A Strategy for Coordination in Agile Software Development Projects for Effective and Efficient System Delivery, A case of Econet Wireless Private Limited.

By

SHOSHORE TAPIWANASHE (R11705Z)

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Supervisor: **Mrs A Mutembedza**

Co- Supervisor: **Mrs N Sarai**

ABSTRACT

Agile software development offered a deceptively simple means to organise complex multi-participant software development while achieving fast delivery of quality software, meeting customer requirements, and coping effectively with project change. There is little understanding, however, of how agile software development projects achieve effective coordination, a critical factor in successful software projects. Agile software development provides a unique set of practices for organising the work of software projects, and these practices seem to achieve effective project coordination. Therefore, this dissertation took a coordination perspective to explore how agile software projects work, and why they are effective. The outcome of this research was a theory of coordination in co-located agile software development projects. The findings show that agile software development practices form a coordination strategy addressing three broad categories of dependency: knowledge dependencies, task dependencies, and resource dependencies. Most coordination is for managing requirement, expertise, historical, and task allocation dependencies; all forms of knowledge dependency. Also present are task dependencies, which include activity or business process dependencies, and resource dependencies, which include technical or entity dependencies. The theory of coordination explains that an agile coordination strategy consists of coordination mechanisms for synchronising the project team, for structuring their relations, and for boundary spanning. A coordination strategy contributes to coordination effectiveness, which has explicit and implicit components.

DECLARATION

I**, Shoshore Tapiwanashe** hereby declare that I am the sole author of this dissertation. I authorize the **Midlands State University** to lend this dissertation to other institutions or individuals for the purpose of scholarly research.

Signature: ……. Date: ……..

APPROVAL

This dissertation, entitled **"A strategy for Coordination in Agile Software Development Projects for Effective and Efficient System Delivery, A case of Econet Wireless Private Limited."** by **Shoshore Tapiwanashe** meets the regulations governing the award of the degree of **MSc Information Systems Management** of the **Midlands State University,** and is approved for its contribution to knowledge and literary presentation.

Supervisor's Signature: …….

Date: ……..

Co-Supervisor's Signature: ……

Date: ……..

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I appreciate the support given by the Econet Wireless Software Developers, Project Managers and Database Administrators, and for their assistance in locating and introducing me to research participants. Thank you to my many research participants who contributed many hours of their time to talk about their work, of which they can be justly proud.

My wife Faith, thank you for your patience, good sense, and good humour, for believing I could do it, and then letting me get on with it. Thanks also to my great friends, Tawananyasha Shoshore, Takudzwa Chikova, Tapiwa Joel, Prosper Jambo and Prosper Shoshore for your support and encouragement, for stepping in when things got tough, and making me take time out for a bit of fun every now and then.

DEDICATION

This study is wholeheartedly dedicated to my beloved Wife and Daughter, who have been my source of inspiration and gave me strength when I thought of giving up, who continually provide their moral, spiritual and emotional support.

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LIST OF ACRONYMS

ASD	Adaptive System Development
BDD	Behaviour-Driven Development
CAS	Complex Adaptive Systems
CVS	Concurrent Versioning System
DSDM	Dynamic System Development Method
FLOSS	Free/Libre Open Source Software
GSD	global software development
GUI	Graphical User Interface
IDE	Integrated Development Environment
IS	Information Systems
ISD	Information System Development
ISDM	Information System Development Methodology
IT	Information Technology
JAD	Joint Application Development
LD	Lean Development
PP	Pragmatic Programming
RAD	Rapid Application Development
RUP	Rational Unified Process
SDLC	System Development Life Cycle
SPSS	Statistical Package for the Social Sciences
SE	Software Engineering
SDM	System development methodology
SMM	Shared Mental Model
TDD	Test Driven Development
TMM	Team Mental Model
UML	Unified Modelling Language
XP	Extreme Programming

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CHAPTER ONE: INTRODUCTION AND BACKGROUND TO THE STUDY

1.1 Introduction

There is an increased need for business flexibility and this comes with the need for the adoption of new software platforms or the alteration of existing ones. Handling such change is a critical factor in software delivery to ensure that businesses maintain a competitive edge. In rigid business environments, change is governed by a lot of rules and regulations and a top-down management style results in a long feedback loop thereby further delaying changes.

With the fast-changing environment there is a need for the rapid adaptation of information systems to keep up with the changes. This has then seen shifts from traditional methods of software development models as they were becoming ineffective in the delivery of software projects. Agile methods because they are flexible thereby responding to change rapidly have been widely adopted over the past decade.

"Agile Methodologies are a group of software development methods that are based on iterative and incremental development" (Kumar & Bhatia, 2012). The defining characteristics of agile methodologies are:

- adaptive planning
- iterative and evolutionary development
- rapid response to change
- communication centric

The aim of agile methods is to achieve higher quality software in a shorter period of time with customer collaboration and less documentation. In as much as agile methods have become the new trend because of quick delivery and easy adaptation, there is a need for good control measures to prevent a helter skelter situation.

1.2 Background

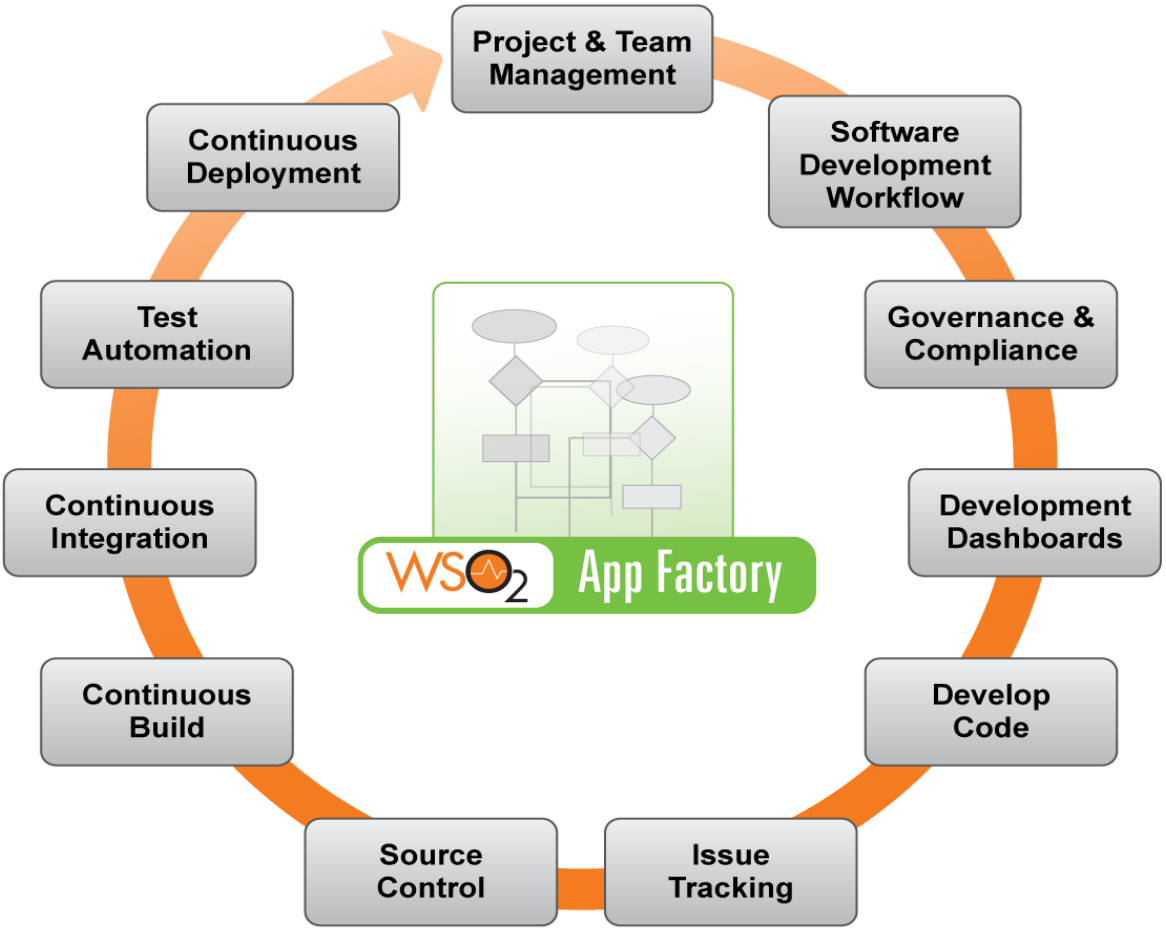


Figure 1. 1: Concepts behind Agile Policy in Software Development

"Agile software development is an approach to software development under which requirements and solutions evolve through the collaborative effort of self-organizing and cross-functional teams and their customers or end users. It advocates for adaptive planning, evolutionary development, early delivery, continual improvement and it encourages rapid and flexible response to change" (Anon., n.d.). "Agile software development is an umbrella term for a set of frameworks and practices based on the values and principles expressed in the Manifesto for Agile Software Development" (Beck et al., 2001). Up until 2001, there were no particular guidelines as to how to apply agility to software projects. People did it haphazardly with no methodical manner. It is in 2001 that a group of 17 people came together, formed the Agile Alliance and developed the agile manifesto.

1.2.1 The Agile Manifesto

The Manifesto by the Agile Alliance highlights the value of "individuals and interactions over processes and tools, working software over comprehensive documentation, Customer collaboration over contract negotiation and responding to change over following a plan" (Beck et al., 2001).

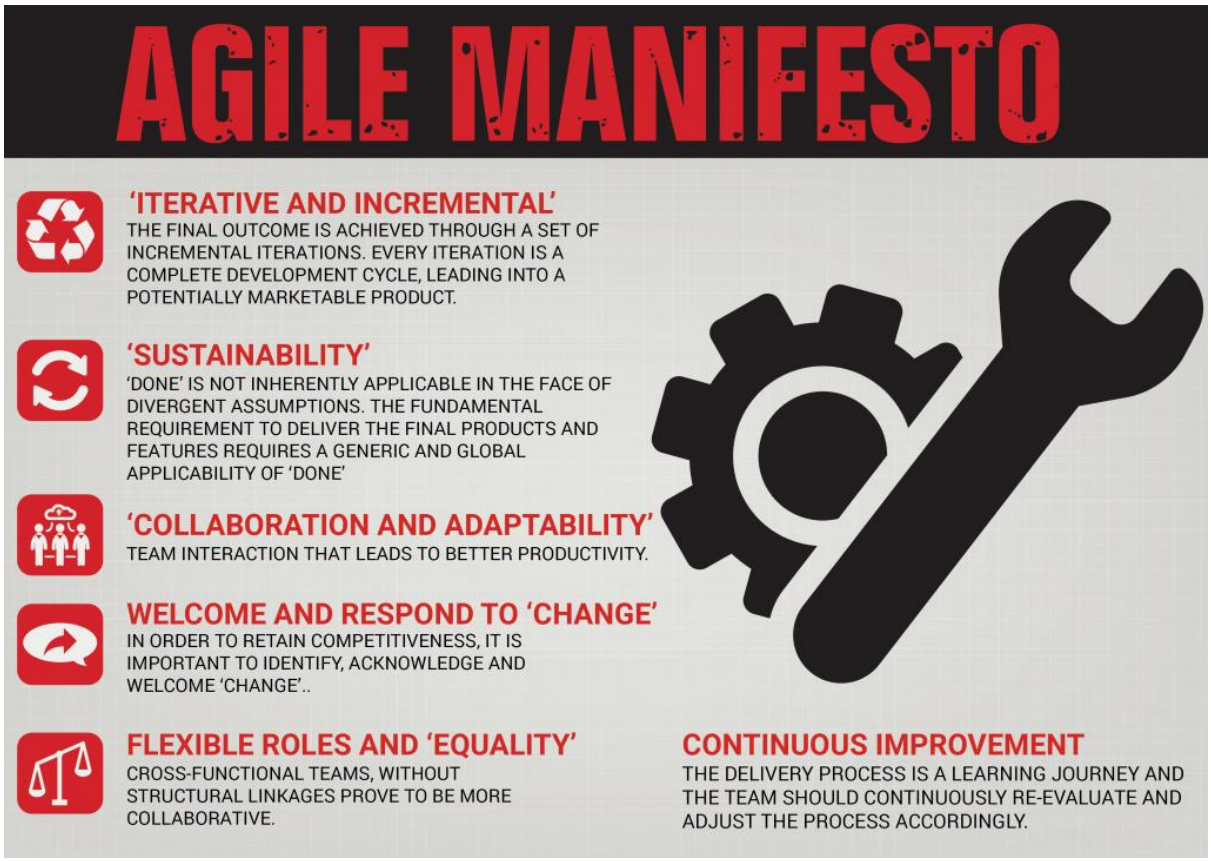


Figure 1. 2 : The Concepts behind Agile Manifesto

1.2.2 Agile Development Principles

There are 12 principles that further expand on the agile manifesto:

a. Our highest priority is to satisfy the customer through early and continuous delivery of valuable software.

b. Welcome changing requirements, even late in development. Agile processes harness change for the customer's competitive advantage.

c. Deliver working software frequently, from a couple of weeks to a couple of months, with a preference to the shorter timescale.

d. Business people and developers must work together daily throughout the project.

e. Build projects around motivated individuals. Give them the environment and support they need, and trust them to get the job done.

f. The most efficient and effective method of conveying information to and within a development team is face-to-face conversation.

h. Working software is the primary measure of progress.

i. Agile processes promote sustainable development. The sponsors, developers, and users should be able to maintain a constant pace indefinitely.

j. Continuous attention to technical excellence and good design enhances agility.

k. Simplicity. The art of maximizing the amount of work not done is essential.

l. The best architectures, requirements, and designs emerge from self-organizing teams.

m. At regular intervals, the team reflects on how to become more effective, then tunes and adjusts its behaviour accordingly. (Beck et al., 2001).

1.2.3 Agile Methodologies

There are quite a number of agile development methodologies that are practiced. Some of them are Extreme programming (XP), Crystal Scrum and Feature Driven Development (FDD). Each method is best suitable for different scenarios and all of these methodologies are based on the Agile Manifesto.

1.2.4 Extreme Programming (XP)

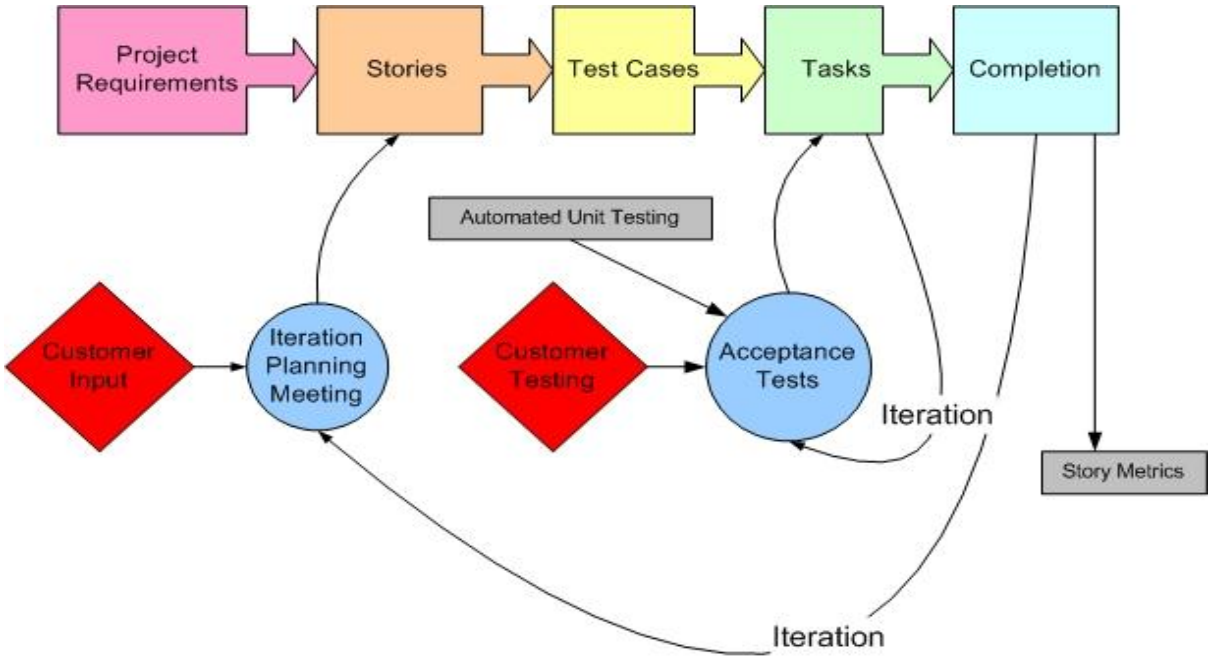


Figure 1. 3 : Extreme Programming (XP)

XP was developed by Kent Beck and is usually used in software development companies. The methodology puts emphasises on communication, simplicity, feedback, respect, courage and customer satisfaction.

Teamwork is of paramount importance in XP and problems are solved as team including all stakeholders. This creates an environment that breeds productivity and efficiency. In XP, software is tested from the very first day, feedback is given and the product is improved with every iteration resulting in a better end product in a shorter period of time.

1.2.5 Crystal

Figure 1. 4 : Crystal Programming Methodology

This is a family of agile methodologies that fall into different categories which are:

- Crystal Clear (up to 6people in the team)
- Crystal Yellow (7 to 20 people in a team)
- Crystal Orange (21 to 40 people in a team)
- Crystal Red (41 to 80 people in a team)
- Crystal darker (81 or more people)

Crystal focuses on the interactions of team member in order to deliver the required software product rather than on tools and processes.

1.2.6 Scrum

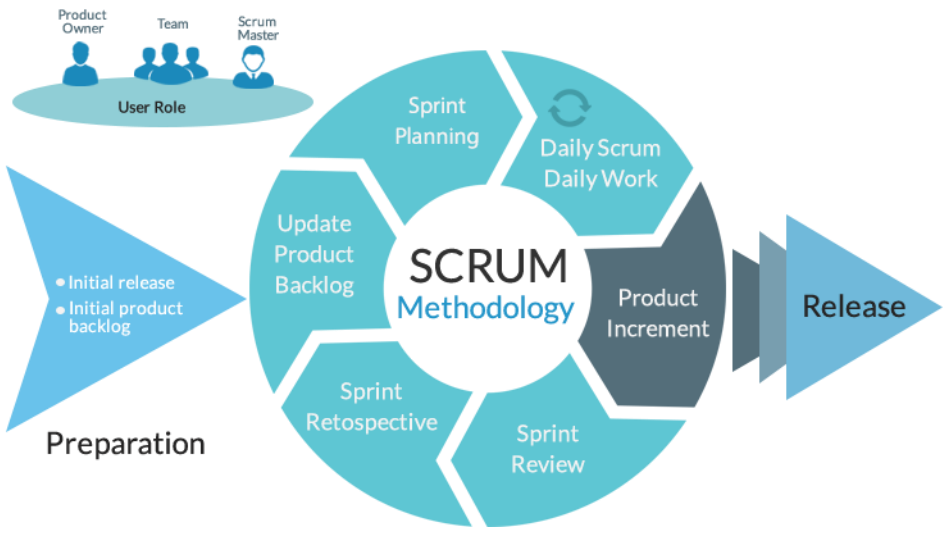


Figure 1. 5 : The Scrum Methodology

This is the most commonly used agile framework. Scrum is characterised by cycles known as sprints that greatly reduce development time for a software product. Every day short meetings (daily scrum) are held for 15 minutes or less plan the workday and discuss any challenges.

1.2.7 Feature Driven Development (FDD)

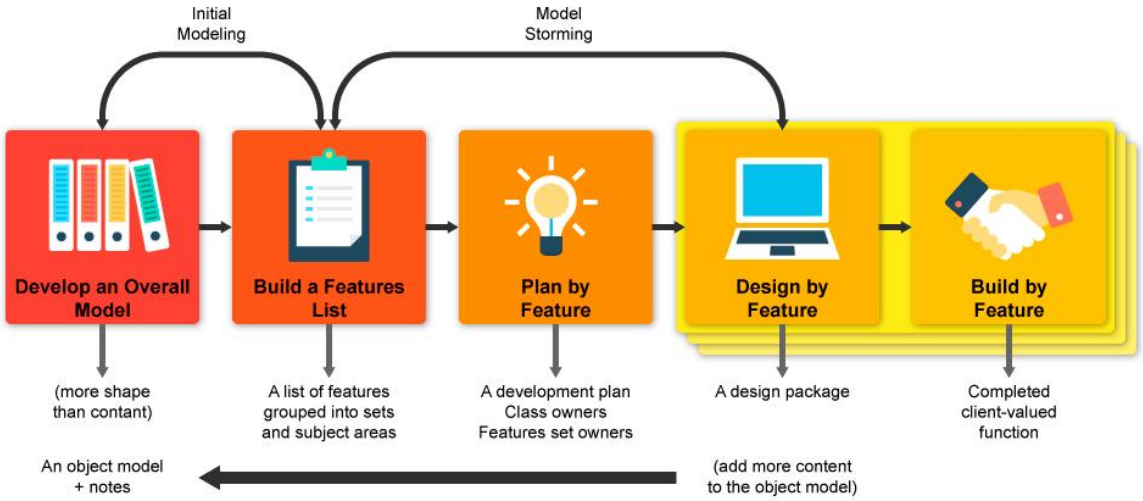


Figure 1. 6 : Feature Driven Development Cycle

This is an iterative and incremental software development model. Firstly the scope of the project is defined then a list of features is derived such as “add employee”, “calculate

invoice" etc. Related features are then grouped and a development team is assigned to each feature group. Practices are driven from a client-valued functionality (feature) perspective. Its main purpose is to deliver tangible, working software repeatedly in a timely manner in accordance with the Principles behind the Agile Manifesto.

All the Agile development methods discussed above call for different coordination methods. Some scholars advise on how coordination may be carried out in agile development but some of these methods are not necessarily applicable across different organizations. Due to the fast-paced development and "lack of structure" of agile projects, there is a need for good coordination.

Principle number 4 of the 12 principles of agile development emphasis on coordination, "Business people and developers must work together daily throughout the project" but no clear guidelines are given as to how this can be achieved. Chapter 2 which is the Literature review will look into the works of other scholars with regard to coordination in agile software projects.

1.3 Statement of the Problem

Agile development approaches are designed to support development in changeable and uncertain conditions therefore by nature agile development methods are lightweight meaning there are very few rules and practices that ought to be stuck to. In as much as this is good for adapting to changes and doing the needful to deliver on requirements, problems such as scope creep, budget overruns and an avalanche of other effects may arise. Nidumolu (1995) investigated coordination in software development projects and raised the question "how can software development projects be coordinated more effectively in the presence of uncertainty?" (Ndidumoli, 1995).

Many scholars give advice on how coordination may be done but there is no consensus on how effective coordination may be achieved. The purpose of this study is to develop a coordination strategy for agile software development projects at Econet taking into consideration organizational structure, practices and business requirements.

1.4 Research Questions

What are the means of coordination in agile developments that can be employed in order to efficiently and effectively deliver systems?

In order to answer the main research question, the following secondary questions are defined:

- Currently how is coordination in agile software development projects being carried out at Econet?
- What coordination challenges do software project managers, software developers and end users during the system development life cycle?
- How does the coordination in agile software development projects affect delivery time and quality of software produced?

1.5 Research Objectives

The main objective of the study is to develop a strategy for the coordination of agile development projects at Econet to ensure timely delivery of good quality software.

In order to meet the main objective, the following are supporting sub-objectives:

- To determine current methods being employed in the coordination of agile software development projects at Econet.
- To determine the challenges faced by software project managers, software developers and end users at Econet during the system development life cycle
- To determine how coordination in agile software development projects affect delivery time and quality of software produced.

1.6 Literature review

Coordination has been studied in software projects and projects in other domains. Agile methods offer flexibility in responding to changing requirements and allow for the rapid development of systems. Agile methods are known to be lightweight meaning that only a few rules exist. In theory because of the flexibility, agile development practices should result in project success but this is not so. Because of the flexibility, it becomes difficult to manage

people, resources and scope. Coordination is one of the essential problems of software engineering and it has become a greater concern with the growing complexity of systems" (Curtis et al, 1988).

(Strode, 2012) "Agile software development offers a deceptively simple means to organise complex multi-participant software development while achieving fast delivery of quality software, meeting customer requirements, and coping effectively with project change".

Coordination theory is "a body of theories about how coordination can occur in diverse kinds of systems" Crowston (1998). March and Simon (1958) came up with two approaches to coordination which are coordination by programming and coordination by feedback. Coordination by programming makes use of work plans, set policies and procedures as the chief means of coordination thereby following the mechanistic strategy. Coordination by feedback approach relies on mutual adjustments among individuals and groups through vertical and horizontal communications.

Nidumolu (1996) conducted a study on sixty-four different software projects to determine how coordination strategies impact project performance. Project performance is defined as "the success of the IS development project in terms of meeting cost, scope and schedule criteria" Wang et al (2015). The study showed that in projects where vertical coordination was used, it was easier to manage risk and uncertainty. Projects that were managed using horizontal coordination mechanisms showed performance. The research therefore showed that coordination strategy played had an impact on project performance.

Andres and Zmud (2001) conducted a study to determine the impact of tasks interdependence, goal conflict and coordination strategy on productivity and satisfaction. The results of the study showed that horizontal or organic structures resulted in better productivity as it allowed for creativity and good communication. The flexibility of horizontal coordination allowed for easier interaction among project team members which allowed for easier management of tasks that depended on each other. This study was aimed at establishing a relationship between coordination strategy and productivity. Productivity may not necessarily result in a "successful project". Further studies will be conducted to determine whether increased productivity would result in project success.

A study was conducted to determine the role of horizontal coordination the performance of Information System Development projects. The study concluded that "rapid application development and prototyping models under strict time constraints can better utilize horizontal coordination where there is a need for speed to develop and get user feedback is required quickly" (Parolia & Jiang, 2006). This research studied only horizontal coordination strategies, the study to be undertaken will evaluate the degree to which vertical coordination may be applied to agile development.

1.7 Significance of the Study

Not enough work has been done in the area of coordination in agile software development projects. There are guiding principles as to how to carry out agility in the development of software but not much on how to effectively coordinate an agile software development project to ensure successful project delivery.

A case study will be done on Econet and a thorough understanding of how current projects are being coordinated, the methods will be evaluated, their strengths and shortfalls evaluated. It is upon these findings that a model or strategy for coordination in agile software development projects will be derived. The strategy will benefit the software development team of Econet and the same strategy may also be applied in the coordination of other projects in other business units of the same organization.

1.8 Justification

There is a need for the adoption of good coordination mechanisms in order to ensure agile software development success. With the ever increasing application needs that are growing in terms of complexity, there is a need to manage change quickly and effectively. In order to stay competitive and relevant, businesses need to adapt quickly therefore software service providers have to respond swiftly and deliver client needs. Good coordination mechanisms will help ensure project success with all other factors being carefully managed.

1.9 Research Methodology

Research methodology defines a system of beliefs and philosophical assumptions which will shape the understanding of the research questions and underpin the choice of research methods (Saunders etal, 2007).

1.9.1 Research Design

The research onion developed by Suanders et al (2016) will guide the researcher in developing an effective research. The research onion provides a description of the layers (see Figure 1) a researcher must undergo in order to develop an effective research methodology. The researcher will work from the outer layer going in.

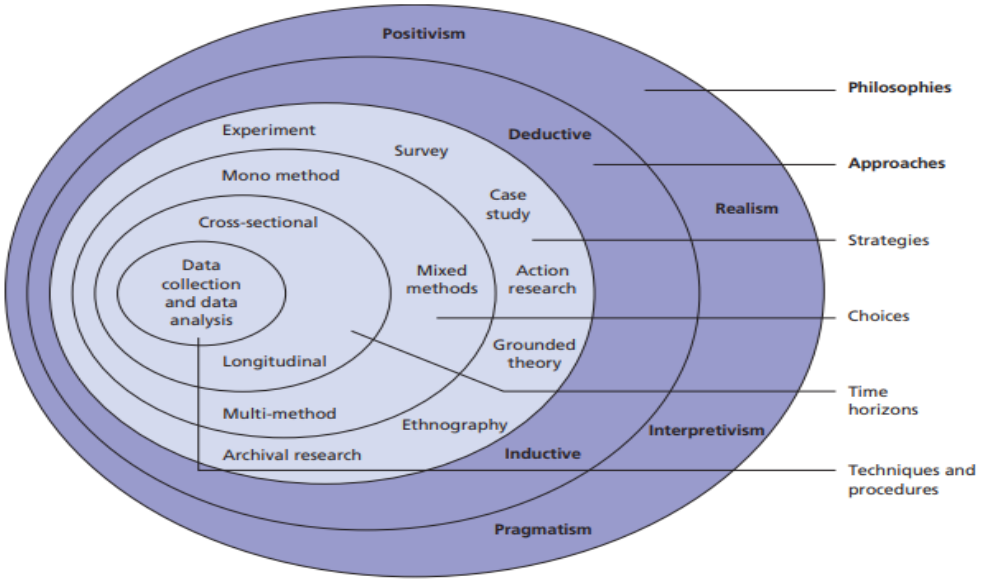


Figure 1. 7 : Research Onion (Saunders et al, 2016)

1.9.2 Research Philosophy

A positivist research philosophy is of the view that only information or knowledge gained through observation is reliable. A case- based approach will be used, with Econet Wireless Private Limited being the case. To explore coordination, it is necessary to carry out an exploratory research in order to gather in-depth and detailed knowledge on how current software development projects are being carried out and the results yielded. There is a need to understand the interactions among the project managers, the developer and the end users/clients and what may be affecting their interactions.

1.9.3 Research Approach

"Research approaches are plans and the procedures for research that span the steps from broad assumptions to detailed methods of data collection, analysis, and interpretation" (Creswell, 2014). The research approach adopted by a study is determined by the nature of the study, these approaches can be inductive or deductive.

Qualitative methods are used to explore and an understanding of certain phenomenon, qualitative methods are used to test theories by studying relationships between variables and mixed methods combine both qualitative and quantitative approaches. Data on how coordination (the variable) impact project performance, these results will then be used to develop a strategy for coordination in agile software developments.

Inductive research "involves the search for patterns from observation and the development of explanations or theories for those patterns through series of hypotheses" (Bernard, 2011).This study wishes to study coordination in agile software development and how it affects project outcomes, there for an inductive approach would be ideal.

A mixed method approach will be taken in which interviews, surveys and observations and observation will be used to gather data.

1.9.4 Research Strategy

"Case study design involves extensive study of one or more individuals or cases in a real life context" (Gerring, 2007). In order to come up with the right conclusions as to how coordination impacts project performance, a thorough investigation needs to be carried out. Econet is the case study, observation on two agile developments will be done.

1.9.5 Study Site

A study site refers to the geographical area in which research will be conducted. The study will be conducted at Econet Offices in Harare where the software development team is housed.

1.9.6 Target population

"Target population refers to the entire group of individuals or objects to which researchers are interested in generalizing the conclusions" (Anon., 2008).The target population is software developers, project managers and end users at Econet.

1.9.7 Sampling Strategies

Stratified sampling will be used. The population will first be divided into subgroups (or strata). The population will be grouped into software developers, project managers and end users/customers.

1.9.8 Sample

Sample is defined by (Anon., n.d.) as "a part or piece that shows the quality or character of the whole". In this study, a sample size of 60 will be used to generalize findings to the whole population.

1.9.9 Data Collection Methods

Questionnaires will be given out that will consist of structured and unstructured questions. Interviews will also be conducted with willing participants to get more insights. Observation will also be done; the researcher will sit in scrum meetings and other stakeholder meetings in order to understand how coordination is currently taking place and how well the methods are working.

1.9.10 Data Quality Control

Creswell (2014) defines data quality as "the condition of a set of values of qualitative or quantitative variables". Data is deemed to be of good quality if it is usable for its intended purpose and is truly representative of the phenomenon which is under study. In qualitative research validity and reliability of data are the major quality control issues. "Reliability refers to the degree to which other researchers performing similar observations in the field, as well as analysis, would produce similar predictions and results.

In qualitative research designs reliability is concerned with the trustworthiness and dependability of the data generated" (Thyer, 2010). "Validity refers to the issue of whether or not an indicator that is designed toward measuring a certain concept actually measures it" (Creswell, 1998). Due to the nature of the research which is qualitative, data quality is rather difficult to control but is not impossible.

The research instrument has to be concise and help in achieving the objectives. In the case of this study, the research instruments are the research questions (interview and questionnaire questions) which should be carefully worded in order to get valid data. Data should also be coded correctly. Dirty data and incorrect coding can affect the outcome of the study therefore due diligence when handling data.

1.10 Data Presentation and Analysis

Once data is collected using the various collection instruments, the next step is to make sense of it and gain some insights into the problem area. Qualitative data is not easily reduced to

figures. Data has to be coded Data from oral interviews has to be transcribed. Observation Data with similarities is indexed and linked.

Content analysis will be used to analyse information obtained from questionnaires, interviewees and observation of how research subjects interacted.

1.11 Ethical Considerations

Research is a professional undertaking therefore there are well established rules and guidelines that define how researchers should conduct themselves and how to treat subjects. "Research ethics is important in our daily research endeavours and requires that researchers should protect the dignity of their subjects and publish well the information that is researched" (Fouka & Mantzorou, 2011).

A letter from Midlands State University was obtained authorizing the researcher to carry out the study was obtained. This will assure respondents that the research being carried out is sanctioned. The anonymity and confidentiality of respondents and their responses will be upheld in line with ethical considerations. The respondents will be made fully aware of the nature of the research and how information collected from them will be used. Only willing participants will take part in the study.

1.12 Limitations and Delimitations of the Study

Creswell (2015) defines limitations as "those physiognomies that influence the analysis of research findings". Due to the nature of the research, a considerable amount of time is required in observing the research subjects and this case the time available to carry out the study was rather limited. The strategy defined as a result of this research may not be applicable to other domains as extensive research was done only at Econet and the strategy derived was in consideration of the Econet business environment.

According to Leedy and Ormrod (2010), delimitations are characteristics that narrow the scope and determine the boundaries of the study set by the researcher. The study will focus on Econet Wireless Zimbabwe which is also unit of study in the case study. There are also many factors that have a bearing on project success but the study will focus only on coordination.

1.13 Research Plan

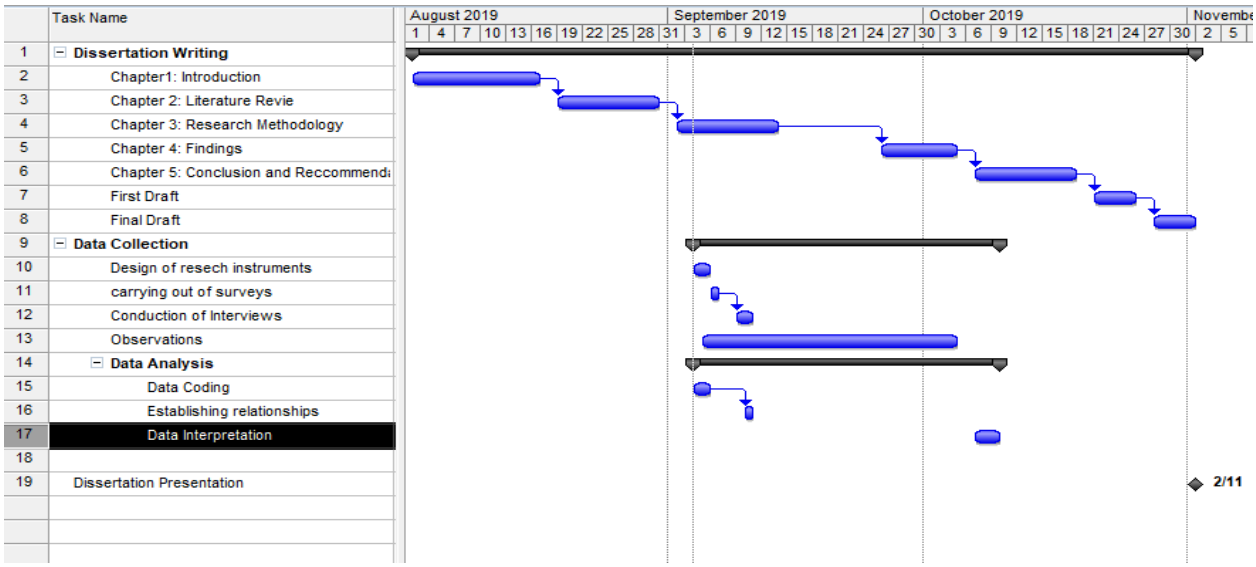


Table 1. 1 : Thesis work plan

1.14 Conclusion

The chapter introduced the research topic, the objectives of the study and gave a background into the study area. Agile development methods provide the flexibility required for projects with a high degree of uncertainty as requirements are always changing. The development process is quick, rather informal and requires a lot of involvement with the end user making the development process quick and a satisfied end user/client. The need to quickly develop a system, the "lack of proper structures" and the high degree of uncertainty presents coordination challenges which can lead to project failure. The following chapter, the literature review will bring together the works of other scholars in the area of concern and identify knowledge gaps some of which are to be filled with this research.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

Chapter 1 of this paper introduced the topic of research which is "A strategy for Coordination in Agile Software Development Projects for Effective and Efficient System Delivery, A case of Econet Wireless Private Limited". The objectives of the study were defined and the limitations and scope of the study were defined. The purpose of this chapter is to give an understating of the research area and to review the works of other scholars in relation to the research topic.

Knowledge gaps will be identified in order to justify the undertaking of this study. A funnel approach will be taken in analyzing literature where the general concepts and underlying theories will be studied then narrowed down to core issues of the research.

"Coordination is one of the essential problems of software engineering and it has become a greater concern with the growing complexity of systems" (Curtis et al, 1988). This has led to some studies in the area of coordination in software projects. Coordination is a rather invisible aspect of project management and coordination efforts usually go unnoticed but where it lacks it is clearly noticeable.

The implementation of IT projects particularly software projects is rather complex as there are lot of moving parts. "Agile software development offers a deceptively simple means to organise complex multi-participant software development while achieving fast delivery of quality software, meeting customer requirements, and coping effectively with project change" (Strode, 2012). More often than not projects run behind time, over budget and at times do not even meet the needs of the clients. Coordination failure plays quite a significant role in these failures.

2.2 Defining Coordination

Many scholars from different fields of study define coordination in different ways. Some of the definitions are listed below:

- Coordination refers to "the linking together of different parts of the organization to accomplish a collective set of tasks" (Van De Ven and Delbecq 1976).
- Thompson (1967) also defines coordination as "the management of interdependence among different activities to accomplish certain objectives".

- "When multiple actors pursue goals together, they have to do things to organize themselves that a single actor pursuing the same goals would not have to do. We call these extra organizing activities coordination" Malone (1988).

For this study, Malones definition of coordination will be adopted.

2.3 Coordination Theory

According to Crowston (1998), coordination theory is "a body of theories about how coordination can occur in diverse kinds of systems". Any given organization requires coordination to achieve any given objective. Coordination is a challenge that is presented as a result of dependencies on resources (people, time, material etc) and tasks which has a direct impact on outcomes.

Coordination challenges may be a result of constrains inherent in the organizational structure or dependencies in resources, tasks etc. Coordination mechanisms solve coordination challenges. The theory recommends that dependencies should be carefully studies and the appropriate mechanisms applied.

In their studies, March and Simon (1958) came up with two approaches to coordination which are coordination by programming and coordination by feedback. Coordination by programming makes use of work plans, set policies and procedures as the chief means of coordination thereby following the mechanistic strategy.

Coordination by feedback approach relies on mutual adjustments among individuals and groups through vertical and horizontal communications. Van de Ven et al., (1976) were of the opinion that coordination by feedback was time consuming and recommended that it be used only for tasks with high uncertainty and high degrees of interdependency.

Thomson, Malone and Crowston in their study identified three typical dependencies among tasks and resources:

- **Producer-consumer:** when a task (producer) creates a resource (output) that another task (consumer) requires as an input.
- **Shared resource:** when multiple tasks are coordinated by the access of shared, mutually exclusive resources.

- **Common output:** when multiple tasks are undertaken concurrently to achieve the same goal output).
- **Resource-resource:** this usually occurs when changes to a resource affects the state of another resource.

2.4 Organizational Structure and Coordination Strategies

The structure of an organization refers to the hierarchy within that particular organization. It defines who reports to whom. A company's culture determines its structure which in turn influences the manner in which it operates and performs. The manner in which responsibilities are assigned throughout the organization/hierarchy depends on the structure of the organization.

In order for organizations to be able to achieve their goals, they require structure. The structure of an organization determines the methods which will be employed to perform business operations and achieve organizational goals. "While organization is necessary for success, the structure can influence the project management process. A company's organizational structure may dictate the level of project management, who makes ultimate project decisions, the communication of project goals and tasks and how the project manager works with his team" Richards (n.d).

2.4.1 Horizontal and Organic Structures

Companies or organizations that have very few levels between managers and subordinates have a horizontal structure. Horizontal structures are typically found in small organizations Horizontal structures believe in empowering employees to be able to make certain decisions and also involving them in some decision making processes thereby increasing productivity. In such structures, the management of the company focuses on the achievement of organizational goals and policy enforcement while lower level employees are focused on the delivery of day to day tasks.

2.4.1.1 Advantages of Horizontal Structure

- Employee-centred Approach which encourages innovation and empowers employees through training and equipping them with tools to discharge their duties effectively.
- Focus is on teamwork to collectively attain organization goals. Focus is on teams rather than individuals.

- The work culture engrained in horizontal organizations encourages development of individuals which leads to job satisfaction which in turn increases productivity.

2.4.2 Vertical and Mechanistic Structures

In organizations with classical management styles, the needs, feelings and opinions of individuals are not take into consideration. The mechanistic management style is based on the thinking that organizations should be run in a military like manner. Orders come from the top going down and reports come from below going up. The chain of command is very clear.

The model advocates for:

- Close coordination and control for efficient task completion.
- Effective transmission of messages.
- Communication to be done via official or formal channels only.
- Adherence to set rules.
- Motivation by punishment or reward.
- Centralization of decision making to those in the top tiers of the organization.

Most companies employ the vertical organization structure with clear distinctions between supervisors and subordinates. The structure is usually follows the form of a triangle with the bulk of people being lower level workers who form the base and ultimately all report to one person.

2.4.2.1 Disadvantages of Vertical Functional organizations

Coordination is rather complex and time consuming in vertical functional organizations. As the organization grows, vertical structure, hierarchy, definition of roles and departments become clearer thereby creating boundaries. This the presents challenges in communication where collaborative efforts are required. Feedback loops are longer as there in a chain of command that needs to be followed to disseminate information and make decisions. This results in projects delays. Vertical functions in agile software development projects provide an even bigger challenge. By nature, agile programming methods call for rapid development and adaptation to changes.

2.5 Coordination and Control

Henri Fayol a management theorist described five elements of management which are planning, organizing, command, coordination and control.

Figure 2. 1: Fayols Elements of Management (Studious Guy,nd)

According to Studios Guy website (n.d),"organizations function well when all actions are harmonized. A positive influence of the employees' behavior is crucial in coordinating. Coordination aims at galvanizing discipline and motivation within the group dynamics, which necessitates good leadership and clear communication. Intended objectives can be achieved only through positive employees' behavior".

Simply put, coordination is all about ensuring everything works well together. It is having the right resources at the right time and right place. Coordination can be internal or external. Internally, managers coordinate resources, team actions and (Studious Guy)procedures so that the objectives are achieved in an efficient and effective manner. Externally, coordination takes place between an organizations manager with clients and other stake holders.

In large enterprises with a high staff complement and many levels of management coordination is essential to ensure the smooth running of the company and projects.

2.6 Coordination Techniques

"Given that IT implementations often involve cross-functional teams, coordination among team members is a key project management issue". (Kraut and Streeter, 1995). Coordination techniques are categorized coordination techniques into five groups:

- formal impersonal procedures
- formal interpersonal procedures
- informal interpersonal procedures
- electronic communication
- interpersonal networks

2.7 Characteristics of Coordination

2.7.1 It is a continuous process

In as much as there will be a project plan in place prior to its commencement, a lot changes during execution. Budgets change, there are delays, changes in scope etc. Coordination is therefore essential in managing changes and ensuring that deliverables are delivered.

2.7.2 Applies to Group Efforts

Different individuals contribute towards the achievement of common goals but coordination is what brings together all the different efforts to attain the goal.

2.7.3 It is a responsibility of managers

Coordination is inherent in the duties of all managers.

2.7.4 It is a Conscious Action

Coordination does not just happen, it takes some conscious decisions and actions

2.7.5 It Avoids Interruption of Operations

To achieve certain goals, there has to be continuity of work. Interruptions may occur but coordination helps in avoiding them.

2.7.6 It avoids duplication of work

Good coordination efforts clearly define roles and assigns tasks carefully thereby avoiding duplication of work or functionality which in turns saves resources and derives maximum value from available resources.

2.8 Coordination in Agile Projects

"Agile software development is well accepted in the practitioner community but there is little understanding of how such projects achieve effective coordination, which is known to be critical in successful software projects" (Strode, 2012).

"Achieving a successful software system requires coordination among the various phases and tasks involved in the software development cycle and minimal backtracking. If the software system is small, and members are physically proximate and respect one another, effective coordination can occur because the group can work out problems together and keep all the implementation details in focus" (Harris, 1994).

(Faraj and Sproull, 2000) studied coordination and studied it from two angles, administrative coordination and expertise coordination. They claim that administrative coordination works when managing simple day to day tasks where things like physical and monetary resources are managed, for complex, specialized tasks/projects, expertise coordination is required to coordinate skill dependant tasks coordination the team can recognize and access expertise when it's needed.

Nidumolu (1996) conducted a study on sixty-four different software projects to determine how coordination strategies impact project performance. Project performance is defined as "the success of the IS development project in terms of meeting cost, scope and schedule criteria" Wang et al (2015).

The study showed that in projects where vertical coordination was used, it was easier to manage risk and uncertainty. Projects that were managed using horizontal coordination mechanisms showed performance. Over the 64 projects that were studied; a relationship between uncertainty, project uncertainty and project performance was established. The higher the project uncertainty was, the higher the performance risk and consequently the lower the project performance.

Andres and Zmud (2001) conducted a study to determine the impact of tasks interdependence, goal conflict and coordination strategy on productivity and satisfaction. The results of the study showed that horizontal or organic structures resulted in better productivity as it allowed for creativity and good communication. The flexibility of horizontal coordination allowed for easier interaction among project team members which allowed for easier management of tasks that depended on each other.

A study was conducted to determine the role of horizontal coordination the performance of Information System Development projects. The study concluded that "rapid application development and prototyping models under strict time constraints can better utilize horizontal coordination where speed to develop is greater and user feedback is required quickly" (Parolia & Jiang, 2006).

2.9 Impact of Coordination on Project Performance

Choudhury (2006) in his studies found that project performance is directly affected by coordination and control. Sabherwal & Choudhury (2006) defined control as "a mechanism to ensure an individual's conformance to stated organisational or project goals". "Improved coordination helps in the exercise of control while effective control may improve coordination" Sabherwal & Choudhury (2006).

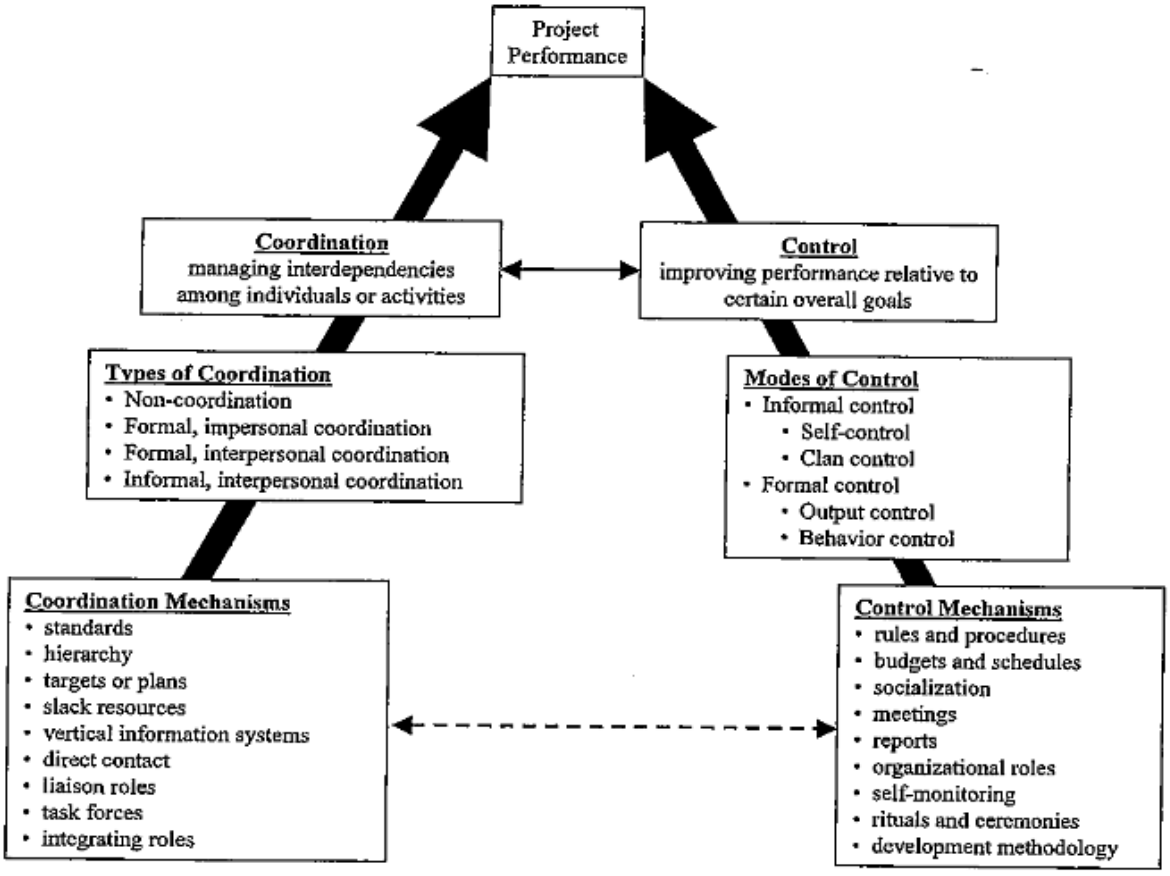


Figure 2. 2 *:* Impact of Coordination and Control on Project performance (Sabherwal & Choudhury, 2006).

They examined the use of various coordination techniques in software development teams and found that formal procedures and interpersonal networks were used in larger projects and interpersonal procedures were employed in the planning stage of the project. Interpersonal networks were used more when the project was highly uncertain and involved a lot of interdependent tasks. All coordination techniques were found as valuable.

Sabherwal (2003) found that coordination mechanisms, from the perspective of both clients and vendors, are influenced by six factors which are complexity, criticality, uncertainty, efficiency, equity, and relational quality.

2.10 Theoretical Framework

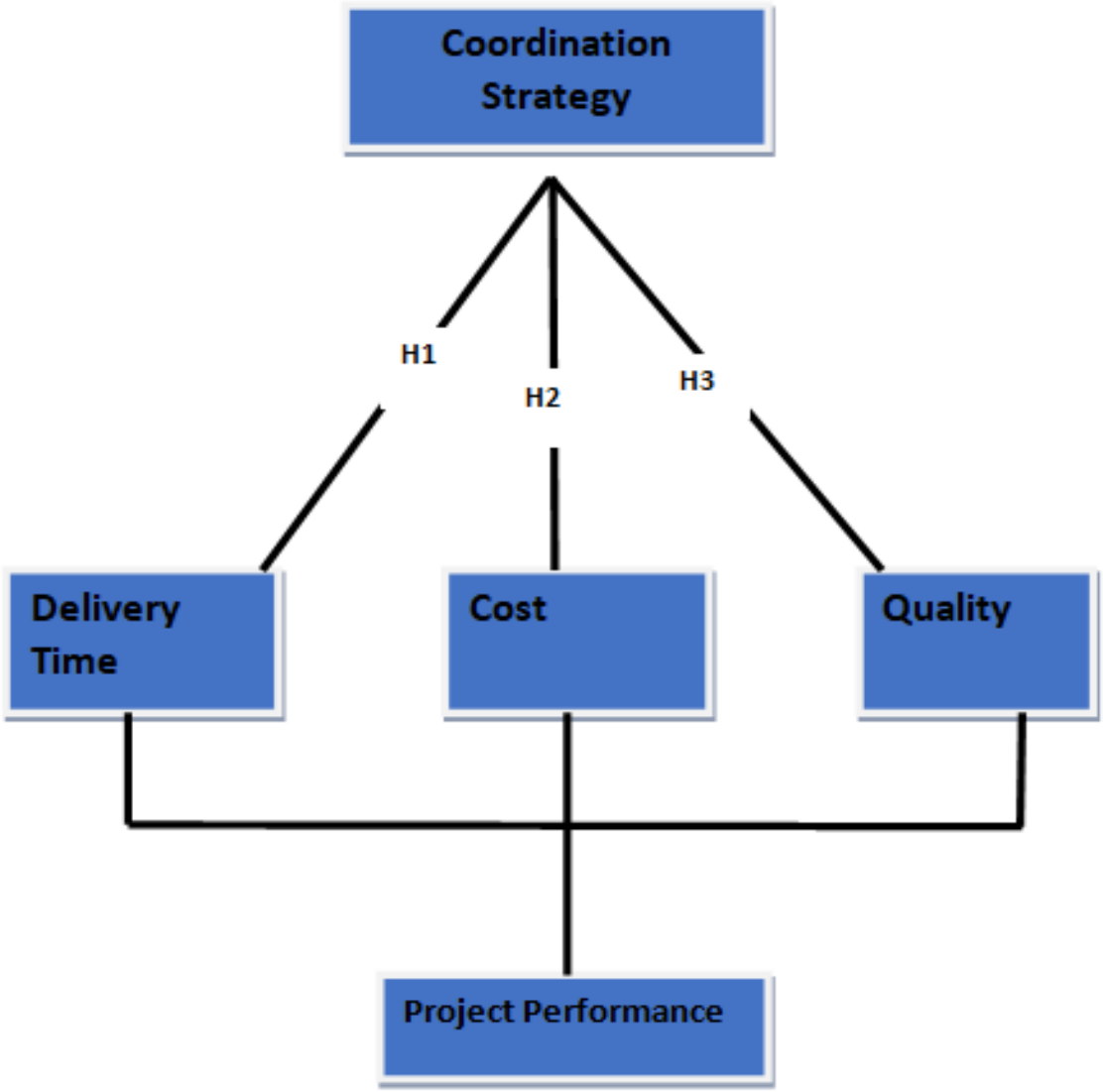


Figure 2. 3: Theoretical Framework for the development of a coordination strategy

2.10.1 Hypothesis 1 (H1)

There is a relationship between coordination strategies the budget of the project.

2.10.2 Hypothesis 2 (H2)

There is a relation that exists between coordination strategies and delivery time.

2.10.3 Hypothesis 3 (H3)

There is a relationship that exists between coordination strategies and the quality of the software that will be produced

Bearing in mind Wangs definition of project performance success which states that "the success of the IS development project in terms of meeting cost, scope and schedule criteria" (Wang et al. 2005), this research will determine how coordination affects project performance. The variable in this case will be the coordination strategy employed and the control will be the nature of the system to be developed. The results of this study will then be used to develop a framework for coordination in agile information system development projects.

2.11 Conclusion

The chapter reviewed existing literature on coordination in the agile development of software systems. From the analysis, it has been noted that organizational structures play a part in the coordination mechanisms employed by an organization which in turns affects business processes.

Project coordination mechanisms are also subject to the constraints brought by organizational structure. Quite a lot of research has been carried on coordination in various domains other than software development. In the domain of software development, theoretical studies were carried out to determine the impact of horizontal coordination on performance as well as the impact of coordination on productivity. The research will aim to determine the impact of different coordination mechanisms on project performance. For the purposes of fulfilling the objectives of this research which is to develop a framework for coordination in agile software development projects, an empirical study will be undertaken. Econet Wireless Zimbabwe is the case unit that will be studied and the above mentioned hypothesis will be tested. The following chapter which is the research methodology will outline how the study will be carried out in order to satisfy the objectives of the study.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Introduction

Chapter Two focused on literature review which is analysis of the past work done by other researchers on related topics. This chapter focuses on the research methodology which is basically the procedure and methods applied to extract a representative population from the target population. It also accounts for the methods used to gather the required information from the extracted sample. Data presentation and data analysis techniques used in the research are also discussed in this chapter.

3.2 Research Philosophy

Research philosophy implies the set of a system of beliefs and assumptions about the development of knowledge (Zukauskas, 2018). It is classified as epistemology, ontology or axiology. This research adopts the epistemology classification applying the pragmatism research philosophy. Saunders et al (2009); postulates that pragmatism research approach deals with the facts about a given research phenomenon. Pragmatism approach has been chosen due to the fact that it gives researchers flexibility on the choice of methods, techniques and procedures to use according to their needs and scientific research aims.

3.3 Research approaches

The researcher employed three research approaches taking advantage of the flexibility offered by pragmatism philosophy adopted. The three approaches used in this research are qualitative research and quantitative research.

3.3.1 Quantitative Research

Kawulich (2005) defines quantitative research as a systematic empirical investigation done on variables that characterise an observable phenomenon through statistical, mathematical or computational techniques. It is such that it deals with numerical data to quantify variables of a research phenomenon (Creswell, 2014). The researcher employed quantitative techniques to present information from questionnaires so as to come up with quantities on responses derived from the closed questions questionnaires.

3.3.1.1 Advantages of Quantitative Research

Quantitative research provided a clear and simple set of data which was easy to analyse due to the use of objective responses in the form of answers chosen by ticking against one's choice. It also eliminated subjective or personal judgement in the analysis due phase due to the presence of supporting statistical data. Generally, quantitative research improved reliability of research data and the analysis done on it.

3.3.1.1 Advantages of Quantitative Research

While the approach brought a series of advantages as acknowledged in the previous paragraph, the method narrowed the response horizon by restricting respondents to the set of responses provided on the paper. This reduced the variations in the natural views of the respondents.

3.3.2 Qualitative Research

Qualitative research is a philosophy which concentrates more on explanatory narratives and does not make use of quantities (Creswell, 2014). It is aimed at providing the researcher with a way of accounting for the insights in data that cannot be accounted for quantitatively. The researcher used qualitative research in explaining findings from the interviews which mainly sought to explain why certain things are the way they are.

3.3.2.1 Advantages of Qualitative Research

Instead of just focusing on mere numbers qualitative research provided an advantage of allowing the researcher to understand issues that could be quantified and became an important tool to provide an in depth compliment the quantitative research.

3.3.2.1 Advantages of Qualitative Research

Qualitative research gave respondents room to express themselves which later saw some going outside the research parameters which increased processing time for the researcher. However, the researcher had to guide the respondents so as to cut short the time by focusing on the research limits.

While the approach brought a series of advantages as acknowledged in the previous paragraph, the method narrowed the response horizon by restricting respondents to the set of responses provided on the paper. This reduced the variations in the natural views of the respondents.

3.4 Research Design

The plan on how the research will be conducted is called the research design (ibid). It encompasses explanations of where the information that answers the research questions will be gathered from as well as the procedure for collecting the information required. The design adopted in this research is a descriptive research approach. Descriptive research as defined by (Grove, 2013) implies the process of researching by observing and measuring variables without manipulating their integrity, it relies on identifying characteristics, trends and correlations of variables.

3.5 Population and Sampling

Population and sampling deals with the target group of people from which the research was carried out while sampling focuses on the methods used to extract a fraction of the population that represents the whole population. This population and sampling procedures are as explained in the following sub-paragraphs.

3.5.1 Sample Size

A sample is a percentage of the total population in statistics. You can use the data from a sample to make inferences about a population as a whole. For example, the standard deviation of a sample can be used to approximate the standard deviation of a population. Finding a sample size can be one of the most challenging tasks in statistics and depends upon many factors including the size of your original population.

The Cochran formula allows you to calculate an ideal sample size given a desired level of precision, desired confidence level, and the estimated proportion of the attribute present in the population.

Cochran’s formula is considered especially appropriate in situations with large populations. A sample of any given size provides more information about a smaller population than a larger

one, so there's a 'correction' through which the number given by Cochran's formula can be reduced if the whole population is relatively small.

The Cochran formula is:

$$n_0 = \frac{Z^2 pq}{e^2}$$

Where:

- e is the desired level of precision (i.e. the margin of error),
- p is the (estimated) proportion of the population which has the attribute in question,
- q is 1 – p.

This method however assumes a 90% confidence level and a 10% margin of error. However the sample size for customers was calculated as follows.

N = 98

And n/N = 0.1

n = 98/1+98(0.1*0.1)

n = 60

Therefore according to the calculations above the total number of respondents that were chosen by the scholar is 60. These all constituted software developers, database administrators and project managers that will provide feedback with regards to the research.

3.5.2 Population

Wegner (2015) defines population as a group of homogeneous elements from which a study on a specific topic of interest can be carried out and can be divided into two categories namely the target population and the sample population. The target population is the larger set from which the sample population can be drawn. The sample population is a fraction of the target population whose characteristics depicts those of the target population.

The population of this study comprises of employees of Econet Private Limited responsible for software development and the management process. The sample population was derived from the target population using stratified and simple random sampling techniques.

3.5.3 Sampling techniques

Sampling refers to the process of choosing representative objects out of the main set of the whole. Creswell (2012); postulates that sampling techniques are used to pull out the sample from the target population and the study will be carried out on the sample such that the results can be transitively applied to the whole population. This research adopted two sampling techniques which are stratified sampling and simple random sampling.

3.5.3.1 Stratified sampling

Creswell (2013) states that, stratified sampling is a technique which divides the target population into non-overlapping and internally homogeneous sub-populations called stratum. In applying this technique, the researcher divided the population at Econet into three sub-populations namely, software developers, project managers and end users. As postulated by Jebreen (2013), after coming up with the stratums, the researcher has to pick individual elements from each stratum using simple random sampling or systematic sampling. This research applied simple random sampling on each stratum to come up with the required sample.

Stratified sampling brought benefits of making the research less complex by dealing with smaller segments of uniform characteristics. It also made it easy to and cheaper to do the research because it requires a smaller sample as compared to that required by other techniques.

However, its major drawback was on the need for the researcher to identify and classify each employee of Econet and classify them into their respective stratum so as to come up with groupings of homogeneous elements. This process consumed more time than was expected which increased the total time budget of the research.

3.5.3.2 Simple random sampling

Simple random sampling is a probabilistic sampling technique in which all the elements in the target population have an equal chance of being selected into the representative population identified as the sample population (Creswell, 2014). The researcher used this technique to pick individuals from the three clusters identified in cluster sampling. The three

clusters on which simple random sampling was used are developers, project managers and end users.

In applying this technique, the researcher used the employee nominal roll of each cluster. The researcher chose those who occupy odd positions in the registers and came up with a sample size of sixty (60) respondents. Simple random sampling was easy to apply and gave each person an equal chance of being nominated into the sample.

3.6 Sources of Data

Data used in this research was sourced from primary and secondary sources through exploiting existing literature or collecting current data using questionnaires and interviews.

3.6.1 Primary Sources

Primary sources of data comprise of current data collected using any technique for the purpose of answering a given research question (Leedy, 2010). The primary sources of data used in this research are interviews, personal experiences as well as questionnaires.

The advantage of primary sources is that they provided current information which is directly relative to the phenomenon being researched on. This also created an advantage of easy processing of the data since every detail was of importance.

3.6.2 Secondary Sources

Secondary sources are those that comprise of data collected by other past researchers on subjects other than the current research but with a relationship with the current research such that the information can be used in filling some knowledge gaps (ibid). The researcher used publications on Agile software development as well as other literature written by other authors in their researches. Secondary sources provided ready information which reduced the collection expense although it required a lot of processing to trim out irrelevant staff.

3.7 Data collection techniques

Creswell (2014) defines data collection techniques as the tools that the researcher uses to gather primary data about the research. This research employed three techniques as explained in the following sub-paragraphs.

3.7.1 Interviews

Godfred (2016) defines an interview as an information gathering tool which features two parties namely the interviewer and the interviewee. The interviewer is the one who poses questions while the interviewee gives responses. This research used structured interviews in which the interviewer uses a formal set of questions and recorded responses on standardised schedule. The interviews were conducted on a predetermined schedule and the interviewees turned up as was expected. The method had some pros and cons as explained in the following sub-paragraphs.

3.7.1.2 Pros

Interviews gave the researcher room to make follow-up questions on areas which were not clearly expressed by the respondents. This helped in gathering more relevant responses and eliminated the burden of processing.

3.7.1.3 Cons

Interviews had a tendency of creating room for being subjective on the side of the researcher through cornering the respondents to some desired results unlike in the questionnaire method where they had to do it independently.

3.7.2 Participatory observation

According to Creswell (2014), it is a type of data collection method commonly used in qualitative research where the researcher relies on personal experience. The researcher being an employee at Econet took the advantage of being an involved in the daily routines of the organisation and in particular the study area. In this regard, the researcher also relied on the personal experiences to provide answers to some of the research questions which required an understanding of the internal dynamics in the coordination process.

3.7.2.1 Pros

Participatory observation provided first-hand information which is more reliable than any other sources of data used. It also allowed the researcher to enter into the research with an open mind of the nature and characteristic of the research phenomenon.

3.7.2.2 Cons

Although the method provided a better starting point, the researcher had limited knowledge since the background knowledge was only restricted to the area of operation.

3.7.3 Questionnaire

A questionnaire is a set of questions which can either be open ended or closed ended. This research adopted a questionnaire with closed ended questions where closed ended questions are ones which narrows the scope of the respondent to the provided choices such that the respondent only ticks against an answer of choice. The questionnaire was categorised into sections that correspond to the objectives of the research such that each objective will be satisfied by qualifying questions.

3.7.3.1 Questionnaire distribution

The researcher personally handed the questionnaires to the respondents and allowed them to go through and respond in seven (7) days. The distribution method was effective enough as it ensured that each respondent in the sample received the questionnaire. It was also less costly given the fact that all the respondents are based at the same locality.

3.7.3.1 Pros

Questionnaires narrowed the variations in the possible responses due to the use of closed questions since the analysis was only based on the frequencies per each response type with respect to the question being answered. The use of closed questions also reduced the ambiguity of questions that could have arisen in open ended questions.

3.7.2.3 Cons

Questionnaires had a challenge of denying the respondent opportunity to express their opinions in other terms which might have been of value in understanding the phenomenon under study. This however, was compensated through the use of interviews.

3.8 Data Presentation and Analysis

Data presentation and analysis relates to the process of presenting the data using statistical methods while analysis relates to the process of interpreting the presented data. The processes are as explained below.

3.8.1 Data presentation techniques

Data presentation techniques refer to the statistical methods used to present the gathered information in a manner that facilitates easy understanding of the patterns in the data (ibid). This research used bar graphs, pie charts and tables to present the statistical findings of the data. The techniques applied had an advantage of providing a measure of the frequency of each characteristic as a percentage of the whole which made it easy to relate the impact or influence of the feature to the overall research objective it is measuring.

3.8.2 Data Analysis Techniques

Data analysis techniques are the approaches used to describe, illustrate and evaluate the data gathered in a research study (Creswell, 2014). This research applied inductive and deductive analysis techniques.

3.8.2.1 Inductive analysis

This is an analysis technique which relies on the interpretation of raw text data in order to derive more general concepts (ibid). In applying this technique, the researcher used questionnaires to do the tests and collected information after which an analysis was done to discover the patterns in the data and interpretation was done accordingly.

3.8.2.2 Deductive analysis

Lincoln (2005) defines deductive analysis as one whose concern is on the exploitation of secondary data by deducing interpretations from what other past researchers have done before. The researcher used this technique to understand what other past researchers found on coordination in Agile software development and draw inferences basing on how it influences the current research. This technique helped in creating a basis for understanding the cause effect relationship between characterising the research question.

3.9 Reliability and validity

3.9.1 Reliability

According to Creswell (2012), reliability refers to consistency of a research tool aimed at discovering if the tool is inviting the expected answers. It is assessed through analysing the answers that are provided by different respondents on the same question and their relationship to the expected set of responses. The use of a pilot survey assisted in ensuring the reliability of the research tools. It can be confirmed that the tools are reliable.

3.9.2 Validity

Validity is a function of the accuracy of the instruments used (Creswell, 2012). It is achieved through the consistency of an instrument in measuring what it is supposed to measure (Leedy, 2010). The validity of this research was ensured through the use of a pilot study which highlighted the weaker areas of the questionnaires and interview guide; the researcher improved the questionnaires to clear out ambiguous areas. This ensured the questionnaires and the interview guide carried questions which were easy to understand and solicited for the desired answers.

3.10 Research ethics

Research ethics are universally accepted rules of conduct but not sanctioned as crimes if breached that should be followed by researchers as they conduct their researches (Lincoln, 2005). The researcher fulfilled two research ethics which are confidentiality and consent.

3.9.1 Confidentiality

The researcher assured the respondents of the privacy on their identity as well as the information they provided prior to the interviews and responding to questionnaires. The researcher also signed a non-disclosure agreement with Econet so as to guarantee that the information will only be used for research purposes only.

3.9.2 Consent

The researcher sought consent of the respondents by requesting their signature on the consent form before proceeding with the interviews. All the participants in the sample consented to the research by signing the consent forms.

3.8 Summary

A detailed account of the methods used to gather the required data has been given in this chapter. A pragmatism approach has been adopted with qualitative and quantitative being the approaches used. The study applied the stratified and simple random sampling techniques to come up with the sample for the study. Inductive and deductive analysis are the two techniques used for data analysis. Chapter four will focus on the data analysis of the findings.

CHAPTER 4: DATA PRESENTATION, ANALYSIS AND DISCUSSION

4.1 Introduction

Explanation of the research methods have been covered in the previous chapter in depth. An explanation of the research philosophy have been covered as well as the information gathering methodology and the data analysis techniques for the research. This chapter aims at presenting and analysing the information gathered in the previous chapter. A presentation of the findings will also be covered as well as a corresponding analysis.

4.2 Presentation and analysis

This part exploits the presentation of the findings on the information collected using questionnaires. The findings have been presented according to the variable which they served to measure as defined by the objectives and the research questions. The response rate of the sample with respect to the information gathering instruments are as depicted in Table 4.1 and Table 4.2. Table 4.1 presents the response rate of the questionnaire respondents while Table 4.2 shows the response rate with respect to interviews.

Response rate = (total number of responses / total number of distributed questionnaires) x 100

Therefore, the response rate s= (54/54) x 100

= 100%

Table 4. 1 : Questionnaire response rate

Serial	Item	Number	Percentage
1	Distributed	54	100%
2	Completed and returned	54	100%
3	Uncompleted	0	0%

Source: Primary data

Table 4.1 shows that the response rate was 100%. According to Saunders (2015), the response rate should at least be 90%. This implies therefore that the response rate is acceptable enough to warrant the analysis and inference of the findings.

Table 4. 2 : Interview response rate

Item	Frequency (F)	Percentage (%)
Scheduled	6	100
Conducted	6	100
Missed	0	0

Source: Primary data

Table 4.2 shows that the interview response rate was 100% which again confirms that the minimum rate of 60% as stated by Eleanor (2000) has been surpassed and analysis can therefore proceed. It can be deduced that the respondents are enough to create a baseline from which inferences can be made as generalisations about the whole population.

4.2.1 Demographic distribution of respondents

Demographics measures were aimed at discovering the demographic patterns of the respondents and try to exploit their influence to the research questions. The next sub-paragraphs provides a presentation of the demographic findings of the study.

4.2.1.1 Gender

The study comprised of a sample size of sixty (60) respondents and the gender distribution was as indicated in Table 4.3.

Table 4. 3 : Gender distributions

Gender	Frequency	Percentage
Female	43	70
Male	17	30
Total	**60**	**100**

Source: Primary data

The results indicates that 70% of the respondents were males while only 30% were females. This shows a dominance of males over females in the software development field given that

the respondents were selected using a simple random sampling technique which gave each an equal chance to be selected.

4.2.1.2 Response by speciality

Fig 4.1 shows a graphical representation of the spread of the respondents based on the specialisation of the respondents.

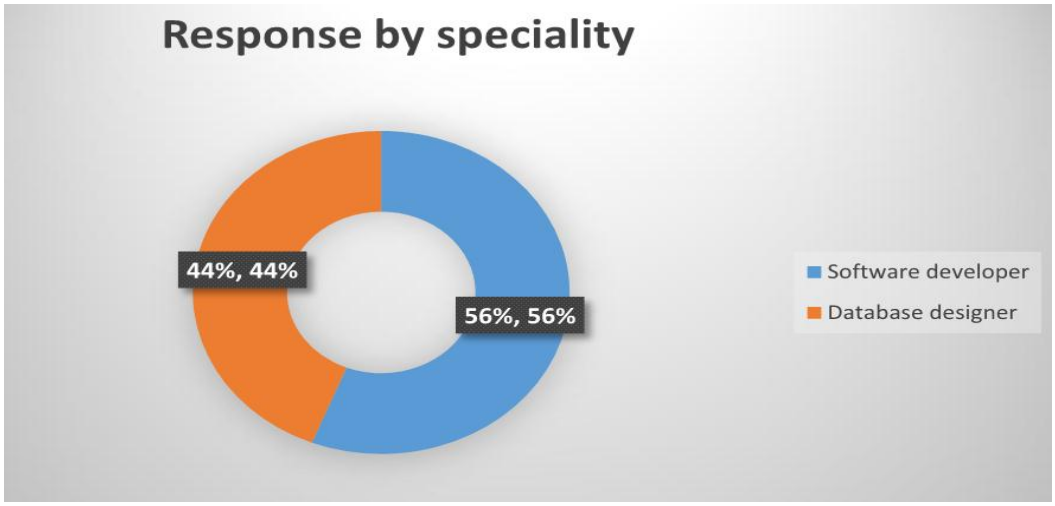


Figure 4. 1 : Response by speciality (Source, primary data)

The pie chart shows that the 56% of the respondents were software developers while 44% were database designers. This infers that the software development process requires more programmers than it requires database designers. As such, the coordination process needs to synchronise the two dimensions to facilitate smooth integration of operations in larger scale projects.

4.2.1 Findings on challenges being faced in the coordination process

This objective was measured by asking respondents through a questionnaire, to indicate by means of a tick the existence or non-existence of an identified challenge. The responses were computed statistically and the results per each factor are as shown in Table 4.4.

Table 4. 4 : Findings on the challenges being faced in coordinating software development at Econet

No	Statement	Yes	No
1	Meeting timelines	79%	21%
2	Team effort	81%	19%
3	Lack of software testing	67%	33%
4	Tracking project progress	77%	23%
5	Quality maintenance	83%	17%

Source: SPSS data analysis

The following insights were deduced from the Table:

a. Meeting timelines

A total of 79% of the respondents indicated that the current coordination approach is causing challenges to the development team in terms of its ability to meet deadlines while 21% indicated that it is not causing such challenges. Project Managers who were interviewed expressed concern over the ability of the development teams to deliver software within the expected time ranges.

It can be deduced that the current coordination approach being used at Econet is causing problems in the ability of the teams to meet timelines. This is as a result of the uncoordinated development of modules on a common system which results on the absence of appraisals by the various teams on progress by other teams working on the same project. As a result, it will be difficulty to meet timelines. This can be addressed by adopting the Agile software development process in which teams are well coordinated and knowledge of progress on another team is easily mirrored to the other teams.

b. Team effort

It was discovered that 81% of the respondents indicated that the current coordination approach is causing challenges in team effort among teams working on a common project, on the other hand, 19% indicated that it did not cause such a challenge. Interviews discovered

responses which also were inclined to the fact that the organisation is facing challenges in promoting team effort using the current development coordination approach. The researcher also has an understanding that team effort is a challenge at Econet due to uncoordinated processes as learnt through participatory observation.

The findings imply that the development process is falling short of the desired team effort in developing its software solutions. This is due to the fact that, teams develop their modules in an uncoordinated environment such that they don't interact as they progress with their tasks. As a result, team effort among teams is lost. Agile software development facilitates team effort through coordination of the development teams which promotes team effort and as such, it is important for Econet to adopt Agile software development which facilitates team effort.

c. Lack of software testing

The survey established that 67% of the respondents were of the view that the development process lacks software testing as a result of the uncoordinated process. It was also discovered that 33% differed with the view and were of the view that the process does not lack software testing. Interviewees confirmed that the absence of coordination in the development process is making it difficult to test the software as the development process progresses.

It can be deduced that the development process at Econet is lacking software testing due to the uncoordinated development of codes. It is crucial to test the code as lines, units and the entire software before delivery which therefore justifies the need to coordinate the development process through adopting the Agile software development approach.

d. Tracking project progress

The survey revealed that 77% of the respondents indicated that the development process is facing challenges in tracking the progress of projects while only 23% indicated that there were no challenges in tracking the progress of projects. Findings from the interviews also indicated that tracking the progress of a project in the face of an uncoordinated development process is posing a great challenge to the overall development process.

This infers that the development process is facing challenges in terms of tracking the progress of projects under development due to lack of coordination. It is of paramount importance that

the development process be coordinated to create room for interaction among teams which will facilitate easy tracking of project progress by teams involved on a common project. In an Agile software development environment, the development process can be easily tracked by involved teams despite the difference in the modules they are working on, this therefore prompts the need to incorporate Agile software development in the contemporary environment of Econet Wireless.

e. Quality maintenance

It was established that 83% of the respondents are of the view that there is a challenge of quality maintenance at Econet due to the uncoordinated development process. However, 17% of the respondents indicated that there was no such a challenge. Information gathered from interviews revealed that the ability of the organisation to maintain software quality is at compromise due to lack of coordination by the development teams. The researcher can also substantiate the findings basing on the experience in the organisation and is of the view that, quality maintenance is critically affected as a result of the uncoordinated development processes.

There is a need to coordinate the development process so as to improve the ability of the team members and the management to maintain the quality of software under development. In a coordinated software development environment, quality maintenance is promoted through code sharing and peer review of code by fellow teams, this essentially is well covered in the Agile development process and adopting such will enhance quality maintenance.

4.2.2 Factors contributing to lack of coordination in software development at Econet.

A Likert scale was used to gather information of the respondents' position in terms of each factor under consideration. The scale gave five options sliding from 1-5 with options strongly disagree, disagree, neither agree nor disagree respectively, disagree or strongly disagree.

Table 4.4 provides a summary of the findings calculated statistically using the SPSS statistical analysis software. The measurement metrics used to analyse the data are the mean and the standard variation. The ratings were done using a Likert with five possibilities reading from 1-5 as follows:

1 – Strongly Disagree, 2- Disagree, 3- Neither Agree nor Disagree, 4 – Agree, 5 – Strongly Agree.

Table 4. 5 : Findings on the factors contributing to coordination challenges

No	Statement	Mean	Standard deviation (SD)
1	Communication issues	1.97	1.8
2	Delays in the feedback cycle	1.4	0.35
3	Variations in organisation cultures	1.3	0.47
4	Lack of trust between project teams	5	0.7

Source: SPSS analysis

The findings are analysed as follows:

a. Communication issues

The research found that on average, the respondents are in agreement to the fact that communication is among the factors that contribute to the challenges of coordination of large scale software development at Econet Wireless. However, the factor had a standard variation of 1.8 which suggests a huge deviation from the mean and should be taken to consideration.

A deduction can be made that communication has a negative is affecting the coordination process at the organisation. There is a need to improve the communication process of the development teams so as to create effective linkages among the developers. In an Agile software development environment, the project teams make regular updates to each other which improves the communication level of the development process. The standard deviation of the factor is larger suggesting that there is a larger variation in the views of the respondents and others could be in disagreement with the position.

b. Delays in the feedback cycle

The study discovered that on average the respondents are strongly agree that the coordination process is affected by delays in the feedback cycle of the progress among team members. This was supported by a favourable standard deviation of 0.35 which implies that the

majority share a common view on the factor. The researcher's experience on the feedback cycle also confirms that the cycle is not as effective as is desirable to allow smooth coordination of the development process.

It can be deduced that the development coordination process is strongly affected by the delays that occur in the feedback on the progress by other team members as well as the feedback on the appraisal by the team leaders. An effective way to promote timely feedback needs to be established so as to do away with the delays.

c. Variations in organisation culture

On average, the respondents are strongly agree that the variations in organisational culture are affecting the coordination process and the factor has a low standard deviation of 0.47. This implies that the respondents have a closely related rating of the factor. The interviews cited that the challenge of organisation cultures was affecting the success of the development coordination process especially in circumstances where development is done in joint with other organisations. The differences in organisation cultures can synchronised by adopting a development formula that defines a common culture of doing things. This makes it easy to blend with team members from other organisations and coordination can be easily.

d. Lack of trust between project teams

It was discovered that on average, the respondents strongly disagree with the view that lack of trust among project team members is affecting the development process. A standard deviation of 0.7 characterised this factor. The Interviews revealed that as of now, there was enough trust among members in the development process. It can be inferred that the teams' level of trust is enough to promote the coordination of the development process.

4.2.3 Effects of lack of coordination on software development process at Econet

This was measured using a bivariate approach in which the respondent was given only two choices from against which they can indicate their choice through ticking against the most appropriate value of their response. The possible responses are either a Yes or a No. Presentation of the results is shown in Table 4.5 while the paragraph that follows carries the analysis. The table shows a classification of the responses in percentage depending on the response indicated by the respondent.

No	Statement	Yes	No
1	It is time consuming	59%	31%
2	Delays in software completion	73%	24%
3	Too many meetings	81%	19%
4	External pressure	73%	27%
5	Ineffective software testing	67%	33%

Source: SPSS analysis

The results in Table 4.4 indicates produced the following insights:

a. A total of 59% of the respondents acknowledged that the uncoordinated software development presently prevailing at Econet Wireless is time consuming while 31% of the respondents indicated that it is not time consuming. It can be inferred that the current development process is time consuming and creates a series of adverse effects on the quality and timely delivery of the product.

b. The majority of the respondents with a total percentage of 73% agreed that the current approach is causing delays in the overall completion of projects. However, 27% of the respondents indicated that there is no relationship between the process delays and the lack of coordination of the development teams. Interviewees also mentioned the delays in product completion which they attributed to lack of coordination among development teams. It can be concluded that delays in product completion are partially as a result of lack of coordination on the development team.

c. The research discovered that 81% of the respondents indicated that, too many meetings are being realised as a result of lack of coordination while 19% were of opposed to the view. The researcher through experience can confirm that the lack of coordination of development teams has resulted in the increase of meetings to try and strike a synchronised position among team members. As expressed by the interviewees, increased number of meetings have also been a cause of concern since it consumes development time.

d. Lack of coordination has led to ineffective software testing as confirmed by a total of 67% respondents who indicated agreement with the assertion that lack of coordination has led to ineffective software testing. Findings from the interviews also concurs with the results as the interviewees mentioned that alpha testing has been greatly affected due to lack of coordination. This results also in challenges of unit testing and the overall testing of the product. There is a need to address the testing process effectiveness which will equally improve the overall product output.

4.3 Conclusion

Data collected in the previous chapter was presented and analysed. The researcher used tables and pie chart to present the information gathered. The SPSS software was used to statistically analyse the data. Both deductive and inductive analysis were used to analyse the findings. The findings summarily revealed that the current development process at Econet Wireless is uncoordinated and which is affecting the overall effective and efficient development process of large scale software. Adoption of an effective coordination model such as the Agile software development can help in improving the status quo.

CHAPTER 5: SUMMARY OF MAJOR FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

Chapter four gave a presentation of the results and the analysis of the findings using descriptive analysis based on the spread of the statistical data on the presentations. This chapter is a summary of the major findings of the research as well as the conclusions of the research. It also gives the recommendations of the study and the future study gap.

5.2 Summary of the study

This research was divided into four chapters with chapter covering the introduction and background of the study. The study owes its background to the software development coordination challenges at Econet Wireless. The absence of coordination in the development process led to poor software delivery as well as untimely delivery of software. The research therefore sought to come up with a strategy for software development using Agile Software Development. The chapter also gave an account of research questions and a timeline for the research process.

Chapter Two was designed with a focus of coming up with the theoretical framework as well as the conceptual framework. The chapter reviewed the works of other past scholars on the same subject matter and drew inferences that assisted in shaping the research framework. The chapter covered the theories that explain the project management processes and coordination models in the software development environment.

Chapter three explained the methodology used to gather the required information from the field. The research used both quantitative and qualitative techniques to collect data from the respondents. Questionnaires and interviews were used as the tools for collecting data from the sample population.

Chapter four presented and discussed the results of the findings. Tables and graphs were used to provide a statistical visualisation of the data. Sampling was done using purposive sampling was used to come up with the sample population. The analysis was done using deductive and inductive techniques.

5.3 Summary of the major findings

The study mad the following major findings:

a. The current coordination approach is causing challenges in team effort among teams working on a common project

b. The development process lacks software testing as a result of the uncoordinated process.

c. The development process is facing challenges in tracking the progress of projects.

d. There is a challenge of quality maintenance at Econet due to the uncoordinated development process.

e. Communication challenges are affecting the successful coordination of software development.

f. The development feedback cycle is ineffective and delays the development process.

g. Software development coordination is being effected by variations in organisational cultures.

h. There is no trust between project teams.

i. The current approach is affecting overall project completion timelines.

j. Lack of coordination in the development process results in wastage of time through meetings.

k. Software testing is ineffective due to lack of effective coordination of the development process.

5.4 Conclusions

The study made the following conclusions:

5.4.1 Challenges being faced in coordinating software development.

It can be concluded that the current coordination process is causing challenges in terms of team effort which affects the co-development of a single system by several developers. This results in lack of proper software Alpha testing. Progress of the development process is difficulty due to the uncoordinated development approach. The poor software quality is as a result of the uncoordinated development.

5.4.2 Factors contributing to lack of coordination in software development at Econet.

Coordination of the development process at Econet is a challenge due to the use of old and incompetent ways of coordinating the development process. Under such circumstances, the development process is affected by lack of effective communication among project team members and synchronization of activities is compromised. This is also triggered by lack of trust among project team members.

5.4.3 Effects of lack of coordination on software development process at Econet.

The uncoordinated software development process is leading to delays in the overall project completion process arising from wastage of time through meetings. The software is also released without effective Alpha testing which will feed to a poor product deployed in the market.

5.5 Recommendations of the study

The study recommends the Agile Software Development process which is depicted in Figure below.

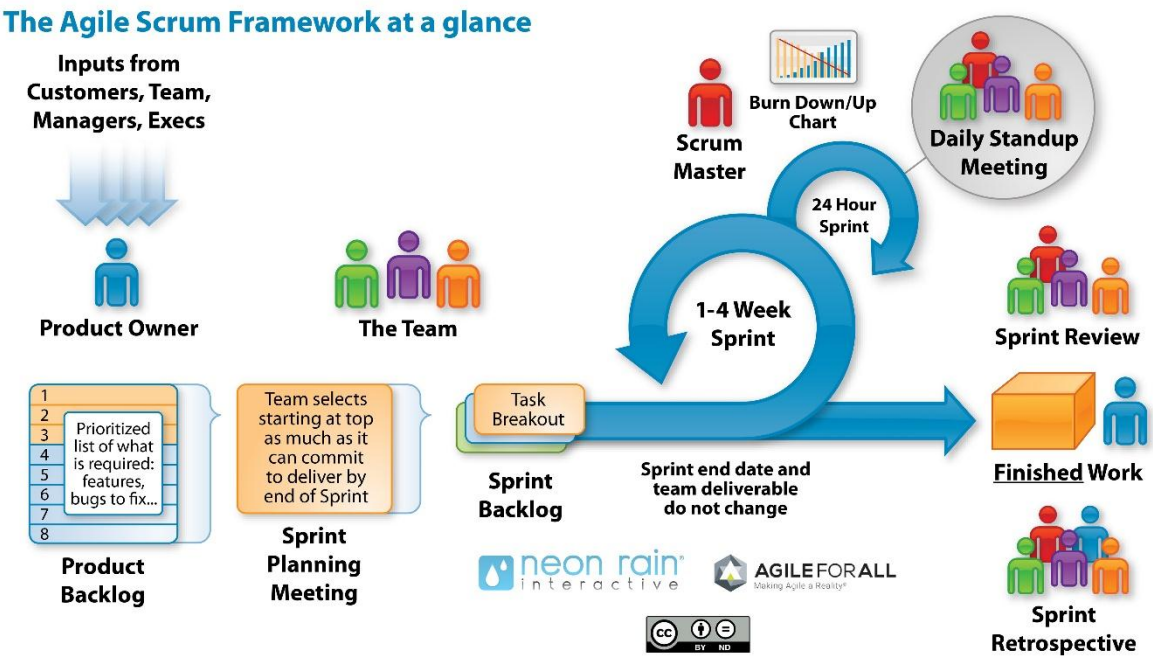


Figure 5. 1: Agile software development process

The study also makes the following recommendations:

a. There is need to coordinate teams in the large scale development of systems;

b. Meetings should be reduced to save time for the development and testing processes;

c. Efforts should be made to build trust among project team members;

d. Alpha testing should be effectively done to promote product quality;

e. Effective means of tracking project progress should be established;

f. There is need to improve the communication process among developers.

g. Feedback should be reliable and timely to facilitate future adjustments where necessary.

5.6 Recommendations for future studies

Further work would be useful to confirm the efficacy of the theory presented in this thesis and refine its concepts and proposed relationships. Future research should aim to verify the concept of coordination strategy (i.e. certain agile practices acting as coordination mechanisms), and in particular the relative contribution of synchronisation (especially at different iteration durations), structure, and boundary spanning coordination mechanisms, along with any interaction effects between these coordination components. Further verification of the concept of coordination effectiveness, in particular the contribution of, and interaction between, implicit and explicit coordination especially at different phases of a project and under various project conditions is needed.

The relationship between coordination strategy and coordination effectiveness, in particular the effect of different coordination strategies on implicit and explicit coordination effectiveness is another area for investigation. This would mean investigating and comparing agile projects using different agile practices with a coordinative function, and the impact of these different strategies on coordination effectiveness.

The concepts of project uncertainty and project complexity need better conceptualisation since, although they are defined in the literature, those definitions are not mutually exclusive in their current form. Clearly, project complexity may increase project uncertainty, although the reverse relationship seems unlikely.

Precise definitions of complexity and uncertainty would enable robust studies of their impact on coordination strategy. This would lead to information for practice because, given certain levels of project complexity and project uncertainty one could select some coordination mechanisms (i.e. certain agile and non-agile coordinative practices) in preference to others.
In future, it would be possible to test this proposed theory using experiments, simulation, or survey methods.

Experimentation in this area is seldom used because of multiple factors involved in the software development process; likewise, simulation of individual coordination mechanisms, pair programming for example, would be extremely difficult. Survey methods could provide a useful and appropriate way to test this theory in the field.

Another useful area of future work would be to operationalise the coordination effectiveness concept. This would provide a valuable measure of coordination effectiveness in agile, and possibly other, software projects. The concept is not currently in a form that can be directly operationalised, but conversion would seem to be straightforward since the factors comprising the concept are simple. Such a measure could be used to assess coordination effectiveness at various time points during a project, providing a profile of project coordination, and an early warning signal when coordination problems begin to occur.

It could assist organisations to identify and address their coordination problems in a timely fashion, and improve the likelihood of successful agile project completion. The concept could also be used to measure the effect of different coordination strategies, in particular different coordination mechanisms and combinations of coordination mechanisms, on coordination effectiveness.

In this way, the most effective mechanisms could be selected for coordinating projects. Further use for this concept might be to compare the coordination effectiveness of distributed agile and co-located agile projects, agile and non-agile projects, and between different system development methodologies that provide different coordination strategies. In particular, approaches to development such as lean development with Kanban processes.

Another benefit of a precisely defined, operationalised, and empirically tested coordination effectiveness concept would be to test its contribution to project success or effectiveness. Project success is not yet well defined. Research such as this would make an important and long-lasting contribution to IS project literature.

5.7 Chapter summary

The chapter summarised the previous chapters from chapter one to chapter four giving a short explanation of what each chapter covered. It provided a summary of the major findings of the research and made conclusions from the findings. Recommendations were made for both the research and future studies.

APPENDIX A: Interview Guide

My name is **Tapiwanashe Shoshore,** a student at the Midlands State University pursuing a Master of Science Degree in Information Systems. As part of the fulfilment of the requirements of this degree, I have to undertake a field research on ***"A strategy for Coordination in Agile Software Development Projects for Effective and efficient Systems Delivery, A case of Econet Wireless Private Limited."*** The information gained during our conversation will be treated with utmost confidentiality and will be used for academic purposes only. If you agree to take part in this interview, kindly sign the informed consent form.

Objective 1:

To determine challenges being faced in coordinating software development.

1. What are the challenges being faced in coordinating software development currently?

Objective 2:

To determine the factors contributing to lack of coordination in software development at Econet.

2. To what extent is the current coordination approach affecting the software development process?

Objective 3*:*

To determine the effects of lack of coordination on software development process at Econet.

3. What should be included in the coordination framework to ensure effective development of software?

Do you have some additions?

Thank you for participating in this interview.

APPENDIX B: Informed consent for interviewee

Interview for the dissertation titled; "A strategy for Coordination in Agile Software Development Projects for Effective and efficient Systems Delivery, A case of Econet Wireless Private Limited."

By this, I agree to be interviewed by the researcher having understood the purpose of the research. I therefore, permit the researcher to carry out his academic research ONLY.

Signature: …… Date: …….……

APPENDIX C: Questionnaire

LETTER OF INTRODUCTION

Dear respondent,

I am **Tapiwanashe Shoshore**, studying towards a Master of Science Degree in Information Systems with the Midlands State University (MSU). I am currently conducting a research entitled "***A strategy for Coordination in Agile Software Development Projects for Effective and efficient Systems Delivery, A case of Econet Wireless Private Limited."*** The purpose of this letter, therefore, is to kindly request you to respond to the attached questionnaire. The information you give will be treated confidentially and at no time will your name be referred to directly. The information given will only be used for academic research purpose.

Thank you in advance for your time and cooperation.

PART A: Background information

1. Gender

Male	Female

2. Specialty

Software developer	Database developer

Objective 1:

To determine challenges being faced in coordinating software development.

3. Indicate if the factor identified in the table below is a challenge arising from lack of coordination of the development process at Econet Wireless Private Limited.

No	Statement	Yes	No
1	Meeting timelines		
2	Team effort		
3	Lack of software testing		
4	Tracking project progress		
5	Quality maintenance		

Objective 2:

To determine the factors contributing to lack of coordination in software development at Econet.

4. Indicate by means of a tick, the degree to which you agree that the following factors are contributing to the lack of coordination in software development at Econet.

The Likert scale below shows the ratings against which the rating can be indicated.

1 – Strongly Disagree, 2- Disagree, 3- Neither Agree nor Disagree, 4 – Agree, 5 – Strongly Agree.

No	Statement	1	2	3	4	5
1	Communication issues					
2	Delays in the feedback cycle					
3	Variations in organisation cultures					
4	Lack of trust between project teams					

Objective 3:

To determine the effects of lack of coordination on software development process at Econet.

5. Using the scale below please tick your level of agreement or disagreement with the following statements about how coordination in Agile software development projects affects delivery time and quality of software.

No	Statement	Yes	No
1	It is time consuming	59%	31%
2	Delays in software completion	73%	24%
3	Too many meetings	81%	19%
4	External pressure	73%	27%
5	Ineffective software testing	67%	33%

Thank you!

APPENDIX D: Request to conduct research

MIDLANDS STATE UNIVERSITY

P. BAG 9055
Gweru.
Zimbabwe

Tel. (263) 54 2260450/2260464
260404/2260525 2260632/2260596
FAX: (263) 54 2260233

DEPARTMENT OF COMPUTER SCIENCE & INFORMATION SYSTEMS

10 September 2018

REQUEST FOR PERMISSION TO CONDUCT RESEARCH FOR TAPIWANASHE SHOSHORE, REG NO. R11705Z AT MIDLANDS STATE UNIVERSITY

Software Development Manager

On behalf of our student, Tapiwanashe Shoshore, we are requesting for permission to conduct research in your in your company. The research is titled **"A Strategy for Coordination in Agile Software Development Projects for Effective and Efficient System Delivery, A case of Econet Wireless Private Limited".**

The student is doing research with Mrs A. Mutembedza (Lecturer) and Mrs N.Sarai (Lecturer) in the Department of Computer Science and Information Systems towards a Master of Science in Information Systems at the Midlands State University. The aim of the study is to develop a strategy for the coordination of agile development projects at Econet to ensure timely delivery of good quality software.

Your company has been selected because the student is currently employed at your company and has experience in the selected field of research hence getting information from workmates allows the research to have solid findings.

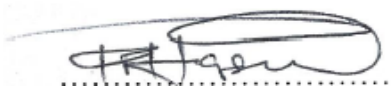
The study will entail interviewing software developers, project managers and database administrators and hear the challenges they are facing in their day to day work concerning collaboration when working in teams.

A case study will be done on Econet and a thorough understanding of how current projects are being coordinated, the methods will be evaluated, their strengths and shortfalls evaluated.

It is upon these findings that a model or strategy for coordination in agile software development projects will be derived. The strategy will benefit the software development team of Econet and the same strategy may also be applied in the coordination of other projects in other business units of the same organization.

Feedback procedure will entail a document that can be availed to the institution for possible use when the research study has been completed.

Yours sincerely



……..

Dr. M. Zhou

Dr Munyaradzi Zhou (PhD – Information Systems)

Senior Lecturer, Department of Information Systems

Midlands State University

Bag 9055 Gweru, Zimbabwe

+263772837264 / +263712307951

Email: zhoum@staff.msu.ac.zw

Email: zhoumalhassan@gmail.com

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