development methodology at each stage is identified. (Avison and Fitzgerald, 2006:603).
- *Practice*: This is measured by looking at the methodology background, the user base and the participants of the systems development methodology. (Avison and Fitzgerald, 2006:597).
- *Product*: This is the end result of the methodology. This can include documentation, software etc. (Avison and Fitzgerald, 2006:597).

In Table 2.3 MODA-TEL, MOBILE-D, Mansurov's Accelerated Development Methodology and ODAC (Open Distributed Applications Construction) are discussed under five elements of a systems development methodology. These elements are the systems development approach, the philosophical approach, the systems development process model, the systems development method and the systems development technique (Huisman & Iivari, 2006:32). The definition by Huisman and Iivari (2006) and the framework suggested by Avison and Fitzgerald (2006) are combined to create a combined comparative model.

By determining each of the five elements of each of these development methodologies they can easily be compared to determine their differences and their similarities.

Table 2.3 contains the following sections under which the systems development methodologies will be discussed:

- Systems Development Methodology (Name)
- Systems development method
- Philosophical approach
- Process Model
- Techniques

	MODA-TEL	MOBILE-D	MADM	ODAC (RM-ODP)
Systems Development Methodology	Model Driven Architecture - Telecommunication	Mobile-D	Mansurov's Accelerated Development Methodology	Open Distributed Applications Construction (Open Distributed Processing – Reference Model)
Systems development method	<ul style="list-style-type: none"> *Preliminary preparation phase *Detailed preparation phase *Infrastructure set-up *Project execution *Project management 	<ul style="list-style-type: none"> * Explore phase * Initialize phase * Productionize * Stabilize * System test and fix 	<ul style="list-style-type: none"> * Capture * Synthesize * Derive * Refine * Generate code * Employ 	<ul style="list-style-type: none"> * Analysis phase * Design * Implementation * ODP Viewpoints <ul style="list-style-type: none"> -Enterprise viewpoint -Information and Engineering viewpoint -Technology viewpoint
Philosophical approach	Object-oriented approach based on Model Driven Architecture.	Blended systems development methodology, created for agility but also focuses on object oriented development.	Based on an Object-oriented systems development methodology.	ODAC is a methodology compliant with the Model Driven Architecture principles. It is grounded in the object-oriented approach.
Paradigm	Based on the Model driven architecture that is object-oriented. It is classified under the science paradigm.	Based on iterative development by breaking the project into smaller pieces, tackling one piece at a time. It is classified under the science paradigm.	Based on an Object-Oriented approach. It is classified under the science paradigm.	ODAC is a methodology compliant with the Model Driven Architecture principles. It is classified under the science paradigm.
Objectives	The development of the systems as well as creating a knowledge base to assist in the development of other projects.	The development of a computerized system.	The development of a computerized system.	The development of a computerized system.
Domain	Setting up of a knowledge base to assist in solving other problems. Does not	Aim is to solve a specific problem.	Aim is to solve a specific problem.	To take a Platform-Specific model and to create a Platform-Independent model.

	only solve a specific problem.			
<i>Target</i>	Designed for telecommunication systems development but it also claims it can be used in other situations.	Agile approach specifically aimed at developing mobile applications.	Designed to improve the engineering of the telecommunication industry.	The methodology is not dedicated to a domain of applications. Mostly used in telecommunications.
<i>Process model</i>	Object –oriented iterative process model	Iterative Model Models and documentation created as development progresses.	Specification and Description Language	Parrallel implementation of steps and ODP viewpoints. Makes use of the Open Distributed Processing viewpoints. “The ODAC analysis process prescribes to consider first the Enterprise viewpoint, then Information and Computational viewpoints.” (Gervias,2002:267)
<i>Techniques</i>	-The user chooses the model. -UML is suggested.	-Project Management techniques -Test-driven development -Pair programming -Continuous integration	-ITU standardized specification languages -CASE tools -Specification and Description Language -Message Sequence Charts -Tree and Tabular Combined Notation -UML sequence diagrams	-UML -PIM Modeler

Table 2.3 Summary of the telecommunication systems development methodologies

By identifying each of the elements of the systems development methodologies they can now be compared. These methodologies contain many differences although in some cases certain similarities do exist. The similarities and differences are deducted by looking at the methodologies as shown in Table 2.3.

Similarities within the telecommunication systems development methodologies:

- MODA-TEL, MOBILE-D, MADM and ODAC are all grounded in object oriented development in their philosophical approach.
- Both MODA-TEL and ODAC are based on Model Driven Architecture principles.
- MODA-TEL, MOBILE-D, MADM and ODAC are all classified under the science paradigm.
- The objectives of MODA-TEL, MOBILE-D, MADM and ODAC are all to develop computerized systems.
- The aim of both MOBILE-D and MADM is to solve a specific problem.
- MODA-TEL and ODAC both use UML as techniques and MADM uses UML sequence diagrams.
- Both MODA-TEL and ODAC uses iterative process models.

Differences within the telecommunication systems development methodologies:

- The objective of MODA-TEL is not only to develop a system but also creating a knowledge base to assist in the development of other projects.
- MODA-TEL does not only aim to solve a specific problem but sets up a knowledge base to assist in the development of other projects.
- MODA-TEL can be used in the development of systems other than telecommunications.
- MOBILE-D uses an agile approach specifically aimed at developing mobile applications.
- MADM is designed to improve the engineering of the telecommunication industry.
- ODAC is mostly used in telecommunications.
- ODAC uses Open Distributed Processing Viewpoints.

The systems development methodologies developed specifically for the telecommunication industry were discussed and compared in this section. It is clear that the systems development methodologies that are developed specifically for the telecommunication industry differs from each other. This may also cause more confusion within telecommunication organizations when deciding which systems development methodology to use. A combined comparative model was used to compare these four systems development methodologies. The next section contains a conclusion of chapter 2.

2.6. Conclusion

Telecommunication differs from other industries and thus needs a different approach when developing a system. Determining which systems development methodology to use is crucial.

There are a number of suggested models that can be used for selecting the correct systems development methodology. One of the first models to determine which systems development methodology to use is the contingent approach suggested by Davis (1982:21).

Fazlollahi and Tanniru (1991:293) then later revised the model suggested by Davis (1982) and extended it using a narrower focus on requirements. Another model suggested by Avison and Fitzgerald is that of Multiview (2006:545). These models have all been used in the industry as a means of selecting systems development methodologies. There are now four main methodologies specifically designed to be used in telecommunication systems development that have been identified. They are MODA-TEL, MOBILE-D, MADM and ODAC. The systems development methodologies have been compared in order to determine differences and similarities that they may contain.

The next chapter deals with the research design used to conduct the research. It looks at the research paradigm used as well as the technique used for conducting the research. A discussion regarding the data gathering method and the data analysis is also included in the following chapter.

CHAPTER 3

RESEARCH DESIGN

3. Research Design

In this chapter the research design will be discussed addressing certain topics. These topics will include the research paradigm, the research method, data collection (interview questions) and analysis.

3.1 Introduction

Research can be carried out in a number of ways. This section will address research approaches briefly. The type of research that needs to be done determines the philosophical approach that should be taken. There are various research strategies and some of them are naturally underpinned by a specific research philosophy (Oates, 2006:303). There are three main types of philosophical approaches when doing research namely, positivistic, interpretive and critical research.

Positivist research takes the scientific approach to doing research. The scientific method looks for the standard patterns or laws in our universe (Oates, 2006:286). Experiments are the main method that is used by the scientific method. Researchers that take this approach believe that they can conduct research without affecting the results. The data that is retrieved is of a quantitative nature and consists of numerical values, usually in the form of statistics and measurements (Oates 2006:286). One of the methods to gather data when using this approach is questionnaires.

Critical research assumes that people create and re-create the social reality (Oates, 2006: 296). Critical research attempts to explain why certain paradigms dominate within organizations. They thus explain why an organization 'naturally' has to be a certain way (Oates, 2006: 296). The primary goal of critical research attempts to identify and dispute the conditions of dominance, the limitations and injustice of the norm as well as the assumptions that are normally taken for granted (Oates, 2006:297). Critical research makes use of action research as well as case studies to gather data.

Interpretive research places focus on understanding a specific situation within its context. This approach does not attempt to prove or disapprove a theory but rather study an organization and how it operates. The aim is to create an understanding of a distinct situation and to make a controlled finding of peoples' perceptions and how those perceptions change over time (Oates 2006:292). The research that will be conducted will be based on this premise.

Telecommunication organizations were studied by creating an understanding of how they use systems development methodologies contingently.

An introduction is given regarding the types of paradigms that could be used to conduct research in this section. The next section addresses the research paradigm used by this research.

3.2 Research paradigm

The aim of this research is to examine the contingent use of systems development methodologies within telecommunication organizations. In order to best achieve this, the interpretive paradigm will be used. The next section addresses the interpretive paradigm.

3.2.1 Interpretive paradigm

Interest within the information systems research community has escalated, regarding organizational and social issues associated with the development and implementation of computer-based information systems (Darke, 1998:273). The research method that will be used in this study is the interpretive approach, which will be addressed in this section. Oates *et al.* (2006:292) defines interpretivism as being “concerned with understanding the social context of an information system: the social processes by which it is developed and construed by people and through which it influences, and is influenced by, its social setting”. The type of research that will be conducted necessitates the use of the interpretive paradigm for studying telecommunication organizations. The research aims to study a specific situation within telecommunications and then to interpret the findings. Interpretive research is best suited for this type of research.

The research will be done by studying telecommunication organizations within their natural environment. By taking this paradigmatic approach the organizations are studied without the researchers presence affecting the data gathered.

The goal is to gather data without affecting the organization. In this manner valuable qualitative data can be obtained for objective analysis.

The paradigm of interpretive research consists of definitive characteristics namely:

- Multiple subjective realities, since what counts as ‘real’ for one party may be ‘false’ for another. People and groups have different perceptions of the world (Oates, 2006:292).
- Dynamic, socially constructed meaning, to enable people to carry over their reality to others by using constructions such as shared meanings or language (Oates, 2006:292).

- Researcher reflexivity, as researchers tend to apply their own meanings to their research, the way they perceive the world will determine how their research is shaped. Researchers should thus be reflexive as regards their personal work and recognize that they influenced their research (Oates, 2006:292).
- Study of people in their natural social settings, as the research should be aimed at understanding people in their own environment and not in an artificial environment (Oates, 2006:292).
- Qualitative data analysis, for the data retrieved is usually qualitative and should be analyzed in a qualitative manner (Oates, 2006:292).
- Multiple interpretations, since there will normally be more than one interpretation of the data that has been gathered and analyzed. The stronger explanation will be identified in the presence of sufficient evidence (Oates 2006:292).

Interpretive research provides a means to understand computing as a human developed and constructed practice (Oates, 2006: 304).

Walsham (1995) states that “Interpretive methods of research adopt the position that our knowledge of reality is a social construction by human actors” (Walsham, 1995:376). This view states that value-free data cannot be obtained. The researcher uses his or her preconceptions to guide the process of investigation (Walsham, 1995:376). The researcher’s interaction with the human subjects of the enquiry changes the perceptions of both parties. Interpretivism differs from positivism where it is assumed that the “objective” data gathered by the researcher can be used to test previous hypotheses and/or theories (Walsham, 1995:376)

Williams (2000) lists two propositions that are linked to interpretivism:

- Proposition 1 (Williams, 2000:210)
 - Interpretivists deny the possibility of generalization, or they ignore the issue, but they do generalize and this is inevitable.

Generalization seems to be inevitable in interpretivist research. Indeed, virtually every reported study will contain at least some kinds of generalizing claim.

- Proposition 2 (Williams, 2000:210)
 - Generalization in interpretive research is impossible.

Williams (2000) paraphrased reasons why prediction is impossible:

- human events exist in an open system. Local effects cannot be distinguished from external interference;

- exactitude in measurement is impossible, interpretations can be criticized in many dissimilar ways and different interpretations can lead to different predictions;
- the social life of humans is defined and formed by people and takes different historical and cultural meanings leading to an incomprehensible number of meanings.

If the abovementioned analysis is correct then it would be impossible for generalization in interpretive research. It has however been proved that interpretivists do generalize (Williams, 2000:213).

The interpretive paradigm and its facets were addressed in this section. The next section will examine the research method that will be used to conduct the research.

3.3 Research method

Research methods associated with the interpretive paradigm includes case studies and surveys. The method that will be used to conduct this research is case studies, which will be discussed in this section.

3.3.1 Case studies

A case study focuses on a single entity, for example an organization. In the norm case studies are conducted in real world settings. The aim of the research is to study four different telecommunication organizations in their real world settings. This leads to case studies having a high degree of realism and is mostly at the expense of the control level (Runeson, 2009:136). As soon as a research question is clearly identified a decision must be made in respect of who, or what the focus of the investigation will be on (Williams, 2000:216). In this research the focus will be placed on the contingent use of systems development methodologies in telecommunication organizations. Such investigation then attempts an in-depth study of this single entity by using various data generation methods. The case study looks at the entity within its real life context and focuses on all the factors that influence the entity. Factors that influence include issues, politics, processes and relationships. The exploration of these factors will provide a detailed view of the entity. Insight gained during research of the entity may prove to be relevant to other similar situations.

3.3.1.1 *Definition of a case study*

A definition of a case study will be addressed in this section. Yin (2003) states that a case study is ‘an empirical enquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident’ (Yin, 2003:13). Yin (2003) also states that it ‘relies on multiple sources of evidence’ (Yin, 2003:14). A case study attempts to investigate predefined phenomena, it does not, however, involve explicit control or manipulation of variables (Darke, 1998:275). It focuses on an in-depth understanding of a phenomenon and the context wherein it exists (Darke, 1998:275). Case studies have been proven to be useful to study information systems development and their implementation and usage in the field (Darke, 1998:274). However there can be practical complications associated with attempting to commence case studies as a meticulous and successful research method (Darke, 1998:274).

It can be a difficult task to design and determine the scope of a case study research project in such a way that the research question can be properly and satisfactorily answered (Yin, 2003:10). The collection of data for a case study can be time-consuming and tiresome, this often results in the accumulation of bulky amounts of data (Yin, 2003:10). Case study research is particularly fitting for studying information systems development as well as the implementation and use within organizations (Darke, 1998:278). There are a number of ways in which it can be used. Case studies have different research perspectives each using a variety of data collection and analysis methods that produce varied types of research outcomes (Darke, 1998:278).

A definition of a case study was given in this section. The next section will address when to choose case studies as a research method.

3.3.1.2 *Choosing a case study*

It is imperative to determine if the case study research method will fit the needs of research. This section addresses the factors that should be examined before choosing case studies. Darke (1999) lists five of the most asked questions that factor into deciding whether or not to use a case study:

1. When using the case study approach, what are the kinds of research that can be addressed? (Darke, 1999:279)
2. In order to sufficiently answer a research question, how can a case study research project be designed, formed and scoped? (Darke, 1999:279)

3. How can the contribution of organizations in research be obtained when using a case study? (Darke, 1999:279)
4. How can case study data be collected from case participants? (Darke, 1999:279)
5. To ensure case study research is suitable for publication in academic journals, how can the severity be established in writing up case study research? (Darke, 1999:279)

Since case study research identifies contemporary phenomena in its natural context, it is a suitable research method for software engineering research (Runeson, 2009:131). It is important to note that the understanding of what constitutes a case study varies and hence the qualities of the resulting studies also vary (Runeson, 2009:131).

The titles of software engineering research papers frequently contain the term ‘case study’ (Runeson, 2009:132). The presented studies however, range from very motivated and well structured studies in the field to lesser studies that argue to be categorized as case studies (Runeson, 2009:132). Within case studies there are different areas of focus. It is usually used with terms like field study and observational study, each of these focuses on a specific aspect of case studies (Runeson, 2009:132).

When conducting a case study a plan should contain the following (Runeson, 2009:139):

- Objective—what needs to be achieved?
- The case—what will be studied?
- Theory—the frame of reference that will be used
- Research questions—what needs to be known?
- Methods—how to collect the data?
- Selection strategy—where to seek for the data that is needed?

This section addressed when to select case studies as a research method. The next section will address the different types of case studies that can be used.

3.3.1.3 *Types of case studies*

The different types of case studies are addressed in this section. Le Roux suggest that there are five different types of case studies (Le Roux, 2003:101), namely:

- Exploratory case study: An exploratory case study attempts to add to the body of knowledge. There are usually few theories.
- Descriptive case study: Where the objective is limited to describing the current practice, amounting to a descriptive case study.
- Illustrative case study: New and possible innovative practices adopted by particular companies are illustrated by the research involving illustrative case studies.
- Experimental case study: Where the researcher examines the difficulties of implementing new procedures and techniques in an organization, an experimental case study is undertaken to evaluate their benefits.
- Explanatory case study: An existing theory is used to comprehend and describe what is presently occurring.

Yin (1994), however, suggests that there are three basic types of case studies namely exploratory, descriptive and explanatory (Yin, 2003:3). Exploratory studies are used to aid the researcher in defining questions or hypotheses. These aim to assist the researcher in better understanding the research dilemma (Oates, 2006: 143).

On the other hand a descriptive study delivers a comprehensive analysis of a specific occurrence and its context. Lastly, an explanatory study goes further than the descriptive study and attempts to elucidate why events happened as they did or how particular outcomes occurred (Oates, 2006: 143). The use of a case study approach allows for the research of single or multiple cases.

- This research will make use of a descriptive case study to examine telecommunication organizations within their own context.

The different types of case studies were addresses on this section. It was determined that there are various types of case studies, which each have their own specific approaches. The next section will address the characteristics of case studies.

3.3.1.4 *Characteristics of case studies*

Case studies have the following characteristics:

- Focus is placed on depth rather than breadth, with as much information as possible obtained regarding a single entity rather than that of many entities (Oates, 2006: 142).
- Natural setting, the case is examined within the entity's natural environment and not in an artificial environment (Oates, 2006: 142).
- Holistic study, the sum of the parts is greater than the whole. This views the entity as an entirety and how the parts intersect and how they relate to each other (Oates, 2006: 142).
- Multiple sources and methods approach, using as many different people within the target area of research within the company or entity (Oates, 2006: 142).

In the areas of psychology, sociology, political science, social work, business, and community planning, case studies are conducted to increase the knowledge about individuals, groups, organizations and about social, political, and related phenomena (Runeson, 2009:137). Therefore one can argue that it is reasonable to compare software engineering to other areas where case study research is commonly used. The research objectives in software engineering can also be compared to the objectives of case study research conducted in other areas (Runeson, 2009:137).

Runeson (2009) proposes five major steps to be applied when conducting a case study (Runeson, 2009:137):

- Case study design
- Preparation for data collection
- Collecting evidence
- Analysis of collected data
- Reporting

During the case study design phase, the case study is planned and the objectives clearly defined (Runeson, 2009:137).

The procedures and protocols that will be used for the collection of data are then clearly defined during the preparation for data collection step (Runeson, 2009:137). During the collecting evidence phase the data collection of the case study is carried out. Analysis is then

conducted using gathered data during the analysis step. Finally the findings are reported in the final phase (Runeson, 2009:137).

3.3.1.5 *Advantages and disadvantages of case studies*

Advantages

- Where it is difficult to study a single factor in isolation, case studies can deal with intricate situations (Oates, 2006:150).
- They are suitable situations wherein the researcher has little or no control over the elements (Oates, 2006:150).
- A case study is appropriate for both building and testing theories (Oates, 2006:150).
- Such study allows the researcher to illustrate the intricacies of life the subject and to explore alternative meanings and explanations (Oates, 2006:150).
- The data that is produced is close to the experiences of people and is more attainable than highly numeric studies, with the data is presented in stories rather than numeric values (Oates, 2006:150).

Disadvantages

- The generalizations that occur are sometimes seen as untrustworthy (Oates, 2006:150).
- Gaining access to people, documents and settings can be complex and time consuming (Oates, 2006:150).

Case studies will be imperative in researching the telecommunication organizations. The approach to time that will be taken is a short-term contemporary study. There are currently six telecommunication organizations in South Africa. They were all contacted, and four of them replied, asserting that they would assist with the research by permitting interviews with system development personnel.

The focus of the study will be to study four of the leading telecommunication organizations in South Africa. The advantages of case studies allow telecommunication organizations to be studied. It allows the researcher to study the contingent use of systems development methodologies in an environment where the researcher has no control over the elements. There is however disadvantages coupled with the use of the case study research method regardless of the philosophical approach that is used (Darke, 1998:278).

The telecommunication organizations will be studied by observing what is currently happening by interviewing people within the organization to explain current circumstances (Oates,

2006:144). Using case studies permits generalizations to be made. The case studied should therefore be explained in great depth, with all the information possible made available.

Any findings that are gained from the research can be applied to similar telecommunication organizations. The similarity of the cases can be in any form namely location, history, technical basis, social mix or the organization type. The type of generalization that will be made is that of rich insight. The findings should give rich insight into understanding the situations of the organizations. Advantages and disadvantages of case studies were addressed in this section. The next section will examine the data collection method that will be used to conduct the research.

3.3.2 *Data collection method*

Data can be collected by using two main approaches namely quantitative and qualitative data collection, which will be discussed in this section. Quantitative data is of a numeric nature and qualitative data consists of non numeric values for example, words. Data can be collected in any one of the following approaches namely interviews, observations, questionnaires and documents (Oates, 2006:36). The research method chosen to conduct the research is case studies. Case studies deliver much insight into a specific case under research.

Each research method has methods for generating data. Because case studies largely consist of qualitative data, they use three kinds of data generation. Such methods include in-depth open ended interviews, direct observation and written documents:

- Interviews that consist of open-ended questions that attempt to deliver in-depth responses about the experiences of people within the organization (Neale, Thapa, and Boyce, C., 2006).
- Observations that consist of fieldwork descriptions of activities, actions, behaviors, conversations, interpersonal interactions, and other observable human experience. The data gathered from fieldwork consist of field notes. These field notes are rich, detailed descriptions that include the context within which the observations were made (Neale, Thapa, and Boyce, C., 2006).
- Documents that consist of written materials gathered from the organization. These can be records, memoranda, personal diaries, letters, written responses to open-ended surveys etc. The data is made up of excerpts from these documents that are captured in such a way that it records and preserves the context wherein it was created (Neale, Thapa, and Boyce, C., 2006).

According to Neale, Thapa and Boyce (2006) “The quality of qualitative data depends to a great extent on the methodological skill, sensitivity, and integrity of the evaluator”. The interviewer should not just be present but must also pay close attention to how the interview and/or observation are conducted.

Data collection techniques can be divided into three levels, (Runeson, 2009:144) namely:

- First degree: Here direct methods are used. This means that the researcher is in direct contact with the subjects and the data is collected in real time (Runeson, 2009:144).
- Second degree: Here indirect methods are used where the researcher directly collects raw data without actually interacting with the subjects during the collection of that data (Runeson, 2009:144).
- Third degree: Here a researcher conducts an independent analysis of work artifacts already available (Runeson, 2009:144).

Case study research requires careful planning and judicious use of both the case participant’s and the researcher’s time for effective and efficient data collection (Darke, 1999:282). The collection of case study data from case participants can be both complicated and time-consuming (Darke, 1999:282). To determine the quality of the qualitative data gathered in interpretive research there are a number of criteria namely, trustworthiness, confirmability, dependability, credibility and transferability. These criteria can be used to prove that the research carried out is sound and correct. Explanations should be provided of how the data was gathered as well as reflections of how the researcher has influenced the outcome of the data.

- Interviews will be used as the data collection method for this study.
- Documents will also be used to gather more data.

The collection of data can be done by using more than one method. The methods are discussed below:

- Interview, a conversation between the researcher and members of the organization, where the researcher controls the content of the conversation and the agenda. Questions are asked to gather data (Oates, 2006:36). There are various types of interviews that can be used namely structured, semi-structured and unstructured interviews. Interviews are the data collection method that will be used in this case study. The interviews that will be used for purposes of the research are structured interviews.

Advantages of interviews

- Interviews are excellent at dealing with subjects in depth and in detail (Oates, 2006:198).
- Respondents in some cases prefer interviews over questionnaires (Oates, 2006:198).
- Interviews are more flexible and adaptable to situations than questionnaires (Oates, 2006:198).

Disadvantages of interviews

- Interviews can be very time-consuming (Oates, 2006:198).
- Interviews can be misleading, as they focus on the subjective insight of the employee rather than what is truly happening (Oates, 2006:198).

Interviews are an essential source of information when doing case study research (Yin, 2003:89). Interviews are also arguably the primary data sources when interpretive case study research is done. It is through the conduction of interviews that researchers can gain access to the views of participants and their interpretations of actions and events (Darke, 1999:282).

In case studies the collection of data by means of interviews are important (Runeson, 2009:145). Interview-based data collection is achieved by the researcher asking a series of questions that cover the areas of interest in the case study (Runeson, 2009:145). Mostly interviews are conducted with individuals but it is also possible to conduct interviews with groups.

A set of questions predefined by the researcher is used to guide the dialogue between the researcher and the subjects (Runeson, 2009:145). These questions are based on the research question and the topic of interest in the case study. Questions can be open, thus allowing the subject to provide more information and to facilitate a broader range of answers. Closed questions on the other hand limit the answers, normally restricted to yes/no or other limited sets of answers. (Runeson, 2009:145).

Interviews are one of the main data generation methods used for conducting a case study. Interviews allow the researcher to gather valued information regarding the interviewee's experiences and their perspectives regarding the subject being evaluated. These experiences and judgments are expressed in their own terms (Neale, Thapa and Boyce, 2006).

Interviews are often divided into unstructured, semi-structured and fully structured interviews (Runeson, 2009:145, Neale, Thapa and Boyce, 2006).

A few types of interviews suggested by Runeson, Neale, Thapa and Boyce (2006) are briefly discussed below:

- Structured open-ended interviews, which consist of standardized questions presented to all the interviewees. This is used to coordinate responses from the interviewees (Neale, Thapa and Boyce, 2006).
- Interview guide approaches which consists of identifying topics and not actually wording questions. This delivers a vast amount of flexibility.
- Conversational interviews, these are highly interactive of nature. The interviewer reacts to the answers given by the interviewee (Neale, Thapa and Boyce, 2006).
- Focus groups where the interviewer acts as a facilitator among interviewees, where both hear and react to one another's responses (Neale, Thapa and Boyce, 2006).

There are a few important things which should be considered when conducting interviews. One should understand the problem under study before conducting the interview. This ensures that the interviewer clearly understands which questions should be asked. Of more importance is the sequence in which these questions are asked.

- Structured interviews will be used to gather data.

It is sometimes necessary that the interviewee is introduced to more difficult questions by starting with simpler questions, such as asking the interviewee about his position in the organization. The interviewer should pay careful attention to listening to responses from the interviewees. It is important to note the context of the answer as well as identifying the interviewees' world views (Neale, Thapa and Boyce, 2006).

The structured interview will look like Table 3.1. The questions that will be asked are listed in the table as well as the rationale for asking the specific questions.

Question no.	Question	Rationale
Interviewee		
1	In your own words, what would you say is your current job title?	<i>Find out what role the employee plays within the organization</i>
2	How long have you occupied this specific job?	<i>Determine the experience the employee has in his current occupation</i>
Groups		
3	Do you work in groups when developing systems?	<i>Determine if employees are used in groups</i>
4	What would you say is the average size of such a group in terms of the number of people involved?	<i>Determine the size of the groups that the employees work in</i>
5	Do the group members have good communication with each other?	Determine if there is sufficient communication between group members
Systems development projects		
6	When a new system is needed do you develop a new system in-house or do you purchase readymade systems that fit your needs?	Determine whether or not the organization develops its own systems
7	What are the typical types of projects that you develop?	Determine the project types that the organization specializes in
8	How many people are involved in the development of each project?	Determining the size of development teams
9	What is the average time and size of the projects?	Determine the size of the projects and the time it takes to complete these projects
Systems development methodologies		
10	How would you define a systems	Determine the employees

	development methodology?	knowledge regarding systems development methodologies
11	Do you use systems development methodologies, if not what other approaches do you use for developing a system, specific methods or steps (Does this differ for different project sizes)?	Determine whether or not the organization makes use of systems development methodologies
12	(If a systems development methodologies are used) What types of methodologies do you use frequently?	Determine the types of methodologies used by the organization
13	Do you tailor the systems development methodologies to fit your specific needs or do you use them as is (Do these differ for different project sizes)?	Determine if the organization tailors the methodologies they use
14	How do you adapt these systems development methodologies? Can you give me a written example to show how you adapt them to your projects	Determine how these methodologies are adapted per project if they are adapted
Criteria : Selecting methodologies for projects		
15	What criteria is used in the selection process for selecting a systems development methodology for a given project (Do these differ for different project sizes) ? Can you please give me a typed example of the criteria that is used in systems development	Determine the criteria the organization uses for selecting systems development methodologies for projects. This criteria can include size of project, type of project etc.
16	Does the criteria change with each project or do you have a set list that is used for all projects?	Determine if the criteria changes in regard to the systems development project
17	Who determines these criteria?	Determine the origin of the criteria, for example management etc.
18	Are these criteria controlled?	Determine whether or not these

		criteria are controlled by management or audits etc.
Success and project comparison		
19	If you could give an estimate, how many systems development projects would you say are completed successfully?	Determine how many systems development projects the organization has completed successfully, in % or number
20	Are the systems that are developed mostly telecommunication oriented or do you also develop other types of systems?	Determine if the organization develops telecommunication oriented systems
21	Would you say that developing systems for telecommunications differ from developing other systems, if so, why?	Determine how systems development projects for telecommunications differ from that of normal systems development projects. The size, frequency of development, approaches to development etc.
22	Do the systems development projects sometimes exceed budget and time constraints?	Determine whether or not the systems are completed within time and budget
23	Do you think there is a correlation between the success of the systems development projects and the use of methodologies?	Determine if the use of methodologies lead to the completion of more successful systems development projects

Table 3.1 Questions to be used in the structured interview

A case study is primarily built on trust between the researcher conducting the study and the case analyzed in the research. Explicit measures should however be taken to prevent any problems (Runeson, 2009: 142). The case studies that are conducted in software engineering often include dealing with confidential information of an organization (Runeson, 2009: 142).

Thus there are a number of ethical factors that need to be considered, these include (Runeson, 2009: 142):

- Informed consent
- Review board approval
- Confidentiality
- Handling of sensitive results
- Inducements
- Feedback

Observation which is important, requires the researcher to investigate the organization by looking at the people and observing them and how they work without having the employees reporting what they do (Oates, 2006:36).

Advantages of observations

- Observations can gather information about the true actions of people rather than what they pretend to do (Oates, 2006:214).
- Observations can generate data that people are oblivious to, or consider routine (Oates, 2006:214).
- Observations are cheap to carry out (Oates, 2006:214).
- Observations give rich insight into social settings (Oates, 2006:214).

Disadvantages of observations

- Observations are limited to the studying of behaviors, and lack the explanation of intentions, meanings and reasons (Oates, 2006:214).
- Observations can oversimplify a situation by assuming that behavior can be broken down into categorizable and observable phenomena (Oates, 2006:214).

Questionnaires, the design of a predefined set of questions that the members of the organization can complete by themselves to record the survey. The questions are arranged in a predefined order. (Oates, 2006:36)

Advantages of questionnaires

- Questionnaires can in some cases be more economical than other data generation methods (Oates, 2006:229).
- Questionnaires make it easier to analyze data and simple for respondents to complete (Oates, 2006:229).

Disadvantages of questionnaires

- The use of pre-defined answers can restrict the feedback from the respondents (Oates, 2006:230).
- Misunderstandings cannot be corrected (Oates, 2006:214).
- The reliability of the answers cannot be tested (Oates, 2006:214).

By using more than one method it is possible to generate more data and thus improve the quality of the research. A broad data base delivers better insight into the given situation (Oates, 2006:37).

The type of research for this study only requires the need for one method of data collection. This will be done by making use of structured interviews.

Researchers can use more than one of these methods to gather data. When more than one data generation method is used it is called the triangulation of methods. The researcher's characteristics and background can influence the data collection and data analysis processes of case study research. The data collection and analysis may rely on the researcher's interpretation of events, documents and interview material (Darke, 1998:278). The validity of the research findings may be limited by this. Yin (2003) notes that prejudice may also penetrate the design and conduct of other types of research (Yin, 2003:10).

To increase the precision of empirical research triangulation is imperative. Triangulation provides a broader picture by adopting different angles of interpretation regarding the study.

When relying primarily on qualitative data, triangulation is obvious due to the fact that the data gathered is likely to be broader and richer and less precise than that of quantitative data. Quantitative data should however compensate for measurement and modeling errors. (Runeson, 2009:136)

Runeson (2009) lists four different types of triangulation that can be applied (Runeson, 2009:136):

- Data triangulation, this is done when using more than one data source or when collecting the same data at different occasions.
- Observer triangulation, this is achieved by using more than one observer in the study being conducted.
- Methodological triangulation, this is achieved by combining different types of data collection methods. This can consist of both qualitative and quantitative methods.
- Theory triangulation, this is achieved by using alternative theories or viewpoints to examine the instance being studied.

Data triangulation is used in the research. This is achieved by using more than one data source and gathering data at different occasions.

Each telecommunication organization was contacted for interviews. The representatives were also contacted at a later stage to gather more data and to ensure data collection had been correct. Documentation was also received from three of the telecommunication organizations regarding the use of systems development methodologies.

The data generation method was addressed in this section. The next section will focus on data analysis and how it will be done.

3.3.3 Data analysis

Before analyzing data of qualitative nature it is necessary to get the data in the correct format for analysis, which will be addressed in the following section. This includes the transcribing of audio tapes and preparation of transcripts. Audio tapes also need to be indexed. An efficient filing system must be used to aid in the analysis process as this can assist with locating data during the analysis process. The data needs to be ordered in such a way that it can easily be analyzed. It is necessary to read through all the data to better understand which data belongs together and which data is more important than others.

Data can be sorted into three main groups namely:

- Segments that are of no importance to the research (Oates, 2006:268).
- Segments that can be used to explain the context of the research to the readers (Oates, 2006:268).
- Segments that are of significance to the research questions (Oates, 2006:268).

The significant segments should be categorized into groups by listing them and clearly defining them with headings and short descriptions. The categories created will assist in more efficient data analysis. Each organization's data will be categorized in the same manner using the same criteria. Categories will frequently change and should be updated. Patterns should be identified within the data, and when identifying the patterns data can be moved within categories or new categories can be created.

The identification of patterns can lead to the establishment of more themes within the data that could not be identified before. Data may not necessarily be complete by only conducting a single

interview. Follow up interviews should be conducted if a lack of data exists or if the data gathered was unclear. The possibility also exists that new data will be identified as the research progresses.

The data analysis conducted should be as well documented as possible. Data can either be textual or non-textual, for example, audio tapes. Non-textual data may present a larger amount of themes and patterns than that of textual data (Oates, 2006:273).

Data will be gathered by recording interviews and then transcribing the recordings in order to gather data that can be converted into useful information for the research.

It is important to consider the validity of the research project; Runeson distinguishes between four aspects of validity (Runeson, 2009:153):

- Construct validity, where the wanted research outcome is met by the research questions and conduct of the research.
- Internal validity: This is of concern in the case where the researchers attempts to examine casual relations.
- External validity: This aspect of validity is concerned with to what extent it is possible to generalize the findings, and to what extent the findings are of interest to other people outside the investigated case.
- Reliability: Concerned with the extent that the data and the analysis are dependent on the researcher. Hypothetically, if another researcher later decides to conduct the same study, the result should more or less be the same.

There are a number of factors to consider when evaluating qualitative data. Firstly one needs to select a qualitative approach that is appropriate for the evaluation's expected uses and that can answer the evaluation's questions (Patton, 2003). Secondly one needs to accumulate high quality data that can be classified as plausible evaluation data.

Lastly the qualitative evaluation findings should be analyzed and reported. Michael Quinn Patton (2003:1) proposes a qualitative evaluation checklist:

- Given the intended uses and purpose of the evaluation, establish the degree to which qualitative methods are suitable (Patton, 2003:1).
- Establish which common strategic themes of qualitative examination will be used to guide the evaluation (Patton, 2003:1).
- Based on the purpose of the evaluation, establish qualitative design strategies, data collection options, and analysis approaches (Patton, 2003:1).

- Given the evaluation's purpose and priorities, establish the suitable qualitative evaluation applications (Patton, 2003:1).
- Ensure the design answers important evaluation questions for intended users by making major design decisions. Select the most appropriate design for the evaluation's purposes by considering different design options (Patton, 2003:1).
- Determine how to approach the fieldwork where fieldwork is used as part of the evaluation (Patton, 2003:1).
- Establish how to approach the interviews, where open-ended interviewing is a component of the evaluation (Patton, 2003:1).
- Pay careful attention to ethical issues when designing the evaluation (Patton, 2003:1).
- Anticipate analysis by designing the evaluation data collection, so that it facilitates analysis (Patton, 2003:1).
- The data should be analyzed so that the qualitative findings are clear, credible, and address the relevant evaluation issues and questions (Patton, 2003:1).
- The qualitative evaluation report should be focused (Patton, 2003:1).

Advantages and disadvantages of qualitative data analysis

Advantages

- Where the study that is conducted is broader than that of numeric values, it delivers a richer and more detailed insight into the situation (Oates, 2006:277).
- It delivers alternative explanations rather than presuming that only 'one' correct explanation exists. Different researchers might reach different but equally valid conclusions (Oates, 2006:277).

Disadvantages

- The amount of data may be overwhelming (Oates, 2006:277).
- Interpretations are closely tied to the researcher and the researchers should be much more tentative (Oates, 2006:277).
- Text is more suited than non-textual data for theses and papers (Oates, 2006:277).

Researchers that use the interpretive paradigm should document the process they used for their research and provide convincing field data to convince others that their research (Oates, 2006:295):

- Is reliable and not contrived (Oates, 2006:295).

- Is a genuine effort to comprehend the people in a particular situation and their perceptions (Oates, 2006:295).

The aim is to deliver plausible data. Arguments should be made to convince people that the explanations and interpretations of the research are plausible and that the data gathered supports it.

There are several structures that can be used for reporting the results of a case study (Runeson, 2009:156):

- Linear-analytic—this is the standard research report structure; problem, related work, methods, analysis, conclusions.
- Comparative— here the same case is repeated more than once to compare alternate descriptions, explanations of paradigms.
- Chronological— this is a structure most suitable for longitudinal studies.
- Theory-building— here the case is presented according to some theory-logic and is built in order to constitute a chain of evidence for a theory.
- Suspense— this method reverts the linear-analytic structure whereby conclusions are reported first and then supported with evidence.
- Unsequenced— when none of the other abovementioned structures are used, e.g. “When reporting general characteristics of a set of cases.” (Runeson, 2009:156)

When academic reporting of cases are done the linear-analytic structure is the most widely acceptable (Runeson, 2009:156). The research makes use of two methods of data gathering, namely interviews and documentation. The interviews were recorded electronically and on paper to ensure the data gathered was correct. The interviews were transcribed and analyzed using ATLAS.ti. A comparative method of reporting is given in chapter 4.

In this section data analysis was addressed and applied to the research to determine which analysis was used. The next section concludes chapter 3.

3.4 Conclusion

There are various approaches to conducting research. The paradigm that will best fit this research that needs to be conducted is that of interpretivism. The interpretive paradigm has many advantages for analyzing the telecommunication companies. By observing the companies, valuable data can be obtained by recording they operate from day to day.

The method of choice is interviews. Interviews will be conducted to gather specific information from employees who work within information technology departments subject to the study. Open questionnaires could be used to gather more structured data from the telecommunication companies, but were not used for this research. Data analysis is required to be done carefully and extensively due to the nature of the data.

The data that will mainly be gathered will be non-numerical and needs to be carefully controlled. The data will be recorded and transcribed. Analyzing the data thoroughly delivers meaningful information that can be used for making assumptions and delivering conclusive information based upon the interviews conducted from the interviews conducted.

The next chapter contains the research that was conducted and the findings made from the study. The chapter looks at each of the organizations on which case studies have been done and propositions are made in order to answer the research questions.

CHAPTER 4

RESULTS OF THE RESEARCH CONDUCTED

4. Results of the research conducted

There are currently six telecommunication organizations in South Africa. All six of the telecommunication organizations were contacted with regard to the research. Four of these telecommunication organizations responded to the research and assisted in conducting interviews with personnel in the systems development departments.

4.1 Introduction

This chapter contains the results from the case studies conducted on four of the leading telecommunication organizations in South Africa. This section will provide an introduction of the research conducted. The four organizations each have attributes that make them unique in their own regard. The organizations were chosen by looking at their systems development and the role they play in the current telecommunications industry. The organizations were contacted by using internet research to determine contact details of personnel responsible for systems development within the organization. The information was gathered by conducting short interviews with representatives from each organization. The interviews were done between June 2010 and August 2010. Organization A's head office is located in Cape Town and interviews were conducted telephonically and recorded. The head offices of organization B is located in Randburg at which the interviews were conducted. The interviews of organization C was conducted at their head office in Midrand. Organization D's head office is located in Pretoria, at which interviews took place. The interviews were recorded electronically and transcribed. On average the interviews lasted for about thirty minutes per representative. The representatives that were interviewed had general expertise in systems development within the organization itself. In order to gain valuable information the interviews were conducted with representatives at different levels within each organization to obtain a broader view of how systems development is implemented.

The four organizations studied all specialize in telecommunications. Two of the four are also mobile telecommunication organizations. One of the fixed line telecommunication organizations has also recently launched their mobile operator. Each of these operators also strives to deliver the best products and services possible to the public, and each also has a distinctive approach in doing so.

In this chapter each organization will be discussed by giving a brief history of the organization and their specialties. The information obtained from the interviews will be discussed in detail to determine an insight into the operations of each organization. In order to keep anonymity the organizations will be named organization A, organization B, organization C and organization D respectively.

At the end of each sub section a list of propositions will be listed for each organization. These propositions will only be valid for the specific organizations to which they refer. As each of these organizations operate differently the propositions will also differ among such organizations. At the end of the chapter a summary will be given of all data gathered, the findings and a conclusion will be reached. At the end of the study tables will be given that contain the codes gathered from the data as well as the values for the codes for each representative.

The notation of the research is as follows, the organizations will be named organization A, B, C and D respectively. Each representative will be given a number, for example a representative that is employed by organization A, will be numbered as representative A1.

In this section the research conducted was discussed. The next section indicates the research aims and objectives of the research.

4.2 Research aims and objectives

This research has a number of aims and objectives, which will be addressed in this section. Firstly and most importantly it aims to provide a better understanding regarding the use of system development methodologies in telecommunication organizations in South Africa. The research's main objective is to determine the contingent use of systems development methodologies in telecommunication organizations.

In order to achieve this goal the research requires the study three important aspects of the so called contingent use of systems development methodologies.

The first aspect to be considered is if this organization uses a systems development methodology. The systems development methodology will be identified and briefly discussed.

The second aspect that should be considered is how an organization chooses a systems development methodology. Here the criteria used for such selection will be identified from each case study. The criteria are then analyzed to determine which ones are more influential in such decisions than others.

The third aspect for consideration is to determine if the organization controls these criteria and whether or not the criteria changes for each systems development project undertaken by the organization. In order to meet this aim, the controlling parties must be identified. These parties can either be the project team, high level management or a controlling body created by the organization.

It will also be established if these criteria affect the selection of the systems development methodology for each systems development project or if it is a set list of criteria that never changes thus leaving the systems development methodology in tact. In order to fully understand contingency, a better understanding is required regarding the organization's systems development operations.

Given the results and findings, the research will aim to identify if the organizations use a so called 'silver bullet' approach to development of their systems. This is seen as a single methodology which can be used to aid in the development of any system (Schwaber, 2002: 2). The 'silver bullet' refers to the 'ideal type'. In order to use systems development methodologies contingently a systems development methodology should be chosen that will provide provision for future systems development projects, which is deemed the 'ideal type'.

In this section the research aims and objectives were listed again to indicate what the primary focus of the research will be. The next section addresses each case study conducted.

4.3 Results

The results of the study are addressed in the next section by examining the findings of each case study. Brief discussions are given regarding each organization and propositions are listed for each of the organization. A cross case analysis will be done at the end to identify similarities between the organizations.

4.3.1 Case Study 1: Organization A

The case study conducted on organization A is discussed in this section. The facets that will be examined are an overview of the organization, the use of systems development methodologies within the organization, systems development methodologies used by the organization, contingency and systems development.

4.3.1.1 Organization Overview

Organization A is one of the leading mobile telecommunication operators in South Africa. Information regarding organization A will be addressed in this section. It was one of the first mobile operators to be launched in South Africa. It was granted two GSM network licenses during September 1993. It had an initial growth projection that provided for 250 000 subscribers within the first ten years of its launch. By 2000, the organization had by far exceeded the projected amount of subscribers and had three million subscribers.

Within five months of establishment their call volumes increased by 540%. Network capacities also expanded as fast as the equipment could be shipped into South Africa. During this period the organization was one of the fastest growing networks in the world.

By the end of 1994 they stretched their position even further by rolling out its network coverage on 3000 kilometers of the national highway. This organization also introduced the innovation of pre-loaded airtime. This substantially reduced the administration burden.

Pre-loaded units that were paid for by the operator took Community Services another step closer by providing a phone on every street corner within townships. This also ensured better safety.

Some rural areas did not have any telephones available within close proximity to the townships. The closest phones were often more than 40 minutes away.

The organization's history shows a track record of rapid advance and expansion. Several innovations made by this organization are:

- First organization to launch Global System for Mobile communication ("GSM") network in South Africa 1994
- The organization was the first to launch High-Speed Downlink Packet Access ("HSDPA") in South Africa.
- The launch of GSM networks within 4 countries by 2003.

- First organization to launch the third generation of developments in wireless technology (“3G”) in South Africa.

Organization A is definitely one of the biggest telecommunication organizations in South Africa as well as one of the largest overall organizations. Two representatives were willing to conduct short interviews for the case study.

The two representatives differ both in experience and the level in which they currently operate in their given occupations.

Summary of representatives interviewed		
<i>Representative No:</i>	<i>Job Title</i>	<i>Experience in current occupation (Years)</i>
<i>A1</i>	Executive Head of Group Strategy and Research	4
<i>A2</i>	Software developer/Application supporter	4

Table 4.1 Organization A representatives

As can be seen from table from Table 4.1, representative A1 is the Executive Head of Group Strategy and Research for organization A.

Representative A1 pointed out that “I focus more on the functional specification of systems development to meet the business objectives”. Representative A1 is involved in systems development within the organization. Representative A2 is a software developer/application supporter for organization A.

They both have acquired different skill sets and they volunteered insightful information regarding their different approaches.

As these representatives work at different levels of the organization the approaches to systems development remarkably differs, and each representative’s interview will be discussed separately. There exists a high level of systems development within the organization and a lower level, at which different systems are developed.

Organization A develops a variety of systems. Information gathered from the case study indicate that organization A develops knowledge management tools, corporate library system, mobile applications of enterprise solutions, social media for enterprises as well as work flow applications. Development is not only restricted to in-house development for organization A.

They also tailor purchased systems depending on the availability of appropriate readymade systems. Organization A also uses systems development methodologies when developing new systems or tailoring readymade systems. The sizes of these projects differ as they can range from small applications to colossal enterprise applications.

The time for completion also varies from several months to several years, depending on the size and requirements of the project. Some projects initially commence with expected completion within 6 months and end up running for 2 or more years. Development usually takes place in groups of 5 to 9 people.

An overview of organization A was given in this section. In the next section the used of systems development methodologies will be addressed.

4.3.1.2 Organization A's use of systems development methodologies

It is certain from the case study conducted on organization A that they do use systems development methodologies, which will be covered in this section. When asked if the organization uses a systems development methodology both the representatives answered yes. The representatives did however refer to different types of methodologies used within the organization.

This variance may possibly be explained by the different levels at which the representatives operate within the organization. Representative A1's occupation is at a very high level within the organization and named that they use Structured Systems Analysis and Design Method ("SSADM") and the CAP-Gemini systems development methodology.

These methodologies are determined by the organization and never change. The use of this methodology for this level can probably be attributed to the development of a functional technical specification as stated by representative A1. The representative stated that focus was placed more on functional specification in order to meet the business objectives. At this level systems are also purchased 60% of the time and only developed in 40% in-house, according to representative A1.

The two methodologies that organization A uses at a higher level will be discussed briefly by an examination of the organization's goals and the basic structure of the systems development

methodology process model. The SSADM has a number of objectives. It ensures that the project can continue when a loss of staff occurs without having a damaging effect on the project. Overall it delivers better quality systems.

According to representative A1 it improves the management of the project as well as control over the project. The SSADM uses a waterfall approach whereby a sequence of events are run in series and each new step follows from where the previous step ended.

This methodology, as implemented by organization A has five steps, namely:

Feasibility study=> Requirements Analysis=> Requirements Specification=> Logical System Specification=> Physical Design

The other systems development methodology that representative A1 stated the organization uses is CAP-Gemini. The systems development methodology is used as it exists and is not tailored for specific projects. The CAP-Gemini systems development methodology is an improvement over SDM (Systems Development Methodology) and is also called SDM2 (Systems Development Methodology 2). CAP-Gemini is a waterfall model that is divided into seven phases, each phase having a clearly defined start and end.

At the end of each phase it delivers sub-products called milestones. Before starting each phase an agreement is reached detailing the activities that should be addressed in that phase, these documents are known as milestone documents.

Representative A1 stated that the 7 phases that are executed successively are:

- Problem definition
- Definition study
- Design
 - Global design (combines functional and technical design to give a broad design of the system)
 - Detailed design (builds on the global design by creating more detailed designs, afterwards it is divided to generate the separate parts of the system to develop)
- Building system
- Testing
- Implementation
- Operation and Support

Representative A2 who is at a lower level within the organization stated that they use a hybrid of methodologies to assist in systems development.

This hybrid consists of a combination between a basic waterfall systems development methodology which has an incremental approach and rapid application development. One of the techniques that are used by the hybrid methodology implemented by the organization is prototyping. The systems development methodology that representative A2 states the organization uses is that of various methods. Firstly the structure is based on the traditional waterfall model where the steps are:

- Define the problem statement
- Look for solutions
- Design solution
- Develop solution – Achieved by prototyping
- Test solution
- Implement solution

This systems development methodology is then executed in a similar way to rapid application development. It is thus a fully functional hybrid systems development methodology. The main goal of this hybrid model is to provide a guideline for systems development. It aims to aid in developing software systems that meet the requirements stated before development.

The development of systems at the lower level greatly depends on the requirements, the deadline and the resources available in the organization. If the need requires a system to be developed in-house, the organizations capability to do so is measured first.

It is apparent from the interviews conducted with both these representatives that the systems development methodologies is used and implemented at both their levels respectively. The systems development methodologies are listed in Table 4.2.

What systems development methodology is currently used by the organization?		
<i>Representative</i>	A1	A2
<i>SSADM</i>	X	
<i>CAP-Gemini</i>	X	
<i>Hybrid Methodology</i>		X

Table 4.2 Systems development methodologies used by organization A

Representative A1 however states that the systems development methodology used at the higher level is used as is, and not tailored. Whereas representative A2 states that the systems development methodology used at the lower level is indeed tailored to fit the specific needs of each project. The use of systems development methodologies by organization A was addressed in this section. In the next section the system development methodologies used by organization A will be discussed.

4.3.1.3 System development methodology used by organization A

Information regarding the use of systems development methodologies for organization A indicates that they use at least three systems development methodologies, which will be addressed in this section.

These methodologies are the SSADM, the CAP-Gemini systems development methodology and a hybrid systems development methodology. In order to get a better understanding of these systems development methodologies, each is discussed under the definition of a systems development methodology as proposed by Huisman and Iivari (2006:32).

The first systems development methodology, being the SSADM, as used by organization A, is summarized in Table 4.3. As stated by representative A, this systems development methodology is used mostly for developing larger systems within the organization.

Discussion of the systems development methodology used by organization A	
Systems development method:	SSADM (Structured Systems Analysis and Design Method)
Philosophical view:	Process oriented
Process model:	<p>A step by step development process where the project is built from the ground up. Particular emphasis is placed on the analysis of end-user requirements. At the same time, the systems model is developed and a complete demand analysis is carried out. Both of them are then attempted to determine if they are well well-matched.</p> <p>The process model is a waterfall approach, there are sequences of events that run in series and each step starts after the previous one is completed:</p> <ul style="list-style-type: none"> • Feasibility Study • Requirements Analysis • Requirements Specification • Logical System Specification • Physical Design • Implementation
Tools and techniques:	<ul style="list-style-type: none"> • Entity Behavior Modeling

	<ul style="list-style-type: none"> • Documentation • Data Flow Modeling • Logical Data Modeling
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Table 4.3 Summary of the first systems development methodology used by organization A

Representative A1 states that the systems development methodology summarized in Table 4.3 is used due to its various benefits. These benefits include better planning before development, the ability to respond to any changes that may arise as well as better quality systems being delivered. The second systems development methodology as used by organization A is the CAP-Gemini systems development methodology. A summary of CAP-Gemini is given in Table 4.4.

Discussion of the systems development methodology used by organization A	
<i>Systems development method:</i>	CAP-Gemini (also known as SDM2)
<i>Philosophical view:</i>	Process oriented
<i>Process model:</i>	<p>Breaks the development down into smaller components. Each component delivering a milestone. Each phase needs to be successfully completed in order to move onto the next phase. It is a top-down development process. End-user involvement is present.</p> <ul style="list-style-type: none"> • Problem definition • Definition study • Design <ul style="list-style-type: none"> A. Global Design B. Detailed Design • Building system • Testing <ul style="list-style-type: none"> A. Systems test B. Acceptance test • Implementation • Operation and Support
<i>Tools and techniques:</i>	<ul style="list-style-type: none"> • Milestone reports

Table 4.4 Summary of the second systems development methodology used by organization A

The CAP-Gemini systems development methodology that is used by organization A is very useful for the development of small or medium sized telecommunication systems. It allows for changes to be made throughout the development of the system. End-user involvement also plays a major part in the use of this systems development methodology. At the end of each phase a milestone report is produced. This report is then used as a guideline for the next phase to be undertaken. Representative A1 stated that neither one of the two abovementioned systems development methodologies that are used by organization A is tailored to fit specific projects. These methodologies are used as and are implemented without any changes. This could possibly be attributed to the development taking place at a much higher level within the organization. Strict development is undertaken and no deviations are permitted.

The third systems development methodology used by organization A is the Hybrid systems development methodology. The hybrid is made up of two very different system development methodologies. It combines the best attributes from the waterfall model and rapid application development. In doing so it delivers a methodology that can easily be adapted for each project. Representative A2 stated that this methodology is implemented at a lower level within the organization and is tailored to suit the needs of the projects. A summary of the hybrid systems development methodology used by organization A is given in Table 4.5.

Discussion of the systems development methodology used by organization A	
<i>Systems development method:</i>	Hybrid systems development methodology (combination of waterfall model and rapid application development)
<i>Philosophical view:</i>	Fast development
<i>Process model:</i>	Incremental development. System is broken down into smaller components. <ul style="list-style-type: none"> • Problem definition • Solution definition • Design • Development - Prototyping • Testing • Implementation
<i>Tools and techniques:</i>	<ul style="list-style-type: none"> • Prototyping • Re-usability of code

Table 4.5 Summary of the third systems development methodology used by organization A

A written example of this methodology was received from representative A2. It indicates that the basic structure is that of the waterfall model. What makes this hybrid unique is that it uses this model and implements it incrementally. It goes through the development process a few times, each increment adding more usability to the system by means of prototyping until it is

complete. When asked if the systems development methodologies are adapted for each project, representative A2 replied in the affirmative, the organization does indeed tailor this methodology to suit each project they develop. By careful analysis the requirements of the given project, the project team can determine the number of iterations necessary to develop the system successfully as well as meet the time constraints of the project.

The experience needed for each project as well as the resources required also plays a major role in the adaptation of the systems development methodology. It can thus be assumed that organization A has at least three systems development methodologies. Two of them are used at a high level. Each of these can be used for differently sized projects. SSADM is used for large systems whilst CAP-Gemini is used for medium to smaller systems development. The systems development methodology used at the lower level can be used for any type of system that requires development at that level.

The system development methodologies used by organization was addressed in this section. The next section will address the contingency criteria used by organization A.

4.3.1.4 Contingency criteria used in organization A

Due to the nature of the case study done on organization A, it is necessary to look at the criteria used for both the high level and the lower level systems design. The criteria used for systems development methodology contingency will differ between the levels, which are addressed in this section.

At the higher level, two systems development methodologies are used. By looking at the size of the project the systems development methodology is chosen.

In the case of a large system that requires development the SSADM will be chosen. This will best fit the requirements of a large system. When asked if the organization uses criteria for selecting a system development methodology, representative A1 replied in the affirmative. The organization has a set list of criteria that determines which methodology to use.

When a small to medium system needs to be developed they use the CAP-Gemini systems development methodology. CAP-Gemini is best suited for smaller types of systems. The organization also develops a wide range of systems which necessitates the need to have more than one development approach at hand.

The lower level uses one systems development methodology, namely the hybrid model. This systems development methodology is better suited at this level due to the fact that the

organization can tailor the methodology to suit the requirements of each individual project. The hybrid model also permits code reusability which can enhance development.

As can be seen in Table 4.6, the criteria used for choosing a systems development methodology differs between the two representatives. Representative A1 states that the experience needed and the project size affects the choice of the systems development methodology. This can possibly be due to the level of systems development at which representative A1 operates and also because at the higher level the organizations has more than one systems development methodology.

How is a systems development methodology chosen when developing a system?		
<i>Representative</i>	A1	A2
<i>Experience Needed</i>	X	
<i>Project type</i>		X
<i>Resources</i>		X
<i>Project Size</i>	X	X

Table 4.6 Contingency criteria used in organization A

Representative A2 however states that the type of the project, the resources and the project size contributes most to the selection of a systems development methodology. It can be deduced that at the lower level the type of adaptation of the systems development methodology plays a role, rather than choosing between systems development methodologies.

Adapting a systems development methodology is akin to choosing one, this is because systems development methodologies that are tailored is unique to each project. This can be seen as a second level of contingency, where a systems development methodology is tailored for each specific project.

A deduction can also be made that control is much stricter at higher levels of systems development within the organization. This was informed by representative A1 who stated that the criteria used is indeed controlled, and strictly so. Representative A2, however, stated that the criteria used when selecting a systems development methodology is not strictly controlled.

This leads to another deduction that can be made, namely that organization A does not control criteria as strictly at a lower level. There appears to be different levels of criteria control within the organization. Criteria are controlled uniquely within each level of the organization.

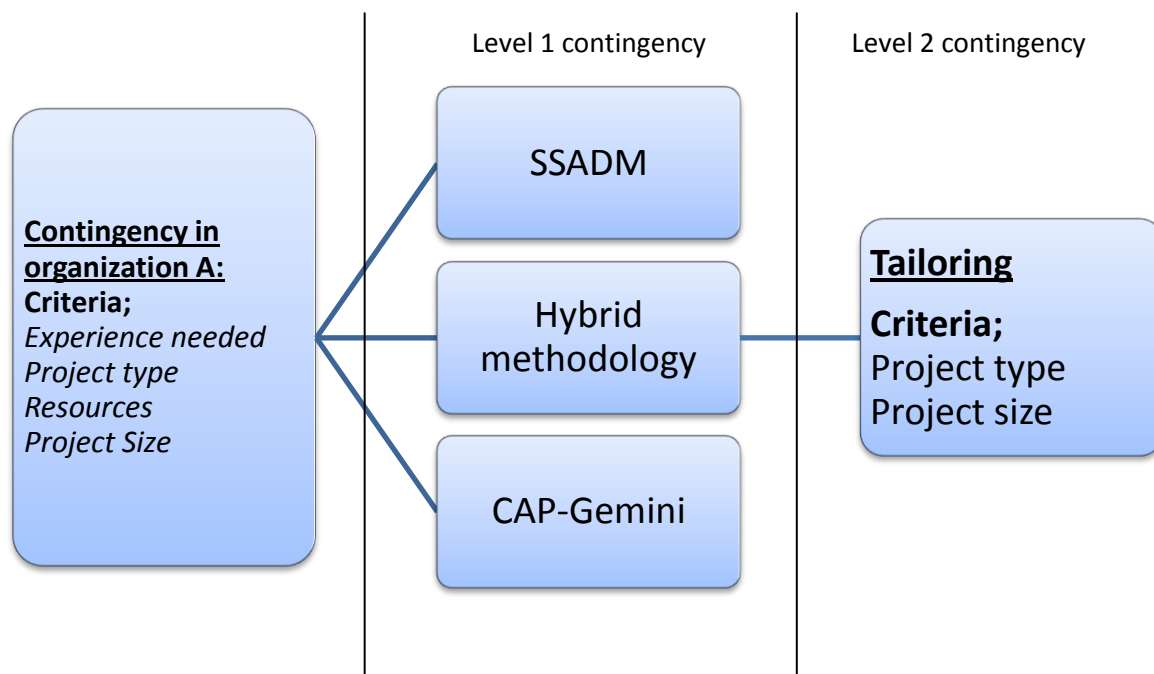


Figure 4.1 Graphical representation of contingency in organization A

Figure 4.1 indicates how contingency is used in organization A. There exist two levels of contingency within the organization. The first level is used for systems development methodology selection and the second level is the tailoring of the systems development methodologies. The contingency criteria used by organization A was discussed in this section. The next section will address the development of telecommunication systems by organization A.

4.3.1.5 Development of telecommunication systems

Organization A is one of the largest mobile telecommunications organizations in South Africa. However it does not specialize in the development of telecommunication systems only, which will be addressed in this section.

A wide range of systems are developed within the organization, these are telecommunication systems, knowledge management tools, corporate library systems, mobile applications of enterprise solutions, social media for enterprises as well as workflow models, to name but a few. Different systems are developed at different levels within the organization.

The representatives were asked if they believed there was a difference between developing systems for telecommunications and developing systems for other industries such as the insurance sector or other industries.

Both the representatives stated that their industry does in fact differ from that of other systems development sectors. Representative A2, however, states that in some cases it can be similar, depending on the knowledge of the developers. The representative stated that “in some ways it can be similar and in others it will be different, depending on what you are familiar with”.

One aspect of telecommunication systems development that representative A2 highlights is that when developing telecommunications solutions, many different parties can be involved and it therefore requires a robust and reliable integration platform. In some instances it can even require more than one integration platform.

Representative A2 views the similarities of development in telecommunications and that of other industries due to the level at which representative A2 operates in system development. Representative A2 may have a very different approach to developing systems than A1. Representative A2 may also discern similarities in development due to the use of a hybrid systems development methodology which can be applied to various types of systems.

The representatives have mixed feelings regarding the use of systems development methodologies. They were questioned regarding the use of systems development methodologies and whether or not they contribute to the success of a project. Representative A1 stated that they have no effect on the success of a system’s development. This could most likely be due to the low success rate of systems development in the organization at a higher level as stated by representative A1. The candidate stated that “none” of the systems development projects are completed successfully.

Project failure rates are much higher and representative A1 attributes the failure of such projects to the use of systems development methodologies. Representative A1 noted that “the systems development methodologies have no effect on the success of projects, in most cases failure could be attributed to a systems development methodology that was followed”. Another possible cause of a high failure rate is due to incorrect systems development methodologies applied to the development of such systems.

Representative A2 stated if a methodology is followed it could positively impact the quality of the system that is developed and also increase the rate of success. Representative A2’s statement can be linked to the high success rate of systems development at the lower level. A

correlation can be made between the use of the systems development methodologies and the success rates of the systems development.

The development of telecommunications by organization A was addressed. The next section contains final notes on organization A as well as a summary of the findings.

4.3.1.6 *Final notes on organization A*

From the information gathered by the case study approach, it is apparent that organization A has different success rates at different levels of systems development within the organization. The organization develops systems at different levels and takes different approaches to systems development.

A1 stated the organization develops, “enterprise solutions to services, which affect more than 5000 people and should be scalable to accommodate operating companies”. At a higher level they purchase ready-made systems 60% of the time and tailor them and develop systems in-house for the other 40% of the time.

At the lower level system development and tailoring is more evenly distributed. Requirements and availability of ready-made systems should be factored in. When questioned about the success of systems development representative A1 stated that none of the systems are completed successfully.

The representative states directly that time “should be 6 months but ends up being 2 years”. This can be attributed to the projects all exceeding time and budget constraints.

Representative A1 who operates within a higher level, measures the success of the project by looking at three main elements. The projects should be completed within time and budget and should meet the business requirements. If any one of these elements is not met, the system is not deemed successfully completed. This may indicate that some projects may possibly achieve all of the business requirements but could possibly have exceeded budget or time constraints.

Representative A1 states that the systems development projects exceed budget and time in 99% of the systems the organization develops. When asked about communication representative A1 stated the following: “Good relationships but they are not very good communicators so confusion is created quite often due to bad communication rather than no communication”. This could possibly have an effect on the success of systems development.

Representative A2 who develops systems at a lower level within organization A states that most systems are completed successfully. These successes are measured by the amount of systems that meet the business requirements.

The representatives stated that “90% or more of projects are completed successfully (if you ignore deadlines), 50% of projects overshoot the deadline because of scope creep”.

The reason for such low achievement rates is attributed to unforeseen problems arising during development. Representative A2 states that deadlines are only missed due to scope creeps. Time constraints seem to be exceeded more often than that of budget constraints. Representative A2 states that time constraints are more likely to be exceeded than budget constraints.

Summary Organization A

Systems development methodology used:

- Structure System Analysis and Design Method
- CAP-Gemini
- Hybrid Methodology

Contingency criteria:

- Experience needed
- Project type
- Resources
- Project size

Advantages of systems development methodology used

- CAP-Gemini delivers structure.
- Hybrid Systems development methodology allows systems to be developed fast.

Disadvantages of systems development methodology used

- Poor project success results are indicated at level where SSADM and CAP-Gemini are used.

Influence of systems development methodology

- At lower level of development the Hybrid Methodology indicates positive project success results.

- At higher level of development the SSADM and Cap-Gemini indicate negative project success results.

This concludes the research on organization A. The next section will list a number of propositions that have been made in regards organization A.

4.3.1.7 *Propositions made for organization A*

Proposition 1

Telecommunication organizations in South Africa use different types of systems development methodologies

The results of the case study conducted on organization A, indicates the organization uses different systems development methodologies.

It is therefore proposed that different systems development methodologies are used to develop systems within this organization. Different methodologies are used at different levels within the organization.

Proposition 2

Systems are developed at different levels within telecommunication organizations in South Africa.

It is proposed that organization A develops systems at different levels within the organization. This is gathered from the information gained from the case study. The two representatives interviewed both occupied different positions within the organization. Both the representatives used different approaches to systems development and both of them developed different types of systems within the organization.

Proposition 3

Systems development methodologies are adapted within telecommunication organizations in South Africa

It can be deduced from the case study that organization A adapts systems development methodologies at a lower level within the organization. The system development methodology used for developing various systems should be adapted for each new systems development project, to suit the requirements of that project. Tailoring is done by looking at the requirements of the project and the resources the systems development project will require.

Proposition 4

Telecommunication organizations in South Africa use Cap-Gemini, SSADM and Hybrid methodologies to develop systems

The case study results indicate that organization A uses at least three systems development methodologies. The methodologies that the organization uses are applied at different levels.

It is therefore proposed that organization A uses CAP-Gemini, SSADM (Structures Systems Analysis development methodology) and a Hybrid systems development methodology for developing systems. This information is clearly shown from the data gathered.

Proposition 5

Systems are developed both in house and purchased by telecommunication organizations in South Africa

The results of the case study show that in organization A systems are developed both in-house as well as purchased. It can be assumed that organization A makes use of both ready-made systems as well in-house development to meet their needs. This assumption is true for both the high level systems development and the low level systems development within the organization.

Proposition 6

Criteria such as, experience needed, project type, resources and project size are used by telecommunication organizations in South Africa to select systems development methodologies.

It is deduced from the results of the case study that organization A does indeed have criteria control measures intact. Criteria are controlled at different levels within the organization A. It is proposed that organization A exercises criteria control at each level for systems development within the organization.

Proposition 7

Different types of systems are developed by telecommunication organizations in South Africa

Organization A develops different types of systems. The information gathered from the case study indicates that the organization, albeit a telecommunications organization, develops a

wide variety of systems. It can be deduced from these findings that organization A develops both telecommunication systems as well as other types of systems, not necessarily specializing in any one of them.

Proposition 8

Project development success rates differ within telecommunication organizations in South Africa

The success rate of system development differs within organization A. The results from the case study indicate that most of the systems developed at a higher level are not completed successfully. Organization A uses systems development methodologies at the higher level of development which seem to have no positive effect on the success of the systems development projects. It is therefore proposed that the use of a system development methodology does not always improve the success rate of systems development projects.

4.3.2 Case Study 2: Organization B

The next section addresses the case study conducted on organization B. The facets that will be examined for organization B is an overview of the organization, the use of systems development methodologies within the organization, systems development methodologies used by the organization, contingency and systems development.

4.3.2.1 Organization Overview

Organization B is another one of the mobile telecommunication service providers available in South Africa, which is addressed in this section. The organization received its operating license only in 2001 and a spectrum license a few months later. These licenses were only valid for a 15 year term with a renewal option. It depended on another leading mobile telecommunications service provider for a roaming service. It began to roll out community service telephones in 2003 in line with its license obligations. This organization currently has approximately seven million subscribers.

Organization B currently covers more than 30% of the South African geographic and 87% of the population. The network provided by this organization is fully edge enabled. The organization is currently planning to take the lead in the telecommunications race. The organization is described as the possibilities provider.

Although this organization is driven by low priced telecommunications provisioning it is also moving its focus to a more intuitive market. Although organization B is one of the youngest cellular telecommunication service providers in South Africa is distinguishes itself by placing unique products and services on the market.

This organization aims to deliver despite the toughest problems yet faced by mobile telecommunication providers in 2010, namely Rica, recession and the reduction of operating costs.

The notable advances made by this organization are:

- The first telecommunications network to operate on a dual band network.
- The first telecommunications network to offer cost-effective call options like per second billing.
- Currently planning on introducing the first HSDPA +900 network in South Africa

In order to gather data for the case study on organization B, interviews were conducted with two representatives that work in the systems development department. The two representatives both occupy managerial positions within organization B. The organization uses two approaches to developing systems; they develop systems in-house as well as outsource systems to other systems development companies.

Representative B1 is a senior manager of business analysis in the organization and is the head of the systems development department within organization B. The second representative is the service delivery manager who also works within the systems development department.

The organization develops systems to improve their service delivery. The representatives are relatively new in their current positions, both occupying them for less than two years. A summary of the representatives' expertise is shown in Table 4.7.

Summary of representatives interviewed		
<i>Representative No:</i>	<i>Job Title</i>	<i>Experience in current occupation (Years)</i>
<i>B1</i>	Senior manager business analysis	1.5
<i>B2</i>	Service delivery manager	0.5

Table 4.7 Organization B representatives

The organization develops mostly telecommunication oriented systems. The project size varies from small to very large systems. Development is done in groups; these groups also vary in size depending on the project size. The project manager is responsible for proper communication within the organization. Representative B1 states that project development times range from 10 days to 18 months. Representative B2 however has a different view and claims the average development takes place within a three month period. The reason for representative B2's answer differing from that of representative B1, is likely due to the lack of experience in his/her current position.

Representative B1 who is the senior manager of business analysis is perceived within organization B as the project manager, and the responsible party for the development of all

systems within the organization. The occupation that B2 currently occupies is the service delivery manager and can be described as a team lead that is in charge of a team of developers.

A brief overview of organization B was given in this section. The next section will look at the use of systems development methodologies in organization B.

4.3.2.2 Organization B's use of systems development methodologies

In this section organization B's use of systems development in regards to systems development is addressed. Organization B uses a framework that is used to conduct all business activities. The framework which it uses is the Enhanced Telecommunication operations Map ("eTom"). This framework was specially developed for telecommunication organizations. The eTom is an initiative developed by TeleManagement to develop a framework for business processes that can be used within the telecommunication industry. The eTom describes an organization's key business processes and seeks to analyze them according to different levels of detail.

This is done according to the significance and priority of the process within the organization. The eTom serves as a blueprint to analyze business processes. Defining a methodology to be used by the organization is part of the enterprise effectiveness category of eTom. Project management, which includes choosing systems development methodologies, is covered by the enterprise effectiveness category.

During the interview both the representatives stated that they use a systems development methodology to develop systems. The system development methodology used by organization B is the Systems development lifecycle ("SDLC") and is called the Release lifecycle model ("RLM") within the organization as shown in Table 4.8. The system development methodology used by organization B is also tailored to suit their specific needs.

What systems development methodology is currently used by the organization?		
Representative	B1	B2
<i>SDLC (Systems development lifecycle) also known as RLM(Release lifecycle model) within the organization</i>	X	X

Table 4.8 Systems development methodologies used by organization B

The basic structure of the systems development lifecycle used by organization B consists of the following steps:

- A detailed feasibility study
- In-depth investigation of the system
- An analysis of the system
- System design and development
 - Quality Checklists
- Peer review
- Implementation of the system
- Maintenance

Representative B1 states that the model used is a waterfall approach and that agile development is too mature for the organization's information technology structure and is not used. Mature in this regard refers to the complexity. The use of systems development methodologies have been addressed in this section. In the next section the systems development methodologies used by organization B will be identified.

4.3.2.3 Systems development methodology used by organization B

It is apparent from the interviews conducted with the representatives from organization B that they utilize the systems development lifecycle methodology, which are examined in this section. Representative B1 states the following regarding the use of systems development methodologies "We use waterfall at best; agile is too mature for our IT structure". This is a very simplistic systems development methodology and can be easy to follow if implemented correctly. Both the representatives agree that the systems development methodology is tailored to suit their needs.

Representative B2 implies that they have introduced a checklist into the system design and development phase of the methodology. It can be derived from the data gathered that this checklist focuses on number of systems impacted and the complexity of the system.

This checklist is used to govern the quality of the development deliverables. Another step has been added to the systems development lifecycle namely, peer reviews. This step allows the development of the system to be carried out with developers each being able to view another's

work to ensure it operates correctly and to identify early problems that may be contained within the system.

The model used by organization B is summarized in Table 4.9 below. The definition of a systems development methodology as proposed by Huisman and Iivari (2006:32) is used to indicate the different elements of the systems development methodology.

Discussion of the systems development methodology used by organization B	
<i>Systems development method:</i>	SDLC (Systems development life cycle), RLM (Release life cycle)
<i>Philosophical view:</i>	Process oriented
<i>Process model:</i>	<p>It has a flexible and iterative approach to systems development.</p> <p>An iterative process model with the following steps:</p> <ul style="list-style-type: none"> • A detailed feasibility study • In depth investigation of the system • An analysis of the system • System design and development <ul style="list-style-type: none"> ○ Quality Checklists • Peer review • Implementation of the system • Maintenance
<i>Tools and techniques:</i>	<ul style="list-style-type: none"> • Documentation (How to use manuals) • Quality checklists

Table 4.9 Summary of systems development methodology used by organization B

The release lifecycle model used by organization B is a typical waterfall model. The organization has however tailored the systems development methodology to suit the needs of the organization. The representatives were questioned regarding the tailoring of the systems development methodology they use. Representative B2 gave a detailed description of this adaptation.

The representative stated that quality checks have been added to the system design and development phase of the release lifecycle model. An extra phase has also been added namely peer review in which developers within the development group review each other's work.

In some cases the development of the project is outsourced and not developed in house. In other instances where development is possible within the organization the release lifecycle is used. Representative B2 also states "We do follow an unofficial fast-track process for some projects depending on the timelines and number of systems impacted" which usually happens when development should be done quickly, in which case the use of the release lifecycle method is then abandoned. This is determined by the size of the project and the timeline allocated to the project. If the timeline is short and the use of the release lifecycle model will take too long, the unofficial fast-track approach is used and the system is developed or tailored very fast. Representative B2 also states that the impact the project will have on other systems may determine the use of the unofficial fast-track approach. Representative B2 also noted that, "We remove an element of risk from the project by following a methodology". Both representatives state that the use of a systems development methodology greatly improves the success rate of the project.

The systems development methodology used by organization B was examined in this section. The next section examines the contingent use of systems development methodologies in organization B.

4.3.2.4 Contingency criteria used in organization B

Contingency and the criteria used by organization B is addressed in this section. The organization clearly uses two approaches to systems development. The first is a formalized systems development methodology that is adapted by the organization and the second being an unofficial fast-track development approach. It should be determined when they use which approach and which criteria they use for selecting the development approach.

The criteria are determined and controlled by the project steering committee as stated by both the representatives when asked who determines and controls the criteria used for selecting a systems development methodology. Representative B1 states that "We try to cluster projects based on size, vendor's involved and scope" regarding the use of criteria when selecting a systems development methodology.

How is a systems development methodology chosen when developing a system?		
<i>Representative</i>	B1	B2
<i>Number of systems impacted</i>	X	X
<i>Complexity of system</i>	X	X
<i>Timelines</i>		X
<i>Vendor's involved</i>	X	
<i>Scope</i>	X	
<i>Project size</i>	X	

Table 4.10 Contingency criteria used in organization B

The representatives were asked to specify the criteria for the selection of a systems development methodology as shown in Table 4.10. Both of the representatives stated that a predetermined set list of criteria is always used. This list determines the number of systems that will be impacted during development and the complexity of the system. Representative B2 states an extra criterion that is used and it is that of timelines.

The representative states that timelines are taken into account as a factor although the timelines should not have an effect on the development process. The criteria that are listed are used to determine if the release lifecycle model should be used or the unofficial fast-track approach to develop the system.

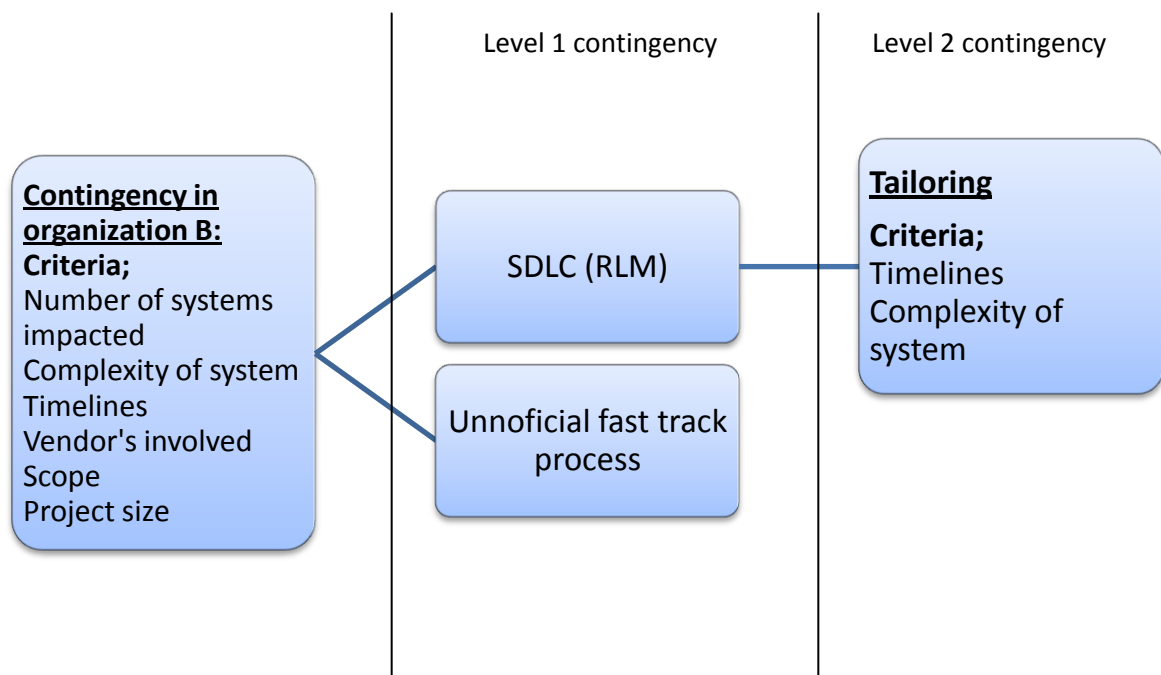


Figure 4.2 Graphical representation of contingency in organization B

The contingency of systems development methodologies in organization B is shown in Figure 4.2. It indicates that this organization has two levels of contingency. The first level applied to select a systems development methodology and the second to tailor systems development methodologies for each new project.

The contingency of systems development methodologies have been addressed in this section. The next section addresses the development of telecommunication systems in organization B.

4.3.2.5 *Development of telecommunication systems*

The representatives were questioned about the types of systems that the organization develops, which is discussed in this section. Both the representatives stated that the organization specializes in the development of telecommunication systems.

The systems developed are implemented to improve the service delivery offered by the organization.

The representatives are both currently developing systems for the organization. In this regard the representatives were asked if they thought that the development of telecommunication oriented systems differed from that of other industries. Both had different responses to this question, but agreed that it does in fact differ. Representative B1 stated that the level of tolerance for faulty systems within telecommunications is highly scrutinized against. The representative states that systems like customer data and customer billing should be correct and accurate at all times as this can have an effect on the customer experience.

Representative B2 states that in some cases there is no test environment and system success can only be determined after it has been implemented. This leads to development and implementation that should be extremely well planned and executed.

Although the answers differ from the two representatives they are not different in substance. Both only confirmed at least one element of how telecommunications differs from that of systems used in other industries. The representatives agree that there is a very low level of fault tolerance in the development of telecommunication systems.

4.3.2.6 *Final notes on organization B*

It is gathered from the case study organization B that the organization specializes in the development of telecommunication oriented systems. The representatives were questioned regarding the success rate of systems development within the organization. The two

representatives gave two very different answers. Representative B1 stated that 60% to 70% of the systems are developed successfully. The representative states that the systems that exceed time and budget are deemed unsuccessful projects even if it meets all the requirements set out by the organization.

Representative B2 however stated that 90% of the projects that are developed are completed successfully. This representative also stated that 50% of the projects exceed budget and time constraints. The representative attributes success to the project meeting all of the requirements.

A system can thus exceed budget and time constraints and still be successful according to representative B2. Representative B1 states that organization B develops systems that range from 10 days to 18 months, in terms of costs these systems can cost anything from a thousand rand to millions of rands. Representative B2 however, is unsure of the size of the projects and states that “I don’t know how to put the size of the projects into words”.

Summary Organization B

Systems development methodology used:

- SDLC (RLM)
- Unofficial fast track development process

Contingency criteria:

- Number of systems impacted
- Complexity of system
- Timeliness
- Vendor’s involved
- Scope

Advantages of systems development methodology used

- Simplistic systems development methodology and can be easy to follow if implemented correct.
- Peer reviews
- Quality checklist used to govern development deliverables

Disadvantages of systems development methodology used

- SDLC not adequate for fast development

Influence of systems development methodology

- Overall the systems development methodologies indicate positive results with more than 50% of projects delivered on time and within budget.

This section addressed the development of telecommunication oriented systems by organization B. In the next section the list of propositions made for organization B will be listed.

4.3.2.7 *Propositions made for organization B*

Proposition 1

Telecommunication organizations in South Africa use systems development methodologies in the development of in-house systems and tailoring of systems.

The findings of the case study conducted on organization B indicate that it uses systems development methodologies to develop systems in-house as well as tailor outsourced systems. It can be deduced that a systems development methodology can be used for both in-house development as well as the tailoring of ready-made systems that are outsourced.

Proposition 2

Telecommunication organizations in South Africa use more than one approach when developing systems.

Organization B uses different approaches to system development. This is gathered from the case study that was conducted on organization B. The organization uses both a systems development methodology as well as an unofficial fast-track approach to develop systems. It is therefore proposed that organization B uses more than one method for developing systems.

Proposition 3

Telecommunication organizations in South Africa have a low tolerance for inaccurate data.

It is deduced from the research that telecommunication has a low tolerance for inaccurate data. In some cases there is no test environment for development and the systems are taken directly into production without testing and integration. The systems must be developed accurately and correctly, there is no room for error.

Proposition 4

Telecommunication organizations use frameworks specifically developed for telecommunications to manage business processes.

Organization B has adopted a business process management framework developed specifically for telecommunications. The organization uses a framework developed especially for telecommunications namely the eTom (Enhanced Telecommunication operations Map). It is proposed the use of this framework can assist telecommunication organizations in managing all the business processes including systems development.

Proposition 5

Telecommunication organizations in South Africa use criteria such as number of systems impacted, complexity of system, timelines, vendor's involved and scope when selecting a systems development methodology for systems development.

The case study indicates that specified criteria are used in organization B when selecting a systems development methodology. The representatives interviewed stated that the criteria is a set list and permits no variation.

Proposition 6

Telecommunication organizations in South Africa exercise control of the criteria used when selecting systems development methodologies.

The research indicated that organization B exercises control of the criteria used when selecting systems development methodologies. As stated by the representatives that were interviewed, the criteria are controlled by a project steering committee. It is proposed that organization B controls the criteria used when selecting a system development methodology for a project.

Proposition 7

Telecommunication organizations in South Africa tailor system development methodologies when developing systems.

The case study conducted on organization B indicates that the system development methodology used by organization B is adapted to suit the needs of the organization. The representatives stated that the methodology they use, namely the release life cycle, is indeed adapted.

They have accomplished this by adding a phase as well as an additional element to one of the existing phases. A proposition is made that organization B adapts a system development methodology to suit the specific needs of the organization.

Proposition 8

Telecommunication organizations in South Africa specialize in the development of telecommunication oriented systems.

The representatives interviewed stated that organization B specializes in the development of telecommunication systems only. It is deducted from this information that organization B specializes in the development of telecommunication specific systems and only develops systems for telecommunications.

4.3.3 Case Study 3: Organization C

This section will examine the case study conducted on organization C. It will address the following facets for organization C, an overview of the organization, the use of systems development methodologies within the organization, systems development methodologies used by the organization, contingency and systems development.

4.3.3.1 Organization Overview

An overview of organization C is addressed in this section. Organization C is South Africa's first converged telecommunications network provider. This simply means that Internet, voice and data is offered on a single connection. The organization claims that by using advance technologies it delivers enhanced value added services. The organization provides services for wholesale, business and home users. They have acquired both an Electronic Communication Network Service License and an Electronic Communication Network License which allows the organization to provide the complete range of telecommunication services.

The organization is relatively new and currently only covers all metropolitan areas in South Africa, but is expanding on a continual basis. The organization's partnership with an international company allows it access to international best practices as well as the latest technological innovations.

Pre-paid vouchers are one of the first practices introduced by this organization; this allows easy access to their products and services. Organization C currently has strategic partnerships with major brands to ensure they deliver the best services possible.

Notable advances by this organization include:

- The first converged telecommunications network provider in South Africa.
- Use of optical fibre based networking.
- The use of digital transmission to move voice and data reliably across networks.
- The implementation of packet networks to provide resilient, flexible information routing.
- Usage of next generation networks that intelligently control content flow over the network.
- The use of broadband wireless, as well as fixed, wireless, copper and fibre access technologies to allow user connectivity.

The systems development group of organization C was interviewed for the case study. Four representatives were interviewed regarding the development of systems and use of systems development methodologies within organization C. All four of these representatives worked at the same level of systems development.

The expertise of the representatives ranged from a year and a half to three years experience in their current occupations. Table 4.11 summarizes the representatives interviewed from organization C.

Summary of representatives interviewed		
<i>Representative No:</i>	<i>Job Title</i>	<i>Experience in current occupation (Years)</i>
<i>C1</i>	Lead enterprise unit	2.8
<i>C2</i>	Production support executive	3
<i>C3</i>	Production support executive	3
<i>C4</i>	Production support executive	1.5

Table 4.11 Organization C representatives

Organization C specializes in the development of telecommunication oriented systems. The types of systems that the representatives develop are mostly support systems that improve the functionality of their services.

They develop in-house systems as well as purchase ready-made systems and tailor them if needed. Development of these systems are done fast and frequently, may often be completed within a week or two. The development takes place in a group of four people with a single project leader who oversees the projects.

The main development that these representatives focus on is operational change request support. They develop initiatives for the operational change request to improve systems functionality. An overview of organization C was provided in this section. The next section will examine the use of systems development methodologies in organization C.

4.3.3.2 Organization C's use of systems development methodologies

Organization C has a well structured approach to systems development, which is examined in this section. Each representative interviewed stated that they use the systems development life cycle (“SDLC”) systems development methodology. The representatives clearly understood their roles as well as the approach they should take with each systems development project. Table 4.12 indicates that all the representatives interviewed from organization C agreed on the systems development methodology used.

What systems development methodology is currently used by the organization?				
Representative	C1	C2	C3	C4
SDLC (Systems development lifecycle)	X	X	X	X

Table 4.12 Systems development methodologies used by organization C

The reason that these representatives all agree on the systems development methodology used by the organization for the development of systems could possibly be due to good communication within the group and the fact that they work closely together when developing systems.

Avison and Fitzgerald claims that the SDLC “has an enormous influence as a general approach to systems development” (Avison and Fitzgerald, 2006:31).

Organization C specializes in telecommunication systems development and this allows the development team to use a general approach to systems development as they always develop the same types of systems. This assumption can be made as all the representatives claim that they only develop telecommunication oriented systems. Representative C4 states, “We do both. It all just depends on the needs of the organization” regarding the development of systems in-house and tailoring of ready-made systems.

The systems development life cycle consists of a number of steps that are repeated in recursion until the best solution to the problem definition is found. This is also known as the waterfall approach to systems development.

The basic steps for developing systems are:

- Feasibility study
- System investigation
- Systems analysis
- System design
- Implementation
- Review and maintenance

These steps are repeated in recursion step by step until a solution is found. This systems development methodology is suitable for organization C. The representatives all state that the use of a systems development methodology improves the success of the project and that this approach has shown great results.

When asked about whether or not systems development methodologies can have an impact on the success of a system representative C2 answered “Most definitely, without guidelines for development the project could become unmanageable”.

The use of systems development methodologies by organization C was examined in this section. The next section will examine the systems development methodology used by organization C.

4.3.3.3 System development methodology used by organization C

The systems development methodology used by organization C is the SDLC, which is examined in this section. This was stated by all of the representatives interviewed. The systems development methodology used by organization C indicates no adaptation or variance. Representative C1 gave information regarding the development of their systems. Representative C1 states that they develop the system in Dev Instance, a software package used by the organization for specific development. After they have completed development, they move the system on to unit testing. If the unit test succeeds they move it on to the SIT (systems integration testing) department to check the system for integration testing. This is then followed by moving the system on to user testing. After user testing succeeds the system is moved on to production.

Organization C’s involvement of end users in the testing phase allows the development team to gain valuable information regarding the system and whether or not the system is fully functional and meets all the requirements. A summary of the systems development methodology used by organization C is given in Table 4.13. The systems development

methodology is summarized by using the definition of a systems development methodology as given by Huisman and Iivari (2006:32).

Discussion of the systems development methodology used by organization C	
<i>Systems development method:</i>	SDLC (Systems development life cycle)
<i>Philosophical view:</i>	Process oriented
<i>Process model:</i>	Flexible and iterative design approach. Finds problems and tries to find a solution, the best solution. An iterative process model with the following steps: <ul style="list-style-type: none"> • Feasibility study • System investigation • System analysis • System design • Implementation • Review and maintenance
<i>Tools and techniques:</i>	<ul style="list-style-type: none"> • Documentation (How to use manuals)

Table 4.13 Summary of systems development methodology used by organization C

The systems development life cycle meets the requirements of the organization and does not necessitate tailoring. The systems development methodology is used by the organization and is implemented in full. According to the information gathered from all the representatives, no adaptation is done at all. Representative C2 for example states that “We do not adapt the SDLC for each project, it is always the same”. Organization C thus utilizes the systems development life cycle in full. Representative C3 made the following remark “We do not tailor the SDLC, we use it as is because it meets our needs”.

The systems development methodology is clearly controlled by the organization, as evidence by the statements of all the representatives who confirmed they use the SDLC. Organization C is the only organization in the case study in which all representatives agreed upon the systems development methodology used.

Given that the representatives are all relatively experienced in their current positions it is clear that they are aware of the use of systems development methodologies and their advantages. Organization C is also relatively new in South Africa.

Given their partnerships in international organizations they could possibly be implementing this methodology from acquired real world experience or from other areas of systems development. The systems development methodology used by organization C was examined in this section. The next section will address the contingency criteria used by organization C.

4.3.3.4 *Contingency criteria used in organization C*

This section will examine the contingency present in organization C. Systems development projects each have special elements and approaches that need to be considered. The representatives of organization C believe that the systems development life cycle is an adequate solution to develop telecommunication oriented systems. The representatives were questioned regarding the use of criteria when selecting a systems development methodology. The criteria provided in this section are the criteria the representatives used when the organization started off in South Africa four years ago to select an appropriate systems development methodology.

Two of the representatives stated that minor and non-functional changes were important criteria when selecting a systems development methodology. This could be attributed to their experience in their current occupations, as representatives C1 and C2, are the more senior representatives. Representative C3 stated that the criteria used when selecting a systems development methodology are time, cost and resources, whilst C2 also stated that time and cost has an effect on the selection of a systems development methodology.

Representative C2 and C3 chose these criteria due to their perceptions of systems development methodologies. Representative C2 and C3 see a system development methodology as a manner of developing systems to meet certain standards and to meet all necessary requirements.

These requirements are typical business requirements which include time and cost targets. The identification of criteria as provided by the representatives is listed in Table 4.14. These criteria are applied whether a system is developed in-house or when a ready-made system is purchased and tailored to suit the needs of the organization.

How was a systems development methodology chosen when developing a system?				
<i>Representative</i>	C1	C2	C3	C4
<i>Time</i>		X	X	
<i>Cost</i>		X	X	
<i>Resources</i>			X	
<i>Project Size</i>				X
<i>Minor and non-functional change</i>	X	X		

Table 4.14 Contingency criteria used in organization C

Representative C4 only provided one, the project size. This representative states that the project size should be taken into consideration when selecting a systems development methodology. This criterion is properly based on the representative's definition of a methodology, being the basic guideline for developing a system. The project's size could possibly have an effect on these guidelines. The same guidelines cannot be used for the development of both large and small systems.

One criterion that is listed by representative C3 is that of resources, which could include people working on the project as well as hardware and software. Given that organization C utilizes many people when testing the systems they develop, resources is an important criterion when selecting a systems development methodology.

However some systems development methodologies do not include the involvement of users and other persons in the development of the system. Organization C relies on user testing to deliver good and fully functional systems to meet all requirements. The criteria that are factored in when selecting a systems development methodology is determined by the project team. All four of the representatives stated that the project team determines the criteria for selecting a systems development methodology. The criteria are however not controlled vigorously as stated by three of the representatives, representatives C2, C3 and C4. Representative C3 simple answered "Not vigorously", when asked about criteria control within the organization. In this case it is not necessary for the criteria to be controlled, as the systems development methodology has already been selected.

Representative C1 however states that the criteria are controlled, and this could be attributed to the representative's role in the team which is that of project manager. Representative C1 feels that there is a certain level of control when applied to the development of systems. The other representatives who took a different view were possibly not aware that the criteria are controlled due to them identifying the criteria themselves.

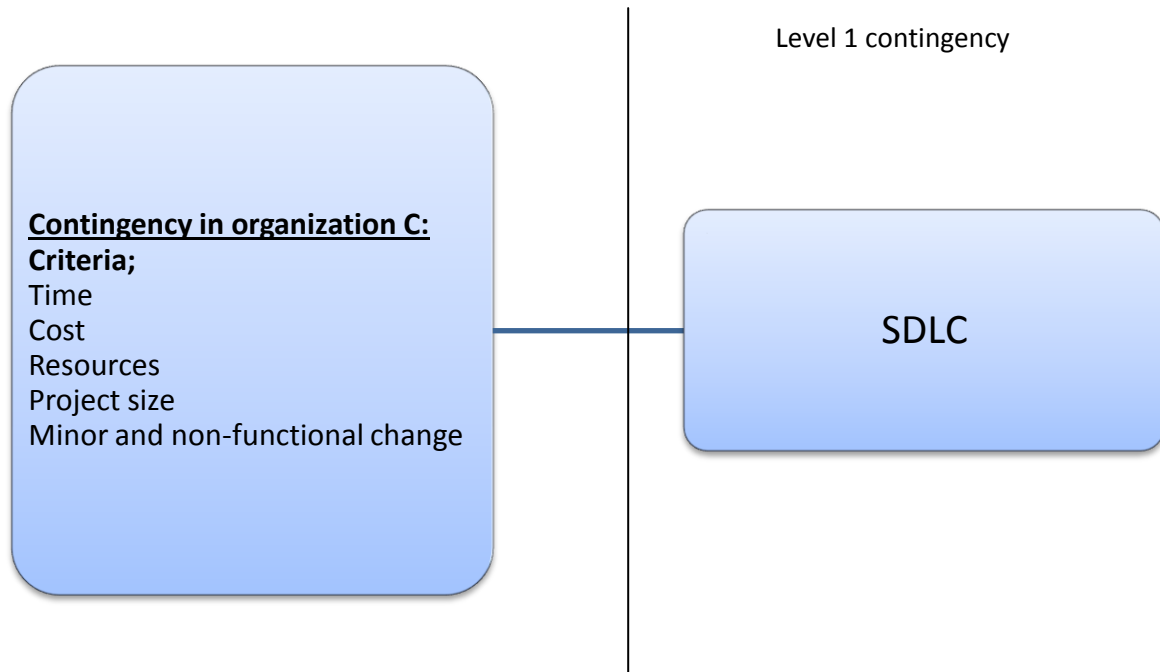


Figure 4.3 Graphical representation of contingency in organization C

The contingency used in organization C is shown in Figure 4.3. It indicates that organization C uses a single level of contingency, which was applied in the selection of their systems development methodology. The contingency in organization C was addressed in this section. The next section will examine the development of telecommunication oriented systems in organization C.

4.3.3.5 *Development of telecommunication systems*

The development of telecommunication oriented systems is addressed in this section. The results from the case study indicate that organization C strictly specializes in the development of telecommunication oriented systems. The representatives who were interviewed also stated that they only develop telecommunication oriented systems. The representatives were questioned regarding the development of telecommunication systems and whether or not such systems differed from that of other systems. All the representatives interviewed stated that they do indeed differ.

Representative C1 believed that basic knowledge of telecommunications is the most important reason they differ from the development of systems in other industries such as finance or marketing. Representative C3 and C4 also believed this to be true. Representative C2 however, provided more detail regarding the differences of developing systems for telecommunications compared with other industries. The representative said that aspects such as networking that play an important role in telecommunications, needs special attention when developing systems for telecommunications.

This section addressed the development of telecommunication oriented systems in organization C. The next section will conclude the case study conducted on organization C.

4.3.3.6 Final notes on organization C

The case study conducted on organization C is concluded in this section. The representatives that were interviewed in organization C report a high success rate in the development of telecommunication systems. When questioned about the success rate of the systems they develop, the representatives stated that almost all of their projects are completed successfully. Representative C2 stated that all of the systems are completed but a few who exceed time and budget constraints. The organization develops systems fast and efficiently.

Other representatives who admit that certain projects that are not successful categorize these as projects that exceed budget and time constraints. However this does not happen very often.

The representatives all believe that the success of the projects can be attributed to the use of a systems development methodology. Representative C1 indicates that training in the use of systems development methodologies can be beneficial to any developer. Representative C2 states that a project can become unmanageable if there are no guidelines for development. In this regard the guidelines referred to are a systems development methodology.

Another claim by representative C3 is that a systems development methodology delivers a basic structure for projects to ensure their success. When asked about the communication in the organization representative C1 stated that “we have an open development environment that is very interactive”.

Summary Organization C

Systems development methodology used:

- SDLC

Contingency criteria:

- Time
- Cost
- Resources
- Project Size
- Minor and non-functional change

Advantages of systems development methodology used

- Methodology delivers a basic structure for projects to ensure their success.
- End-user involvement.
- SDLC is used as is because it meets the requirements of the organization.

Disadvantages of systems development methodology used

- No noticeable disadvantages.

Influence of systems development methodology

- High success rates regarding systems development projects.

This section concluded the case study conducted on organization C. In the next section the propositions made for organization C will be listed.

4.3.3.7 Propositions made for organization C

Proposition 1

Telecommunication organizations in South Africa use systems development methodologies when developing systems.

From the information gathered from organization C it is clear that they use the SDLC (Systems development life cycle) to develop systems. This is a waterfall approach to systems

development. It is therefore proposed that organization C uses a systems development methodology when developing telecommunication systems.

Proposition 2

There exists a correlation between the use of systems development methodologies and the success rate of systems development projects in the South African telecommunication industry.

The success of the systems development projects could be attributed to the use of systems development methodologies. The representatives all state that they do in fact use systems development methodologies. It is also clear that they have a high success rate when developing systems. The representatives also state that systems development methodologies greatly improve the success rate of systems development. A proposition is thus made that there is a strong correlation between the use of systems development methodologies in telecommunication and the success rate of the development of telecommunication oriented systems.

Proposition 3

Telecommunication organizations in South Africa develop both systems in house and tailor ready-made systems.

The organization develops in-house systems as well as tailor ready-made systems. The organization utilizes the same systems development methodology for both these approaches, being the systems development life cycle. It is deducted that the use of a single systems development methodology could be applied to in-house development as well as tailoring ready-made systems.

The correct use of the systems development life cycle in organization C allows it to develop and adapt projects without having to choose between systems development methodologies for each new project.

Proposition 4

Telecommunication organizations in South Africa use criteria when selecting systems development methodologies.

The information gathered from organization C indicates that it used criteria to select a systems development methodology. These criteria were only used once to determine the systems development methodology to be used in organization C. The representatives interviewed stated that criteria were used to select a systems development methodology.

In this case the systems development life cycle meets all the criteria of the organization and they only use this single approach when developing systems. A proposition is thus made that criteria does indeed selection of a systems development methodology for a telecommunication organization.

Proposition 5

Criteria used for selecting systems development methodologies are not controlled in South African telecommunication organizations.

It is deducted from the findings of the case study on organization C that although criteria are used to select systems development methodologies, such selection is not controlled. This is not necessary, the criteria was only used in the initial selection of the systems development for the organization. The representatives interviewed stated that the criteria are not controlled and is determined by the organization itself. A deduction is made that although criteria are present in the selection process of a systems development project in organization C, it is not controlled. In some cases control may not be necessary.

Proposition 6

Telecommunication organizations in South Africa only develop telecommunication oriented systems.

The information gathered from the representatives interviewed shows that organization C specializes in the development of telecommunication oriented systems. The representatives stated that they only develop telecommunication systems and that the organization does indeed specialize in the development of telecommunication oriented systems. It is therefore proposed that organization C only develops telecommunication oriented systems.

Proposition 7

The development of telecommunication systems differ from other industries in South Africa.

It is shown in the findings of the case study conducted on organization C that the representatives believe the development of telecommunication systems differ from that of other industries. A proposition is made that the development of telecommunication systems does indeed differ from that of other industries.

Proposition 8

There is adequate control of business processes in the South African telecommunication industry.

There is a clear understanding of the business processes and development approaches amongst the representatives. All representatives are aware and make use of the same development approaches. This could be attributed to careful and proper management. It is proposed that organization C has adequate control measures and management that ensures all the employees in the systems development department is aware of business processes and how to apply them.

4.3.4 Case Study 4: Organization D

This case study conducted on organization D will be examined in this section. The following facets will be addresses for organization D, an overview of the organization, the use of systems development methodologies within the organization, systems development methodologies used by the organization, contingency and systems development.

4.3.4.1 Organization Overview

An overview of organization D will be addressed in this section. Organization D was the first telecommunication network provider in South Africa. They essentially started out as a telephone company in 1878. As the times changed and the country underwent changes so did the organization. The organization later expanded to include internet based networking. The organization improved operating efficiencies and cost-effectiveness and also became one of the most demographically representative organizations. Information and communication technology (“ICT”) skills development investment by the organization led to various changes within the country. The organization was listed on the Johannesburg Stock Exchange (“JSE”) in March 2003. The Electronic Communications Act of 2006 replaced the Telecommunications Act of 1996 and paved the way for service based competition and a new licensing establishment.

In 2007 organization D acquired the largest Pan-African Internet Service Provider in Sub-Saharan Africa. The organization, deemed a fixed line operator, also had a large investment in one of South Africa’s largest mobile operators. It now seeks differentiation by moving away from being a voice and data service provider to being a full technology service provider. This service will consist of fully converged voice, data, video and Internet services.

Organization D sold its investment in the mobile telecommunication operator in 2009 in order so as to permit expansion into new telecommunication areas. This transaction allowed the organization to commence certain of their strategies such as providing mobile telecommunications services. This also freed the organization of any geographical limitations imposed by their previously existing partnership.

A brief history of the organization and its advances over the years are:

- The first telecommunications operator in South Africa
- Privatized as a telecommunications service provider in 1991
- Joint ventures between international operators in 1993

- Asymmetric Digital Subscriber Line (“ADSL”) powered internet providing broadband access in 2002
- Listed on the New York Stock Exchange and the JSE Limited
- Acquisition of the largest Pan-African Internet Service Provider in Sub-Saharan Africa
- Launches its mobile network in October 2010

In organization D there are various departments that handle systems development. Interviews were conducted with six representatives from the systems development department. The representatives’ expertise ranged between system analysts and designers, software developers and project managers. All the representatives have more than two years experience in their specific occupations. Three of the representatives are more experienced and have occupied their specific positions for more than four years.

The table below, Table 4.15, shows a summary of the representatives in terms of their expertise and their current occupations.

Summary of representatives interviewed		
<i>Representative No:</i>	<i>Job Title</i>	<i>Experience in current occupation (Years)</i>
<i>D1</i>	Analyst/Designer	4.5
<i>D2</i>	System developer	5
<i>D3</i>	Team lead	4
<i>D4</i>	Solution designer	3
<i>D5</i>	Software developer	3
<i>D6</i>	Consultant/Developer	2.5

Table 4.15 Organization D representatives

The types of systems that these representatives develop for the organization are mostly Network inventory oriented systems. These systems are generally Open Source System (“OSS”) suites that are tailored and integrated with other systems currently in use in the organization. These projects usually take more than two months to develop. Some of the larger projects can continue for a year or more. The development team varies in size, from three to nine people. The number of personnel depends on the size of the project and the expertise required. A framework, specifically designed for the organization is used to conduct

business activities. This framework also imposes a systems development methodology that should be used. The framework is called the Solution Value Chain (“SVC”). The systems development methodology imposed by this framework is called the SVC systems development methodology. It is important to acknowledge that they could be confused. In the chapter when referring to the SVC it will mostly be that of the systems development methodology.

An overview of organization D was addressed in this section. The next section will examine the use of systems development methodologies in organization D.

4.3.4.2 Organization D’s use of systems development methodologies

The use of systems development methodologies in organization D will be examined in this section. Organization D has a framework that implies the systems development methodology that should be used, which includes every aspect of the design, from design through to development and implementation. This framework provides a systems development methodology that is to be used by the whole organization. The representatives that were interviewed are part of the systems development team.

What systems development methodology is currently used by the organization?						
<i>Representative</i>	D1	D2	D3	D4	D5	D6
<i>SVC</i>	X	X	X		X	
<i>Prototyping</i>				X		X

Table 4.16 Systems development methodologies used by organization D

Four of the six representatives stated that they make use of the Solution Value Chain systems development methodology, as can be seen in Table 4.16. The two representatives, who offered a different opinion, stated they made use of prototyping as a systems development methodology. This could possibly be due to the fact that they, when asked in the interview to define a systems development methodology, they could not properly provide such a definition. These interviewees see prototyping as a systems development methodology, rather than a technique used to assist in the implementation of a systems development methodology. Prototyping can be seen as a both a technique and a philosophy for developing systems as

stated by Fitzgerald *et al.* (Fitzgerald, Russo and Stolterman, 2002:50). In organization D prototyping is used as a technique within the SVC systems development methodology.

The SVC is used as a basic implementation of the traditional waterfall model. The Solution Value Chain aims to improve the quality of the solutions (systems) that are to be delivered.

The main goals are to produce these systems more effectively and efficiently. The SVC framework imposed on the organization is a control method. The SVC systems development methodology is determined by the SVC framework.

The systems development methodology is used for business systems that frequently change and applies to all the numerous business solutions including Information Technology. These ever changing business systems include planning, defining, architecture, specifying, building, testing and implementing.

The basic structure of the SVC (Solution Value Chain) consists of the following:

- Launch
 - A. Stage 0: Pre-Initiation => Pre-Initiation
 - B. Stage 1: Planning and High Level Design Phase
- Execution
 - C. Stage 2: Detailed Design => Development Phase => Verification Phase => Pilot Phase => Roll-Out Phase => Handover Phase

The Solution Value chain should be seen as a chain that provides guidance and a list of deliverables of which can be chosen. The Solution Value Chain should not be seen as a series of actions which should always occur in a specific order.

A governance council within organization D imposes the use of the SVC, to ensure the Solution Value Chain framework is implemented at specific levels of the organization. The Solution Value Chain is continually changing in order to improve the framework used by information technology systems, support project teams and individual team leaders. It is clear from the interview that most of the representatives in organization D do use and adheres to a systems development methodology. It is also apparent that they do tailor the Solution Value Chain to fit their needs in systems development. Representative D1 for example stated that “We use the SVC but only the parts that are of interest to us” when asked about the use of a methodology. Representative D1 also goes on to state that “we tailor it to our own methodological needs”.

The use of systems development methodologies in organization D was examined in this section. The systems development methodology used by organization D will be discussed in the next section.

4.3.4.3 System development methodology used by organization D

The results gathered from the case study of organization D show that the organization uses a basic waterfall model when developing systems, which is discussed in this section.

The waterfall model they used is basic, easy to follow and easy to adapt as a systems development methodology. A breakdown of the waterfall systems development methodology is given in Table 4.17. The waterfall model is discussed by using the definition of a systems development methodology as stated by Huisman and Iivari (2006:32).

Discussion of the systems development methodology used by organization D	
<i>Systems development method:</i>	SVC-Waterfall Model.
<i>Philosophical view:</i>	Process oriented
<i>Process model:</i>	<p>Step by step development, building a system by completing steps in a specific order. Each step building on the outcome of its preceding steps. Can be used for almost all types and sizes of systems development.</p> <p>It uses a step by step, top down development approach. The steps of the process model used by organization D are:</p> <ul style="list-style-type: none"> • Investigation • Design • Development • Testing • Implementation
<i>Tools and techniques:</i>	<ul style="list-style-type: none"> • Documentation • Prototyping

Table 4.17 Summary of systems development methodology used by organization D

The waterfall model used by organization D differs from the traditional waterfall model in that the organization attempts to attend to the design and testing phases in recursion.

The representatives were asked if they tailor the systems development methodology to suit their needs. All the representatives agreed that they do tailor the model they use. This tailoring is done based on the decisions and competence of project members.

The project team meets as a group to determine which steps they must follow to successfully complete the development of the system. In most cases the project team follows the basic steps provided by the SVC model.

Documentation is one aspect that is often neglected in the development of projects. This may be a result of the project size and the volumes of work required, but smaller projects involving small changes do not necessitate extensive documentation. Of the 6 representatives, 5 representatives stated that the projects they generally undertake have an average duration of two months.

The representative who did not agree regarding the duration of projects is the one with the most experience, currently occupying his position for 5 years, and claimed that the projects he undertook ranged between 10 to 12 months. In some cases the documentation is produced only after the system has been developed, if it is required. Representative D2 states that “Documentation has to be one of the most important aspects that we tailor”.

Another factor that affects the adaptation of the systems development methodology is the use of resources. These resources are usually skilled personnel that will accompany the specific project. If skilled people are required to the project, certain changes may be required to implement the systems development methodology.

The systems development methodology used by organization D was discussed in this section. The next section will examine the contingency criteria used by organization D.

4.3.4.4 Contingency criteria used in organization D

The contingency criteria that is present in organization D is examined in this section. Each systems development project is unique. This leads to the adoption of different approaches by the development team.

The representatives were asked if they use criteria when selecting a systems development methodology. In this case they only use one.

The systems development methodology used is adapted for each system developed by considering specific criteria. The representatives each listed the criteria in their answers; a summary of these criteria can be seen in Table 4.18.

How is a systems development methodology chosen when developing a system?						
<i>Representative</i>	D1	D2	D3	D4	D5	D6
<i>Time</i>	X		X	X	X	X
<i>Cost</i>			X		X	
<i>Resources</i>	X			X		
<i>Project Size</i>				X		X
<i>Company Structure</i>		X				
<i>Documentation required</i>	X	X	X	X	X	X

Table 4.18 Contingency criteria used in organization D

Time seems to be one of the most important factors that influence systems development. Cost, resources and project size also seem to be of equal importance. Representatives D1, D3, D4, D5 and D6 all listed time as one of the main criteria they consider when deciding which development approach to use. Representative D2, who is the most experience of the 6 representatives, stated that other factors such as the company's structure plays an important role in systems development.

The reason for the emphasis on time can possibly be a result of the experience of projects exceeding the time constraints that are assigned to them. All 6 of the representatives stated that the system development projects they undertake almost always exceed time and budget constraints. Budget in this regard is linked to the time available. If people are required to work overtime in order for the system to be completed, this leads to higher costs.

Costs added to the project often lead to the project exceeding its budget and its time constraints. The amount of time required for the completion of each project is unique and may vary depending on the specific factors of each project. The constraints regarding selecting a systems development methodology is in most cases determined by the project team.

The representatives were asked who determines the criteria they use for selecting a systems development methodology. Four of them, being, D3, D4, D5 and D6, answered that the criteria is determined by the project team.

The other 2 representatives, D1, D2 stated that criteria for systems methodology selection are determined by the organization and management, respectively. The reason they may have answered differently is because D2 is more experienced and seems to understand that such criteria are determined by management and impose on to the project team. The team perceives the criteria are provided by the project leader and accepts this.

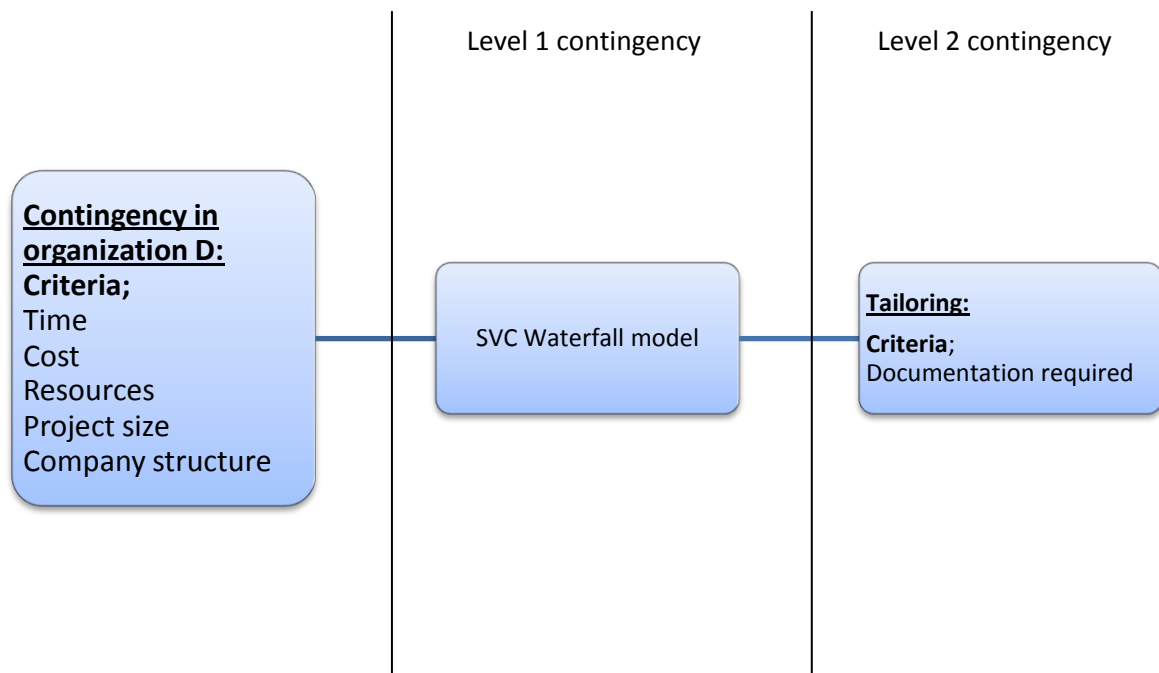


Figure 4.4 Graphical representation of contingency in organization D

Contingency in organization is indicated in Figure 4.4. Organization D applies contingency on two levels, namely choosing of systems and system tailoring. The contingency criteria used in organization D was examined in this section. The next section will address the development of telecommunication oriented systems in organization D.

4.3.4.5 *Development of telecommunication systems*

Organization D specializes in a wide range of telecommunications, which is addressed in this section. The representatives interviewed also stated that the development projects they

undertake are only telecommunications specific, albeit the development of new systems or the tailoring of ready-made systems. Most of the representatives were employed in other industries before converting to systems development for telecommunications. The representatives were asked if they thought the development of systems for telecommunications differed from other industries such as finance and other industries. Representatives D2, and D3 said that telecommunications does indeed differ from other industries. The types of architecture and the rules that need to be programmed into the systems are all factors perceived to be unique to telecommunications.

The representatives, who did not agree, representatives D1, D2, D5 and D6, said that the development approach did not differ from that of other industries. Representative D6 stated “I would say the approach to development is the same, but one needs to understand the requirements and the constraints”. They stated that the development approach is basically the same for systems development in telecommunications. Other factors that are also unique to telecommunication are the requirements and the constraints that are part of telecommunication systems development.

The development of telecommunication oriented systems was addressed in this section. The next section concludes the case study conducted on organization D.

4.3.4.6 Final notes on organization D

The organization, specifically the department interviewed, has delivered more than 10 successful projects over the last three years. The representatives were questioned about the success rate of the systems they develop and if these systems exceed budget and time constraints. The representatives stated that although most of the systems exceed the budget and time constraints allocated to the project they still deem such projects successful if they are implemented correctly. Representative D4 states the following “using a methodology does not always guarantee that a project will be successful”.

Representative D2 states that he is uncertain of the number of systems delivered successfully, the candidate has worked in the organization longer and the number of systems he has worked on exceeded that of the other representatives. The representative simply stated “I have lost count”. Representatives D1, D4, D5 and D6 all agree that they have completed more than 10 systems successfully.

On the other hand representative D3 is more realistic in this regard, and states that if a system exceeds time and budget, such system, even if it is used and implemented and operational, is

not successful. The representative defines a system as successful if it meets all constraints and all requirements.

A few remarks regarding communication within the organization were also notable. Representative D4 stated the following regarding communication within the team, “Not always, they sometimes neglect communication”. This also plays an important factor when developing systems. Good communication is critical.

Summary Organization D

Systems development methodology used:

- SVC-Waterfall model

Contingency criteria:

- Time
- Cost
- Resources
- Project size
- Company structure

Advantages of systems development methodology used

- Aims to improve the quality of the solutions systems that are to be delivered.
- Aims to produce systems more effectively and efficiently.

Disadvantages of systems development methodology used

- Contains unnecessary steps that are often let out.
- Time consuming and not always implemented as a result of this.

Influence of systems development methodology

- Positive project success results.

The case study conducted on organization D was concluded in this section. In the next section the propositions made for organization D will be listed.

4.3.4.7 Propositions made for organization D

The case study on organization D allows for a set of propositions to be listed that applies to organization D only. These propositions will thus be valid only for organization D.

Proposition 1

Telecommunication organizations in South Africa uses specifically designed frameworks to conduct business operations.

From the information gathered on organization D, it can be implied that organization D uses a framework to conduct all company activities in all departments. The use of a framework in a telecommunications organization is thus true for this specific instance. The framework covers a wide range of departments. It controls to conduct all activities carried out and how communication throughout departments should be carried out. This framework best suits the needs of this large organization.

It is proposed that the SVC framework gives the organization an advantage and evolves to encourage the development of new technologies and other advancements.

Proposition 2

Systems development methodologies are beneficial to the success of systems development in telecommunication organizations in South Africa.

It is deducted from the case study on organization D that the use of systems development methodologies is beneficial to the success of systems development.

It is proposed for organization D, that system development methodologies can be beneficial to systems development. Organization D makes use of a systems development methodology based on the traditional waterfall systems development methodology. The organization shows great success in the development of their systems. It attributes success to a system if such system is operating efficiently and meets the needs and requirements imposed. In most cases however, these system development projects exceed budget and time constraints.

Proposition 3

System development methodologies are tailored by telecommunication organizations in South Africa.

The case study on organization D indicates that the systems development methodology used is adapted for each system that is developed. It is proposed that system development

methodologies are tailored in organization D. The organization uses an approach of considering the need for documentation for the system developed. It is apparent that recording data and processes in documentation is one of the problems encountered by organization D when developing new systems. The size of the project and the difficulty of the project usually have an effect on this decision.

Proposition 4

Telecommunication organizations in South Africa develop systems in-house and tailor ready-made systems

From the information gathered from organization D it is apparent that they develop systems in-house and also tailor ready-made systems.

The organization not only relies on in-house systems to meet its needs, but if a system is available that meets its current requirements such system may be purchased and tailored to suit the requirements of the organization. It is proposed that organization D develops systems in-house and tailors ready-made systems.

Proposition 5

Telecommunication organizations in South Africa use criteria when selecting systems development methodologies.

The organization uses criteria for selecting systems development methodologies. A list of criteria is determined before embarking on the development of the system. These requirements are usually time, cost and resources. The criteria that are identified determine how the methodology will be adapted. In other words, this organization looks at the criteria for the specific project and determines how the systems development methodology will look for the given systems development project.

Proposition 6

Telecommunication organizations in South Africa administer criteria control.

Criteria control is administered by the project team being a finding of the case study. It is therefore proposed that organization D does indeed control the criteria used when selecting systems development methodologies for developing systems. The project manager works with the project team to determine these criteria before commencement of a project. Any frequent changes to the criteria are also controlled in this manner.

Proposition 7

Telecommunication organizations in South Africa develop small and large systems.

Organization D is a large business group. It develops both small systems as well as large systems for use within the organization. The information gathered in regard to the size of the organization and the size of the systems development projects undertaken leads to the conclusion that the organization develops both small as well as large systems. From the information gathered this organization specializes in the development of telecommunication systems.

Proposition 8

System development for telecommunications does not differ from system development for other industries.

A strong trend discerned regarding the development of systems for telecommunication within this organization, is that it does not differ from other areas of systems development. The developers within this organization believe the development approach used in telecommunications is the same as other systems development. It is proposed that the representatives of organization believe that system development in telecommunications is the same system development in other industries. The development approach is also a basic one and can be applied to different sized systems development projects.

4.3.5 Comparison of results

The research was done by making use of the method suggested by Seaman (1999:568). Seaman lists various methods for data analysis, which can be used to analyze qualitative data. Content analysis was performed by creating a set list of codes. Passages in the research were then attached to these codes. The codes were then examined to determine underlying themes and phenomena as suggested by Seaman (1999:568). The set codes were construed after data collection, and each case study was analyzed by using the same codes throughout all the case studies. These codes were predetermined by the aims and objectives of the study. The coding was conducted by using ATLAS.ti.

After each case study had been analyzed, cross case analysis was performed (Seaman, 1999:568). The first step is to link codes with the text. After the codes have been linked to specific passages within the text, groups of coded patterns should be identified. In this study, data was divided into different cases. Within each of these cases the data was also grouped.

This made cross-case analysis appropriate for this study. When grouping is finished, similarities and differences can be identified. The next step after comparison is to list propositions. The propositions should be associated with the data. If a specific proposition is supported by more than one source within the data it is seen as a supported, which is rich in detail.

In order to determine the similarities between the telecommunication organizations, the propositions made for each organization will be reconsidered for similarities, and suitable application to any of the other organizations. For example Proposition 1 is supported by (X1, X1), with X referring to the object that supports it, which could be documentation, tapes or people. If a proposition is only supported by one data source and differs from or contradicts other propositions it is listed as a refuted proposition.

The propositions will be discussed as follows; all the propositions will be listed in tables and the organizations to which it applies will be listed. There are a total number of 24 propositions; in this chapter 8 propositions were listed for each organization. There are four organizations namely, organization A, organization B, organization C and organization D. The propositions made for each organization can in some cases be valid for more than one organization and a brief summary of each of these propositions will be given below. The propositions will be listed under the research questions posed in chapter 1.

Do telecommunication organizations in South Africa use systems development methodologies when developing telecommunication systems?

The study indicates that telecommunication organizations do indeed use system development methodologies. Proposition 1 states that an organization utilizes more than one systems development methodology. This is applicable to organizations A and B as shown in Table 4.19.

Proposition 1:	Telecommunication organizations in South Africa use more than one system development methodology when developing systems
Organizations to which it applies:	A and B

Table 4.19 Proposition 1

The use of system development methodologies is a clear finding of the research. Proposition 2, refers to the system development methodologies used by these organizations, and which are sometimes adapted to accommodate specific requirements of the organization.

Table 4.20 indicates the organizations to which this proposition applies. In this case organization A, organization B and organization D adapt their systems development methodologies to suit the requirements of the organization. The manner of such adaptation differs from organization to organization.

Proposition 2:	Telecommunication organizations in South Africa adapt systems development methodologies when developing systems within the organization
Organizations to which it applies:	A,B and D

Table 4.20 Proposition 2

This proposition is supported by information gathered from three of the four organizations. It is therefore strongly proposed that system development methodologies are adapted within telecommunication organizations.

The third proposition is aimed at the correlation between the use of a systems development methodology and the success of system's development projects. This proposition applies to two of the four organizations. Both organization D and organization C point out that the use of system's development methodologies is a factor influencing the success rate of a system's development project. This is shown in Table 4.21.

Proposition 3:	The use of a systems development methodology is beneficial to telecommunication organizations in South Africa.
Organizations to which it applies:	C and D

Table 4.21 Proposition 3

The study indicates that all the organizations use a waterfall approach to system development. Proposition 4 states that an organization uses a waterfall based approach to systems development as indicated in Table 4.22. This proposition is applicable to organization A, B, C and D.

Proposition 4:	Telecommunication organizations in South Africa utilizes a waterfall based approach to develop systems
Organizations to which it applies:	A, B, C and D

Table 4.22 Proposition 4

How do the telecommunication organizations in South Africa decide on a systems development methodology and what criteria do they use?

One of the main focus points of the study was to determine whether or not organizations use criteria when selecting system development methodologies. Proposition 5 indicates

that three organizations use criteria when selecting a systems development methodology as shown in Table 4.23. There are criteria applied in some organizations when selecting systems development methodologies.

<i>Proposition 5:</i>	Telecommunication organizations use criteria when selecting a systems development methodologies
<i>Organizations to which it applies:</i>	A, B and D

Table 4.23 Proposition 5

The criteria that were identified are:

- Experience needed
- Project Type
- Resources
- Project size
- Number of system impacted
- Complexity of system
- Timelines
- Vendor's involved
- ScopeTime
- Cost
- Minor and non-functional change
- Company Structure

Are the criteria used for systems development methodology selection controlled?

Proposition 6 implies that the organization uses a framework to conduct all business activities. As can be seen in Table 4.24 there are two organizations to which this applies. Both organization B and D use such a framework. However the frameworks used by these two organizations differ substantially. The basic approach to business activities are however similar. Both these frameworks allow the organizations to choose the correct elements to fit the requirements of the organizations. The model used by organization D is a framework developed specifically for the organization and is based on an international framework developed specifically for telecommunication organizations.

Proposition 6:	Telecommunication organizations in South Africa use a framework for conducting all business activities.
Organizations to which it applies:	B and D

Table 4.24 Proposition 6

The organizations that were studied in the research are all large telecommunication organizations. In these organizations there is sometimes a lack of co-ordination between developers and the rest of the system development role players.

In some cases they are coordinated very well and there exists a clear understanding of the business processes and the development approaches adopted. This is stated in proposition 7 and is applicable to organization C as shown in Table 4.25.

Proposition 7:	There exists a clear understanding of the business processes and development approaches between the representatives within South African telecommunication organizations.
Organizations to which it applies:	C

Table 4.25 Proposition 7

The propositions that are not used to answer the research questions are listed under the telecommunication environment. The propositions are listed as:

There are two basic approaches to developing systems within organizations. These approaches are the development of in-house systems and the tailoring of ready-made systems that are purchased. Proposition 8 deals with both these approaches.

In all four the organizations, a trend was established that they develop their own, and adapt ready-made systems, as can be seen in Table 4.26.

Proposition 8:	Telecommunication organizations in South Africa develop systems in-house and tailor ready-made systems.
Organizations to which it applies:	A, B,C and D

Table 4.26 Proposition 8

Proposition 8 is supported by all four of the telecommunication organizations subject to the study. The telecommunication organizations all develop different types of systems. Proposition 9, as shown in Table 4.27, indicates which of these organizations develop different sizes of systems. The study shows that organization A, B and D all develop a variety of systems ranging in various sizes.

Proposition 9:	Telecommunication organizations in South Africa develop small to large systems
Organizations to which it applies:	A,B and D

Table 4.27 Proposition 9

This can lead to different results regarding the success of projects. The organizations are all telecommunication organizations, but they do differ in certain respects. Organization A develops telecommunication oriented systems as well as other types of systems. Proposition 10 states that the organization develops different types of systems as shown in Table 4.28.

Proposition 10:	Telecommunication organizations in South Africa develop different types of systems
Organizations to which it applies:	A

Table 4.28 Proposition 10

There are various approaches to system development. Proposition 11 states that system development approaches do not differ, regardless of the industry. This proposition is

applicable to both organization C and D, who believe that the basic approach to systems development are all the same as shown in table 4.29.

Proposition 11:	Representatives in South African telecommunication organizations believe that developing systems for the telecommunication industry does not differ from developing systems in other industries
Organizations to which it applies:	C and D

Table 4.29 Proposition 11

Systems are developed within different levels of the organization. This means that there are different types of systems as well as different systems development approaches. The study indicates that this proposition is only applicable to organization A as shown in Table 4.30. This indicates that there are different levels at which systems can be developed in the telecommunication industry.

Proposition 12:	There exists different levels of system development within telecommunication organizations in South Africa
Organizations to which it applies:	A

Table 4.30 Proposition 12

In some organizations development takes place at different levels within the organization. Organization A is one such organization in which there are different levels at which they develop different systems.

All the organizations in the study develop telecommunication specific systems. Proposition 13 is based on the assumption that the organization specializes in the development of telecommunication systems. This assumption applies to organization B, D and C as shown in Table 4.31.

Proposition 13:	Telecommunication organizations in South Africa only develop telecommunication oriented systems
Organizations to which it applies:	B, D and C

Table 4.31 Proposition 13

Proposition 12 states that different levels of success exist within the organization as shown in Table 4.30. This proposition is only applicable to organization A.

Proposition 14:	Different levels of systems development success exists within telecommunication organizations in South Africa.
Organizations to which it applies:	A

Table 4.32 Proposition 14

Certain aspects of system development for the telecommunication industry differ from those in other industries. One of these aspects is the low tolerance the telecommunication industry has regarding faulty systems. Proposition 15 states just that as shown in Table 4.33. This proposition is applicable to organization B only. The representatives in organization B believe that there is an extremely low tolerance regarding faulty systems and incorrect data.

Proposition 15:	There is a low tolerance for faulty systems within South Africa telecommunication organizations
Organizations to which it applies:	B

Table 4.33 Proposition 15

The criteria that the organizations apply when selecting a systems development methodology should be controlled. Table 2.34 shows proposition 16 which indicates that criteria control is not always applied within telecommunication organizations.

<i>Proposition 16:</i>	Criteria control is administered within the South Africa telecommunication organizations
<i>Organizations to which it applies:</i>	A and D

Table 4.34 Proposition 16

These propositions were made according to the information gathered from the case studies conducted on the four telecommunication organizations. Some of the propositions were valid for more than one organization. This indicates that there are elements in the telecommunication industry applicable to all the telecommunication organizations.

The research indicates that there is a contingent use of systems development methodologies in the telecommunication industry. The organizations determine which methodologies to use for systems development by using criteria. In some cases these criteria are set out in a policy document. The research also indicates that telecommunication organizations use systems development methodologies when developing systems.

4.4. Conclusion

The case studies conducted on the four telecommunication organizations in South Africa gave insight into systems development within this industry. Short interviews were conducted with representatives within each of these telecommunication organizations. The information gained from the case studies delivered propositions for each telecommunication organization which were listed in this chapter. Each organization and its attributes were briefly described. The propositions formulated were compared to determine patterns within the telecommunication industry. Two propositions of systems development that are applicable to all the telecommunication organizations in the study are the use of a waterfall based development approach, and the development by organizations of systems in-house as well as the tailoring of ready-made systems.

Codes were given and values for each of these codes were gained from each representative. The codes are summarized and listed in appendix A. The following chapter deals with a conclusion of the study and a summary of the findings gathered from the research.

CHAPTER 5

RESEACH SUMMARY AND CONCLUSION

5. Research summary and conclusion

The research will be concluded in this chapter. This is achieved by summarizing the findings of the study and linking the findings to the literature in chapter 2. This chapter includes the research questions, the summary of the results, research contributions, limitations of the study and future work.

5.1 Introduction

An overview of the results of the study is addressed in this section. The goal of this research was to conduct an interpretive study regarding the contingent use of systems development methodologies in the telecommunication industry. The research consisted of two elements. The first was a detailed literature study which focused on the telecommunication industry. This included the use of system development methodologies as well as the contingent use of system development methodologies. The literature study provided a foundation for the research that followed. The second element was the actual research that was conducted. This research included the propositions concluded from the information gathered from short interviews with representatives in the telecommunication organizations. The interviews were conducted with representatives from four of the leading telecommunication organizations in South Africa.

After the analysis of the interviews a list of propositions was made for each of the organizations. These propositions were then compared to propositions from the other organizations by using cross case analysis. The information gathered from the cross case analysis was then used to answer the research questions.

In this section an overview of the study was addressed. The next section reviews the research questions posed at the beginning of the research.

5.2 Research questions

The three research questions that were proposed in chapter 1 are examined in this section. The goal of the research was to answer these questions by conducting case studies on telecommunication organizations. The research questions were:

- *Do telecommunication organizations in South Africa use system development methodologies when developing systems?*
- *How do the telecommunication organizations in South Africa decide on a system development methodology, and what are the criteria they use?*
- *Whether or not the criteria used for selection of a systems development methodology is controlled?*

The contingent use of systems development methodologies in telecommunication organizations was determined by the abovementioned questions. This section summarized the research questions that were posed. The next section contains a detailed summary of the results of the study.

5.3 Summary of results

A summary of the study will be given in this section. The case studies conducted on the four telecommunication organizations gave insight into systems development within the organizations. Ketunnen and Laanti (2005:587) stated that there are a wide range of systems that are developed in telecommunications, which range from large systems to small in-house developments. The research conducted indicated that this statement is true and that telecommunication organizations develop different systems. The research also determined that although systems differ between telecommunication organizations they also differ within the organizations themselves. The four telecommunication organizations included in the study all stated that they develop different systems. Organization A for example, develops knowledge management tools, mobile applications, social media and corporate library systems, whereas organization D develops network inventory systems and MetroLan networks. Schwalbe (2007) stated that projects have unique purposes. The systems development projects in telecommunication organizations are unique and have unique purposes, which was shown in the research by the types of systems that each telecommunication organization develops.

Otto (2007:1) noted that telecommunication systems are more complex than on other industries. The research indicated that the majority of the representatives agreed with this statement.

The research determined that although systems development methodologies like MODA-TEL (Parviainen, Takalo and Tepolla, 2009:14), MOBILE-D, Mansurov's Accelerated Development Methodology (Mansurov and Propert, 2000:8) and ODAC (Gervais, 2002:1) were created for the sole purpose of use within the telecommunication industry, they are not implemented by South African telecommunication organizations.

Each of these organizations used a waterfall based approach and this indicates that the waterfall approach to systems development is appropriate and is widely applied within the telecommunication industry.

The telecommunication organizations used different systems development methodologies. The systems development methodologies identified in the study were, CAP-Gemini, SSADM, a Hybrid systems development methodology, SDLC (RLM), SDLC, SVC (Waterfall model), Prototyping and an Unofficial Fast-Track systems development approach. Durham (1993:22) stated that the effectiveness of a methodology depends on its intended application. It can be proposed that the waterfall model is a good fit for the telecommunication industry. The system development methodologies were examined by using the definition provided by Huisman and Iivari (2006:32). The research also indicated that there are differences between mobile and fixed-line telecommunication organizations. Most notably are the types of systems that they develop.

These organizations use these SDM's in two scenarios, the first is for the development of systems in-house and the second is the tailoring of ready-made systems. This also indicates that the waterfall approach can be used for both these scenarios. The tailoring of systems development methodologies in the telecommunication industry indicates that they are currently in the post methodology era (Avison and Fitzgerald, 2006:582). Although the telecommunication industry appears to be in the post methodology era, the organizations still utilize older systems development methodologies to develop systems.

Ketunnen and Laanti (2005:588) stated that current trends in the system development environment indicate that development is leaning towards a more adaptable and flexible approach to systems development. The research conducted indicates that the telecommunication organization is using system development methodologies which they can easily adapt for systems development.

Two of the four organizations use a framework as the basis for conducting all their business activities. This includes the selection of a system development methodology. These organizations all have a predetermined manner in which they select system's development methodologies. This is an indication that there is some sort of selection process within the organization, whether it is the selection of a single methodology for all projects or a new systems development methodology that is tailored for each new systems development project. As stated by Ketunnen and Laanti (2005:589), there are no standardized methods for selecting a systems development methodology.

The research determined contingency methods that are currently used in the telecommunication industry in South Africa. The method used by organization B is similar to that of Gremmilion and Pyburn (1983). The organization looks at the number of systems impacted which corresponds to Gremmilion and Pyburn's (1983) model that determines the impact the systems will have. Organization B also looks at the structure of the systems by examining the complexity of the system.

The other organizations do not follow the contingency models, as discussed in chapter 2. Organization A, C and D focuses more on criteria that have been set out by either the organization or the project team to determine which systems development methodology they should use. Organization A and C use different systems development methodologies, and the organizations determine which systems development methodology to use by examining the requirements of the project which is similar to the model proposed by Ketunnen and Laanti (2005). The model compares the system development methodologies to each other by examining the requirements of the project to determine which systems development methodology will be the best fit.

Contingency did not only take place in the selection of systems development methodologies but also in the tailoring of existing systems development methodologies. Figure 5.1 provides a graphical summary of the contingency within telecommunication organizations in South Africa. Most of these organizations apply two levels of contingency. The use of criteria to determine a proper systems development methodology is proposed by Shomenta (1983:7).

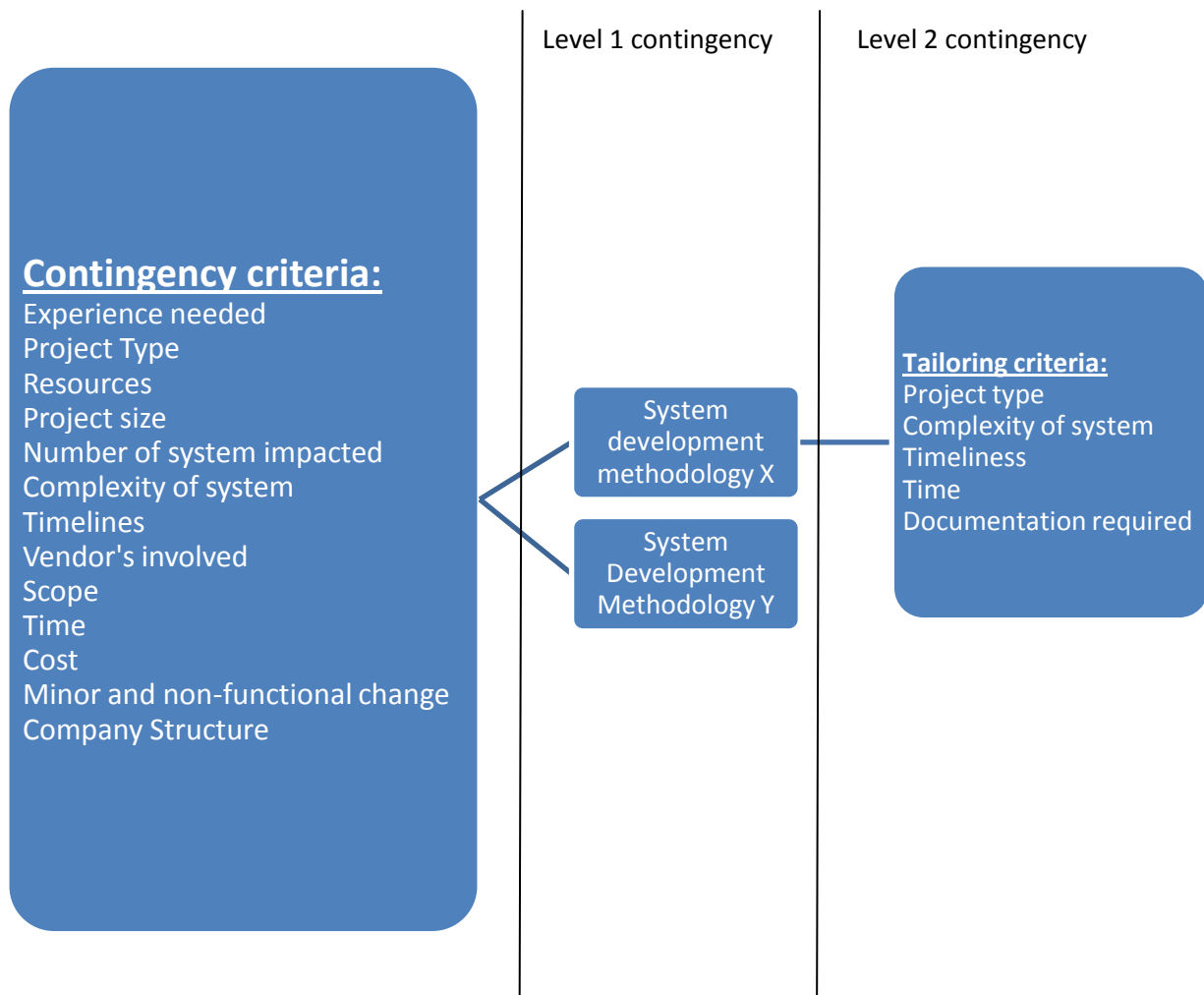


Figure 5.1 Summary of contingency in the telecommunication industry

Criteria are used within some of the organizations to assist in this selection process and it was clear from the research that the most implemented criteria were time, budget and resources.

The contingency criteria on the left, are the criteria that the organization's use to determine which systems development methodology to use for the specific systems development project. This is referred to as level 1 contingency. When an organization already has a systems development methodology and they tailor it according to criteria, it is referred to as level 2 contingency as shown in Figure 5.1. Multiview (Avison and Taylor, 1999:77) recommends documentation practices. Fazlollahi and Tanniru (1991) suggested that a narrow focus on requirements should determine which systems development methodology to use. The results of the study indicate that telecommunication organizations in South Africa examine requirements when they select a systems development methodology for a specific project, for example time, cost, resources and scope.

The research also indicated that criteria such as the complexity and structure of a system, corresponds to the contingency model suggested by Gremillion and Pyburn (1983). The contingency model proposed by Davis (1982), requires the identification of two levels of requirements, namely the organizational information requirements and the detailed information requirements. Contingency criteria used by telecommunication organizations in South Africa could adhere to this model if criteria such as company structure, scope, time and budget and were to be used as organizational information requirements and resources, and the complexity of the system and minor and non functional change as detailed information requirements.

Another aspect of the research was to determine who controls these criteria. In most instances the research showed that the project team decided which criteria are applied to each specific project. Table 5.1 indicates how the criteria are supported between representatives of the different telecommunication organizations. It is evident from Table 5.1 that there are criteria which could be deemed more important than others.

Criteria such as the project size could be deemed as the most important contingency criteria used by telecommunication organizations in South Africa. All the organizations make use of project size as a criterion when selecting and/or tailoring a systems development methodology.

The project size criterion is used within organization A and B when a systems development methodology is selected within the organization.

Organization C implemented this criterion when the organization initially selected its systems development methodology. In organization D, project size is used to determine how the existing systems development methodology should be tailored to meet the requirements of the project.

The second most important contingency criterion that was identified is resources; three of the telecommunication organizations use this criterion when selecting a systems development methodology. Organization B uses resources as a criterion when selecting a systems development methodology for a specific project. The criterion was used by organization C to determine the systems development methodology they currently implement. Organization D uses resources as a criterion to determine how the SVC should be tailored for each new systems development project.

Time is also an important criterion as deduced from the results of the study. Two of the four organizations use time as a contingency criterion. Organization C implemented time as a criterion when it initially selected its systems development methodology. Time is used by organization D to tailor the SVC for each new project.

Documentation appears to be an important criterion in organization D. This is attributed to the tailoring of the SVC for each new project, the documentation need, if it is needed and to what extent, is determined beforehand. Organization D places a large focus on the use of documentation and to the extent to which the documentation is done. It may be beneficial for organization D to adopt a contingency approach such as Multiview.

The rest of the contingency criteria appear to be unique for each organization. This could be attributed to the types of systems that are developed, which differ. It could also be attributed to the nature of the telecommunication organization, mobile telecommunication organizations differ from fixed-line telecommunication organizations.

<i>Representative/Criteria</i>	<i>Organization A</i>		<i>Organization B</i>		<i>Organization C</i>				<i>Organization D</i>					
	A1	A2	B1	B2	C1	C2	C3	C4	D1	D2	D3	D4	D5	D6
<i>Experience needed</i>	X													
<i>Project type</i>			X											
<i>Resources</i>			X				X		X			X		
<i>Project size</i>	X	X	X					X				X		X
<i>Number of systems affected</i>			X	X										
<i>Complexity of system</i>			X	X										
<i>Timelines</i>					X									
<i>Vendor's involved</i>			X											
<i>Scope</i>			X											
<i>Time</i>					X	X			X		X	X	X	X
<i>Cost</i>											X		X	
<i>Minor and non-functional change</i>					X	X								
<i>Company structure</i>										X				
<i>Documentation required</i>									X	X	X	X	X	X

Table 5.1 A summary of the contingency criteria

These criteria are usually identified beforehand to determine which systems development methodology will be used. Control is necessary due to the impact the criteria have on the systems development project. There is an indication that criteria control is widely used in the telecommunication industry. A number of propositions were made for each of the telecommunication organizations and they were compared with each other. There are a total of sixteen propositions.

As indicated in section 4.3.5 these propositions may be true for more than one telecommunication organization. These propositions are listed below under the research questions they apply to:

- *Do telecommunication organizations in South Africa use system development methodologies when developing systems?*

Proposition 1

Telecommunication organizations use more than one system development methodology when developing systems.

Proposition 2

Telecommunication organizations adapt a system's development methodology when developing systems within the organization.

Proposition 3

Use of a system development methodology is beneficial to the development of systems within South African telecommunication organizations.

Proposition 4

Telecommunication organizations in South Africa make use of a waterfall based approach to system development.

- *How do the telecommunication organizations in South Africa decide on a system development methodology, and what the criteria that they use?*

Proposition 5

Criteria are applied in South African telecommunication organizations when selecting a systems development methodology.

- *Is criteria used by South African telecommunication organizations when selecting a system's development methodology is controlled?*

Proposition 6

South African telecommunication organizations use a framework to conduct all business activities.

Proposition 7

Criteria control is administered within South African telecommunication organizations.

The propositions that are not used to answer the research questions are listed under the telecommunication environment. The propositions are listed as:

Proposition 8

Telecommunication organizations develop systems in-house and also tailor ready-made systems.

Proposition 9

South Africa telecommunication organizations develop small to large systems.

Proposition 10

Different types of systems are developed in South Africa telecommunication organizations.

Proposition 11

Representatives in the South African telecommunication industry believe that the approach of developing systems in the telecommunications industry does not differ from developing systems in other industries.

Proposition 12

Different levels of systems development exists within South African telecommunication organizations.

Proposition 13

Different levels of systems development success exist within South African telecommunication organizations.

Proposition 14

Most South African telecommunication organizations only develop telecommunication oriented systems.

Proposition 15

There is a low tolerance for faulty systems in South African telecommunication organizations.

Proposition 16

Representatives in South African telecommunication organizations have a clear understanding of the business processes and development.

A summary of the results of this study was provided in this section. The next section will list the research contributions made by this research.

5.4 Research contributions

The research delivered several contributions, which are listed in this section. The results of this study delivers meaningful and valuable information regarding the contingent use of systems development methodologies in South African telecommunication organizations both to academics and practitioners. The most important contribution was the contingency criteria identified by the study. These criteria are:

- Experience needed
- Project Type
- Resources
- Project size
- Number of system impacted
- Complexity of system
- Timelines
- Vendor's involved
- Scope
- Time
- Cost
- Minor and non-functional change
- Company Structure

The study also determined that there are levels of contingency within telecommunication organizations, the first level being the selection of a systems development methodology and the second level the tailoring of an existing systems development methodology. In practice the results of this study can also be used by management to identify important criteria to select a systems development methodology, or when a systems development methodology needs to be tailored for a specific project.

The research also identified which systems development methodologies are currently being used by telecommunication organizations in South Africa. The adaptations of these systems development methodologies are also shown in the research.

The systems development methodologies that are currently used are:

- SSADM
- CAP-Gemini
- SDLC (RLM)
- SDLC
- Hybrid systems development methodology
- Unofficial fast-track systems development methodology
- SVC

This research examined the majority of the telecommunication organizations. The representatives that were interviewed were also identified as key role players. The interviews were conducted with personnel that were employed at different levels of systems development within the organizations to gain as much valuable data as possible.

A brief summary of the contributions are listed as:

- Identified the use of systems development methodologies in the telecommunication industry.
- Identified the systems development methodologies used in telecommunication organizations.
- Determined the use of contingency criteria in telecommunication organizations.
- The parties responsible for controlling the criteria were identified.
- Identified the contingent use of system development methodologies in the telecommunication industry.
- Identified the contingency criteria used by telecommunication organizations.
- Indicated that there are different levels of contingency.
- Identified the criteria used at each level of contingency.

- Showed that in some instances systems development methodologies are tailored to suit the needs of the organization.

The research contributions were listed in this section. The next section will address the limitations of the study and future work.

5.5 Limitations of study and future work

The study faced a few limitations, which are addressed in this section. This included documentation regarding the criteria and tailoring of systems development methodologies in telecommunication organizations. The organizations were reluctant to provide information regarding the contingent use of systems development methodologies in the organization due to privacy policies within the organization.

Future work may be necessary regarding the documentation the organizations use when selecting and tailoring systems development methodologies. If the documentation could be acquired it could provide more detailed information regarding the use of systems development methodologies in the telecommunication industry.

Difficulties within the organizations were encountered. The personnel involved in developing systems were difficult to contact and only a few responded and assisted with interviews. The research could have gained more information if more representatives could have been interviewed. More than one representative was interviewed within each of the telecommunication organizations. These representatives were employed at different levels within the organization which allowed for more valuable data to be gathered. There is wide scope for future study and research. If more representatives could respond to research, then more valuable information could be obtained.

Future work may be to conduct a survey to test the propositions made in this research within telecommunication organizations.

The research limitations were listed in this section. The scope for possible future work has also been identified. The next section concludes chapter 5.

5.6 Conclusion

A summary of the research was given in this chapter. This included an overview of the literature study as well as the areas covered in the literature study. The results of the study were given and the propositions made for the study were listed.

The research contributions were listed to show the contributions that this study has made. The study encountered a number of limitations that affected the research. These limitations were listed and future work was identified. The main goal of the research, to study the contingent use of systems development methodologies in the telecommunication industry, was achieved.

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APPENDIX A

ORGANIZATION A		REPRESENTATIVE	
	CODE	A1	A2
1	<i>JOBTITLE</i>	Executive head of group strategy and research	Software developer/designer
2	<i>JOBHISTORY</i>	4 years	4 years
3	<i>GROUPWORK</i>	Yes	Yes
4	<i>TEAMSIZE</i>	6	2
5	<i>COMMUNICATION</i>	Yes, bad communicators	Yes
6	<i>SYSTEMSDEVELOPMENT</i>	Both, inhouse (40%), readymade (60%)	Both
7	<i>SD_TYPES</i>	Knowledge management tools, corporate library systems, mobile applications and social media for enterprises	Workflow applications
8	<i>DEVELOPERGROUPSIZE</i>	5-9 people	5-9 people
9	<i>PROJECTIMESIZE</i>	Size- Enterprise solutions for more than 500 people, Time- between 6 months and 2 years	2-5 Months
10	<i>SDM_DEFTION</i>	Developing a functional and technical specification.	A framework to plan and control the development process, in order to produce a software component that meets the requirements of the customer
11	<i>SDM_USED</i>	YES	YES
12	<i>SDM_TYPEUSED</i>	Structures systems analysis and design method, Cap Gemini SDM	Hybrid of incremental, prototyping, rapid application development
13	<i>SDM_TAILORING</i>	As is	Tailored
14	<i>SDM_ADAPT</i>	N/A	Combine methods to fit needs
15	<i>CRITERIA</i>	Expertise and experience of the development team	Size and type of project, amount of resources
16	<i>CRITERIA_CHANGE</i>	Set list	Sometimes
17	<i>CRITERIA_DETERMINED_BY</i>	Project sponsor or Head of development team	Head of development
18	<i>CRITERIA_CONTROL</i>	Yes	Not strictly
19	<i>SD_SUCCESS</i>	None	90+ successful, 50% of projects overshoot deadline due to scope creep
20	<i>SYSTEM_TYPES</i>	Mostly other types of systems	Telco and other types of systems
21	<i>TELECOMS_DIFFER</i>	Yes	No, depending on knowledge of developer
22	<i>SD_EXCEED_TIME/BUDGET</i>	99% of the time	Often
23	<i>USE_OF_SDM_SUCCESS</i>	No	Yes

Organization A: Summary of codes

ORGANIZATION B		REPRESENTATIVE	
	CODE	B1	B2
1	<i>JOBTITLE</i>	Senior manager of business analysis	Service deliver manager
2	<i>JOBHISTORY</i>	1.5 years	0.5 years
3	<i>GROUPWORK</i>	Yes	Yes
4	<i>TEAMSIZE</i>	Yes, Small 2-10 people, Medium 11-30 people and large 31+ people	2-3
5	<i>COMMUNICATION</i>	Yes	Sometimes
6	<i>SYSTEMSDEVELOPMENT</i>	Purpose made solutions to fit business delivery needs, in-house	Both
7	<i>SD_TYPES</i>	IS related development from vendor built systems integrated into the service delivery environment	Both simple and complex. Data management systems
8	<i>DEVELOPERGROUPSIZE</i>	Yes, Small 2-10 people, Medium 11-30 people and large 31+ people	5-20
9	<i>PROJECTIMESIZE</i>	Size-R1000's to R10millions Time -10 days to 1.5 years	Size-Unsure Time-3 months
10	<i>SDM_DEFITION</i>	As a waterfall model	The process that governs systems development in our organization
11	<i>SDM_USED</i>	Yes	Yes
12	<i>SDM_TYPEUSED</i>	SDLC	Waterfall model (Release life cycle model (RLM))
13	<i>SDM_TAILORING</i>	SDLC tailored to business requirements	Tailored to suit specific needs
14	<i>SDM_ADAPT</i>	Yes, outsourcing	Yes, unofficial processes depending on timelines
15	<i>CRITERIA</i>	Breadth of system, number of vendors involved	1-Number of systems impacted. 2-Complexity. 3-Timelines
16	<i>CRITERIA_CHANGE</i>	Cluster projects based on size and vendors involved	Set list
17	<i>CRITERIA_DETERMINED_BY</i>	Project steering committee	Senior group of people (account management, architects and process specialists)
18	<i>CRITERIA_CONTROL</i>	Yes	Yes
19	<i>SD_SUCCESS</i>	60% -70%	90%
20	<i>SYSTEM_TYPES</i>	Mostly telco related	IT and telco systems
21	<i>TELECOMS_DIFFER</i>	Yes	Yes
22	<i>SD_EXCEED_TIME/BUDGET</i>	Yes	Yes, 50%
23	<i>USE_OF_SDM_SUCCESS</i>	Yes	Yes

Organization B: Summary of codes

ORGANIZATION C		REPRESENTATIVE			
	CODE	C1	C2	C3	C4
1	<i>JOBTITLE</i>	Lead enterprise business unit	Production support executive	Production support executive	Production support executive
2	<i>JOBHISTORY</i>	2.8 years	3 years	2 years	1.5 years
3	<i>GROUPWORK</i>	Yes	Yes	Yes	Yes
4	<i>TEAMSIZE</i>	15 people	15 members	15 people	15people
5	<i>COMMUNICATION</i>	Yes	Yes	Yes	Yes
6	<i>SYSTEMSDEVELOPMENT</i>	Both, ready-made and in-house	Equal, make use of in-house and ready-made systems	Depending on the needs of the organization, both	Both scenarios are applicable
7	<i>SD_TYPES</i>	OPS support	OPS support	OPS support	OPS support
8	<i>DEVELOPERGROUPSIZE</i>	4-5	4 developers, 1 project leader	4	4
9	<i>PROJECTIMESIZE</i>	5 days	1 week	1-2 weeks	1 week
10	<i>SDM_DEFTION</i>	A structure to assist in development	As a manner of developing systems to meet certain standards	Framework that can be used to develop systems	Development guidelines
11	<i>SDM_USED</i>	Yes	Yes	Yes	Yes
12	<i>SDM_TYPEUSED</i>	SDLC	SDLC	Systems development lifecycle	
13	<i>SDM_TAILORING</i>	Use it as is	No tailoring	SDLC as is	Use it as is
14	<i>SDM_ADAPT</i>	N/A	N/A	N/A	N/A
15	<i>CRITERIA</i>	Minor and non-functional change	Time, budget, minor and non-functional change	Time, budget, resources	Time, budget, resources
16	<i>CRITERIA_CHANGE</i>	Project dependant	Always the same	No	No
17	<i>CRITERIA_DETERMINED_BY</i>	Project members	Project leader, organization	Management	Management
18	<i>CRITERIA_CONTROL</i>	No	Yes	Not vigorously	Yes
19	<i>SD_SUCCESS</i>	98%	All of them except for a few who exceed time and budget	More than 70%	About 80%
20	<i>SYSTEM_TYPES</i>	All telecoms	Specialize only in telecoms	All telecoms	All telecommunication oriented
21	<i>TELECOMS_DIFFER</i>	Yes	Yes	No	Only in terms of knowledge
22	<i>SD_EXCEED_TIME/BUDGET</i>	Yes	Yes	Sometimes	Yes
23	<i>USE_OF_SDM_SUCCESS</i>	Yes	Most definitely	Yes	Yes

Organization C: Summary of codes

ORGANIZATION D		REPRESENTATIVE					
	CODE	D1	D2	D3	D4	D5	D6
1	<i>JOBTITLE</i>	Analyst/Designer	Systems development	Team lead	Solution designer	Software developer	Consultant/ Developer
2	<i>JOBHISTORY</i>	4-5 years	5 years	4 years	3 years	3 years	2.5 years
3	<i>GROUPWORK</i>	Yes	Most the time	Yes always	Yes	Yes	Yes
4	<i>TEAMSIZ</i>	6 people	+10 people	9 members	7 people	3 people	3 people
5	<i>COMMUNICATION</i>	Yes	Communication channels are in place	Yes	Not always	Yes	Yes
6	<i>SYSTEMS DEVELOPMENT</i>	Buy systems and then tailor them	Both, sometimes in-house and sometimes ready-made	Develop these systems in house	Purchase and customize it if needed	Ready-made systems are customized	Mostly ready-made systems
7	<i>SD_TYPES</i>	Enhancements on an OSS suite	Telecommunications oriented	Network inventory oriented	Integration between systems	Telecommunications oriented systems	MetroLAN networks
8	<i>DEVELOPER GROUPSIZE</i>	9 people	+10 people	8 team members	3 people	9 people	3 people
9	<i>PROJEC TIMESIZE</i>	2 months	10-12 months	3 months	Months, sometimes close to years	2 months, others still ongoing	+ 2 months
10	<i>SDM_DEFINITION</i>	Set of rules and guidelines to help follow in order to develop applications	As a set of procedures that need to be followed by the project team in developing the system	Agile prototyping	Guidelines to follow for building an end to end system	As a blue print of the projects	A frameworks that tracks planning, implementation and monitoring
11	<i>SDM_USED</i>	SVC, only use parts that are of interest	Company specific SDLC	Yes	Mostly agile and prototyping so yes	Yes	Yes
12	<i>SDM_TYPEUSED</i>	Waterfall like model	Adopted version of the SVC	Agile, SVC waterfall approach	Prototyping	Investigation, design, development, testing and implementation	Agile, SVC and prototyping
13	<i>SDM_TAILORING</i>	Tailor to methodological needs	Tailor it down	Documentation is tailored	Tailor them to suit needs	Sometimes	Yes, sometimes
14	<i>SDM_ADAPT</i>	Develop and only produce documentation if necessary	Unique to each project. Documentation has to be one of the most important aspects that we tailor	Adapted SVC to use a more agile approach to systems development. Certain documentation have been	Adapt them by looking at the needs of the project and then look at what needs to be delivered in order for the	Focused on the extent of the documentation that accompanies a specific project. Some	Include people who came with the requirements and receive guidelines as to determine the

				inherited from the SVC	project to be successful	require more than others as well as the resources the projects use	appropriate solution
15	CRITERIA	Time and resources	Company structure	Time and cost	Size of the project as well as resources needed	Time and costs	Size and time
16	CRITERIA_CHANGE	Not always	Changes from time to time	Depends on the skills needed for each project	Changes depending on the project's size, cost and resources needed	Sometimes	Changes depending on the time and size of the given project
17	CRITERIA_DETERMINED_BY	The business	Management at a tactical level	Project development team	Project tem	Project manager, design head an project team	Project manager
18	CRITERIA_CONTROL	No, not at all	No not really	Determined by the project manager	Not really	Yes they are	Yes they are
19	SD_SUCCESS	More than 10	Uncertain (I have lost count)	2%, projects almost always exceed budget and time constraints	40% are completed within time and budget	10, more than 80%	10 projects to date
20	SYSTEM_TYPES	All telecoms	Most of them are telecommunication related	Telecom's related	Mostly telecom's oriented	All telecoms systems	Telecoms oriented
21	TELECOMS_DIFFER	No	No	They differ, different architecture and technology is used in telecommunications	Yes	Yes	No, the approach to development is the same
22	SD_EXCEED_TIME/BUDGET	yes	Most of the time	Yes	Yes	Yes	Yes
23	USE_OF_SDM_SUCCESS	No	Yes	yes	No not really	Yes	Yes

Organization D: Summary of codes

	CODES 1-4			
Representative	CODE 1:JOBTITLE	CODE 2:JOBHISTORY	CODE 3:GROUPWORK	CODE 4:TEAMSIZ
A1	Executive head of group strategy and research	4 years	Yes	6
A2	Software developer/designer	4 years	Yes	2
B1	Senior manager of business analysis	1.5 years	Yes	Yes, Small 2-10 people, Medium 11-30 people and large 31+ people
B2	Service deliver manager	0.5 years	Yes	2-3
C1	Lead enterprise business unit	2.8 years	Yes	15 people
C2	Production support executive	3 years	Yes	15 members
C3	Production support executive	2 years	Yes	15 people
C4	Production support executive	1.5 years	Yes	15people
D1	Analyst/Designer	4-5 yeas	Yes	6 people
D2	Systems development	5 years	Most the time	+10 people
D3	Team lead	4 years	Yes always	9 members
D4	Solution designer	3 years	Yes	7 people
D5	Software developer	3 years	Yes	3 people
D6	Consultant/ Developer	2.5 years	Yes	3 people

Summary of codes 1-4 for all representatives

	CODES 5-8			
Representative	CODE 5: COMMUNICATION	CODE 6: SYSTEMS DEVELOPMENT	CODE 7: SD_TYPES	CODE 8: DEVELOPER GROUPSIZE
A1	Yes, bad communicators	Both, in-house (40%), readymade (60%)	Knowledge management tools, corporate library systems, mobile applications and social media for enterprises	5-9 people
A2	Yes	Both	Workflow applications	5-9 people
B1	Yes	Purpose made solutions to fit business delivery needs, in-house	IS related development from vendor built systems integrated into the service delivery environment	Yes, Small 2-10 people, Medium 11- 30 people and large 31+ people
B2	Sometimes	Both	Both simple and complex. Data management systems	5-20
C1	Yes	Both, ready-made and in- house	OPS support	4-5
C2	Yes	Equal, make use of in- house and ready-made systems	OPS support	4 developers, 1 project leader
C3	Yes	Depending on the needs of the organization, both	OPS support	4
C4	Yes	Both scenarios are applicable	OPS support	4
D1	Yes	Buy systems and then tailor them	Enhancements on an OSS suite	9 people
D2	Communication channels are in place	Both, sometimes in-house and sometimes ready-made	Telecommunications oriented	+/- 10 people
D3	Yes	Develop these systems in house	Network inventory oriented	8 team members
D4	Not always	Purchase and customize it if needed	Integration between systems	3 people
D5	Yes	Ready-made systems are customized	Telecommunication oriented systems	9 people
D6	Yes	Mostly ready-made systems	MetroLAN networks	3 people

Summary of codes 5-8 for all representatives

	CODES 9-12			
Representative	CODE 9: PROJECT TIMESIZE	CODE 10: SDM_DEFINITIO N	CODE 11: SDM_USED	CODE 12: SDM_TYPE USED
A1	Size- Enterprise solutions for more than 500 people, Time- between 6 months and 2 years	Developing a functional and technical specification	Yes	Structures systems analysis and design method, Cap Gemini SDM
A2	2-5 Months	A framework to plan and control the development process, produce a software component that meets the requirements of the customer	Yes	Hybrid of incremental, prototyping, rapid application development
B1	Size-R1000's to R10millions Time -10 days to 1.5 years	As a waterfall model	Yes	SDLC
B2	Size-Unsure Time-3 months	The process that governs systems development in our organization	Yes	Waterfall model (Release life cycle model (RLM))
C1	5 days	A structure to assist in development	Yes	SDLC
C2	1 week	As a manner of developing systems to meet certain standards	Yes	SDLC
C3	1-2 weeks	Framework that can be used to develop systems	Yes	Systems development lifecycle
C4	1 week	Development guidelines	Yes	SDLC
D1	2 months	Set of rules and guidelines to help follow in order to develop applications	SVC, only use parts that are of interest	Waterfall like model
D2	10-12 months	As a set of procedures that need to be followed by the project team in developing the system	Company specific SDLC	Adopted version of the SVC
D3	3 months	Agile prototyping	Yes	Agile, SVC waterfall approach
D4	Months, sometimes close to years	Guidelines to follow for building an end to end system	Mostly agile and prototyping so yes	Prototyping
D5	2 months, others still ongoing	As a blue print of the projects	Yes	Investigation, design, development, testing and implementation
D6	+ 2 months	A frameworks that tracks planning, implementation and monitoring	Yes	Agile, SVC and prototyping

Summary of codes 9-12 for all representatives

	CODES 13-16			
Representative	CODE 13: SDM_TAILORING	CODE 14: SDM_ADAPT	CODE 15: CRITERIA	CODE 16: CRITERIA CHANGE
A1	As is	N/A	Expertise and experience of the development team	Set list
A2	Tailored	Combine methods to fit needs	Size and type of project, amount of resources	Sometimes
B1	SDLC tailored to business requirements	Yes, outsourcing	Breadth of system, number of vendors involved	Cluster projects based on size and vendors involved
B2	Tailored to suit specific needs	Yes, unofficial processes depending on timelines	1-Number of systems impacted. 2-Complecity. 3-Timelines	Set list
C1	Use it as is	N/A	Minor and non-functional change	Project dependant
C2	No tailoring	N/A	Time, budget, minor and non-functional change	Always the same
C3	SDLC as is	N/A	Time, budget, resources	No
C4	Use it as is	N/A	Time, budget, resources	No
D1	Tailor to methodological needs	Develop and only produce documentation if necessary	Time and resources	Not always
D2	Tailor it down	Unique to each project. Documentation has to be one of the most important aspects that we tailor	Company structure	Changes from time to time
D3	Documentation is tailored	Adapted SVC to use a more agile approach to systems development. Certain documentation have been inherited from the SVC	Time and cost	Depends on the skills needed for each project
D4	Tailor them to suit needs	Adapt them by looking at the needs of the project and then look at what needs to be delivered in order for the project to be successful	Size of the project as ell as resources needed	Changes depending on the project's size, cost and resources needed
D5	Sometimes	Focused on the extent of the documentation that accompanies a specific project. Some require	Time and costs	Sometimes

		more than others as well as the resources the projects use		
D6	Yes, sometimes	Include people who came with the requirements and receive guidelines as to determine the appropriate solution	Size and time	Changes depending on the time and size of the given project

Summary of codes 13-16 for all representatives

	CODES 17-20			
<i>Representative</i>	<i>CODE 17: CRITERIA_DETERMINED_BY</i>	<i>CODE 18: CRITERIA_CONTROL</i>	<i>CODE 19: SD_SUCCESS</i>	<i>CODE 20: SYSTEM_TYPES</i>
A1	Project sponsor or Head of development team	Yes	None	Mostly other types of systems
A2	Head of development	Not strictly	90+ successful, 50% of projects overshoot deadline due to scope creep	Telco and other types of systems
B1	Project steering committee	Yes	60% -70%	Mostly telco related
B2	Senior group of people (account management, architects and process specialists)	Yes	90%	IT and telco systems
C1	Project members	No	98%	All telecoms
C2	Project leader, organization	Yes	All of them except for a few who exceed time and budget	Specialize only in telecoms
C3	Management	Not vigorously	More than 70%	All telecoms
C4	Management	yes	About 80%	All telecommunication oriented
D1	The business	No, not at all	More than 10	All telecoms
D2	Management at a tactical level	No not really	Uncertain (I have lost count)	Most of them are telecommunication related
D3	Project development team	Determined by the project manager	2%, projects almost always exceed	Telecom's related

			budget and time constraints	
D4	Project tem	Not really	40% are completed within time and budget	Mostly telecom's oriented
D5	Project manager, design head an project team	Yes they are	10, more than 80%	All telecoms systems
D6	Project manager	Yes they are	10 projects to date	Telecoms oriented

Summary of codes 17-20 for all representatives

CODES 21-23			
<i>Representative</i>	<i>CODE 21: TELECOMS_DIFFER</i>	<i>CODE 22: SD_EXCEED_ TIME/BUDGET</i>	<i>CODE 23: USE OF_SDM_SUCCESS</i>
A1	Yes	99% of the time	No
A2	No, depending on knowledge of developer	Often	Yes
B1	Yes	Yes	Yes
B2	Yes	Yes, 50%	Yes
C1	Yes	Yes	Yes
C2	Yes	Yes	Most definitely
C3	No	Sometimes	Yes
C4	Only in terms of knowledge	Yes	Yes
D1	No	Yes	No
D2	No	Most of the time	Yes
D3	They differ, different architecture and technology is used in telecommunications	Yes	Yes
D4	Yes	Yes	No not really
D5	Yes	Yes	Yes
D6	No, the approach to development is the same	Yes	Yes

Summary of codes 21-23 for all representatives