*AGILE SOFTWARE DEVELOPMENT:*

*DYNAMICS OF WORKING IN A DISPERSED ENVIRONMENT IN A SOUTH AFRICAN RETAIL AND COMMERCIAL BANK*

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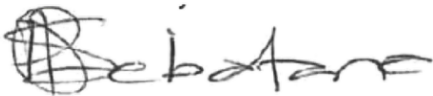
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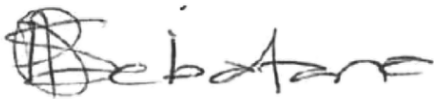
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# ACKNOWLEDGEMENTS

## DEDICATIONS

This work is dedicated to the memory of my late father, Kabelo Enoch Sebatana. You continue to be my rock beyond the grave. I'm sure you are proud of me now as you were when you saw my first report card in grade one, when I received my first academic achievement, and when I graduated for the first time.

# ABSTRACT

This study aimed to examine the dynamics of working in a dispersed environment for Agile Software Development within the context of one of the South African banks. This study identified the challenge of dispersed teams working together on ASD and confronted by unpredictable business circumstances in the South African banking industry. The theoretical framework which underpinned this study was General Systems Theory. This study also critically reviewed relevant and recent literature on Agile Software Development and working in a dispersed environment. This study was conducted using a qualitative research design of Phenomenology. Interpretivism was chosen as a philosophical research lens for this study. In this study, convenience and purposive sampling were followed to select 38 participants from one of the retail and commercial banks in South Africa. This researcher collected data using a questionnaires and semi-structured interviews. This study employed Saldaña's (2013) code-to-theory analytical model as the analytic tool for qualitative data. This study's findings showed that the impact of ASD team member participation on the communication and collaboration dynamics was examined by assessing other parts of the system, such as the dispersed environment, tools, and work-life balance. This study recommends that the bank conducts multiple professional development training workshops on working in dispersed environments. The needs of the employees must mainly guide those workshops. Theoretically and practically, this study contributes to team performance according to the team performance model.

Keywords: Agile Software Development (ASD); dispersed environment; performance.

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| | |
|---|---|
| AC | Agile coach |
| ASD | Agile Software Development |
| GST | General System Theory |
| ICT | Information and Communication Technology |
| IT | Information Technology |
| PO | Product Owner |
| SM | Scrum Master |
| SMS | Short Message Service |
| VNC | Virtual Network Computing |
| VPN | Virtual Private Network |
| WFH | Work From Home |
| WHO | World Health Organisation |
| XP | eXtreme Programming |

# CHAPTER ONE
# INTRODUCTION AND BACKGROUND

## 1.1 Introduction

This study aimed to examine the dynamics of working in a dispersed environment for Agile Software Development (ASD) within the context of one of the South African Retail and Commercial banks. ASD is one of the methodologies used by organisations to create software.

A software development methodology (SDM) coordinates a software development initiative that covers scope, timelines, resourcing, and tasks (Al-Saqqa, Sawalha & AbdelNabi, 2020; Young, 2013). Software is a set of programmes instructing the computer on how it should function, behave, and look (Simmons, Kereiakes, Pickens & Erickson, 1985). Software is necessary to ensure that gadgets such as computers, gaming consoles and cell phones can perform what the user requires. For example, a cell phone has multiple applications that a user can utilise to send a text message, such as the Short Message Service (SMS) and WhatsApp, to name a few. These applications look, behave, and function differently depending on the software running that controls them. The process followed to create software is referred to as software development (Seniv, 2023). It describes all activities involved when making software programmes (Rouse, 2016). These activities will be further discussed in Chapter Two. This study focused on ASD.

Agile Software Development (ASD) is a process which produces software in small increments that are delivered in short iterations (Abrahamsson, Salo, Ronkainen & Warsta, 2002). These iterations are fixed periods lasting from two to four weeks per iteration (Hoda, 2011; Mircea, 2019). The ASD methodology is based on the Agile Manifesto. The Agile Manifesto is governed by a set of values and principles (Manifesto for Agile Software Development (MASD), 2001). These are meant to guide teams on how to be agile (Agile Alliance, 2020). These values and principles are discussed further in Chapter Two. According to tutorialspoint.com, ASD teams are cross-functional; they work on activities concurrently. Cross-functional teams are at

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least three members working together to achieve a common goal; these members must possess different functional skillsets (Dinca & Voinescu, 2012). ASD allows organisations to swiftly respond to rapidly changing software needs by delivering high-quality outputs while meeting customer needs (Li, 2012). For this reason, this study examined the dynamics of working in a dispersed environment for ASD within the context of one of the South African banks. The following section delves into the background of this study.

## 1.2 Background

In 2020 there was a drastic change in how the world functioned due to the outbreak of the COVID-19 virus. COVID-19 was discovered in Wuhan, China, in December 2019 (World Health Organisation, 2020). The high number of cases reported in different parts of the world led the World Health Organisation (WHO) to declare this a pandemic in March 2020 (World Health Organisation, 2020). This declaration resulted in governments worldwide imposing restrictive measures to contain the spread of the virus.

In South Africa, these restrictions were a lockdown of the country (COVID-19 South African Online Portal , 2020). A lockdown is a requirement imposed by the government to restrict the movement of people except for those providing essential services; some of those include health services, policing, and food (COVID-19 South African Online Portal , 2020). Financial services were part of essential services which was required to be operational. However, most were required to work in dispersed environments for safety measures. Some of the financial services employees were ASD teams which are being looked at in this study. The reason for choosing ASD teams in the current research is that the dispersed environments may bring unfamiliar dynamics to these ASD teams. Hence, this study examined the dynamics of working in a dispersed climate for ASD teams.

## 1.3 Problem Statement

This study investigates opportunities and challenges connected to practices of ASD within a dispersed working environment specific to a South African retail and commercial bank to understand how geographic dispersion affects team

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communication, project outcomes, and collaboration. The problem that this investigation addresses is to identify the effects of adopting ASD on the dynamics of working in a dispersed environment within a South African retail and commercial bank, and the key factors that drive successful application of Agile practices in such an organisational context. The problem that this study identified is the practice of ASD by teams who are working from different physical locations due to unpredictable business circumstances in the South African banking industry. Under normal circumstances, ASD teams work in the same physical area to enhance teamwork, which is believed to improve communication, collaboration, and performance. However, Sharp, Barroca, Deshpande, Gregory and Taylor (2016) argue that working from different physical locations is not ideal for ASD teams; instead, it is recommended that teams work in a collocated manner. To explore the problem identified in this study, the main research question intended to be answered is:

**How do ASD teams apply agile practices within the dynamics of a dispersed environment for performance?**

The following sub-questions have been formulated for the study.

i. What are the dynamics of Agile Software Development teams working in a dispersed environment?
ii. Which processes and tools are utilised to assist Agile Software Development teams in enhancing performance working in a dispersed environment?
iii. How is the delivery performance of the Agile Software Development team in a dispersed environment?

## 1.4 Research Philosophy

A research philosophy encompasses a set of assumptions and beliefs concerning knowledge generation (Saunders *et al.*, 2015). These assumptions and beliefs are related to either the nature of society or the nature of science (Holden & Lynch, 2004) and collectively form a research paradigm (Mason, 2014). The research conducted in this paper follows a scientific research philosophy, which represents a structured thought process utilised by researchers to acquire new knowledge based on their own assumptions (Patton, 2015). This process involves the examination of three

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fundamental components: ontology (belief about reality), epistemology (how knowledge is acquired), and axiology (how knowledge is created) (Patton, 2015; Rehman & Alharthi, 2016; Žukauskas *et al.*, 2018). Below, we provide descriptions of these three key components:

*i.  Ontology*

Ontology is the perception of how an individual perceives the reality of the world (Saunders *et al.*, 2015). Saunders *et. al* (2015) further states that it directs how a researcher studies the objects of the study. It is important to know the researcher's background to understand the researcher's view of reality. The researcher is a seasoned Information Technology (IT) professional with close to two decades of experience. Her entire career has been devoted to the South African financial services industry, where she has worked in diverse capacities. Throughout her journey, she has been associated with four of the largest banks in South Africa, contributing her expertise and skills to their operations.

Presently, her role entails overseeing a team of IT professionals who specialise in the analysis discipline of software development. This group of individuals forms an integral part of agile software development teams within the bank she is currently employed. The researcher's responsibilities involve guiding and supporting the team, ensuring efficient and effective software development practices, and facilitating seamless collaboration between team members.

The researcher brings a valuable perspective with her wealth of experience and in-depth knowledge of the financial services industry. Having expertise in IT and software development and familiarity with the financial sector's specific needs and challenges, she emerges as a key player in driving innovation and excellence within her organisation. These teams are made up of different people who specialise in different disciplines. Most ASD teams in her place of employment were working collocated, except for a few that were distributed. Since March 2020, all ASD teams have changed to working in a dispersed environment.

The research understands the emergent dynamics due to the changes in the working environment of ASD teams. The researcher believes that these changes can be

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understood differently depending on interpretation. Due to having experience and work interactions coupled with the desire to understand the dynamics, the researcher views the world as a series of complicated interactions and relationships which are context dependent. In line with this, a relativist ontological position is embraced to assist in unpacking the dynamics of ASD teams working in a dispersed environment.

### ii. Epistemology

Epistemology is "the theory of knowledge, thus epistemological assumptions concern the nature of knowledge, what constitutes knowledge and what is possible to know, understand and represent" (Opie, 2004). The researcher's view of reality affects how they obtain knowledge (Mason, 2014). This implies that their ontological position determines their epistemological view. Epistemology is a perception of knowledge, it covers areas such as what is accepted and how that knowledge is filtered and communicated (Saunders, Lewis, Thornhill & Bristow, 2015). In this study, epistemology is about the relationship between the researcher and the researched and the truth about how knowledge is acquired.

The researcher accepts an interpretivist epistemological research paradigm to understand the world in a subjective manner (Žukauskas, Vveinhardt & Andriukaitiene, (2018). Žukauskas *et al.* (2018) explain that consideration in this paradigm is given to the interpretation of the approaches through which individuals experience the social world. Žukauskas *et al.* (2018:123) clarify that the "interpretivist research philosophy is based on the principle which states that the researcher performs a specific role in observing the social world". Research is built and relies on the researcher's interest in this paradigm (Žukauskas *et al.*, 2018).

### iii. Axiology

Axiology refers to how the existence of values shapes how knowledge is created (Biedenbach & Jacobsson, 2016). Therefore, the assumptions a person has about reality and knowledge help one act accordingly based on their ontological and epistemological positions (Aliyu *et al.,* 2015). Any researcher must be able to clearly state their values as these will influence their judgment and how the research study is executed (Saunders *et al.,* 2015). Furthermore, Saunders *et al.* (2015) explain that

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when a researcher is clear about their own values, it is much easier to decide what is ethically acceptable. It also makes it easier to justify decisions made and their decisions. Axiology helps the researcher develop an approach to conduct research and consolidate an acceptance criterion for the study (Aliyu *et al.,* 2015). Similarly, axiology is specific to a research paradigm in ontology and epistemology. An axiology may be value-free or value-bound based on whether the research paradigm is objective or subjective (Saunders *et al.,* 2015). Since this study was based on a qualitative paradigm, the axiology applicable is value-bound. Value-bound research means the researcher must be immersed in what is being studied, and interpreting research data is critical (Saunders *et al.,* 2015). The researcher had to consider her values alongside those of the research participants while conducting the study.

According to Žukauskas *et al.* (2018), there are four main research philosophies: positivist, interpretivism, pragmatism, and realism. Each philosophy is discussed briefly below, showing how interpretivism was deemed suited as a lens for this study. Pragmatist research philosophy enables a single study to be conducted using a mixture of qualitative and quantitative methods (Shannon-Baker, 2016; Creswell & Creswell, 2017; Kaushik & Walsh, 2019).

According to Siddiqui (2019), pragmatist research philosophy draws on. It integrates numerical and qualitative approaches to data as necessary and relevant to meet the research needs to answer research questions. However, the current study draws from qualitative methods; thus, pragmatist research philosophy was deemed irrelevant to the present study.

A realist research philosophy affirms that "scientific theories are or aim at truth, that they (aim to) provide a correct description of a mind-independent world" (Allmark & Machaczek, 2018). Affirming a scientific theory is not the purpose of the current study. Realist research philosophy is generally problematic to use as a lens in a study, including the current study, since, according to Allmark & Machaczek (2018, p. 8), "it is always possible to construct more than one theory to explain a set of data. As such, the choice of one theory over the others cannot be because it alone is consistent with the data and thus provides a true picture of the world, any others that provide a picture

consistent with the data could equally well be true." Therefore, a realist research philosophy was not adopted in the current study.

A positivist research philosophy infers that there is only one truth and that it can be measured using numbers (Mason, 2014). A positivist research philosophy, usually quantitative, rejects studying the world through human experiences, reasoning, or interpretation (Fox, 2008). Hence, its data generation methods are quantitative and numerical, so generated data is analysed statistically. For this description, positivist research philosophy was deemed irrelevant since this study follows a phenomenological qualitative approach.

Interpretive research philosophy contrasts with positivist research philosophy regarding how data is generated and interpreted (Walsham, 1995). Al-Riyami (2015) describes interpretivism as a constructivist research philosophy convinced that knowledge is socially constructed. An interpretive research philosophy refers to reality as comprising multiple truths (Mason, 2014). These truths are based on interpretation and thus presented using words. Interpretivism is associated with qualitative studies field (Elshafie, 2013).

Studies that are inductive and emergent and it does not intend to generalise its findings It is important to mention that this insertion resonates with what this study intended. Interpretive ontology is anti-foundationalist where multiple realities socially construct knowledge; truth and reality are created rather than discovered (Rehman & Alharthi, 2016).

Interpretive epistemology is an inter-subjective knowledge construction field (Taylor & Medina, 2011). Interpretivism is generative of qualitative research methods such as case studies, interviews, and observation because they are better ways of understanding how humans interpret the world (Willis, 2007).

Although interpretive study abandons the scientific verification procedures and cannot be generalised to other situations, it deliberately intervenes in the research setting to achieve change or improvement; its goal is to create a focused theory for practice rather than generalisation (Mack, 2010). The interpretive philosophy supports the researcher's intention to gain in-depth knowledge of the lived experience of ASD

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teams that work in a dispersed environment. Hence it was chosen as a research philosophical lens for this study.

## 1.5 Research Aim

### 1.5.1 Research Purpose

This study aimed to examine the dynamics of working in a dispersed environment for Agile Software Development within the context of one of the South African banks. The exploration of the research problem and aim is important in articulating the research objectives. The research objectives which this study aims to achieve are stated below.

### 1.5.2 Research Objectives

Research objectives are an extension of the broader research aim. The following research objectives were identified as being pertinent in ensuring that the purpose of the study is achieved, these are:

i. To examine the dynamics of Agile Software Development teams working in a dispersed environment.
ii. To analyse the teams' delivery performance of dispersed Agile Software Development teams.
iii. To establish processes and tools utilised to assist Agile Software Development teams in enhancing delivery performance in a dispersed environment.

## 1.6 Rationale of the study

The rationale for conducting this study was to examine the dynamics of working in a dispersed environment for Agile Software Development (ASD) within the context of one of the South African Retail and Commercial banks. ASD is one of the methodologies used by organisations to create software.

## 1.7 Theoretical Framework and Literature Review

A theoretical framework constitutes the substance and knowledge foundations of a research (Grant & Osanloo, 2014). In other words, a theoretical framework refers to applying a particular theory in a study to explore the research problem and answer the research questions.

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The theoretical framework which underpinned this study was General Systems Theory (GST). A literature review is a "narrative account of information already available, accessible and published, which may be written from several differing perspectives, depending on the researcher's standpoint" (Jesson & Lacey, 2006). Furthermore, an overarching conceptual framework underpinning this study is The DaVinci Institute's Managerial Leadership Framework referred to as TIPS. The TIPS framework covers the Technology, Innovation, People and Systems aspects of an organisation and will be discussed to detail in Chapter 2. Therefore, the literature review will also present a relevant and recent literature review of this study's key concepts relating to Agile Software Development and working in a dispersed environment.

It is important to note that the theoretical and conceptual frameworks are presented first, followed by the literature review. The chosen theory was an established summary of thoughts by experts in a field of research related to this study field (Kivunja, 2018).

## 1.8  Research Methodology

Research methodology relates to a theory of undertaking research and a research method denotes the procedure or technique for collecting and analysing the data (Saunders, Lewis, Thornhill, 2019). Newman (2014:2) explains that "methodology means understanding the entire research process-including its social organisational context, philosophical assumptions, ethical principles, and the political impact of new knowledge from the research enterprise". Methods concern "the collection of specific techniques we use in a study to select cases, measure and observe social life, gather and refine data, analyse data, and report on the results" (Neuman,2014:2).

The researcher uses a qualitative methodology in this investigation to explore and interpret the understanding that people attribute to a research problem. According to Creswell and Creswell (2018:41), qualitative research consists of emerging procedures and questions, data gathered in participant's setting and analysed inductively by "building from particulars to general themes, and the researcher making interpretations of the meaning of the data". The researcher uses qualitative research as a means "of looking at research that honours an inductive style, a focus on individual meaning, and the importance of reporting the complexity of a situation" (Creswell & Creswell, 2018:41).

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### 1.8.1 Research Design

The research design is defined by Creswell and Creswell (2018) as a type of an investigation within quantitative, mixed methods, and qualitative approaches that generate precise direction for processes in research. It is the overall plan of answering the research question and it contains objectives that are derived from the research questions (Saunders *et al.*, 2019). It specifies the data collection sources and how the researcher proposes to analyse the data and outlines constraints and ethical issues to be encountered (Saunders *et al.*, 2019). The researcher adopts an exploratory qualitative study design to pursue new insights into the research problem, "to ask questions, and to assess the phenomena in a new light" (Saunders *et al.*, 2019:803). According to Saunders *et al.* (2019:186) "an exploratory study is a valuable means to ask open questions to discover what is happening and gain insights about a topic of interest". It has the benefit of clarifying the researcher's interpretation of the research problem and its adaptable and flexibility to change (Saunders *at al.*, 2019).

The researcher uses a cross-sectional research design concerning the investigation of a specific problem at a specific time (Saunders *at al.*, 2019). Cross-sectional research collects "data at one time point and creates a kind of "snapshot" of social life" (Neuman, 2014:44). Neuman (2014:44) adds that "cross-sectional research can be exploratory, descriptive or explanatory, but it is most consistent with a descriptive approach".

In addressing the research questions of this study, a phenomenological design was adopted. The reason for adopting this design is because phenomenology is a qualitative research approach in line with what the study had intended to achieve by getting a common understanding. Phenomenological research is an inquiry into what experiences mean to people who have had them (Bliss, 2016). In other words, "phenomenology can be defined as an approach to research that seeks to describe the essence of a phenomenon by exploring it from the perspective of those who have experienced it" (Neubauer *et al.,* 2019, p. 91). Phenomenology intends to describe the meaning of participants' experiences and how it was experienced (Teherani, Martimianakis, Stenfors-Hayes, Wadhwa & Varpio, 2015).

The sample size of 38 participants was conveniently selected from one of the Retail and Commercial banks in South Africa. Notably, one bank chosen in this study was conveniently sampled as it was accessible to the researcher.

## 1.9 Ethical Considerations

Ensuring the protection of participants through the application of ethical principles is of utmost importance in academic research, as highlighted by Arifin (2018). This significance also holds in qualitative studies, given their all-encompassing nature and the involvement of individuals within their respective systems (Arifin, 2018). Thus, before commencing the fieldwork, the researcher took necessary measures by acquiring human research ethics approval from the Da Vinci Institute. Additionally, Arifin (2018), the researcher sought informed consent and voluntary participation agreements from all participants after obtaining authorisation from the specific SA Retail Bank.

## 1.10 Delimitation and Scope of the Study

Delimitations regarding a research study refer to the boundaries the researcher sets (Theofanidis & Fountouki, 2018). These boundaries are set to assist the researcher in fulfilling the study's aim and objectives (Theofanidis & Fountouki, 2018). The delimitations of this study are as follows:

i.   This study was limited to one of the big five (5) banks in South Africa.
ii.  This study focused on Agile Software Development teams within the chosen bank.
iii. The study excluded Agile Software Development teams that are not working in a dispersed manner.

## 1.11 Chapter Outline

Chapter One: Introduction and background of the study - This chapter serves as an orientation to the explored research problem. It covers the ground, statement of the problem with research questions, the research aim, methodology and ethical considerations.

Chapter Two: Theoretical Framework and Literature Review - This chapter interrogates this study's critical theoretical framework, including recent and relevant literature analysed critically.

Chapter Three: Research Methodology - This chapter outlines and describes the empirical research methodology used to achieve the study's objectives under the following subtitles. Research Design and Methodology, site, Participant selection, Data collection strategies, Data analysis, Trustworthiness, Researcher's positionality, Ethical considerations, and a chapter summary.

Chapter Four: Data Presentation and Discussion - This chapter discusses findings from this study that answer the research questions and has a chapter summary.

Chapter Five: Conclusions and Recommendations – This final chapter brings the study to a close by first answering the study's main research question and then presenting some recommendations, and the study concludes.

## 2   CHAPTER TWO

## LITERATURE REVIEW

### 2.1  Introduction

This chapter focuses on the literature review of this study. As part of the literature review for this study, literature about the theoretical and conceptual frameworks underpinning the study, are also presented in this chapter. A theoretical framework constitutes a research study field's substance and knowledge foundations (Grant & Osanloo, 2014). In other words, a theoretical framework refers to applying a particular theory in a study to explore the research problem and answer the research questions. A conceptual framework is "an argument about why the topic one wishes to study matters, and why the means proposed to study it are appropriate and rigorous" (Ravitch & Riggan, 2017, p. 5). In other words, a conceptual framework positions the study into existing literature to show appropriateness.  A literature review "is a narrative account of information that is already available, accessible and published, which may be written from several differing perspectives, depending on the researcher's standpoint" (Jesson & Lacey, 2006, p. 140). Therefore, this chapter will also present a relevant and recent literature review of this study's key concepts relating to Agile Software Development and working in a dispersed environment. It is important to note that the theoretical framework is presented first, followed by the conceptual framework, and finally followed by the literature review.

### 2.2  The Theoretical Framework: General Systems Theory

#### 2.2.1  Definition

The theoretical framework which underpinned this study was General Systems Theory (GST). GST is a "skeleton of science in the sense that it aims to provide a framework or structure of systems on which to hang flesh and blood of particular disciplines and particular subject matters in an orderly and coherent corpus of knowledge" (Boulding, 1956, p. 208). GST is also a program of theory construction aimed at building concepts, postulates, principles, and derived theorems that apply universally across

all application domains. Hence, GST is a theory of systems in the general (Whitchurch & Constantine, 1993).

In this study, GST is seen as a blueprint that can be applied across different domains, such as ASD, in an orderly and coherent corpus of knowledge. The definition of GST shows its relevance for examining ASD, which is twofold.

Firstly, ASD consists of people, processes and tools interacting with each other and the environment to produce software artefacts, making it a system. Secondly, the interactions that occur in this system result in complex behaviour. Based on the outcomes of those interactions, people can adjust their behaviour to handle environmental changes. In the case of this study, the work environment in which ASD teams work changed from collocation to dispersed. This, by implication, meant that ASD teams had to change their mode of operation to continue delivering software. Thus, the chosen theoretical framework assisted the researcher in understanding the dynamics presented by the process of ASD teams in a dispersed environment.

In an attempt to define GST, "one might limit it to its 'technical' meaning in the sense of mathematical theory, which is not the case since there are many 'system' problems asking for 'theory' which is not presently available in mathematical terms" (Von Bertalanffy, 1972, p. 414). The present study may be an excellent example of a system problem requiring a theory such as GST. One theory which shows parallelism to General Systems Theory is Systems Theory (ST). Because of this, this study also takes a leaf into (ST). Another reason for this study tapping into (ST) is an insertion made by Lai & Huili Lin (2017) that aims to explicate dynamic relationships and interdependence between components of the system and the organisation environment relationships. This insertion relates to the purpose of this study.

Systems Theory is fundamentally an approach to intellectually engaging change and complexity. ST is a broad approach to understanding complex systems, encompassing various subfields, such as cybernetics, information theory, and control theory (Checkland, 1981). It focuses on the analysis of individual components of a system and their interactions, intending to identify patterns of behaviour and feedback loops that influence system dynamics (Laszlo, 1972; Checkland, 1981). While

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grasping the basic definition of ST, it is important not to dwell on it since ST does not necessarily underpin this study. Instead, it might be necessary to contrast its definition to that of GST since they are more similar than different. It is noteworthy that ST may keep appearing where critical to augment and/or complement GST. The following section discusses the background of GST.

### 2.2.2   Background of General Systems Theory

General Systems Theory is a framework that emerged in the mid-20th century as an interdisciplinary approach to understanding complex systems (Straussfogel & von Schilling, 2009). Its origins can be traced back to the work of Austrian biologist Ludwig von Bertalanffy, who proposed that traditional reductionist approaches to science were insufficient to explain complex systems. Von Bertalanffy believed that systems could not be understood by studying their parts in isolation but rather by examining the relationships and interactions between those parts (Wiener, 1948; Von Bertalanffy, 1950; Boulding, 1956)."General system theory, therefore, is a general science of "wholeness" which up till now was considered a vague, hazy, and semi-metaphysical concept. GST is purely formal, but applicable to the various empirical sciences. For sciences concerned with "organised wholes," it would be of similar significance to that which probability theory has for sciences concerned with "chance events". The concept of wholeness is delved into in relation to ASD process in the literature review section in this chapter. GST is about formulation and exploration of principles that are valid for "systems" in general, whatever the nature of their component elements and the relations or "dynamics" between them. In this study, GST is used to explore the principles and dynamics of ASD, as mentioned in Chapter One.

### 2.2.3   Components of the General Systems Theory

The General Systems Theory (GST) comprises four components: the input, the system, the boundary, the output, and the system's environment (see Figure 2.1).
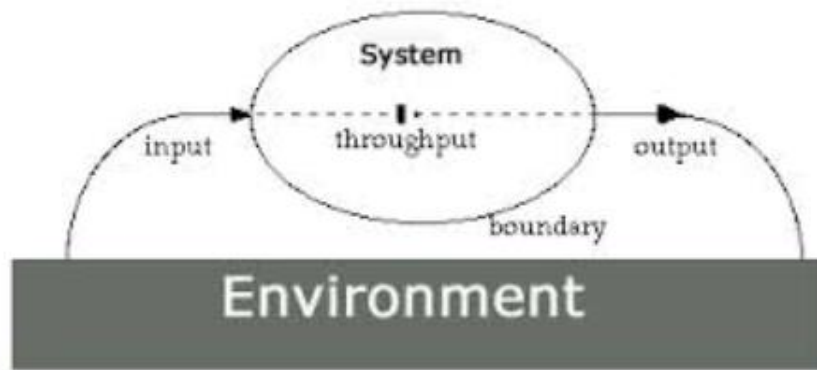
*Figure 2-1 General Systems Theory*

(Heylighen,1998)

Figure 2.1 Indicates how General Systems Theory's components interlink. The environment is a critical component where everything begins and ends. An example of an Environment is an office space. However, in this study, the environment is twofold: it refers to a platform where ASD teams meet virtually and in dispersed environments. For instance, when an input is made, it starts from the environment to a system with a boundary. An example of information is unstable network and/or power cuts which might make it difficult for an ASD team member to enter a system. The next section discusses the conceptual framework of this study with relevant literature review.

## 2.3   The TIPS Framework

An overarching conceptual framework underpinning this study is The DaVinci Institute's Managerial Leadership Framework referred to as TIPS. The TIPS framework covers the Technology, Innovation, People and Systems aspects of an organisation, see Figure 2.2.

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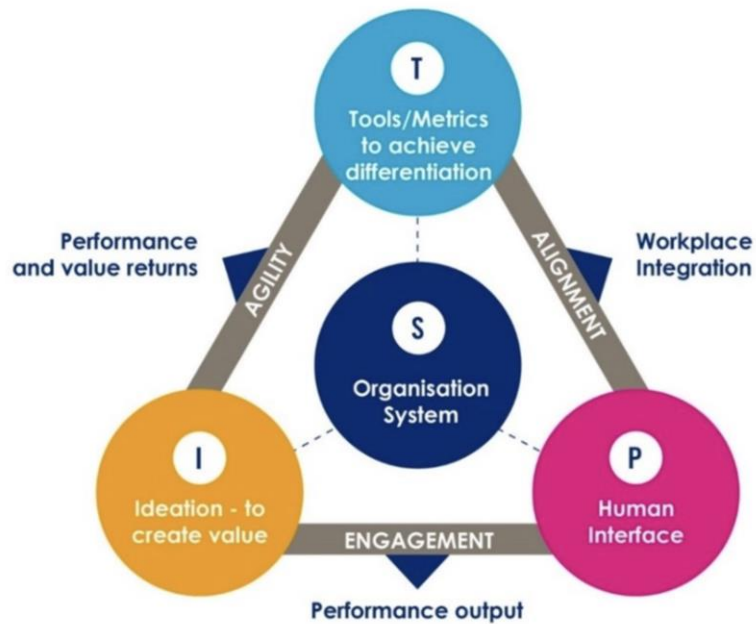
*Figure 2-2 TIPS Managerial Leadership Framework*

(Da Vinci Institute, n.d.)

Figure 2.2 outlines the TIPS framework, which assimilates technology, innovation, people, and systems thinking (TIPS) relating to Agile Software Development and working in a dispersed environment and how they are interlinked with one another, as stated by the DaVinci Institute (2019). Technology refers to the tools and measures that are implemented to improve the way things are done in an organisation. Innovation refers to the process of implementing ideas which creates value for the organisation. People or human interface refers to how people are leveraged to create sustainable growth for an organisation (DaVinci Institute, 2019). At the centre is system thinking, which is required to determine how the different parts of the organisational system are connected and interdependent to one another, and it is therefore necessary to consider the various administrative components that can impact one other.

According to Figure 2.2, when technology and people are linked, it aligns with workplace integration. When people are engaged with innovation, it results in performance output. Agility results in performance and value returns when tools are innovative and/or used innovatively. Consequently, the interlinks between the technology, innovation and people elements develop leaders who are agile, aligned

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and engaged in the workplace (DaVinci Institute, 2019). The systems thinking perspective also sits at the core of the TIPS framework and implies that all the components of the system must be examined individually and its influences on the other component parts of the system.

## 2.4 Literature Review

As mentioned in Chapter One, software development methodology is a process of coordinating a software development initiative. It mainly covers the scope, timelines, resourcing, and tasks (Al-Saqqa *et al*, 2020; Young, 2013). Software is a set of programs instructing the computer on how it should function, behave, and look (Simmons *et al.*, 1985). Software is necessary to ensure that electronic gadgets such as computers, gaming consoles and cell phones can perform what the user requires. For example, a cell phone has multiple applications that a user can utilise to send a text message, such as the Short Message Service (SMS) and WhatsApp, to name a few. These applications look, behave, and function differently depending on the software installed. Software is part of the modern global society (Sommerville, 2011), where human beings are looking for easy solutions and quickly accessing applications in a fast-paced world of change. Its usage extends to computer-based systems that control economic activities such as national infrastructure, electrical products, manufacturing, distribution, and financial systems (Sommerville, 2011). When using relevant software, organisations can develop products and services that are differentiated from competitors (Stralin, Gnanasambandam, Anden, Comella-Dorda & Burkacky*,* 2016). This means organisations across different industries rely on access to quality software to effectively compete in the ever-changing market (Stralin *et al.*, 2016). The process followed to create software is referred to as software development.

### 2.4.1 Software Development Methodologies

SDM and Software Development Life Cycle (SDLC) can be used interchangeably to refer to a methodology with definitive processes required for creating high-quality software (Ruparelia, 2010). However, this study uses software development methodology over SDLC for consistency. SDM provides a well-structured flow of phases that help an organisation to quickly produce high-quality software which is well-

tested and ready for production use; these phases include but are not limited to analysis, planning, development, testing, and deployment (Zima, 2015).

Software utilised by organisations is created through a process called software development. An SDM is a process of facilitating the creation of software; it specifies activities involved in the process (Young, 2013; Zima, 2015). Those activities include creating software programs, scope definition, timelines, people allocation and task identification (Young, 2013). Organisations may choose to follow a single or combination of software development methodologies for different reasons (Young, 2013). Choosing the correct methods and processes is key to delivering good software that is easy to maintain, on time and within budget. Popular software development methodologies include the waterfall model (traditional) and the Agile model (Zima, 2015; Altvater, 2020).

Traditional software development methodology is characterised by detailed planning upfront, a rigid approach, meticulously following a process and detailed documentation upfront (Matharu *et al*., 2015). Therefore, when a business requires software to be developed, these characteristics must be articulated upfront. By articulating these characteristics upfront, most of the communication with the business will effectively occur during the analysis stage of the process (Zima, 2015). The conclusion of the analysis stage signifies a critical juncture where modifying requirements for a business could present difficulties.

The stages in traditional software development are sequential in a linear manner (Li, 2012). Sequential linearly means that each stage must be concluded, reviewed, and passed before the next stage can commence (Li, 2012). Thus, analysis, planning, development, testing, and deployment stages must be completed chronologically. The conventional software development approach places emphasis on predictability, envisioning the product in advance (Li, 2012). However, this study's scope does not encompass traditional software development; thus, no further elaboration will be provided. As highlighted in Chapter One, the primary focus of this research revolves around Agile Software Development and the dynamics associated with dispersed teams.

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### 2.4.2 Agile Software Development

Agile Software Development (ASD) evolved in the 1990s as a break-away from the traditional way of software development at the time (McCormick, 2012). ASD is considered more flexible as a software development methodology than alternative ways. According to McCormick (2012), ASD is a suitable methodology for rapidly delivering products. The requirements and the solutions stem from collaboration within self-organising and cross-functional teams. As mentioned in Chapter One, ASD is a process which produces software in small increments that are delivered in short iterations. According to The Agile Alliance (2020), agile is the capability to successfully manage and respond to change with high uncertainty and volatility. A group of software engineering professionals known as The Agile Alliance met to advance Agile to what it is today (HighSmith, 2001). The Agile Alliance intended to unearth, practice, and teach more effective software development methods than ever before (MASD, 2001).

The Agile Alliance believed that more effective software development could be achieved by creating people-centred organisational structures that operate based on collaboration (Highsmith, 2001). ASD is supported by different frameworks and applications based on the values and principles documented in the agile manifesto (Agile Alliance, 2020). The Agile Alliance created this agile manifesto in 2001 (MASD, 2001).  The Agile manifesto aimed to capture values and principles that would guide agile teams on how to apply this approach in any manner they choose (Agile Alliance, 2020). Teams choose to do ASD differently because agile is a mindset driven by the manifesto (Agile Alliance, 2020). The agile manifesto is governed by a set of values and principles (MASD, 2001).

### 2.4.3 Agile Values

According to Agile Manifesto (MASD, 2001), ASD has four Agile values, which are as follows:

*Value 1* states that it is more important for the teams to interact through collaboration and communication than strictly adhering to processes and the use of tools. For the

purposes of this study, this value emphasises the importance of building trustful relationships within ASD teams.

*Value 2* emphasises the importance of creating working software over comprehensive documentation. This study argues that a well-documented system is only useful if it works as expected, so more focus should be on creating the software rather than documenting it. It does not mean there should be no documentation; it should be just enough to enable the delivery process to continue.

*Value 3* speaks to the importance of collaborating with the business to create the right output over the extensive negotiation of contracts. For this study, it is understood that although contracts are important, more time must be spent with business during the actual development of software rather than in boardrooms negotiating service-level agreements.

*Value 4* emphasises the importance of responding to change over strictly following a plan. In this study, it is understood that this does not imply that planning must be discarded completely; it just means that the plan should be adjustable as changes occur (MASD, 2001)

### 2.4.4 Agile Principles

Agile values are expanded through specific principles. These principles serve as a guideline on how to practice ASD. The principles are drawn from the Agile Manifesto (2021) and are documented as follows:

> *Principle One* - The top priority of this methodology is to meet customer needs by delivering relevant software early and consistently. In this instance, the customer refers to the business or organisation that has requested the software to be created. This principle encourages the delivery of software quickly and regularly.

> *Principle Two* - To welcome changing and late requirements to support and assist the business to have a competitive edge in the market. This principle addresses a scenario at the beginning of the project where there are uncertainties and pending decisions. Thus, requirements are not expected to

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be fully documented and final at the beginning of the project. This allows the team to accept and implement changes at any stage of the process (Li, 2012).

*Principle Three* - To regularly deliver software that works every few weeks or every few months, favouring shorter delivery intervals. Unlike the traditional approach, ASD is characterised by multiple incremental software releases over time instead of one big-bang release after a long period (Young, 2013). In this short interval, the team should deliver software that works according to the business and its requirements.

*Principle Four* – The business and the development team should collaborate daily until all the required software is delivered. This is because ASD is about teamwork (Li, 2012). This implies that the business becomes part of the agile team since they are expected to work closely with the development team (Lindsjørn *et al.*, 2016). The purpose of working as a team is to ensure the correct requirements are worked on at any given point and time.

*Principle Five* - To ensure that people working on a project are trusted and supported by leadership to do their work in a productive environment. This is so that the teams are motivated to take on more projects. This principle encourages the development team to drive themselves by determining their own timelines based on their own understanding and capabilities.

*Principle Six* - Face to face is the best way of communicating within a software development team. This principle encourages development teams and businesses to communicate effectively to have a high level of responsiveness (Lindsjørn *et al.,* 2016). Therefore, face to face makes it easier and quicker to discuss and resolve issues as they happen.

*Principle Seven* - Progress is to be measured purely based on working software. As indicated, software development is divided into tasks such as analysis, development, testing and implementation. Since traditional software development is sequential, progress is measured by completing each task. This is not the case in ASD; a project is divided into smaller chunks. Each task must have been completed to deliver each chunk as working software independently.

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*Principle Eight* - Agile processes are meant to support and encourage software development in a sustainable manner. This means that the project sponsors, the development team, and the software users must maintain a consistent delivery pace. This is because agile does not impose the process on the team (Li, 2012). The team can accept the process and make decisions around it (Li, 2012). This understanding is built up as the team works closely over time. Thus, the principle facilitates the team's understanding of how much work can be delivered based on capacity and skillset.

*Principle Nine* - Agility is improved by consistently focusing on technical mastery and good design. This means that when a team becomes more competent with its technical skills and ability to create good designs, its agile mindset strengthens. As a result, that team becomes better at being agile.

*Principle Ten* - Simplicity is fundamental for maximising the amount of work not done. This principle can be achieved by implementing simple processes. These processes sift out unnecessary requirements that do not add business value so that the team can focus only on core requirements with high business value.

*Principle Eleven* – it is believed that self-organising teams develop the best architectures, designs, and requirements. ASD is driven from a people's perspective and teamwork is an important aspect of (Li, 2012). Therefore, self-organising teams are empowered to devise ways to solve problems independently (Agile Alliance, 2020).

*Principle Twelve* - The agile team must retrospect and adjust its conduct accordingly to improve its effectiveness. In other words, it is important for an agile team to assess and improve its way of working regularly to increase its efficiency and productivity levels.

## 2.4.5 Agile System

Agile systems/processes focus on people, the environment, communication and collaboration, organisational culture, and shared understanding (Srinivasan & Mukherjee, 2015). This comes across clearly in the agile values. The agile principles

are highlighted by the deduction made by. (Srinivasan & Mukherjee, 2015) state that ASD processes emphasise the accommodation of changes, transparency, trust, and flexibility (Srinivasan & Mukherjee, 2015); these traits come across clearly in the Agile principles.

The agile principles imply that ASD is highly adaptable and flexible. In addition, Matharu, Mishra, Singh and Upadhyay (2015) state that ASD improves a team's productivity by managing customer needs effectively and accelerating software development (Matharu *et al.*, 2015). To Matharu *et al.* (2015), these characteristics allow agile to be more successful than the traditional approach to software development. The ASD approach has gained popularity and usage over time (Li, 2012). The usage of ASD by teams spans organisations of different sizes, ranging from small to large organisations (Abdalhamid & Mishra, 2017).

### 2.4.6 Agile Software Development Participants

An ASD team is defined based on intrinsic characteristics within the team. The definition given by Rothman and Kirby (2019) is: that ASD teams are a group of cross-functional individuals who possess the combined ability to produce the required software outputs, focus and combine efforts to meet the same outcome, are interdependent, make an effort to accommodate each individual, use collaborative approaches to plan for and deliver work outputs, collaboratively retrospect on their outputs and processes, and belong to only one team at any given time (Rothman & Kirby, 2019)

Studying this ASD team definition closer, it is noted that it is aligned with some of the Agile principles discussed earlier in this chapter. The Agile Alliance (2020) provides some guidelines regarding ASD teams. The first guideline talks about team size. It states that an agile team must have at least three members. It is worth noting that the Agile Alliance does not indicate a maximum size for ASD teams. Secondly, the Agile Alliance has indicated that a small subset of team members may be part-time in the team or have clashing responsibilities. Third, and lastly, the Agile Alliance encourages ASD teams to be set up based on specific Agile frameworks at an organisational, departmental or team level.

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Adopting ASD is no easy feat. It is a gradual process that can unfold over several years (Stray, Memomn & Paruch, 2020). Adopting Agile usually comes with multiple challenges (Parizi, Gandpmani & Nafchi, 2014). These challenges are usually related to the behaviours and mindsets of the people, as well as organisational cultures that have strict processes (Parizi *et al.*, 2014; Stray *et al.*, 2020). To deal with these, organisations are encouraged to acquire the services of experts who will facilitate and advise them on the journey of becoming Agile (Parizi *et al.*, 2014). Such an expert is often called an Agile Coach (AC). AC has proven to be the most critical success factor in agile adoption and application across organisations (Stray *et al.*, 2020). An AC facilitates adopting and applying agile in software development organisations *(Stray et al.*, 2020). coaching has been shown to enhance decision-making, team commitment and accountability levels, and teamwork (Stray, Tkalich & Moe, 2021). Agile Teams are encouraged to have a full-time AC (Parizi *et al.*, 2014). The responsibilities of the AC include the following (Parizi *et al.*, 2014): Work with the teams and leadership to plan, upskill people (including teaching agile values and principles), execute, and implement Agile in an organisation or department.

For an AC to be able to fulfil their responsibilities, specific skills and traits are required of them. These skills include leadership, project management, expertise, agile practices and methods knowledge, and technical skills (Stray *et al.*, 2020). Some traits required for an AC are humility, creativity, resourcefulness and problem-solving (Stray *et al.*, 2020). Another aspect of Agile coaching is familiarising and guiding teams on utilising the chosen Agile framework(s) that enable a practical application of ASD (Stray *et al.,* 2020).

### 2.4.7  Agile Frameworks

Multiple frameworks are available to assist organisations and teams in adopting and executing ASD. Some agile frameworks include eXtreme Programming (XP), Lean Programming, Kanban, and SCRUM (Altexsoft, 2016; Pócsová *et al.*, 2020). XP was established by Kent Beck in the 1990s  (Langley, 2008); it predates the Agile manifesto making it one of the first ASD frameworks which contributed to its establishment. Kent is one of the founders of the agile methodologies and creators of the agile manifesto (Manifesto for Agile Software Development (MASD), 2001).

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The idea behind XP was to develop software with minimal resources, such as less time, fewer people, and less money (Langley, 2008). Some agile principles, such as incremental development cycles and joint ownership of code, originated in XP (Langley, 2008). Unlike other frameworks, XP focuses on creating the software (Altexsoft, 2016). Lean is said to be based on seven principles which are to remove waste, postpone decisions to as late as possible in the process, deliver quickly, create learning opportunities and knowledge, have a view of the whole picture, produce quality outputs, and empower the team. The Lean programming framework is closely related to Kanban, as such, there are similarities between them (Altexsoft, 2016).

Kanban is the second most used ASD framework, according to Altexsoft (2016) and Mircea (2019). This framework focuses on removing delays (Brezočnik & Majer, 2016); and wastage by minimising the number of work items in progress at any given time (Mircea, 2019). It offers an ASD process that is clear, transparent, flexible, and quick (Altexsoft, 2016). This process is managed through the visualisation of work items and management of the flow of items from beginning to end while enabling the provision of regular feedback (Mircea, 2019). Kanban incorporates the old into the new by working with structures that are already in place (Mircea, 2019). In addition to the agile principles, the Kanban framework is guided by four principles (Mircea, 2019). These are to focus on what is required immediately, implement changes in a gradual manner, keep the existing roles and their function and encourage shared leadership regardless of position level.

Unlike Kanban, which works with existing structures, SCRUM introduces many changes to the rules and practices (Mircea, 2019). These rules influence the ASD team structure, process, artefacts, and tools. The SCRUM framework is the most used ASD framework Altexsoft (2016). As such, it is the guiding ASD framework on which this study will be based.

## 2.4.8 SCRUM

The SCRUM team structure consists of specific roles within the team. These SCRUM framework roles are Product Owner (PO), SCRUM Master and Development Team Member (Poscova, Bednarova, Bogdanovska & Mojzisova, 2020). A PO is responsible

for communicating the anticipated outcomes of the project to the development team on behalf of the customer; they determine the priority and final product output (Poscova *et al.*, 2020). A SCRUM Master's responsibility lies with assisting the team to ensure that they fulfil the project's outcomes as outlined by the PO (Poscova *et al.*, 2020). This is done by ensuring that the development team has an agile mindset, adheres to SCRUM processes, and ensures that their work environment is conducive to maximum output (Poscova *et al.*, 2020).

The ASD team comprises people with specialised skills that enable them to produce and deliver a software product per the requirements of a Product Owner (PO) (Poscova *et al.*, 2020). They are jointly responsible for producing and delivering the final product (Poscova *et al.*, 2020). In SCRUM, development team members are skilled individuals, and there's no emphasis on the specific skill sets like analysis, development, and testing required to qualify these individuals as members of the development team  (Mircea, 2019).

These development team skill sets and roles linked to them are expanded on in this study to provide context. Development Team Members include analysts, developers, and testers. The analyst does analysis, the developer, development, and the Tester testing. The descriptions of these roles are articulated based on a general understanding within the context of the study. An Analyst refers to a person who interprets business objectives into system logic and designs. A developer refers to a person who uses the designs provided by an Analyst to produce software programs that aim to bring the business objectives to life. Lastly, a Tester is a person who will interrogate the software programs to ensure that they operate as per the logic and designs, thus satisfying the intended objectives.

A scrum process has a distinct set of artefacts that the team must produce. These artefacts include the product backlog, the sprint backlog, and a burndown chart (Altexsoft, 2016; Hoda, 2011). The product backlog is a list of business requests at a feature level, this list is arranged by the perceived value to the business  (Hoda, 2011) and is owned by the PO (Mircea, 2019). A sprint backlog is a list of tasks ready to be worked on and completed within a single sprint  (Mircea, 2019). The concept of a sprint will be explained further down in this chapter. The sprint backlog is determined using

the product backlog as an input  (Altexsoft, 2016). A burndown chart is the depiction of daily progress within a sprint. It shows how much work has been completed versus remaining on any given day during a sprint  (Hoda, 2011).

Agile teams utilise different tools for the SCRUM process to run effectively and add value. These tools enable teams to create, track, assign tasks, and report on progress within a sprint  (Management Solutions, 2019). In addition, these tools enable agile teams to visualise tasks  (Mircea, 2019). An example of these tools is a scrum board (Mircea, 2019).

A scrum board may be a physical whiteboard (Deshpande, Sharp, Barroca & Gregory, 2016) where each task is represented by a sticky note (Mircea, 2019); see Figure 2.2. An alternative to a physical SCRUM board is an electronic board. Examples of available electronic boards in the market, according to Management Solutions (2019), include Jira, Trello, Wrike, Evernote, Flow, Azendoo, Asana, and Project Place. Refer to Figure 2 for additional details regarding these tools.

SCRUM boards are not mutually exclusive; some teams use a combination of physical and electronic boards (Deshpande *et al.*, 2016). These boards have different capabilities and benefits, as shown in Figures 2.3 and 2.4.  (Eby, 2016). Figure 2.3 shows the physical scrum board.
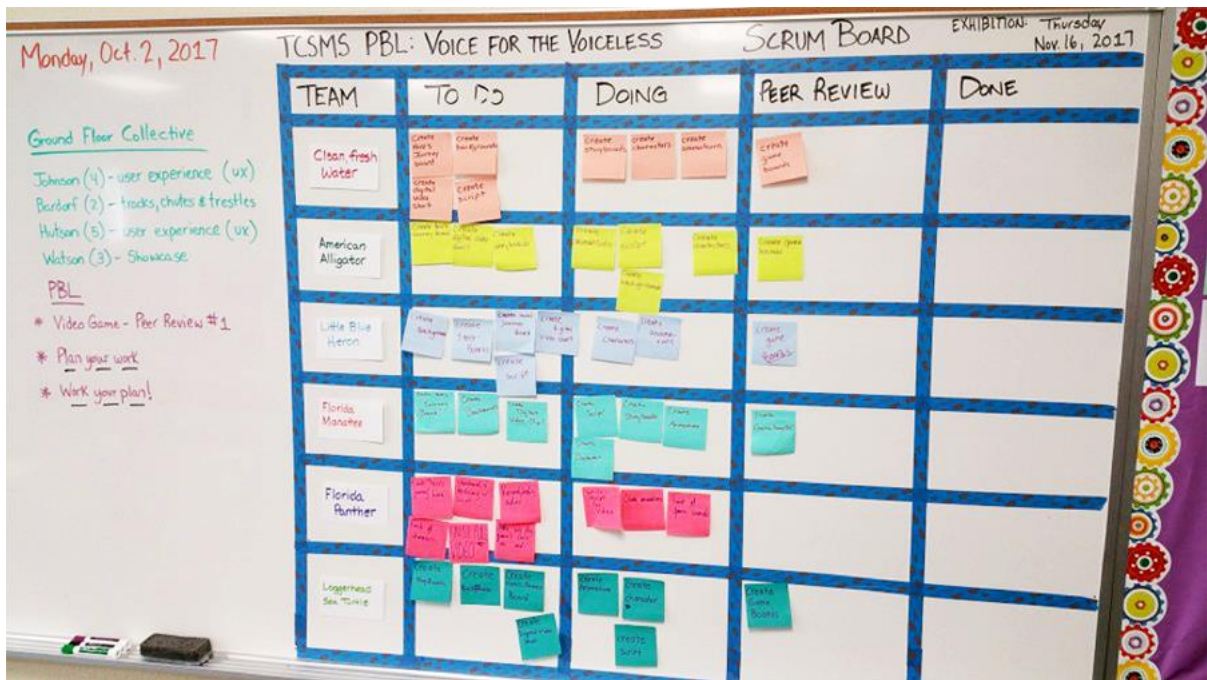
*Figure 2-3 Physical SCRUM Board*

(LaVogue, 2020)

    i.   Work for collocated teams as team members must have access to them.

    ii.  It can be customised and decorated to the team's satisfaction (see Figure 1).

    iii. They are easy to use for new agile teams.

    iv. Are visible, thus making visualisation easy for the team.

    v.  A team member can modify the board at any given time.

    vi. They are great for face-to-face interactions (as per one of the agile principles).

Figure 2.4 outlines what an electronic board may look like.

**Trello**
- Interactive platform that imitates the convenience of sticky notes.
- Easily organize project cards, assign tasks and share documents. Option to hold discussions.
- The team gets email notifications any time a change is made on a project card.
- Compatible with mobile usage.

**JIRA**
- Mostly used to plan, track, and release effective software.
- Highly customizable and feature-rich solution to adapt to each user scenario.
- JIRA collects and unites all historic data in a single, searchable hub, and provides access to it at any point of time.

**Evernote**
- It allows the sharing of handwritten notes, small comments, and all kind of documents.
- Powerful search and discovery features.
- It has administration controls as well as data ownership that gives control to the company regardless of team composition.
- Compatible with multiple digital platforms.

**Asana**
- Users can monitor completion of tasks and delegate assignments.
- Document sharing is possible, and users can start conversations on a particular task, share images, attachments and links, and sign up for email notifications.
- Focus mode feature to boost concentration.

**Flow**
- Simple interface with numerous features in order to plan, monitor and prioritize tasks.
- Online chat option and direct messaging service for interacting with team members on a more personal level.
- Activity notification is sent to email with customizable settings.

**Wrike**
- Ability to put an item/task in different folders without duplication.
- Powerful analytics for Easy Reporting.
- Audit Reports for Enterprise-Grade Users.
- Panels for tracking individual and overall Progress (you can attach files, show pictures or tables, and cross-link to other tasks).

**Azendoo**
- It allows to monitor progress status (real-time) and makes task delegation simple.
- Emails can easily be converted to tasks and it allows you to syncronize your timetable with the calendar.
- Team discussions can be located in one open and accessible place.

**Projectplace**
- Provided with real time communication features.
- Allows you to share files straight from your Google, Box, or Dropbox accounts.
- Security is confirmed by the presence of a Single Sign-On mechanism (SSO).
- Offers open developer API, allowing powerful integrations.

*Figure 2-4 Electronic Agile Tracking Tools*

(Management Solutions, 2019)

i. It can be used by both collocated and virtual teams.

ii. It can also be customised according to the teams' preferences.

iii. Have the capabilities of sending alerts and tracking any updates made to tasks etc.

iv. The team can attach supporting documentation to tasks.

v. Possess the ability to limit permissions of who can do what on the board.

SCRUM teams, like other ASD teams, deliver small pieces of work incrementally. In SCRUM this is achieved via an iteration or sprint process  (Mircea, 2019). A sprint is a development cycle where the team is expected to collaborate and engage in activities that will see them deliver a piece of usable software at the end of that period (Hoda, 2011). This period is fixed and can be two to four weeks  (Hoda, 2011; Mircea, 2019). Figure 2.5 depicts a full SCRUM development cycle.
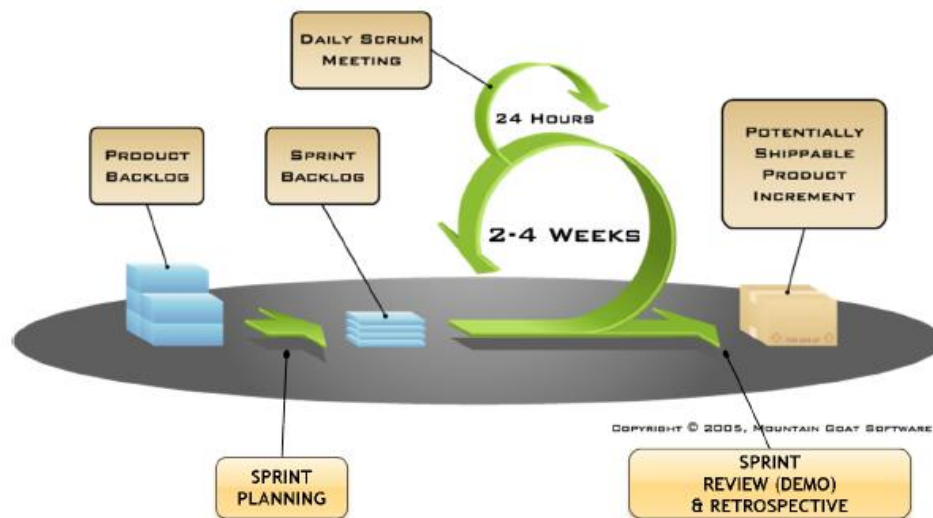
*Figure 2-5 SCRUM Sprint Cycle*

 (Hoda, 2011)

Figure 2.5 shows the product backlog at the beginning of the SCRUM sprint cycle, as it is a prerequisite for sprint planning. Sprint planning is a collaborative process where decisions about what work will be carried out within a sprint are made  (Hoda, 2011). According to Management Solutions (2019), this process may require 8 hours for a sprint planned to last four weeks. Part of sprint planning is creating a sprint backlog by extracting software development tasks from the product backlog for the sprint cycle. In addition, ASD teams estimate the required effort to complete the planned work and set goals for the sprint cycle  (Hoda, 2011). The daily scrum meeting, mostly known as a 'stand-up', is a meeting that takes place daily during the sprint for up to 15 minutes (Hoda, 2011; Management Solutions, 2019; Mircea, 2019).

A stand-up meeting aims to report on the sprint progress  (Hoda, 2011). This process allows the team to give feedback regarding what they have achieved since the last stand-up and what they plan to achieve until the next sand-up  (Hoda, 2011; Management Solutions, 2019). At the end of the sprint, the team participates in a ceremony known as the sprint review  (Management Solutions, 2019).  Management Solutions adds that this process can take up to four hours for a four-week sprint. In the sprint review ceremony, the team reviews and confirms what they were able to deliver

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within the concluding sprint cycle. The retrospective is a ceremony which takes place after the sprint has concluded to allow the team to reflect on the sprint that has just been concluded to identify and plan for future sprint improvements (Hoda, 2011; Management Solutions, 2019; Mircea, 2019).

Figure 2.5 shows where in the development cycle each ceremony fits in and how the product backlog artefact discussed previously fits into the process. Agile ceremonies assist teams with coordination, communication, and collaboration. These SCRUM ceremonies include sprint planning, daily stand-up, sprint review and retrospective (Management Solutions, 2019; Mircea, 2019). Agile ceremonies focus on team members and their interactions rather than processes (Srinivasan & Mukherjee, 2015).

SCRUM processes speak to guidelines on how ASD can be practically applied within a team environment. These processes demonstrate how people, tools, ceremonies, and artefacts combined to apply the Agile principles. As stated earlier in the chapter, the first Agile principle states that the top priority of this methodology is to meet customer needs through early and consistent delivery of software.

It is important to note that mentioning the first principle is the top priority, which implies the main principle. This first principle speaks to performance based on how quickly and often a team can deliver software. A closer look at the other principles shows they are guidelines for achieving the first principle. Thus, it is reasonable to deduce that the prime focus of ASD is high performance which will be discussed next.

### 2.4.9  Factors Influencing Agile Software Development Team Performance

The ASD process is supposed to assist teams in increasing organisational performance to gain a competitive advantage by innovating quicker. Dingsøyr *et al.* (2016) proposed a model with five factors that when done well, will increase the performance of ASD teams. These are 1) team coordination, 2) goal orientation, 3) team cohesion, 4) shared mental models and 5) team learning, figure 2.6.
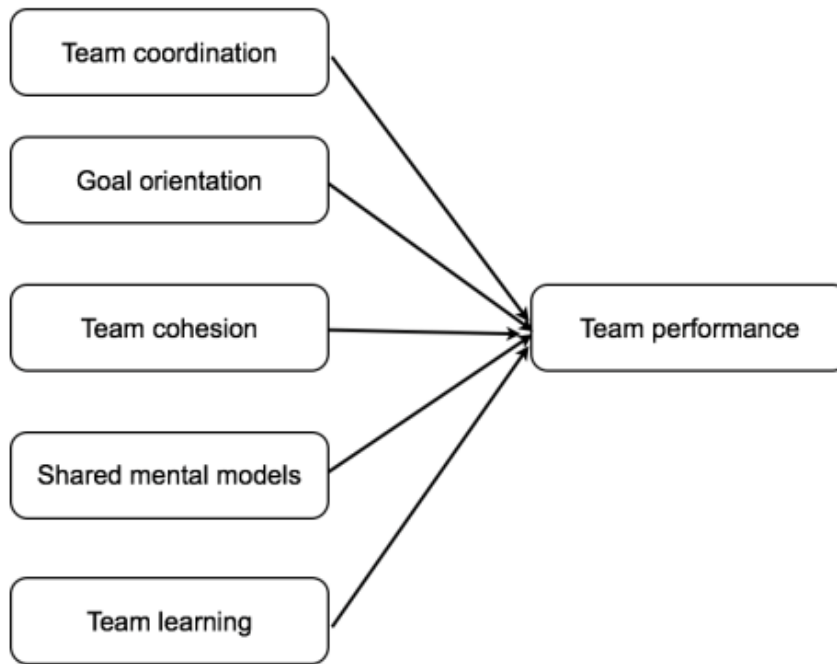
*Figure 2-6 Software Team Performance Model*

*(Dingsøyr et al., 2016, p. 107)*

Team coordination describes ensuring that project tasks are executed efficiently and in the correct order. In SCRUM ASD, this is done by using tools such as the SCRUM board and having stand-up meetings to ensure everyone is aware of and on track with their tasks. Goal orientation looks at the team's goals as well as the ability of the team to achieve those goals.

In SCRUM ASD, the team can set clear goals for each sprint (sprint planning) and participate in other ceremonies (daily stand-ups) during execution to achieve these goals. Team cohesion refers to oneness and chemistry, resulting in commitment and willingness to uphold the team's values.

This oneness can be achieved through a combination of SCRUM ceremonies which create an environment for the team to communicate and collaborate regularly. Shared mental models refer to common knowledge within a team; it helps the team understand their environment and their work in order to coordinate and perform optimally. This statement is supported by Deshpande *et al.,* (n.d.) and Manjusak (2019), who claim

that greater quality of shared knowledge  can improve the performance levels of a team through the maintenance of trust and increased team member loyalty.

Shared mental models can be achieved through ceremonies such as Sprint Planning and Stand-ups are key to distributing knowledge and growing understanding within a team. Team learning is a result of shared experiences in a team; it occurs as the team reflects and refines its approach to solving problems and working together. Moe *et al.* (2015) agree that learning together in virtual ASD teams improves performance ((Moe, et al., 2015). This may be achieved through the retrospective ceremony as it allows the team to look back at their performance and devise plans to improve anything that requires improving. This is simply because failures in a virtual ASD team context present opportunities for a team to learn  (Moe, et al., 2015).

Dingsøyr *et al.* (2016) demonstrated a relationship between the five propositions listed above and some of the 12 agile principles as well as how the SCRUM framework is able to facilitate the realisation of each of these in Table 2.1.

*Table 2-1 Five Propositions for Team Performance of ASD Teams*

(Dingsøy *et al.,* 2016, p. 109)

| Proposition | Agile Principle | Implication | SCRUM Impact |
|---|---|---|---|
| 1. Team coordination | Principle 3 - To regularly deliver software that works every few weeks or every few months, favouring shorter delivery intervals | This regular delivery of software within a short of period emphasises the need for team coordination. | SCRUM ceremonies that facilitate this are:<br><br>• Daily stand ups<br>• Sprint planning<br>• Sprint Reviews<br>• Retrospectives<br>These ceremonies are performed for every sprint/delivery cycle. |
| 2. Goal Orientation | Principle 1 - The top priority of this methodology is to meet the customer needs by delivering relevant software early and consistently.<br><br>Principle 2 - To welcome changing and late requirements in order to support and assist the business to have a competitive edge in the market.<br><br>Principle 7 - The measurement of progress should be solely based on the functionality of the working software.<br><br>Principle 11 - It is believed that self-organising teams come up with the best architectures, designs, and requirements. | Principles 1 and 2 speak to customer satisfaction, this can be translated into a goal for the team.<br><br>Another goal for the team would be to produce working software as per principle number 7.<br><br>The part of principle 11 coincides with goal orientation is the mandate to build good architectures and designs | Sprint planning is a ceremony that deals with setting team goals for any given sprint, and the sprint itself is a process that focuses on achieving the goals set in sprint planning, thus making the daily stand up a mechanism of tracking goal progress. |
| 3. Team cohesion | Principle 4 – The business and the development team should collaborate daily until all the required software is delivered. | Cohesion takes place when the ASD team and business participate in the agile process to achieve the same objective. | SCRUM ceremonies that facilitate this are:<br><br>• Daily stand ups<br>• Sprint planning<br>• Sprint Reviews |
| 4. Shared Mental Models | Principle 6 - Face to face is the best way of communicating within a software development team. | The agile principles have no explicit concept of shared mental models, however, face to face communication in a collocated setting increases the teams' opportunities to develop shared mental models | Agile team members are required to know their ASD framework in order to participate, this holistic understanding creates a common understanding of software development across the team.<br><br>In a collocated team, all SCRUM ceremonies are performed face to face. |
| 5. Team Learning | Principle 12 - The agile team must retrospect and adjust their conduct accordingly to improve their effectiveness. | This principle requires of ASD teams to learn from their previous experiences in order to improve their team dynamics and processes. | A SCRUM ceremony that facilitates team learning the Retrospective. |

### 2.4.10 Dynamics of a Virtual Agile Software Development Environment

Agile environments differ according to the context and preferences of different organisations (Deshpande *et al.,* 2016). These environmental arrangements refer to whether a team is collocated, distributed, dispersed or hybrid (Deshpande *et al*., 2016). In a collocated environment, team members work within the same physical and shared office space (Eccles, Smith, Tanner, Van Belle & Van Der Watt, 2010). All other environments have a virtual element outside the collocated environment due to multiple physical locations. A distributed environment is when a team is divided into smaller groups who work from different geographical locations (Deshpande *et al.,* 2016). A hybrid environment on the other hand is where a team has some members working collocated while others work alone in a physical location (Sharp *et a*l., 2016). A dispersed environment refers to a team where individual team members work from different physical locations (Deshpande *et al*., 2016; Massimo *et al.,* 2018). When all team members work in this fashion, they are referred to as dispersed. This study examines the dynamics of ASD teams working in a dispersed environment.

Although this study focuses on a dispersed environment, there is limited literature on fully dispersed ASD teams. As such, distributed, dispersed and hybrid ASD environments will be considered. The three environments, distributed, dispersed and hybrid, will be collectively called virtual environments. The common thread among virtual ASD teams is that work is performed from multiple locations or sites. Another common thread among virtual ASD environments is that they depend on technological tools for communication and collaboration. As such, it is reasonable to expect that virtual ASD teams will share similar dynamics related to communication and collaboration.

When adopting Agile principles, communication and collaboration are key to ASD. For example, principle 4 states that the ASD team should collaborate daily. Principle 6 on the other hand emphasises the superiority of face-to-face communication over other forms of communication. The concept of virtual ASD teams is not new. The need for virtual agile teams came about as a result of globalisation. Globalisation presented opportunities for organisations to explore the concept of virtual ASD to take advantage of resources and talent available in different parts of the world  (Rothman & Kilby, 2019). Other reasons that have necessitated virtual ASD were bad weather conditions

that prevented employees from getting to their place of work  (Rothman & Kilby, 2019). In the context of this study, a global pandemic caused created a situation that called for fully dispersed ASD teams in South African Bank. Some concerns are raised regarding the communication and collaboration dynamics of ASD teams in a virtual environment. These dynamics include connectivity, tools, global distribution, team relations and awareness.

These are discussed in this section. According to Deshpande *et al.* (2016), communication may suffer when working in a virtual environment. Physical distance in virtual teams is said to reduce the amount of communication between team members (Stadler, et al., 2019). The previous statement is supported by   (Stadler, et al., 2019) who state that communication frequency will be low when virtual ASD teams rely on technological solutions that have shortcomings like poor infrastructure, low-quality hardware and unreliable network      (Stadler, et al., 2019). The technological shortcomings slow down the communication Field's turnaround time (Deshpande *et al.*, 2016).

Another aspect that impacts the communication and collaboration dynamic of virtual ASD teams is the efficiency of communication and collaboration tools. The inefficiency of communication and collaboration tools includes usage, sociocultural challenges, time zone differences, coordination challenges, team member participation restrictions, relationship building, and shared understanding and awareness  (Stadler, et al., 2019). Using incorrect tools for managing tasks and workflow in a virtual ASD environment will impede collaboration (Deshpande *et al.*, 2016).

These aspects will likely impact the team performance dynamic as they form part of the five factors that increase team performance listed by Dingsøyr *et al.* (2016). When the correct tools are available, it is imperative that team members understand how to use them to communicate and collaborate with one another (Deshpande *et al.*, 2016). Even when virtual tools are used correctly, they have a shortcoming in that they are not suitable for sharing tacit knowledge such as emotions (Deshpande *et al.*, 2016). This implies that there is still a communication gap that cannot be closed using the best tools. A high number of sites creates communication issues that can lead to poor coordination within the context of the team  (Stadler, et al., 2019). An example would

be where a large team is fully dispersed. This also makes it difficult to enable a good level of participation in collaboration efforts (Sharp, et al., 2016).

Although technological tools play a critical role in the virtual communication and collaboration of ASD teams, other issues impede the communication and collaboration dynamic. When team members work from different countries the socio-cultural challenges due to differences in language, motivation, and work ethic come into play (Stadler *et al.*, 2019). Different time zones can be a factor when AST virtual teams are spread across the global field (Stadler *et al.*, 2019). This reduces the frequency of synchronous communication between team members where there's little time overlap (Deshpande *et al.*, 2016; (Stadler *et al.*, 2019) The little overlap window also means teams have less time for collaboration efforts. This study focuses on locally dispersed ASD teams, thus factors that specifically impact globally distributed teams will not be considered in the discussion of findings.

Good colleague relationships are essential for good teamwork and a pleasant working environment (Manjusak, 2019). These make communication and collaboration easier, hence the enhanced level of teamwork. For ASD teams, good relationships create trust which is important along with a shared understanding (Deshpande *et al.*, 2016; Manjusak, 2019). Establishing or lacking shared mental models impacts communication and collaboration efforts in virtual ASD teams. It is said that virtual ASD teams may struggle to establish rapport and shared mental models due to the physical distance between them (Manjusak, 2019). Collaboration is impacted negatively when teams do not have shared mental models due to the lack of good relationships and trust between team members. This will result in a lack of cohesion within the team and with their business stakeholders. This makes it harder for teams to communicate and collaborate efficiently (Manjusak, 2019).

Communication and collaboration are also impacted by awareness or the lack thereof. Sharp *et al.* (2016) describes awareness as three dimensions. The first dimension speaks to awareness regarding the availability of other team members. It is not easy to keep track and know when colleagues are available or not when you are not in the same physical environment. Team members must know who is available for communication and collaboration, whether one-to-one or in a group format. The second dimension is knowing who works on which task at any given time. It is easy to

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lose track of this when working virtually. To deal with and manage dependencies, it is important that team members know who is working on what task to engage them directly when information is required regarding the said tasks.

The third and final dimension is the awareness of important issues and engagements that should be paid attention to. Knowledge of what issues are present and as well as the activities they need to participate in helps the team prioritise and focus on the most important items and activities. Thus, the presence of awareness helps virtual ASD teams collaborate and communicate better and it facilitates a shared understanding thus enhancing teamwork.

Although most of the general concerns of virtual ASD teams apply to this study, it is also important to emphasise the unique aspects of this study. This study is unique because the team members are dispersed locally in one country, thus no global implications. Another unique aspect of this study is that the teams are fully dispersed, meaning each site hosts one team member per site as people usually work from home. This implies that the bigger the team, the greater the number of sites which can lead to increased complexity in the coordination effort.  (Stadler, et al., 2019).

In addition, what has been covered so far in the literature needs to address other aspects of the physical environment each team member is subjected to, mainly their home. This means that two aspects of the environments to consider are involved, the virtual one influenced by technology and tools and the physical environment home to most team members. Thus, the working-from-home aspect is discussed next.

2.4.11 The Dispersed Work Environment in General

Working dispersed or from home (WFH) or virtually is not particularly new in the Financial Services and ICT sectors  (Reddy & Ramasamy, 2018). Some organisations have had it as an option for employees to work from home to provide them with flexible working arrangements  (Sulaiman, et al., 2020), or to accommodate globally dispersed teams (Deshpande *et al.*, 2016). Working from home as the name suggests implies that one is fulfilling employer duties from their residence without physical access to colleagues, subordinates, or superiors  (Reddy & Ramasamy, 2018). According to OECD (2020), working dispersed is possible based on the requirements of the job, thus it is easier to implement for knowledge-intensive occupations where work

activities can be fulfilled by using a laptop. This statement is relevant within the context of this study as ASD teams are knowledge-based professionals whose work starts with access to a laptop. Working dispersed has certain implications for an organisation and its employees.

As noted, not all jobs can be done away from the office or work site. Certain requirements must be in place for those that can be done to enable this. These requirements are from an organisation and an employee perspective that must be in place to enable working from home. Technology is an important enabler as far as working from home is concerned. It enables employees to connect to each other as well as access company resources without being at the company premises  (Reddy & Ramasamy, 2018). Organisations are required to provide technological tools for employees to fulfil their work.

Using the laptop, the employee must be able to communicate with colleagues and access company resources securely (Reddy & Ramasamy, 2018). This enabled a combination of technologies such as internet connection, Virtual Private Networks (VPN), Virtual Network Computing (VNC), collaborative software also known as groupware, conference voice and video calling, and Wi-Fi  (Reddy & Ramasamy, 2018). To ensure smooth operation for dispersed staff, the organisation must ensure the availability of IT support for their staff  (Sulaiman, et al., 2020). This support is necessary to assist employees in overcoming technological day-to-day challenges as they occur.

According to Sulaiman *et.al.*, (2020), efficient support by IT has been shown to positively affect employee productivity. Infrastructure access for an employee is another important requirement to enable working from home  (Sulaiman, et al., 2020). Thus, it is imperative that each employee who works from home has a reliable network connection to the internet from their place of residence. The internet, Wi-Fi, VNC and VPN form part of the foundational technologies that enable an employee to access the organisation's resources for work. On the other hand, collaborative software, conference voice and video calling enable colleagues to communicate and collaborate as they carry out their day-to-day tasks.

The upward trend in working from home has meant that technologies that support this have spiked in usage, especially since the pandemic was declared in 2020. Different

tools utilise communication and collaboration technologies to enable working virtually. The tools used for communication and collaboration may differ or be the same depending on the task being performed (Dávideková & Hvorecký, 2017). These tools are available as applications, some enable real-time communication and collaboration while others can achieve the same in a delayed manner (Dávideková & Hvorecký, 2017).

Real-time or synchronous tools enable real-time feedback as all participants are available simultaneously to share their thoughts and contribute to a task or topic. It mimics having participants in a meeting room without physical presence. Real-time communication and collaboration tools include Videoconferencing and audioconferencing (Lopes, et al., 2015). Videoconferencing enables two or more people in different locations to communicate and collaborate virtually in a face-to-face manner using the Internet (Lopes, et al., 2015). Some applications that enable videoconferencing include GoToMeeting (Lopes, et al., 2015) and Skype (Lopes *et al.*, 2015; Sulaiman *et al.*, 2020).

Microsoft Teams and Zoom (Sulaiman, et al., 2020). An audioconference is the same as a video conference, except that it does not have the face-to-face aspect, it is a voice call that allows two or more people to collaborate over the internet or telephone connections (Lopes, et al., 2015)Some of videoconferencing applications are multifunctional with audioconferencing and instant messaging functionality. These multifunctional tools include Skype, Microsft Teams and Zoom. Other audioconference applications include ZOHO Meetings and the telephone (Lopes, et al., 2015).

Although both videoconferencing and audio conferencing provide the benefit of real-time communication, video is considered richer than audio (Hassell & Limayem, 2017). This is because in video conferencing come non-verbal cues like facial expressions can be observed (Hassell & Limayem, 2017).

Unlike real-time, delayed communication and collaboration implies that participants do not have to be available simultaneously to communicate. Thus, it allows the flexibility for a participant to respond at a time suitable for them. Delayed or asynchronous communication and collaboration tools include email, instant messaging, file sharing and shared documents (Lopes *et al.*, 2015; Dávideková & Hvorecký, 2017). The most

used communication tool in organisations is email (Lopes *et al.*, 2015; Dávideková & Hvorecký, 2017).

Email allows an employee to compose a written message and send it to one or more recipients concurrently  (Lopes, et al., 2015). Instant messaging applications such as Lync Online and Hangout are like emails, enabling more than one user to communicate via a text chat in an asynchronous manner  (Lopes, et al., 2015).

Sharing files via applications such as Dropbox and We Transfer is a way of enhancing collaboration and transferring knowledge between team members. Applications that allow teams to share documents such as Google Drive, Microsoft Web Apps and Huddle allow members to work on a document simultaneously, thus enhancing the collaboration efforts of virtual teams  (Lopes, et al., 2015). Knowledge sharing contributes to high team performance as it increases team learning and shared mental models within the team.

The disadvantages of asynchronous communication tools are that they can create conflict due to misunderstanding is written communication and a delayed response (Lopes, et al., 2015). The lack to voice tone, facial expression and body language paired with the choice of words and use of language can misconstrue a message based on the understanding of the reader. Where the same message was sent to multiple readers, they may all have a different understanding of what was being communicated.

Working in a dispersed environment in general does not come without challenges. Technology has made working in a dispersed environment possible over the years. However, there are still some challenges presented by working dispersed as indicated by the literature. Working virtually relies on computerised systems to enable collaboration and communication. The implication is that a technological failure such as the inability to connect to the internet will reduce the quality of communication and collaboration. Communication tools that are unreliable and not easy to use can cause frustration  (Dávideková & Hvorecký, 2017).

In addition, asynchronous communication can cause delays, resulting in less effective communication between colleagues (Massimo *et al.*, 2018; OECD, 2020). In addition, Massimo *et al.* (2018) states that teams that collaborate virtually struggle to establish

shared mental models (Magni, et al., 2018), which is key for high-performing ASD teams. Working virtually removes the ability to observe colleagues' behaviour and their non-verbal cues during communication (Magni, et al., 2018). This makes it difficult for team members to learn each other's personalities and traits (Charlier, et al., 2016), thus making it difficult for team members to build relationships (Charlier *et al.,* 2016; Massimo *et al.*, 2018), and trust (Hill & Bartol, 2016).

According to Hill and Bartol (2016), this, in turn, makes it challenging for the team to collaborate and deal with any conflicts that arise. The lack of familiarity with each other can also increase the team members' levels of uncertainty (Gliksona & Erezb, 2020). The uncertainty results from the knowledge-sharing impediments, which is especially challenging for new employees who must acquire business knowledge and learn processes. According to Massimo *et al.* (2018) and Behrens, Kichko and Thisse (2021), working virtually reduces innovation within the team.

There are also individual challenges that transpire when people are working from home. The inability of a person to build relationships can lead to a feeling of isolation when working virtually (Magni, Ahuja & Maruping, 2018; OECD, 2020).

Working virtually has exposed some existing inequalities among colleagues (OECD, 2020). For example, depending on one's situation an employee who does not have an office space at home may be exposed to disruptions and struggle to be productive. In another scenario, employees who live in areas that do not have sufficient internet coverage will struggle to connect during collaboration sessions or meetings. Working from home creates a grey area between home and work, with home interfering with the work (Behrens, et al., 2021).

The opposite is also true as work can interfere with the home where employees work unintended longer hours resulting in hidden overtime (OECD, 2020). In addition to hidden overtime, employees sometimes incur additional costs due to working from home (OECD, 2020). The OECD report lists an increase in water and electricity usage at home as an example of what may increase home maintenance costs while working from home.

Working virtually has management-related challenges as well. The overtime worked by employees can go unnoticed, thus unacknowledged by management (OECD,

2020). Management's lack of physical oversight can hamper the efficient execution of work tasks and share of knowledge  (OECD, 2020). These challenges have a direct impact on performance in some instances (Hassell & Limayem, 2017; Prasad, DeRosa & Beyerlein, 2017; Magni *et al.,* 2018)

Although there are challenges to be noted for teams who are working dispersed, there are benefits as well. Working from home can benefit employees due to fewer distractions from colleagues  (OECD, 2020) as there is no opportunity for one to walk up to another's desk unannounced. Since communicating occurs electronically, people can choose whether to take a call or not and when to respond to text communication. This gives employees some flexibility  (Adonis & Kabanda, 2019) and more control of their day   (Behrens, et al., 2021).

Access to different communication tools and applications enables communication to be more effective  (Prasad, et al., 2017).  This allows employees to select different tools as they see fit for purpose. There's a higher possibility for team members to share leadership-related aspects of work in a dispersed environment   (Charlier, et al., 2016). This leads to teams being able to create shared mental models, build trust, coordinate better, and manage conflict efficiently  (Hill & Bartol, 2016).

Individually, better work-life balance has been noted due to working from home (Sulaiman, et al., 2020). This results in no commuting time between home and work necessary, thus one can spend that time in an alternative manner   (Behrens, et al., 2021). The time gained in commuting also implies reduced transport-associated costs for employees (OECD, 2020; Behrens *et al.*, 2021).

The reduced cost benefit of working from home is extended to the employer. This results from the reduced cost of operating  (OECD, 2020). Therefore, the employer will require less office space and less water and electricity usage. The employer further benefits from less absenteeism when people work from home  (OECD, 2020). People can easily attend to personal matters at home without taking a leave of absence.

Virtual work generates a lot of data management that can use to monitor employee performance  (OECD, 2020). In addition, some studies have linked working dispersed to a high level of performance (Adonis & Kabanda, 2019; Conradie & de Klerk, 2019). This is a significant benefit for the employer. This is because most of the tools used in

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a virtual environment have audit information that enables a view of how much time an employee spent on the system and which meetings they attended for any given day.

As established from the literature, several dynamics arise when people work in a dispersed environment. These dynamics present challenging and beneficial aspects for the employer and employee. Regarding the bottom line dynamic and performance, it is still being determined what the impact of working in a dispersed environment is (OECD, 2020). Some researchers claim that working in a dispersed environment hurts productivity (Hassell & Limayem, 2017; Prasad *et al.*, 2017; Magni e*t al.*, 2018). Other researchers such as  (Conradie & De Klerk, 2019), and Prasad *et al.* (2017) claims that working in a dispersed environment increases productivity.

Hence, effectively utilising electronic communication tools is expected to impact performance positively. This viewpoint is reinforced by the assertion that individuals working in virtual settings should possess strong proficiency in text-based communication (Charlier *et al.,* 2016). According to Charlier *et al.* (2016), competence in using communication tools facilitates prompt responses and decision-making. Furthermore, clashes between various work tasks are identified as an additional factor that may lead to decreased productivity in dispersed environments (Behrens *et al.* 2021). Sulaiman *et al.* (2020) on the other hand argues that working in a dispersed environment will lead to increased performance for employees with a conducive work environment to manage their tasks and work commitments. A conducive work environment also leads to an efficient work-life balance and increased job satisfaction (Sulaiman, et al., 2020). Also, when employees working from home are afforded trust, they can become high-performing individuals  (OECD, 2020). Access to efficient IT support is also attributed to positively impacting performance  (Sulaiman, et al., 2020).

## 2.5   The Relevance of General Systems Theory in Agile Software Development

coIn this section, relevant deductions of GST in ASD for this study are made from the pertinent literature discussed above. The relationship between agile software development (ASD) and general systems theory (GST) is one of mutual influence and alignment. While agile software development provides a practical process for managing software delivery in a dynamic and iterative manner; general systems theory offers a conceptual foundation for understanding complex systems and their interdependencies. Together, they provide a holistic approach to software

development that considers the broader context and interactions within a system. In this section, the relationship between ASD and GST is explored and evaluated.

As discussed, agile software development is an iterative and flexible approach to software development that prioritizes collaboration, adaptability, and customer satisfaction. It recognises the complexity of software projects and acknowledges that they are part of larger systems. Agile methodologies, such as Scrum, Kanban, and Extreme Programming (XP), provide practical frameworks for managing the development process, enabling teams to deliver value incrementally and respond to changing requirements. General systems theory, conversely, is a theoretical framework developed by Ludwig von Bertalanffy in the mid-20th century as mentioned in the preceding sections of this chapter. It provides a way to understand complex systems and their interrelationships. General systems theory emphasises that systems are composed of interconnected and interdependent components, and that changes in one part can affect the entire system. It offers principles and concepts for analysing and managing complex systems, focusing on their emergent properties, interdependencies, and feedback loops.

The relationship between agile software development and general systems theory can be understood through several key points which were deduced from the literature, such as: Complexity and Adaptability; Emergent Properties; Holistic Perspective; Feedback and Learning; Systems Thinking Mindset; and Self-Organisation and Autonomy. These key points are discussed in no order.

### 2.5.1 Complexity and Adaptability

Complexity and Adaptability for both ASD and GST recognise the inherent complexity of software projects and the need for adaptability in dealing with uncertainty and change, such as the uncertainty created by working in a dispersed environment. General systems theory helps us understand the complex nature of software delivery systems, where various components, processes, and people interact and influence one another. An example of this would be the interaction of ASD team members with each other, other teams, the tools they use as well as the physical home environment as well as the virtual work environments they work in. Agile methodologies embrace adaptability by promoting iterative development, frequent feedback, and the ability to respond to evolving requirements.

### 2.5.2 Emergent Properties

Regarding emergent properties, General Systems Theory (GST) highlights the concept of emergent properties, referring to phenomena that arise from the interactions and relationships among system components and their environment, while ASD acknowledges that the best solutions and ideas may emerge over time through collaboration and continuous improvement. In the context of this study, these emergent properties are viewed from the context of agile software development teams working in a dispersed environment. Over time, emergent properties become apparent through teams embracing the iterative nature of agile software development and feedback loops. Agile software development teams can explore and discover emergent properties that lead to innovative and effective software solutions.

### 2.5.3 Holistic Perspective

General systems theory encourages a holistic perspective, it considers a system that is greater than the sum of its parts. It emphasises the need to understand the interconnections and interdependencies within a system as well as the impact brought about by interacting with the environment in which the system operates. Agile software development shares this perspective by focusing on the overall system and its interactions, rather than individual components. The system in the context of agile software development teams includes the people, processes, and tools necessary for these teams to deliver software products. The environment in the case of this study refers to the dispersed nature of the engagement for the teams to deliver software products. Therefore, agile software development teams consider the broader context and aim to optimise the entire software development process rather than isolated elements that align with the principles of the general systems theory.

### 2.5.4 Feedback and Learning

In feedback and learning, both agile software development and general systems theory value feedback and learning. General systems theory emphasises the importance of feedback loops in understanding and managing systems. At the same time, agile methodologies rely on regular feedback through practices like daily stand-ups, sprint reviews, and retrospectives. This feedback facilitates learning and

continuous improvements; enabling teams to adapt and enhance their processes outputs.

## 2.5.5 System Thinking Mindset

General systems theory fosters a Systems Thinking mindset, which involves considering the broader system and its dynamics, rather than focusing solely on isolated elements. Agile software development encourages a similar mindset by advocating for cross-functional collaboration, shared ownership, and understanding of the system. Both approaches recognise the interconnectedness of system elements and encourage individuals to think beyond their specific roles or responsibilities. In the context of this study, one can argue relevance by considering that agile software development teams are subsystems within a more extensive system, the organisation. These teams interact with other agile software teams and other departments in the organisation to deliver software.

## 2.5.6 Self-Organisation and Autonomy

Shifting to self-organisation and autonomy, general systems theory recognises the self-organizing need for complex systems to self-organise, where elements interact without centralized control. Agile methodologies align with this concept by promoting self-organizing teams. Agile teams are empowered to make decisions and adapt to changes, fostering autonomy and distributed decision-making.

## 2.5.7 The Relationship Between General Systems Theory and Agile Software Development

The integration of GST concepts into ASD practices, as done in this study, allows the research to delve into a deeper understanding of the complexities involved in the agile software development process and better navigate the challenges of building and delivering software products. This integration allows for a more holistic approach to software development as it considers the interdependencies, emergent properties, and feedback loops within a system. The relationship between agile software development and general systems theory can be seen in practice through various aspects of agile methodologies. These aspects include iterative and incremental

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development. Agile frameworks such as SCRUM advocate for iterative and incremental development by breaking down the software deliverables into smaller, manageable iterations or sprints. This approach aligns with the idea of systems thinking, it recognises that software development is an ongoing process of continuous improvement and adaptation.

Agile teams are typically self-organising and cross-functional, meaning they consist of members with diverse skills required for software development, including developers, testers, and analysts. This cross-functional nature of skillset compositions reflects the notion of general systems theory, which emphasises the interdependencies and interactions among various components in a system. Agile methodologies emphasise close collaboration with customers and other stakeholders throughout the development process. Regular feedback and involvement of the customer help ensure that the software meets their expectations and business needs. This customer-centric approach aligns with systems thinking, which recognises the importance of understanding and addressing the needs of various stakeholders within a system.

Agile projects embrace changing requirements and recognise that software development is an evolving process. Instead of attempting to plan the entire project upfront, agile teams adapt their plans and priorities based on feedback and emerging insights. This adaptive planning approach resonates with the principles of general systems theory, which emphasises adaptability and the ability to respond to change within a system. Continuous Delivery and Integration: Agile methodologies advocate for continuous integration and continuous delivery practices, enabling teams to deliver working increments of software frequently. This iterative and incremental delivery approach aligns with the idea of systems thinking, which recognises that a system evolves and improves over time through ongoing iterations and feedback loops.

Agile methodologies foster transparency and open communication within the team and with stakeholders. Techniques like daily stand-up meetings, visual boards, and regular retrospectives promote collaboration and shared understanding. These communication practices align with systems thinking, which emphasises the importance of effective communication to understand and manage complex systems.

In essence, the relationship between agile software development and general systems theory is characterized by shared principles and perspectives. Both approaches

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recognise the complexity and interdependencies within systems, embrace adaptability and emergent properties, and promote a holistic perspective. By integrating concepts from general systems theory into agile software development practices, teams can gain a deeper understanding of the complexities involved and better navigate the challenges of building and delivering software systems. This integration allows for a more holistic and systems-oriented approach to software development, leading to improved outcomes and customer satisfaction.

## 2.6 Relationship Between TIPS and Agile Software Development

This section explores the relationship between TIPS and ASD as deduced from the literature. The pillars that make up the TIPS model will be individually assessed against some of the fundamental and core aspects of ASD. These pillars are Technology and Tools, Innovation, System Thinking and People. Each will be discussed based on its relationship with ASD.

### 2.6.1 Technology and Tools

This study sees the relationship between technology tools and agile software development as integral and symbiotic. Technology tools play a significant role in supporting and enhancing the practices and principles of agile methodologies. They provide valuable resources for agile teams to collaborate, manage work, communicate, and automate various aspects of the software development process in various ways. These tools can be explored and categorised as communication and collaboration, agile task management, ASD practices, agile metrics and reporting, documentation and knowledge sharing, and virtual remote working tools.

Communication and collaboration are where Agile methodologies emphasise effective communication and collaboration among team members and other stakeholders. Technology tools that include task management platforms, instant messaging applications, and video conferencing software enable real-time communication, document sharing, and remote collaboration. These tools help distributed teams stay connected, share information, and work together seamlessly, fostering collaboration and improving overall team communication.

Agile Task Management on the other hand focuses on technology tools specifically designed to manage task in an Agile project or sprint such as Scrum boards or Kanban

boards. These digital workspaces facilitate the visualisation and tracking of work progress. These tools offer features for creating and organizing and tracking work tasks, managing the product backlog, and visualizing the status of work items. They enhance transparency, facilitate prioritization, and enable efficient workflow management, aligning with the principles of ASD.

There are various technology tools support specific agile software development practices. For example, version control systems like Git enable teams to collaborate on code development, manage branches, and merge changes efficiently. Continuous integration and continuous delivery (CI/CD) tools automate the build, test, and deployment processes, promoting rapid and reliable software delivery. Test management tools support test-driven development and facilitate test case management and execution. These tools assist in implementing and streamlining agile development practices, improving performance, and ensuring high-quality software deliverables.

 When it comes to agile metrics and reporting, there are technological tools which can assist in capturing and analysing agile metrics to monitor project progress and team performance. Agile dashboards and reporting tools provide visualizations of key metrics, such as sprint velocity, burn-down charts, and defect trends. These tools help agile teams make data-driven decisions, identify bottlenecks, and continuously improve their processes. By providing insights into team performance, these tools align with the agile principle of reflecting and adapting.

Agile methodologies encourage lightweight documentation and emphasise knowledge sharing. Technology tools like wikis, knowledge bases, and documentation platforms enable teams to create and maintain project documentation, user manuals, and technical guides. They facilitate collaboration, version control, and easy access to information, supporting effective knowledge sharing within the team and other with stakeholders. These tools help document evolving requirements, decisions, and lessons learned, aligning with the agile principle of valuing working software and comprehensive documentation.

Remote working in agile software development has become increasingly relevant in the context of remote and distributed teams. Technology tools play a crucial role in enabling virtual collaboration and supporting remote work. Online task boards, video

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conferencing tools, chat applications, and shared repositories facilitate real-time collaboration, enabling teams to work together irrespective of their physical location. The availability of these tools allows agile teams to maintain their productivity and collaboration even in a distributed environment.

It is important to note that technology tools are not a substitute for the core principles and practices of agile software development. While they provide valuable support, successful agile implementation requires a focus on people, collaboration, and flexibility. Agile methodologies are centred around individuals and interactions, working software, customer collaboration, and responding to change. Technology tools serve as enablers, enhancing efficiency, transparency, and communication within the agile process. It is advisable to carefully select technology tools based on the specific needs of the team, project, and organisation. Consider factors such as scalability, ease of use, integration capabilities, and the tool's alignment with agile principles and organisational culture.

### 2.6.2 Innovation

The relationship between agile software development and innovation is a complex and interconnected one. Agile methodologies have gained significant popularity in the software development industry due to their ability to foster innovation and adaptability. This section explores how agile software development principles and practices contribute to promoting innovation. Agile software development is an iterative and incremental approach to software development that emphasises flexibility, collaboration, and customer feedback. It breaks down the traditional linear approach of software development into smaller, manageable iterations called sprints. Each sprint involves a cross-functional team working together to deliver a small piece of functionality, which is then reviewed and refined based on feedback.

One of the ways in which agile promotes innovation is through its emphasis on continuous improvement. Agile teams regularly reflect on their processes and adapt them to improve efficiency and effectiveness. This iterative approach allows teams to experiment, learn from their mistakes, and make necessary adjustments, fostering an environment that encourages innovation. Agile methodologies also prioritize customer collaboration and feedback. By involving customers throughout the development process, agile teams gain a deeper understanding of their needs and can quickly

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incorporate changes and new ideas. This customer-centric approach reduces the risk of developing products that do not meet market demands and increases the likelihood of delivering innovative solutions. Furthermore, agile methodologies promote cross-functional collaboration and self-organizing teams. By bringing together individuals with diverse skills and perspectives, agile teams can generate innovative ideas and approaches to problem-solving. The emphasis on teamwork and open communication within agile environments allows for the exchange of knowledge and encourages creativity and participation.

Agile also encourages a more proactive and flexible mindset towards change. Traditional software development methodologies often struggle to accommodate changes in requirements, resulting in rigid and inflexible development processes. In contrast, agile embraces change as a natural part of the development process. This adaptability allows agile teams to respond quickly to market shifts, emerging technologies, and new opportunities, enabling them to innovate and stay ahead of the competition. Another aspect of agile that contributes to innovation is its focus on delivering working software in short, frequent iterations. This approach enables organisations to obtain early feedback from users, allowing them to validate ideas and adjust early in the development cycle. By regularly delivering functional software, agile teams can gather real-world data and insights, facilitating faster learning and innovation.

In other words, agile software development and innovation are deeply intertwined. Agile methodologies provide a model that promotes continuous improvement, customer collaboration, cross-functional teamwork, adaptability, and early feedback. These principles and practices create an environment that encourages innovation within ASD teams and the broader organisation. By embracing agile, organisations can enhance their ability to develop innovative solutions that meet customer needs and stay competitive in an ever-evolving marketplace.

### 2.6.3  Systems Thinking

The relationship between agile software development and systems thinking is one of mutual benefit and synergy. Agile methodologies and systems thinking share common principles and complement each other in addressing complex software development challenges. Agile software development approaches, such as SCRUM or Extreme

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Programming focus on iterative and incremental development. This focus emphasises adaptability, collaboration, and customer value. Systems thinking, on the other hand, is a holistic approach that views a system as a complex, interconnected network of components and interactions. It seeks to understand the interdependencies and feedback loops within the system to achieve a comprehensive understanding of its behaviour. Agile methodologies embrace systems thinking by recognizing that software development is not just about writing code but about creating complex interactions between various components of the process itself, including, people processes and technology. It involves various stakeholders, including sponsors, SCRUM Masters, Agile Coaches, the ASD team, other teams, users, and customers who interact both with the process of ASD and the finished software products once it's released for use. Agile teams strive to understand the broader context and implications of their work by acknowledging the broader stakeholders who are interested in the products they deliver. They consider the interactions between different modules, components, and teams to ensure that the system, functions effectively and meets the desired objectives.

Systems thinking complements agile software development by providing a broader perspective that views ASD as a system. It helps identify potential bottlenecks, dependencies, and risks that may arise during the development process. By applying systems thinking, agile teams can anticipate and address these issues early, leading to better overall design and performance. Moreover, systems thinking promotes a holistic view of value creation and encourages considering the impact of software decisions on the entire process and software products. It helps ASD team understand the trade-offs involved in different design choices, such as scalability, maintainability, and performance. This holistic perspective ensures that the development process aligns with the overall goals and objectives of the project. The relationship between agile software development and systems thinking is characterized by mutual reinforcement. Agile methodologies provide the iterative and customer-centric practices necessary for effective software development, while systems thinking offers a broader perspective and understanding of the complex systems being developed. By embracing both approaches, organisations can achieve more robust, adaptable, and valuable software solutions.

### 2.6.4 People

The relationship between agile software development and people is one of growth and execution. It goes without saying that for technology tools, innovation and systems thinking in the TIPS model are driven by people. People are also the drivers when it comes to ASD, interact with, and drive each component of the ASD process. These people include the ASD team, business stakeholders, other technical teams, and customers. All these people contribute towards the ASD process, directly or indirectly. The business stakeholders request and pay for the innovation and development of new software products that are necessary for the organisation to compete in the market. The ASD team takes all of this into consideration by building the required products quickly and iteratively which brings about value to the organisation as quickly as possible, thus contributing executing the organisational competitive strategy. This is the execution aspect of people. To execute, the ASD team must interact with ASD tools, execute ASD processes, and self-reflect to increase efficiency and quality of their deliverables. This touches on aspects such as measuring performance through working software, simple designs due to the need for quick turnaround times and regular communication and collaboration through stand ups, planning sessions, grooming etc. In addition, the necessary tools are utilised to enable documentation, software development and deployment of code. Once the products have been released to use in the market, customers interact with these products which creates a feedback loop back to the business stakeholders. This Feedback loop may call for further innovation which triggers the ASD process again. Every subsequent sprint triggers growth within the ASD teams. Growth is symbolised by ASD processes that focus on the self-reflection of the team, such as the retrospective ceremony. This allows the team to reflect of what was done well so that they can continue doing it, and what was not done well so that they can work on improving those aspect thus adapting. As such, each new sprint a team must focus on something to improve from previous sprints.

## 2.7   Review of Other Related Studies

This section critically reviews some of the studies related to the current study. In Iowa, United States of America, Ashmore (2012) conducted a study comparing the impact of the waterfall and agile software development processes on virtual teams.

Conversely, the current study examined the dynamics of working in a dispersed environment for ASD teams. Juxtaposing the two studies, the current study is like that of Ashmore (2012) since both studies explore teams working virtually in a dispersed environment. Contrary to Ashmore (2012), who looked at both waterfall and agile software development, the current study only looked at agile software development.

Interestingly, both studies were conducted using a qualitative research design and collected data using interviews. Some of Ashmore's findings show that ASD teams were consistent, competent, and productive at work. Furthermore, ASD teams were able to communicate effectively and collaboratively with each other despite working in a dispersed environment. However, Ashmore's findings also show that some participants felt like their teams were not teams but more individualised. Some of the findings by Ashmore (2012) indicate that there is limited understanding of ASD, as such, teams don't always stick to agile processes. These findings are contrasted to those of the current study in Chapter Four.

In Johannesburg, South Africa, Njomo (2017) aimed at describing and explaining the attributes that ASD teams possess which provides them with the capability to enhance and sustain higher productivity levels. It is worth noting that Njomo's study was conducted within a similar context as the current study. Both Njomo's and the current study were conducted within the field of ASD (teams) in the banking sector in Johannesburg South Africa.

In addition, both studies were conducted following qualitative research approaches, where Njomo used a case study as a research design, and the current study used phenomenology. While Njomo's study had 18 participants and the current study had 38 participants, both studies collected data using semi-structured interviews. Findings by Njomo (2017) show that ASD team members were knowledgeable regarding ASD practices, thus, were competent. One of Njomo's findings shows that support provided by agile coaches contributes to ASD team's successes. These findings by Njomo are interesting as they relate to those found in the current study and are presented and discussed in Chapter Four.

In Ontario, Canada, Whitworth (2006) conducted a study titled "Agile experience: communication and collaboration ASD teams." Whitworth's study looked at ASD teams in both collocated and dispersed environments while the current study looked

at ASD teams in a dispersed environment only. Both the current and Whitworth studies followed a qualitative research approach where data was collected by means of interviews. The study by Whitworth (2006) sampled 22 participants while the current study had 38 participants in ASD teams.

Whitworth (2006) argues that different participants had different views on which agile practices were important. Another interesting finding from Whitworth's study is that most participants unanimously performed sprint planning and stand-up ceremonies. Whitworth (2006) findings are like those by Ashmore (2012) where participants could work well together, collaborate, and cooperate easily and were happy. The similarity of these findings is interesting given the difference in the context of both studies. Therefore, it is anticipated that the current study's findings may not be far from those reviewed in this section.

During the review of related studies in the literature, findings of studies by Mark (2002) and Teasley *et al.* (2002) advocate for ASD teams to work in collocated rather than dispersed environments. These studies argue that collocated environments have more benefits. The current study findings contrast these arguments in Chapter Four. Pertinent review of related studies, most studies around Agile Software Development teams follow qualitative research designs rather than quantitative or mixed method designs. This observation is important since it brings some validation given that this study also followed a qualitative research design. This study's research design is discussed in detail in Chapter Three.

## 2.8   Deductions from the Literature

Pertinent literature shows that Agile software development teams have successfully adapted to working in dispersed or remote environments by leveraging technology, communication tools, agile principles, and agile frameworks such as SCRUM and Kanban. While traditionally agile teams are co-located, the increasing trend of remote work has required teams to find innovative ways to collaborate and maintain productivity. This study explored how agile teams have managed to work in dispersed environments in various ways summarised below.

   i.   Embracing collaboration tools: Agile software development teams in virtual environments rely heavily on collaboration tools to bridge the distance gap.

Task management tools like Jira and Trello help teams track tasks, progress, and maintain visibility of work underway. Communication tools such as Microsoft Teams and Zoom facilitate real-time communication, virtual meetings, and screen sharing. By leveraging these tools, teams can maintain seamless communication, share information, and collaborate effectively despite physical separation. These tools rely on the internet to operate; thus, a stable internet connection and infrastructure are critical to ensuring interactions that lead to effective collaboration.

ii. Continued practice of agile ceremonies: Agile frameworks such as SCRUM give structure to the agile software development process, making it easier for teams to execute agile. Thus, participating in SCRUM ceremonies such as daily stand-ups, sprint planning, sprint reviews, and retrospectives is crucial for agile software development teams, even in a virtually dispersed environment. In a virtual environment, these ceremonies are facilitated through the use of communication and collaboration tools such as Microsoft Teams. These tools have video conferencing abilities, as such, agile software development teams can still gather virtually, share updates, discuss progress, plan future work. Some of these tools also enable face to face conversation through their video conferencing capabilities. These online tools also allow team members to visually track progress, update task boards, and monitor sprint backlogs.

iii. Clear communication channels: Communication is essential in ASD, thus also critical in dispersed environments. Agile software development teams establish clear communication channels to ensure effective collaboration. This includes defining preferred communication methods, establishing response time expectations, and setting up regular check-ins through the use of agile ceremonies. Teams may also adopt synchronous communication strategies such as voice or video calls, and asynchronous communication strategies such as emails to accommodate different time zones, preferences, and work schedules for globally distributed teams.

iv. Focus on deliverables and accountability: Agile teams working in dispersed environments prioritize deliverables and outcomes. By defining clear sprint goals and tasks, teams can maintain a shared understanding of the work to be done. Individual team members take ownership of their tasks, ensuring accountability and timely delivery. This focus on deliverables helps align the

team's goal orientation and team coordination team's efforts, thus promotes high performance even in remote settings.

v. Continuous Feedback and Adaptation: Agile teams in dispersed environments place a strong emphasis on continuous feedback and adaptation. Regular communication and participation in agile ceremonies among ASD team members allows them to collaborate and provide feedback on work in progress. By embracing an iterative approach and actively seeking feedback, teams can adapt to changing requirements and address any challenges that arise.

vi. Trust and Empowerment: Trust is crucial for ASD teams, especially in a dispersed agile software development environment. Team members need to trust each other's expertise, commitment, and accountability. Agile principles, such as self-organizing teams and servant leadership, empower individuals to take ownership of their work and make decisions. By fostering trust and empowerment, teams can overcome the challenges of physical separation and collaborate effectively. This contributes towards team learning and a development of shared mental models.

vii. Cultivating Team Culture: Agile teams invest in cultivating a strong team culture even in dispersed environments. This means that teams have had to find creative ways of interacting and socializing virtually through virtual team-building activities, and informal foster relationships that create familiarity and trust. Celebrating team successes and recognizing individual contributions are essential for boosting team morale and maintaining a sense of unity and shared purpose and team cohesion.

## 2.9   Chapter Summary

This chapter provided an overview of the theoretical framework of General Systems Theory, the TIPS conceptual framework and a relevant and recent literature review of this study's key concepts relating to Agile Software Development and working in a dispersed environment. Agile software development teams have successfully adapted to dispersed environments by leveraging technology tools, and agile principles. By embracing communication and collaboration tools, conducting virtual ceremonies, establishing clear communication channels, focusing on deliverables, seeking continuous feedback, fostering trust and empowerment, and cultivating team culture; dispersed agile teams can collaborate effectively and deliver high-quality software

solutions despite physical separation. The chapter also dealt and presented brief synopses of systems thinking, technology and tools, innovation, people, and culture, among other factors impacting ASD and related work within organisations. The following chapter delves into the research methodology of this study, beginning with the research design and outlining the sample of participants, the instruments employed for data collection, and data analysis procedures.

# 3 CHAPTER THREE

## RESEARCH METHODOLOGY

### 3.1 Introduction

This chapter discusses the empirical research methodology used to conduct this study. A research methodology describes how knowledge is gained (Mason, 2014). It specifies rules, tools and methods that will be used to collect and analyse data (Žukauskas *et al.*, 2018).

In this study, aspects of the research methodology articulated in this chapter include the research design, research philosophy, sampling, data collection, research methods, data analyses, positionality, trustworthiness, and ethical considerations to answer the research questions. This study aims to answer the main research question: *How do ASD teams apply agile practices within their dynamics in a dispersed environment?*

### 3.2 Research Philosophy

The philosophical underpinning used to conduct of this study was based on a qualitative approach, resulting in an interpretive research philosophy. This implies that the philosophical lens of this study was qualitative in nature including the ontological, epistemological, and axiological stances of the study. Thus ontological, epistemological, and axiological stances used to conduct this were relativist, interpretivist and value-bound in nature.

### 3.3 Research Design

The research design refers to the complete research process starting with defining the problem and questions, collecting, analysing, and interpreting data, and articulating the findings of the research (Cresswell, 2013).

It is a roadmap or a path that a research project will follow. This study was conducted using a qualitative research strategy. Qualitative research consists of multiple designs. Some of the basic qualitative designs include narrative, ethnography, grounded theory, case study and phenomenology (Cresswell, 2013). These designs are briefly discussed below showing why phenomenology was followed over others for this study.

Narrative research is a form of research where the understanding of a society is formulated through listening to and analysing their stories (Wolgemuth & Agosto, 2019). Ethnography is a type of research that focuses of the discovery and documentation of a group's culture (Sharma & Sarkar, 2019).

Grounded theory is a research approach that aims to generate a theory using data which has been collected and analysed (Noble & Mitchell, 2016). A case study is an approach to research that has a detailed and in-depth description and analysis of a real-life single case (Starman, 2013). However, the approaches mentioned in this paragraph will not be used in this. Rather, phenomenology is an approach adopted in this study.

A phenomenological design was found to be the best approach for this study. The reason for adopting this design is because phenomenology is a qualitative research approach in line with what the study had intended to achieve by getting a common understanding. Phenomenological research is an inquiry into what experiences mean to people who have had them (Bliss, 2016). The outcome of a phenomenological study is to identify and articulate the common thread in people's experiences regarding a phenomenon (Creswell, Hanson & Morales, 2007). As such, this design steered the researcher to get a general understanding and meaning that people give to their daily experiences regarding the chosen phenomenon (Bliss, 2016). This easily resonated with the lived experiences of Agile Software Development (ASD) teams working dispersedly.

Phenomenology is divided into transcendental, descriptive phenomenology, and hermeneutic, interpretive phenomenology. Sloan and Bowe (2014) define descriptive phenomenology as finding a link between experiences and how they are experienced to identify the essence of those experiences (Sloan & Bowe, 2014). They further say that interpretive phenomenology focuses on understanding what the meaning of an experience is, thus requiring the researcher to interpret the meaning to understand them (Sloan & Bowe, 2014). These factors made interpretive phenomenology ideal for this study. This was based on the researcher's intention to interpret the study's findings to gain the required understanding of the dynamics that exist when ASD teams work in a dispersed environment.

## 3.4   Sampling

Sampling is defined by Sharma (2017) as a technique the researcher uses to systematically extract a small number of representatives from a population for observation to answer the research questions. There are different ways of determining a sample for a qualitative study, these include 1) convenience sampling, 2) purposive sampling, 3) snowball sampling and 4) theoretical sampling (Lopez & Whitehead, 2013).

In this study, only convenience and snowball sampling were followed. Convenience sampling usually takes place when the participants are easily accessible and are willing to participate in the study. With purposive sampling, a pre-determined criterion is used to select research participants. With a snowball sampling, the researcher(s) start with a small number of participants, who fit the research criteria and are invited to become participants within the research. The agreeable participants are then asked to recommend other contacts who fit the research criteria and who potentially might also be willing participants, who then in turn recommend other potential participants, and so on (Parker & Scott, 2019).

The sample size of 38 participants was conveniently selected from one of the Retail and Commercial banks in South Africa. It is noteworthy that one bank chosen in this study was conveniently sampled as it was accessible to the researcher. This study referred to the chosen bank as SA Retail Bank to safeguard confidentiality. Given the sampling techniques followed in this study, no selection and exclusion criterion were necessary. However, 38 participants were considered to enough in order to generate the necessary data which can adequately answer the research questions of this study.

Of the 38 participants selected at SA Retail Bank, 34 are part of different Agile Software Development (ASD) teams, and 4 are Agile Coaches (AC). The 4 Agile Coaches who participated in the interviews are referred to as AC-1, AC-2, AC-3, and AC-4 in this study. It is important to note that Agile Coaches oversee and guide the ASD team Agile practices, thus, are more knowledgeable, as described in Chapter Two.

It is important to note that in this study, the responsibilities of an AC include engaging leadership on Agile transitioning and reporting on the progress to that effect, training

teams in Agile and SCRUM practices, restructuring teams to ideal sizes, helping teams become high-performing teams, train SCRUM masters on their duties, observe ASD teams, provide feedback to teams and leadership on progress, build rapport and relationships with teams and leadership, let teams improve on their Agile processes, support ongoing team SCRUM practices.

The ASD team consists of members with different titles and roles as mentioned in the earlier chapters in this dissertation. Agile coaches are not members of ASD teams, they are custodians of the agile process within the organisation. These coaches guide agile teams on best practising the methodology within the organisation's context and the different business units. The 34 ASD team members were selected based on their roles.

Of the 34 participants, 4 were Scrum Masters, 14 Analysts, 8 Developers and 8 Testers. As these roles were explained in Chapter Two, it was deemed necessary to balance the selection of participants as described here to provide in-depth data for this study.

In this study, chosen SCRUM Masters' responsibilities included being an extension of the Agile Coach (i.e., Agile expert) by ensuring that teams adhere to Agile and SCRUM practices, ensuring that the team delivers what it is committed to doing by removing impediments; facilitating SCRUM ceremonies; doing team contracting; facilitating interactions between team members, other teams, and stakeholders; encouraging team members to build relationships with one another. Moreover, it is noteworthy that of the 34 participants, Scrum masters were the only participants selected for further data collection since they have more oversight within ASD teams. The SCRUM masters who participated in the interviews are referred to as SM-1, SM-2, SM-3, and SM-4 in this study.

### 3.5 Data Collection

Data collection is a process used to gather the information that enables the researcher to answer the research question(s) (Kabir, 2016). This research study collected data using a questionnaire containing both closed-ended and open-ended questions, and semi-structured interviews. The questionnaire was used first, then followed by interviews to gain an in-depth insight on the outcomes of the questionnaire. Therefore,

the two types of data collection techniques were considered necessary and relevant to answer the research questions of this study.

An questionnaire corroborates and illustrates the participants' responses by providing valuable information (Bird, 2009). It is noteworthy to mention that the open-ended questionnaire was online rather than physical in this study. The questionnaire in this study consisted of 26 questions and was expected to take a maximum of 20 minutes to complete.

Examples of open-ended questions asked are: *"List up to 4 tools you use to enable and enable and support the agile practice while working remotely"* and *"List up to 4 challenges of working remotely"*. Open-ended questions allow participants to provide more answer options, some of the responses may provide unexpected insight (Sierra & Hyman, 2016). The questionnaire used in this study is attached as Appendix A.

Kassu (2019) describes interviews as loosely structured qualitative in-depth dialogue with people who are particularly knowledgeable about the topic of interest. For this study, semi-structured interviews were conducted virtually since participants were working remotely. Semi-structured interviews are usually conducted in a virtual setting, which permits the researcher to seek new insights, ask questions, and assess phenomena from different perspectives while participants are in their comfort places.

Interviews are described as face-to-face conversations with the participant, it has the benefits of observing body language, facial expressions, and other non-verbal communication (Kabir, 2016). During the interviews, open-ended questions ask participants for facts and opinions; this allows for follow-up questions and prompts based on the given answers (Dikko, 2016). This approach was used to collect data from Scrum masters and Agile coaches. The interviews consisted of 22 questions and took an average of 1 hour. Interview questions were asked: "What *agile practices are challenging to execute while working dispersed?*" and "*what changes do you recommend for enhancing agility while working dispersed?*" Interview schedule is attached on the appendices section as Appendix B.

## 3.6   Data Collection Procedure

Firstly, the researcher created an account on a website for an online questionnaire tool. The website used was www.surveymonkey.com. She then generated a

questionnaire on the said online tool. The researcher then asked the participants for their consent to participate in the study. Once they agreed, she sent the questionnaire to 30 of the selected participants who are part of agile software development teams. These participants were made up of 14 Analysts, 8 Developers and 8 Testers. An example of a completed questionnaire is attached as Appendix C. Responses were monitored for about a week as they were updated on the tool. She then generated and downloaded a report using the mentioned online tool.

Once it was collected, data from the questionnaire was analysed, the researcher then selected 8 participants for interviews, these were made up of 4 Agile Coaches and 4 Scrum Masters. All interviews were conducted successfully within a period of two months. They were all conducted virtually using Microsoft Teams. All interviews were recorded with the participants' permission. The screenshot of one virtual interview is attached as Appendix D. The average interview time was one hour, the shortest one took 45 minutes with the longest taking 1.5 hours. Once data has been collected using the chosen tools, it was analysed to derive meaning to answer the research questions and achieve its objectives as described in the next section.

## 3.7   Data Analyses

Data analysis in qualitative research aims to discover themes, patterns, insights, and patterns as they form to create understandings (Newton Suter, 2012). This study employed Saldaña's (2013) code-to-theory analytical model as the analytic tool for qualitative data (see Figure 3.1).
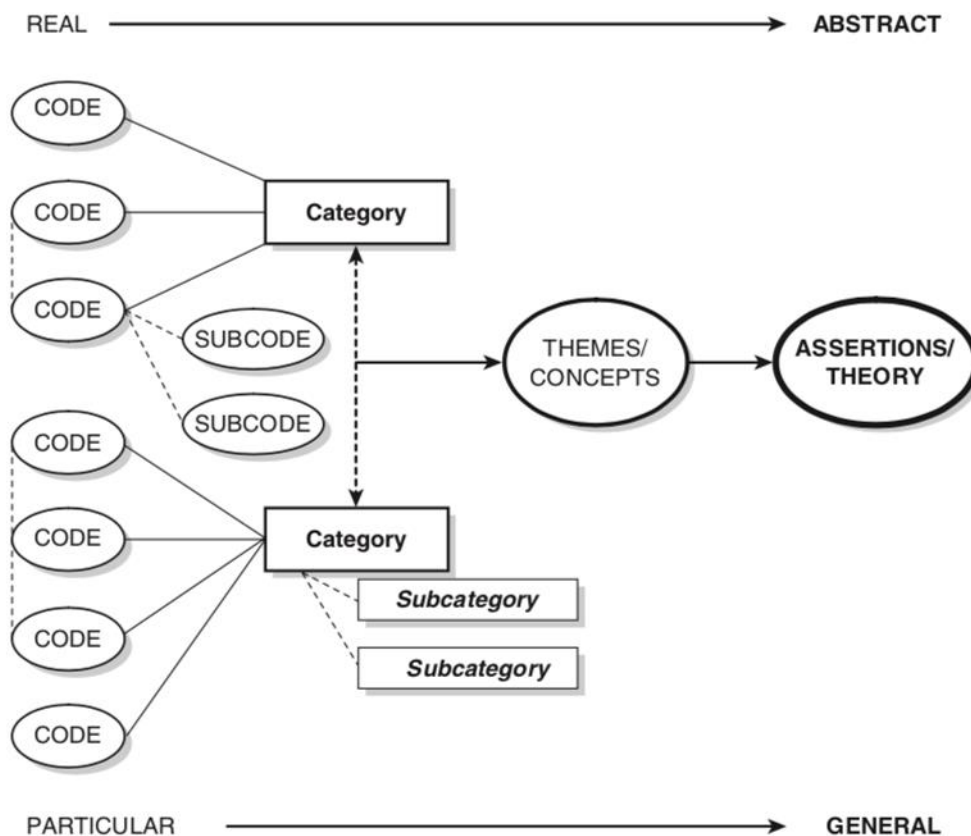
*Figure 3-1 Figure 3.1: Code-to-theory Analytical Model*

(Saldaña, 2013, p. 12)

The Saldaña's (2013) code-to-theory analytical model process shows how codes eventually become themes and finally relate to the study theory. In this study, a questionnaire and interview transcripts were coded by scrutinising each line of text following an inductive approach which "allows research findings to emerge from the frequent, dominant or significant themes inherent in raw data, without the restraints imposed by structured methodologies" (Thomas, 2006). This section presents how data from this study's data collection instruments were analysed.

Firstly, the researcher read and re-read responses on the questionnaire and interview transcripts data and consulted with literature to get their expertise and understand each data set. Then the researcher started with the initial coding of data manually to identify codes. An example of identified codes in one questionnaire is attached as Appendix E. Thirdly, the researcher grouped identified codes into categories, then themes. Finally, the researcher started with a process of writing a project and using these themes to answer the research questions of this study.

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## 3.8 Positionality

Positionality is when a researcher asserts their own position in a desk study, showing how that position may affect aspect of the study, such how data is collected or interpreted (Qin, 2016). According to Olukotun, Mkandawire, Antilla, Alfaifa, and Wetzel (2021), positionality is essential in a qualitative study since there may be relative differences and similarities between the characteristics of the researcher and the participants which might have some implications on the research process. In this study, (Holmes, 2020) principles of positionality were followed, normally identified by positioning the researcher in three areas: the subject under investigation, the research participants, and the research context and process. Regarding the subject under investigation, despite a plethora of research on Agile Software Development (ASD), there is a dearth of studies on how ASD teams work remotely from different physical locations. Therefore, the researcher intended to address this gap. Although the researcher works with some participants, it is worth noting that none report to and are friends with the researcher.

Regarding the research context, this study's data collection was conducted electronically and virtually to ensure professionalism. Furthermore, all data were combined and analysed as described in the preceding section—grouping of interviews and questionnaire responses into themes to reduce possible biases.

## 3.9 Trustworthiness

Trustworthiness is a qualitative research rigour construct referring to the degree of confidence in data, interpretation, and methods used to ensure the quality of a study (Connelly, 2016), To ensure the trustworthiness of this study, the degree of 1) credibility, 2) confirmability, 3) dependability and 4) transferability of collected data to enhance audit trail with regards conclusions and answering the research questions (Shenton, 2004). Credibility refers to the participant's involvement in the study findings to ensure the study results are true or credible (Yilmaz, 2013).

In this study, the researcher undertook a prolonged immersion in the field, checked his interpretations with his participants, and displayed a learning process with the supervisors' help. Dependability refers to the level of consistency of a study over a period (Anney, 2014). In this study, the researcher used the code-recode process to establish dependability. This process was done by initially coding, then coding it again

after about 7 to 14 days and then comparing the findings to see whether they are similar as described in the previous section. Confirmability is the extent to which an outcome of a study can be established and verified by different investigators (Anney, 2014).

The researcher documented detailed accounts of events during the inquiry (Anney, 2014). Lastly, transferability is the extent to which the results of a study can be applied to different situations with different participants (Anney, 2014). To ensure transferability, the researcher followed purposive sampling. The criteria for selecting the study participants were based on the need to fulfil a need within the study related to the research questioned (Anney, 2014).

## 3.10 Ethical Considerations

It is important to protect participants when conducting a research study, this is done by applying the correct ethical principles (Arifin, 2018). This is especially critical in a qualitative study as the process is comprehensive (Arifin, 2018). For this reason, the researcher obtained human research ethics approval from the Da Vinci Institute before embarking on the fieldwork.

An ethical clearance letter from the Da Vinci Institute is attached as Appendix F. Once the committee approval was obtained, the researcher applied for additional ethical measures regarding the participants at the SA Retail Bank. An approval from the SA Retail Bank is attached as Appendix G. After obtaining authorisation from SA Retail Bank, the researcher requested informed consent and voluntary participation agreements from the participants (Arifin, 2018). The participant informed consent is attached labelled as Appendix H.

The three permissions mentioned above were obtained before the commencement of this study. The informed consent and voluntary participation agreement from the participants provided participants with full information regarding the study and required to give a signed consent confirming that they understood the implications of participating in the study (Fleming & Zegwaard, 2018).

The following information regarding the study was provided to the participants as per Fleming and Zegwaard (2018):

i.     The name of the researcher.

ii.    The intent of the research study.

iii.   What data will be collected?

iv.    How the data will be collected.

v.     The commitment required from participants.

vi.    How data collected will be used and reported on.

vii.   The potential risks associated with participating in the research study.

viii.  The signed consent must be given by the participants.

It is noteworthy to mention that participants were further verbally informed that taking part in this study was voluntarily and can withdraw from the study any time should they wish. Furthermore, it was reiterated verbally to the participants that they have a right of access the information as obtained and interpreted.

In addition to these ethical considerations, the researcher assured participants of anonymity and confidentiality as argued by Arifin (2018). Anonymity means the researcher does not know who the participants are (Fleming & Zegwaard, 2018). Confidentiality means the researcher knows the identity of the participants, however, ensure that they remove any data that can identify any participant (Fleming & Zegwaard, 2018).

## 3.11 Chapter Summary

This chapter focused on details regarding the execution of this research study. The research design addressed how the research would be carried out by providing a roadmap. This roadmap was in the form of phenomenology, a qualitative research design. The sample section discussed details regarding the criteria used to select the sample using purposive sampling.

Data collection, analyses and the researcher's positionality were discussed in detail in this chapter. Specific measures regarding trustworthiness were also discussed. Lastly, the researcher specified ethical considerations to be applied, ensuring that the ethical standards within the research domain bind the study. The next chapter proffers the presentation and discussion of findings.

# 4 CHAPTER FOUR

## PRESENTATION AND DISCUSSION OF FINDINGS

## 4.1 Introduction

This chapter presents and discusses findings for the study addressing research questions. The previous chapter outlined the research methodology followed in this study where data collection instruments, a questionnaire and semi-structured interviews were discussed. It is important to note that findings from both data collection instruments are presented concurrently.

Furthermore, findings are presented and discussed simultaneously. The findings are presented in the order of the research sub-questions in Chapter One. Graphs are used to present some on the findings visually to emphasise the different user inputs groupings and disparities between these selections. Finally, this chapter outlines the application of this study's theoretical framework and research philosophy during the discussion sections to interpret the data, followed by the chapter summary.

To particularise the findings presented and discussed in answering the research questions of this study, it was deemed necessary first to present some of the demographic data of the study participants. As mentioned in Chapter Three, the first section of the questionnaire used in this study collected participants' demographic data. It is important to note that the author created all tables and figures in this chapter. Demographic data sets are summarised in Tables 4.1 and 4.2.

*Table 4-2 Demographic Dataset 1 of 2, of participants*

| **Gender** | Female 62% | Male 38% |
|---|---|---|
| **Age** | < 40 79% | 40+ 21% |
| **Children** | Yes 59% | No 41% |
| **Number of years with team** | 0 – 3 69% | 3+ 31% |
| **Number of years with organisation** | 0 – 5 59% | 5+ 41% |

*Table 3 Table 4-2 Demographic Dataset 2 of 2, of participants*

| Gender | Female 37% | Male 63% | |
|---|---|---|---|
| Children | Yes 63% | No 0% | Unknown |
| Number of years with organisation | 0 – 5 50% | 5+ 50% | |

The findings of this study showed that most of the participants who answered the questionnaire were females who made up 62% and fewer males who made up 38% of the participants. These findings are important for identifying whether there are differences between male and female experiences of the phenomenon being investigated in this study.

Another interesting finding was that most (79%) participants were aged below 40, while fewer (21%) were 40 and above. This finding is interesting because it shows that ASD teams mostly comprise youth. Another finding in this study is that 59% of the participants are parents and 41% are not. These findings are necessary to identify any differences in how parents experience the phenomenon vs non-parents.

This study's findings showed that 69% of participants have been part of their respective teams for under 3 years, while the other 31% have been there for over 3 years. These findings indicate that most of the ASD team members are relatively young. This also corroborates with the age findings. This study's findings also showed that a significant number of participants, 59%, had been with the SA Retail Bank for less than 5 years, while fewer (31%) of the participants had between 6 and 10 years, and a lesser number of participants (10%) had more than 10 years.

Since most of the participants are in their youth, it would be surprising if their experience at SA Retail Bank differed from what is presented here. Therefore, these findings provide cognisance to contextualised answering this study's research questions.

The demographic data for interview participants are shown in Table 2. These findings show that 63% of participants were male with 37% female. Regarding parenthood, 63% indicated they had children, and participants volunteered this information during

the interview process. For 37% of the participants, the topic of children never came up. The finding for the number of years in the organisation was interesting; although it's a 50/50 between those who have been in the organisation for under five years and five years plus, 75% of the 50% under five years had previously left the bank and come back.

## 4.2   Research Themes

Themes were derived as part of the data analyses process described in Chapter 3. There was a total of six themes were derived for this project. Figure 3.2 is a representation of the identified themes.
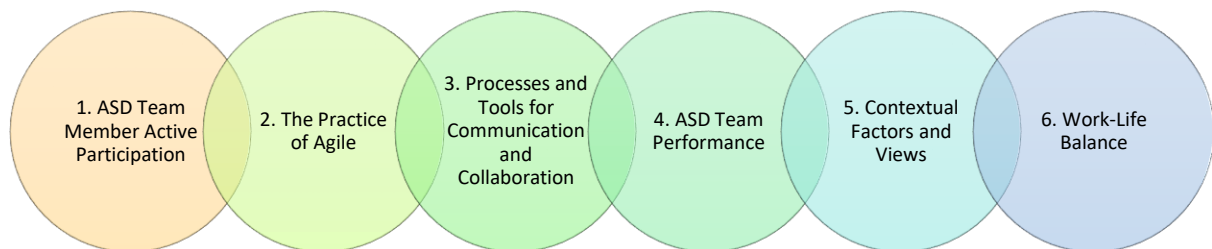


*Figure 4-1   Research Themes for study*

The six themes identified for this study are as follows:

    i.   ASD Team Member Active Participation
    ii.   The Practice of Agile
    iii.   Processes and Tools for Communication and Collaboration
    iv.   ASD Team Performance
    v.   Contextual Factors and Views
    vi.   Work-Life Balance

## 4.3   Research Sub-Question One

What are the dynamics of Agile Software Development teams working in a dispersed environment?

The research findings are presented in themes generated during data analyses. For research sub-question 1, one theme was identified. The theme identified is Agile Software Development (ASD) team members' active participation. This theme may be divided into two sub-themes: communication and collaboration.

### 4.3.1 Agile Software Development Team Members' Active Participation

The ASD team member active participation theme is one of the themes which emerged from the data and was informed by pertinent literature review. This theme aims to answer the first research sub-question related to ASD team dynamics when working in a dispersed environment. Active participation was found to be a critical factor for the dynamics of ASD teams, particularly in communication and collaboration.

As referenced in Chapter two, ASD has gained widespread popularity due to its adaptability and iterative approach. The active participation of ASD team members is recognised as a crucial factor for successful implementation of this methodology. This section explores the concept of active participation in Agile software development teams, highlighting its benefits and impact on project outcomes. It also examines the role of team members in fostering active participation, emphasising the significance of communication, collaboration, and empowerment within the Agile framework. This theme is divided into two sections, namely, i) Communication; and ii) Collaboration.

*i. Communication*

Active participation in Agile software development involves the involvement, commitment, and contribution of team members throughout the project lifecycle. One of the key advantages of active participation is heightened engagement and ownership, leading to improved team morale and motivation. When team members actively participate, they become more invested in the project's success and strive to deliver high-quality outputs as a software product. Moreover, active participation fosters a sense of collective accountability, as team members jointly share responsibility for task progress and outcomes.

However, active participation in Agile teams also presents challenges. One major hurdle is striking a balance between individual contributions and collaboration. While

individual expertise is valuable, Agile values the team's collective intelligence. Team members must find a delicate equilibrium, actively participating while collaborating effectively. Additionally, active participation can be hindered by factors such as workload, conflicting priorities, or unclear roles and responsibilities. Addressing these challenges requires strong leadership, effective task management, and an organisational culture that promotes and supports active participation.

To cultivate active participation, team members must prioritise effective communication and collaboration. Agile methodologies emphasise frequent and transparent communication channels, such as daily stand-ups, planning, and retrospective ceremonies. These practices enable team members to share progress, identify challenges, and seek collective solutions. Fostering a culture of psychological safety promotes an open dialogue, where team members feel at ease expressing ideas and concerns. This inclusivity enhances active participation by encouraging diverse perspectives and creative problem-solving.

Furthermore, empowering team members plays a crucial role in active participation. Agile frameworks promote self-organizing teams, granting autonomy and decision-making authority to individuals. Empowered team members are more likely to actively engage in project activities, contribute innovative ideas, and take ownership of their work. Empowerment can be facilitated by providing necessary resources, encouraging skill development, and recognising individual achievements. However, it is important to maintain a balance between empowerment and accountability to preserve a cohesive team dynamic.

Active participation of team members is vital for successful Agile software development. It enhances engagement, ownership, and accountability, ultimately improving performance. Although challenges exist, effective communication, collaboration, and empowerment can overcome them. Agile teams must strive to foster a culture that encourages and supports active participation, valuing both individual expertise and collective intelligence. By embracing active participation, Agile teams can unlock the full potential of their members and deliver innovative and high-quality software solutions.

The findings of this study from the questionnaire showed that participants' level of participation in virtual Agile ceremonies was generally higher. However, some participants found participation to be rather average. The ASD team members' participation may be average due to fluctuations in the quality of the network connectivity. The findings of this study showed that the quality of the network connectivity, which is vital for ASD teams working in dispersed environments, is not always stable and/or the same for all participants during meetings. However, the findings of this study are similar to those of Whitworth (2006) and Ashmore (2012) in the relevant literature, where the level of participation of ASD teams in Agile ceremonies was also higher. The resemblance of these findings is intriguing, considering the difference in the context of both studies compared to the current study's context.

This study was not able to delve into geographical and structural factors which may contribute the quality of the connectivity as experienced by ASD team member-participants as it not the focus. These findings about the network connectivity, were reiterated during the interviews where AC-2 and AC-4, stated that during their meetings bandwidth could be a challenge in keeping all cameras on during meetings, it sometimes distorts the quality of the meeting. Another aspect that makes video calls a challenge is cost, as per the input from AC-2, experimenting with video calls versus voice during meetings indicated that a video call can cost 10 times more data resources than voice calling. This might be the reason that ASD team members even prefer texting over calling. However, this dynamic violates one of the agile principles mentioned by the Agile Manifesto (2001) and articulated in Chapter Two of this study.

When asked to describe their preferred method of communication during their participation with their ASD teams, more than half of the participants indicated that they preferred texting while the rest preferred voice calling. Interestingly, all the participants clearly preferred mentioned communication methods using Microsoft Teams, a tool provided and recommended by SA Retail Bank. Microsoft Teams is discussed later in detail in this chapter.

These findings regarding participants' preferred method of communication are interesting that texting is preferred over voice calling. This finding could be because

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texting always keeps records which one may always go back to and refer. Alternatively, it could be attributed to the convenience of asynchronous communication, where responses are not necessarily required immediately. Almost all participants mentioned that there is constant and timely communication within their ASD teams throughout the day.

### ii. Collaboration

As mentioned in Chapter One, it is noteworthy to mention that these ASD teams were traditionally collocated. However, since the COVID-19 pandemic, these ASD teams have adapted to virtual work environments, allowing team members to collaborate remotely. In this context, effective collaboration becomes even more critical for achieving success. This study explores the importance of collaboration in virtual agile software development teams, highlighting the benefits it brings, the challenges it poses, and strategies to foster collaboration in a virtual setting.

Collaboration plays a pivotal role in virtual agile software development teams, offering several key benefits. Firstly, collaboration enhances communication and knowledge sharing among team members, ensuring that everyone has access to relevant information and can contribute effectively. It fosters a sense of teamwork and unity, even when team members are physically distant, promoting a shared understanding of project goals and objectives. Furthermore, collaboration facilitates continuous feedback loops, enabling timely adjustments and improvements throughout development. By working collaboratively, team members can leverage their collective strengths and expertise, resulting in higher quality software solutions.

It is equally important to highlight unique challenges caused by working in a dispersed environment with reference to collaboration. One major hurdle is the lack of face-to-face interaction, which can impact team dynamics and interpersonal relationships. Building trust and rapport becomes more challenging when team members are not physically co-located. Additionally, communication barriers, such as time zone differences and language barriers, can hinder effective collaboration, especially in the context of globally dispersed teams. Misinterpretations and misunderstandings are more likely to occur in virtual settings, requiring extra effort to ensure clarity and alignment. Lastly, coordinating and synchronising activities across distributed team

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members can be complex, as it requires efficient coordination of tasks, dependencies, and priorities.

To overcome these challenges and foster effective collaboration in virtual Agile teams, certain strategies can be implemented. Firstly, establishing clear and frequent communication channels is vital. Utilising video conferencing, instant messaging tools, and collaborative platforms can help bridge the gap created by physical distance and enable real-time interactions. Regular virtual meetings, such as daily stand-ups, sprint planning sessions, and grooming sessions, should be scheduled to maintain transparency and alignment.

Secondly, fostering a culture of trust and psychological safety is essential. Team members should feel comfortable expressing their ideas, concerns, and challenges in a virtual environment. Encouraging open and respectful communication ensures that diverse perspectives are heard and valued, leading to better decision-making and problem-solving.

Thirdly, promoting knowledge sharing and documentation is crucial. Virtual Agile teams should have accessible repositories of project documentation, coding standards, and best practices. Encouraging team members to share their knowledge and document their work facilitates collaboration and ensures that information is readily available to all. Moreover, emphasising teamwork and shared accountability can strengthen collaboration in virtual Agile teams. Encouraging a sense of collective ownership and fostering cross-functional collaboration helps break down silos and promotes a collaborative mindset.

Lastly, regular team-building activities and virtual social interactions can help strengthen relationships among team members. Virtual coffee breaks, team lunches, or online games provide opportunities for informal conversations and building personal connections, enhancing collaboration and team cohesion.

In virtual Agile software development teams, collaboration plays a pivotal role in driving project success. Despite the challenges posed by virtual work environments, the benefits of collaboration, such as enhanced communication, knowledge sharing, and

improved decision-making, are significant. By implementing strategies to foster collaboration, such as clear communication channels, trust-building, knowledge sharing, and team-building activities, virtual Agile teams can overcome challenges and maximize their potential for delivering high-quality software solutions.

Therefore, when asked about how working in a dispersed environments may have affected communication within ASD teams, most participants indicated that they can still actively participate with one another.

When asked: "*How does working remotely affect how you communicate with your colleagues and business stakeholders?*" in the questionnaire, more than half of the participants indicated that they mostly used voice to communicate with colleagues and stakeholders. Fewer participants used text-based methods. The remaining fewer participants indicated that they used other communication methods. These other methods combined text and voice-based communication via MS Teams and Emails. None of the participants indicated that they mostly used video-based communication methods. These findings are not surprising as it was anticipated and expected as discussed in Chapter 2.

Regarding collaboration, participants were asked to rank the collaboration methods used within their ASD teams to perform Agile ceremonies. Figure 4.1 outlines those findings.
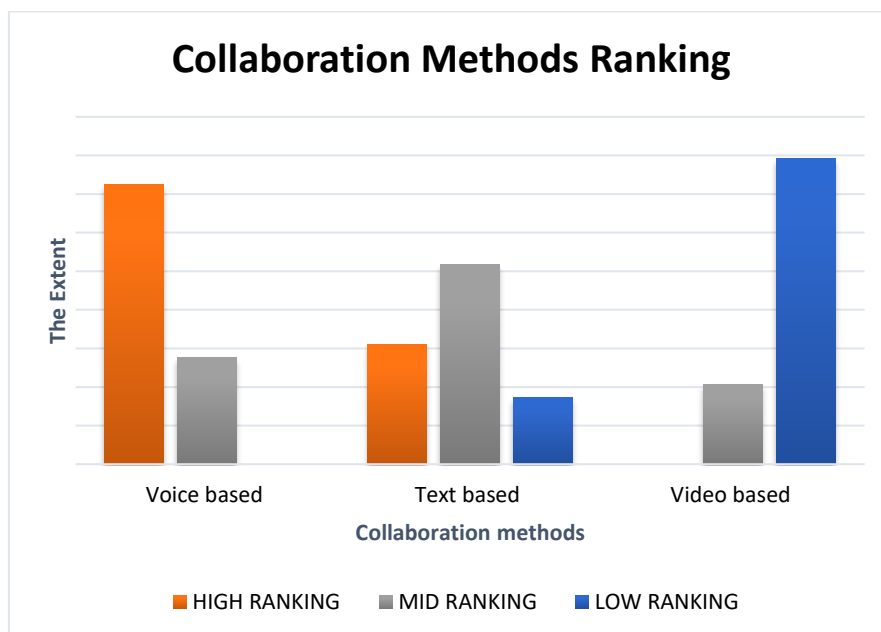


*Figure 4-2 Graph of collaboration methods ranks*

Figure 4.1 illustrates the collaboration methods used by participants, ranked from high to low, including voice, text, and video-based methods. The voice-based collaboration method received a high ranking from many participants, with fewer participants ranking it as medium. Interestingly, no participants ranked the voice-based method as low. Many participants ranked The text-based collaboration method as medium, with fewer participants ranking it as high, and even fewer ranking it as low. Similarly, the video-based method had only two rankings, with a majority of participants ranking it as low and very few ranking it as medium. In contrast to the voice-based method, the video-based method was less preferred.

It is not surprising that voice-based collaboration is widely used by ASD teams, given its high ranking, while video-based collaboration is less favored due to its low ranking. As mentioned earlier in this chapter, network connectivity issues in South Africa, particularly due to load-shedding and infrastructure deficiencies, make text-based collaboration methods critical due to their asynchronous nature. This finding agrees with the assertion made by Charlier *et al.,* (2016) that individuals working in virtual dispersed environments should be skilled in text-based communication.

The study also revealed that most participants indicated finding it easier to work in virtual dispersed environments, while very few participants found it challenging. Despite the challenges faced by a minority of participants, all were asked to mention up to four benefits of working in dispersed environments, and the findings are presented in Figure 4.2.
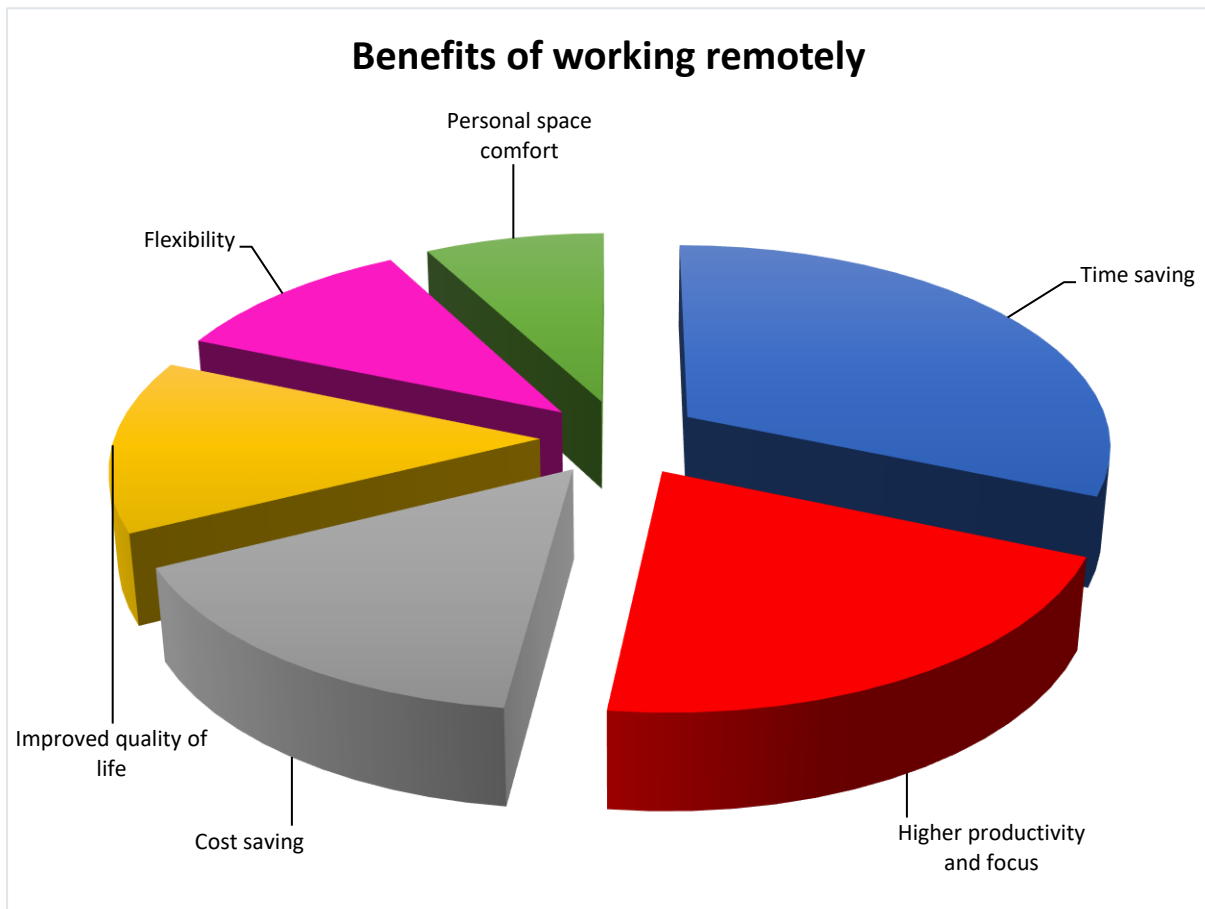
*Figure 4-3 Benefits of working in dispersed environments*

There were 96 data inputs for this question. Some of the benefits from these themes include timesaving. The highest number of participants mentioned that working dispersed is timesaving. This could mean that ASD team members do not have to prepare themselves; and must travel to work and back. It was found that working virtually makes participants highly productivity and focused by fewer participants in the red segment. Other benefits which were mentioned by fewer participants included cost saving, improved quality of life, flexibility, and comfort of working in own personal space. The emergence of virtual work environments has transformed the way Agile software development teams operate. As discussed earlier, virtual ASD teams, where team members work remotely, offer numerous benefits that can enhance productivity, flexibility, and collaboration. Those benefits increased access to talent, improved work-life balance, enhanced productivity, and reduced operational costs.

Virtual Agile teams provide access to a diverse pool of talent from around the globe. By removing geographical constraints, organisations can tap into a wider talent pool and attract top performers, regardless of their physical location. This enables teams to bring together individuals with specialized skills and expertise, fostering innovation and creativity. Access to global talent also promotes diversity within the team, leading to a broader range of perspectives and ideas. The collaboration and knowledge exchange among team members from different cultural backgrounds can result in more robust and comprehensive solutions.

Working remotely in a virtual Agile team allows for greater flexibility and improved work-life balance. Team members have the freedom to structure their work hours to accommodate personal commitments and preferences. This flexibility promotes a healthier work-life integration, reducing stress and burnout. Virtual work eliminates the need for commuting, which saves time and energy that can be redirected towards productive work. Additionally, virtual teams offer the opportunity to work from the comfort of one's preferred environment, enhancing job satisfaction and overall well-being. When team members have a better work-life balance, they are likely to be more engaged, motivated, and productive, leading to improved performance outcomes. This benefit is discussed later in this chapter as it is one of the themes identified.

Virtual Agile teams can experience increased productivity due to several factors. Firstly, remote work reduces interruptions and distractions commonly found in traditional office settings, allowing team members to focus on their tasks without constant disruptions. Moreover, virtual teams can leverage asynchronous communication tools, enabling flexible work hours and ensuring continuous progress even when team members are in different time zones. Collaboration platforms and task management tools further streamline workflows, facilitating seamless communication, task allocation, and progress tracking. Virtual Agile teams can benefit from the "flow" state, where individuals are deeply engaged and immersed in their work, resulting in heightened productivity and efficiency. Additionally, remote work eliminates the limitations of physical office space, enabling teams to scale and adapt quickly to project requirements by seamlessly adding or transitioning team members.

Virtual Agile teams offer cost savings for organisations. Operating remotely eliminates the need for physical office spaces, resulting in reduced expenses related to rent, utilities, and office equipment. Additionally, organisations can save on commuting allowances, travel expenses, and relocation costs for team members. These cost savings can be redirected towards other areas, such as talent acquisition, training, and technology infrastructure, further enhancing the capabilities and effectiveness of the virtual Agile team. Virtual Agile software development teams bring numerous benefits, including access to global talent, improved work-life balance, enhanced productivity, and reduced operational costs. By embracing remote work, organisations can tap into a diverse talent pool, promote work-life integration, boost team performance, and optimize resource allocation. Virtual Agile teams represent a compelling approach for organisations seeking flexibility, collaboration, and innovation in their software development processes.

During the interviews, when asked about how the bank ensures adequate execution of duties while working from home, SM-1 responded, "Adopting and respecting the process, buy-in/understanding of the importance of the process by stakeholders." This response indicates that SA Retail Bank ensures that agile software development teams are aware of and respect the agile processes, as discussed in Chapter Two. It can be argued that by adopting and respecting the agile process, agile software development team members are more likely to participate actively and effectively.

In response to the same interview question, SM-4 mentioned, "Different work campuses are accessible to work from by staff who are unable to work from home, no restrictions of campuses, employees can go to whichever is convenient. Rules that govern working remotely: less or no meetings on Wednesdays; No meetings on Friday after 3 PM; No meetings during the lunch hour (12 to 1 PM). Working within a certain common time frame so that there's synchronization within the team and availability of people. It is discouraged to have meetings or any kinds of sessions other than emergencies after 5 PM."

From SM-4's response, the study found that SA Retail Bank provides ASD team members with spaces that allow them to adhere to agile processes. This approach is encouraged for members who might not be able to actively participate within their ASD teams. SM-4's response shows that the bank allows for flexibility to respect agile processes and facilitate effective remote work for the team members.

Figure 4.3 below outlines additional support required to mitigate dynamics of working dispersed.
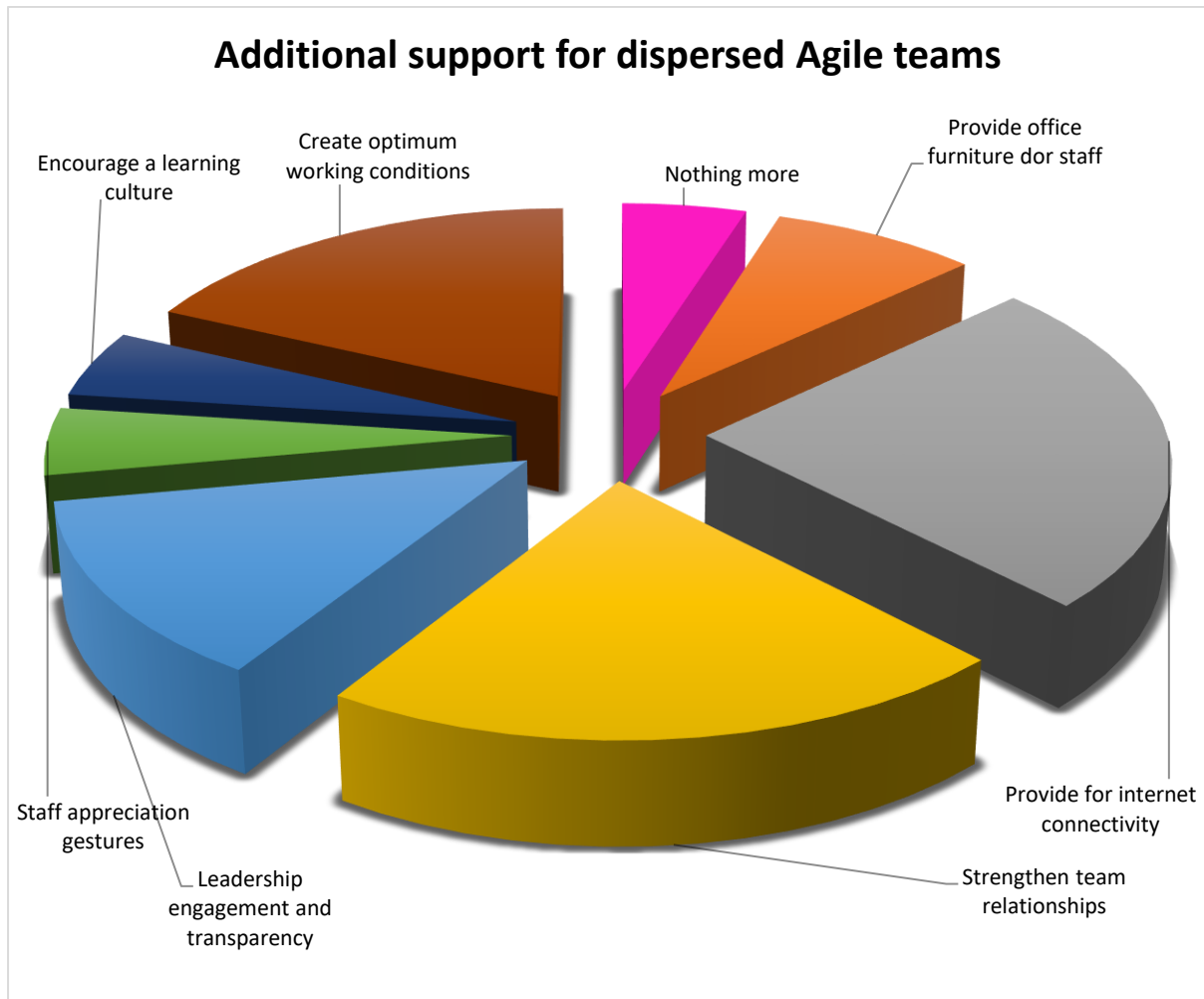


*Figure 4-4 Required support in dispersed environments.*

Figure 4.3 presents the findings of this study regarding the kind of support required to mitigate the challenges of working in a dispersed environment. The most significant support required by most ASD team members is the provision of stable internet connectivity, where the bank covers the costs. Fewer participants believe that SA Retail Bank should have structures and/or policies that enable teams to strengthen their relationships through regular interactions and engagements, such as team-building activities. Much fewer ASD team participants would like leadership to create optimum working conditions, including enabling flexibility, among other things. They also appreciate leadership engaging with them more often and enabling a safe and

transparent environment that encourages communication and honesty. Some participants request the bank to provide them with office furniture, for leadership to encourage a learning culture and show staff appreciation through gestures. However, some participants are of the opinion that the bank has already provided everything required to enable and support agile teams working in a dispersed manner.

In attempting to answer research sub-question 1 based on the findings presented in this section, the study's results, supported by relevant literature review, show that ASD teams working in a dispersed environment face unique dynamics that can impact their collaboration and performance. These dynamics can be summarised as follows:

Communication Barriers: Dispersed teams encounter communication barriers due to physical distance, relying on technology for communication, collaboration, and building relationships. This can lead to delays in information sharing, misinterpretations, and difficulties in maintaining a common understanding.

Task Coordination: Collaborating and coordinating tasks among dispersed team members can be complex. Synchronizing activities, managing dependencies, and ensuring alignment require effective coordination and collaboration tools. Clear roles, responsibilities, and task ownership are essential to maintain a cohesive workflow.

Trust Building: Building trust and rapport among team members becomes more challenging in a dispersed environment. Face-to-face interactions are limited, making it crucial to establish virtual relationships and foster a sense of teamwork. Regular virtual team-building activities, open communication, and transparent decision-making can help build trust and strengthen team dynamics.

Autonomy and Self-Organisation: Dispersed Agile teams often benefit from a higher level of autonomy and self-organisation. Team members are empowered to make decisions and take ownership of their work. This autonomy allows individuals to adapt their work processes to suit their preferences and work effectively in their respective environments.

Technological Infrastructure: Having a reliable and secure technological infrastructure is essential for dispersed Agile teams. Access to collaboration tools, project management platforms, and video conferencing software is crucial for effective communication, task management, and progress tracking.

Cultural Diversity: Dispersed teams may consist of members from different cultural backgrounds and language proficiency levels. This diversity can bring valuable perspectives but also requires awareness and sensitivity to cultural differences. Clear communication, active listening, and patience are necessary to overcome potential misunderstandings.

To navigate these dynamics, a proactive approach from both team members and leadership is required. Effective communication, collaboration tools, trust-building initiatives, and a focus on continuous improvement are essential to overcome the challenges and maximize the potential of dispersed ASD teams. Regular retrospectives and feedback loops allow teams to reflect on their work processes, identify areas for improvement, and implement changes that optimize their performance in a dispersed environment.

## 4.4   Research Sub-Question Two

Which processes and tools assist Agile Software Development teams working in a dispersed environment?

To answer this research sub-question, two themes were identified. These themes are The Practice of Agile and Processes and tools for communication and collaboration. It is worth noting that these ASD teams use the SCRUM framework. The SCRUM framework is described in Chapter Two.

### 4.4.1   The Practice of Agile

The Practice of Agile was identified as a theme during the Data Analyses process as described in Chapter Three. It is important to mention that the Practice of Agile was touched on in this study's theoretical framework of General Systems Theory and the pertinent literature in Chapter Two. This theme refers to the application of agile principles and SCRUM practices by ASD teams.  To briefly elucidate on this theme, practice of agile allows for adaptation such that requirements can be changed and incremental value to stakeholders can be delivered. The iterative nature of Agile allows for regular feedback and course corrections, leading to faster delivery of working software. Agile emphasises collaboration, communication, and self-organisation

promotes a sense of ownership and engagement among team members, leading to increased productivity and motivation.

However, it is important to be cognisant that Agile practice is not without challenges. One criticism is the potential lack of upfront planning and documentation, which can lead to uncertainty and difficulty in managing complex projects. Agile focuses on delivering quickly can sometimes sacrifice long-term strategic planning and architectural considerations. Another concern is the scalability of Agile practices to large projects and distributed teams. While Agile works well in small, co-located teams, scaling Agile to accommodate larger projects or teams spread across different locations can pose challenges. Coordinating and synchronising activities, maintaining consistent communication, and managing dependencies become more complex in such scenarios. Furthermore, Agile emphasises flexibility and adaptability can lead to scope creep and frequent changes, potentially impacting project timelines and budgets. The need for continuous feedback and involvement from stakeholders can be demanding, requiring their active participation and availability throughout the project.

Nonetheless, the practice of agile offers numerous benefits in terms of flexibility, collaboration, and delivering value incrementally. However, it is crucial to critically evaluate its suitability for specific project contexts and consider the potential challenges related to planning, scalability, and stakeholder management. A balanced and informed approach that incorporates Agile principles while addressing its limitations is essential for successful implementation.

For the Practice of Agile theme, participants were asked which agile ceremonies they perform within their respective teams using virtual tools as prescribed. Stand-up was found to be mentioned by all the participants while retrospectives were the least performed in comparison with other ceremonies. Figure 4.4 shows each agile ceremony performed and the extent at which is performed across the different teams.
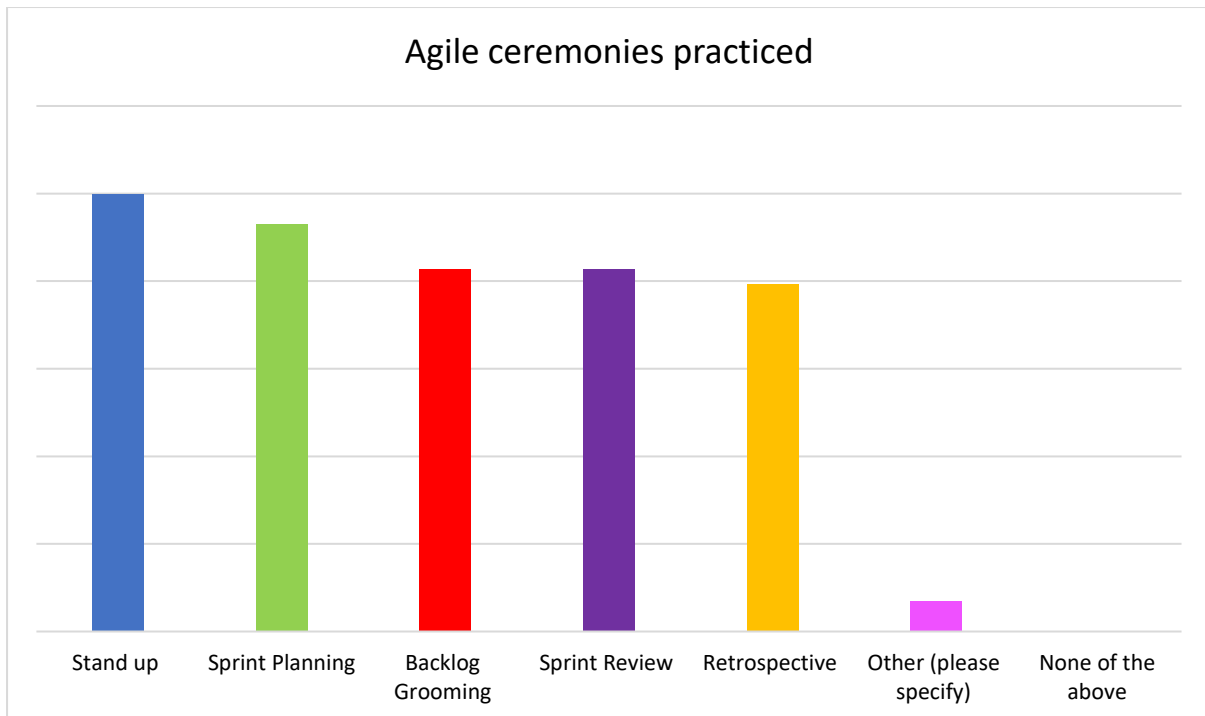
*Figure 4-5 Agile ceremonies practiced.*

Figure 4.4 illustrates that all participants indicated that their teams held stand-up meetings, which is a common Agile ceremony. However, other ceremonies following the SCRUM methodology were not consistently practiced by all teams. The most practiced Agile ceremonies, which are attended by almost all ASD team member-participants, include sprint planning, backlog grooming, and retrospectives in their teams. Fewer participants mentioned participating in other ceremonies not listed in the SCRUM framework, such as JAD (Joint Application Development) sessions and war rooms. These findings indicate that while stand-up meetings are widely adopted, other SCRUM ceremonies may vary in their implementation across different ASD teams.

During interviews, participants were asked *Which agile ceremonies are held using a video call in your ASD teams?*

AC-2 and AC-4 answered that they use video calls for agile ceremonies. AC-4 added stating that in his ASD teams, there is a rule that when speaking camera must be on. AC-1 said that they rarely use video calls, although some teams do it once a week. A similar finding was found in AC-3's response who mentioned that ASD team members do not want to switch on their cameras. Interestingly, SM-1, SM-2, SM-3, and SM-4 mentioned that they use video calls for the Retrospective agile ceremony.

Another interesting finding is by AC-1 who said video calls are distracting, while SM-4 said video calls help members to focus. This finding is interesting because AC-1 and SM-4 contradict each other. It is not clear why AC-1 would find video calls distracting while face-to-face interactions are one of the principles of agile software development.

The findings indicated varying levels of compliance in adhering to SCRUM ceremonies by ASD teams. Most of the of team members comply with SCRUM ceremonies completely, while fewer of ASD teams indicated that their team's default on some of the SCRUM ceremonies. In addition, a small percentage of teams practice other non-standard scrum ceremonies such as JAD sessions and War rooms. It is not clear from the research data how these other ceremonies contribute towards the application of agile software development.

The findings indicated varying levels of compliance in adhering to SCRUM ceremonies by ASD teams. 79,3% of teams comply with 100% of SCRUM ceremonies, while 20,7% of ASD teams default on some. In addition, a small percentage of teams practice other non-standard scrum ceremonies such as JAD sessions and War rooms. It is not clear from the research data how these other ceremonies contribute towards the application of Agile.

The interview findings corroborate with the questionnaire regarding the official SCRUM ceremonies practised by the ASD teams. The findings indicate backlog grooming, sprint planning, retrospective, stand up and ASD teams perform sprint review ceremonies.

In general, the process followed by Agile Coaches includes training teams in the fundamentals of ASD using the SCRUM framework, structuring teams to ideal sizes where possible, Training SCRUM masters, work with the teams to constantly improve their application of Agile.

The ASD teams follow the SCRUM ASD described and illustrated in Chapter Two. For example, before a sprint, the team must agree on what work will be done during the sprint, in addition, daily stand-ups are held during the sprint to report on progress.

Other ceremonies like planning, grooming, print review and retrospectives are held once off at some point during the sprint. This aligns with the Agile process described in Chapter Two. Most interview participants indicated that at least one ceremony is held with video switched on to mimic a face-to-face scenario.

The findings in this regard have indicated that ASD was still at an adoption stage for some of the teams within the bank. There seem to be some teething problems with some of the teams. For example, one of the Agile Coaches mentioned that some team members struggle to shift their mindsets to the Agile way of doing things. This may explain why some ASD teams skip some of the ceremonies.

For the enabling tools, the questionnaire participants were asked to list tools that enable and support Agile practice while working from home. The findings of this study regarding tools can be seen in Figure 4.5 in Word Cloud.



*Figure 4-6 Word cloud of Agile Tools*

    i.    Microsoft Teams – Teams for communication, collaboration and sharing files,

    ii.    Jira – Used for task management,

    iii.    Confluence – Used as a document repository,

    iv.    Bitbucket – used by developers as a repository for code, and

email – one of the oldest tools, used for communication.

Findings from the questionnaire show that all participants are of a view that the resources which are at their disposal (see Figure 4.5) are sufficient.

During interviews, all the Scrum Masters (SM-1, SM-2, SM-3, and SM-4) and two Agile Coaches (AC-2 and AC-4) equally agreed that the tools provided by the bank are sufficient. However, AC-1 and AC-3 believe that the tools provided by the company are insufficient. Both AC-1 and AC-3 mentioned that there are more efficient tools such as Miro, which the bank may provide to work effectively in dispersed environments.

Unsurprisingly, these Agile Coaches' views differ from those of other participants. As mentioned in Chapter Two and Chapter Three, Agile Coaches are the most knowledgeable others – experts.  The next section answers the research sub-question 2 using the second theme which was identified.

### 4.4.2  Processes and Tools for Communication and Collaboration

The theme of processes and tools for communication and collaboration while working in a dispersed environment. As mentioned earlier, in the current chapter, communication and collaboration are fundamental aspects of agile software development, enabling ASD teams to work efficiently and effectively. While agile software development emphasises individuals and interactions over processes and tools, it still provides a range of processes and tools to facilitate communication and collaboration. However, it is crucial to briefly touch on those processes and tools to ensure they align with the team's needs and promote successful outcomes and high performance.

One widely adopted process in agile software development is the daily stand-up or daily scrum meeting. While these short meetings provide an opportunity for team members to share updates and address any roadblocks, they can sometimes become routine and lose their value. It is important to ensure that these meetings remain focused, relevant, and encourage open communication rather than becoming mere status updates. Collaboration tools play a vital role in agile software development,

especially in dispersed or remote teams. Tools such as task management applications such as Jira, version control applications such as bamboo, and virtual communication platforms such as Microsoft Teams enable agile software development teams to collaborate on tasks, track progress, and share knowledge. However, the choice and implementation of these tools must be carefully considered. Over-reliance on tools can lead to information overload, increased complexity, and hinder face-to-face interactions and relationship building between team members. It is essential to strike a balance between using tools to enhance collaboration and maintaining personal connections and direct communication within the team.

Another critical aspect of communication in Agile is feedback mechanisms. Processes such as sprint reviews, retrospectives, and user feedback loops are designed to gather input and insights from stakeholders. However, it is important to ensure that these feedback mechanisms are structured, actionable, and consistently incorporated into the development process. Simply gathering feedback without taking appropriate action can lead to a lack of trust and disillusionment among stakeholders. Additionally, the choice of communication channels should be evaluated critically. While instant messaging and email are commonly used, they may not always be the most effective means of communication. Face-to-face or video conferencing interactions allow for nuanced discussions and better understanding among team members. Balancing synchronous and asynchronous communication channels is important to accommodate different user preferences and flexibility while still promoting real-time collaboration.

While Agile provides processes and tools for communication and collaboration, they should be critically evaluated to ensure they align with the team's needs and promote effective communication. It is important to strike a balance between structured processes and the flexibility to adapt and experiment with communication approaches. Regular reflection and adjustments are necessary to optimize communication and collaboration within Agile software development teams.

In the questionnaire, participants were asked *"How can agility be improved in a virtual setting?"* Highlights of findings from this questionnaire are outlined in Figure 4.6.

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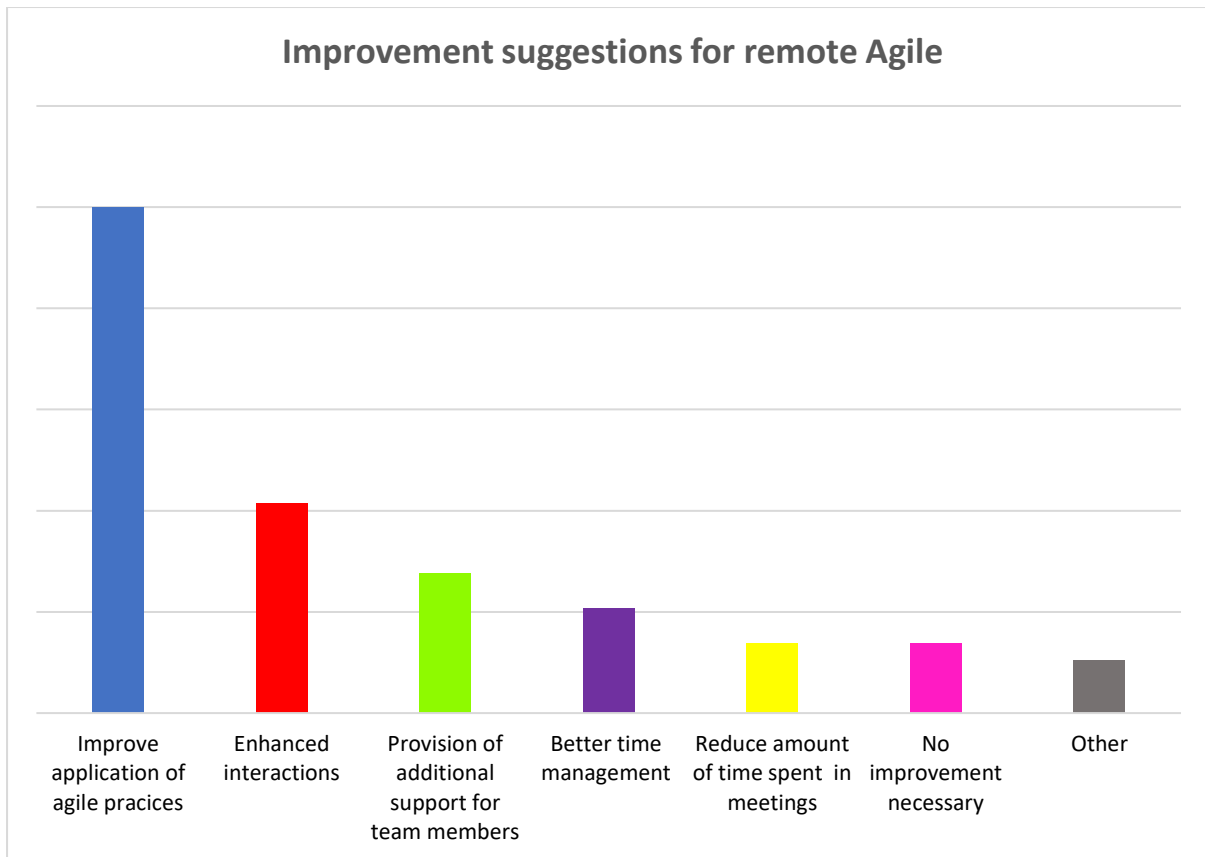
*Figure 4-7 Improvement suggestions for the remote Agility*

To enhance agile in a remote environment, all participants indicated the need for applying agile methodology practices to be improved in general and most of the participants indicated that interactions between people needed to be enhanced. Fewer participants indicated that they required additional support from their organisational leadership. Almost the same number of participants indicated that better time management is required; that they would have liked the amount of time spent in meetings to be reduced; some believe that no improvements were necessary; and the rest suggested that other non-specified improvements were necessary for an enhanced remote agile environment. These findings are contradictory where equal number of participants are of the opinion that some improvements are needed, yet other are of the opinion that no improvements are needed. These might be due different team cultures and maybe belonging different department. Nonetheless, it is this study's argument that improvements are always necessary since technology grows rapidly, in addition, the agile software development methodology encourages constant improvement to create high performing ASD teams.

When asked whether these tools were sufficient to enable and support the practice of Agile in a dispersed environment. All 100% of questionnaire participants agreed, which indicated that the organisational leadership had provided sufficient support to enable ASD teams to work from home.

On the surface the core ASD team (analysts, developers, and testers) seem content with the tools provided, however, when asked how ASD can be improved, they indicated a need for additional tools which ties in with the need indicated by some of the interviewees.

The combined data indicated a need for alternative communication platforms to use as a backup in case the primary ones fail. All communication tools the organisation provides require internet connectivity, as observed by the researcher load-shedding hurts internet connectivity in South Africa.

It was indicated that some employees had an internet and UPS solution provided by the organisation, however, some employees had not taken it up as it was generic and lacked the flexibility to suit different employee preferences. Some participants indicated a need for additional physical tools such as office chairs, desks, monitors, and uninterruptable power supply (UPS) devices.

This finding indicates that the tools provided by the organisation were sufficient to enable ASD teams to work in a dispersed environment and most of the team is satisfied. It is worth noting that other collaboration tools were being tested for suitability according to some of the interview participants. With everything taken into consideration, there is room for improvement based on the points raised by some participants. The existing tools are the inputs to the ASD system, the tools used within the system which in return provide output based on the team experience. Based on this output, the tools require improvement to better suit the dispersed environment.

When asked "*How does the bank ensure that you can adequately execute your duties while working from home?*" during the interviews, it was found that SA Retail Bank ensures that ASD team members are provided with collaboration tools such as MS Teams, MS Office suite and Atlassian suite. Some participants are provided internet data for connection and server access via VPN. These findings were reiterated by all the participants interviewed.

*Are there any agile processes which are challenging to execute when working dispersed?*

In answering this interview question, three of four Agile Coaches (AC-2, AC-3, and AC-4) and all four Scrum masters said there are challenges with agile processes: sprint planning, sprint review and retrospective. AC-2 further highlighted that it is challenging to train ASD team members on agile processes when working dispersed. To SM-2, there is a challenge in value sessions when forming a new team. AC-1 on the other hand, said there are no agile processes that are challenging to execute when working dispersed. However, AC-1 mentioned that issues arising require positive responses and support from leadership to adjust.

Findings presented and discussed in this section answered the research sub-question 2 by showing that working in a dispersed environment, ASD teams rely on various processes and tools to facilitate effective collaboration and communication; and adhering to the agile principles. These processes and tools play a crucial role in ensuring that dispersed teams can work together seamlessly. These processes are implemented by through the use SCRUM as an agile framework. One of these key processes the daily stand-up meetings or daily scrums which is conducted virtually via the use of a collaboration and communication tool such as Microsoft Teams. These short, focused meetings enable team members to provide updates, discuss roadblocks, and maintain alignment. By leveraging video conferencing tools, dispersed teams can maintain face-to-face interactions and foster a sense of connection. Collaboration tools are also essential for dispersed Agile teams. Task management software, version control systems, and virtual communication platforms enable teams to collaborate on tasks, track progress, and share information in real-time. These tools facilitate transparency, task allocation, and progress tracking,

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ensuring that team members can work synchronously and stay informed about project status.

Furthermore, asynchronous communication tools, such as instant messaging platforms such as Microsoft Teams and email, allow team members to communicate and collaborate on their own schedules, which enables flexibility. This flexibility ensures that work can continue smoothly despite geographical separation. Additionally, video conferencing and screen-sharing tools enable effective virtual meetings, including sprint planning sessions, retrospectives, and stakeholder feedback sessions. These tools facilitate real-time discussions, brainstorming, and visual presentations, enhancing collaboration and decision-making within dispersed teams. Virtual daily stand-ups, collaboration tools, asynchronous communication channels, and video conferencing/screen-sharing tools are vital for supporting agile software development teams in dispersed environments. These processes and tools promote effective collaboration, communication, and coordination, enabling dispersed teams to work together cohesively and deliver successful outcomes. Thus, contributing positively to team performance.

## 4.5  Research Sub-Question Three

How is the delivery performance of Agile Software Development team in a dispersed environment?

In answering this research question, three themes were identified: Agile Software Development (ASD) team performance, contextual factors and views, and work-life balance.

### 4.5.1  Agile Software Development Team Performance

Agile software development teams working remotely can exhibit a range of performance dynamics. While remote work offers flexibility and the potential for increased productivity, it also presents challenges that can impact team performance. While remote, agile software development teams have the potential for high performance, addressing communication, collaboration, trust, and productivity challenges is critical. By leveraging appropriate processes, tools, and management

techniques, remote Agile teams can achieve optimal performance and deliver successful outcomes as discussed under Research sub-questions 1 and 2. This theme was informed by collected data and pertinent literature review done in Chapter Two. Team performance is a derivative of five propositions, namely, team coordination, goal orientation, team cohesion, shared mental models and team learning. Therefore, it is important to note that these propositions guide this theme and extend to other themes.

When asked to rate the participation of members in virtual Agile ceremonies within their ASD teams, more than half of the participants stated that participation was at a higher level. Different SCRUM ceremonies contribute towards the five propositions of the team performance model as articulated in Chapter Two in Table 2.1 by Dingsoyr, Faegri, Dyba, Haugset and Lindsjorn (2016). Thus, high participation in SCRUM ceremonies enhances ASD teams' performance. This finding stood out since performing in ASD teams requires team coordination, team learning shared mental models, team learning and goal orientation; the five performance propositions by Dingsoyr *et al.,* (2016).

*When asked "How does the bank ensure that you can adequately execute your duties while working from home*?" during the interviews:

AC-1 said the bank ensures ASD team members are responsible, visible, and accountable. It is important to note that SM-2 shares the same sentiments regarding accountability and responsibility for oneself to ensure performance. AC-1 added, "These principles are suitable for remote working, so they are central to both physical and remote environment approaches. Focus is on output within reason."
Responding to the same interview question, AC-4 said there was an opportunity to attend remote coaching and facilitation training.

On an interview question of "What are some of the benefits to agility that have been realised through of working dispersed?" AC-1's response highlighted that working dispersed has resulted in a balanced lifestyle between home and work as these can happen concurrently.

According to AC-1, people are more available, and the flexibility benefits the people and the business as people are much happier. This finding relates to well-being, which also relates to the next theme for the research sub-question 3. AC-2 said that the benefit of working dispersed is that it has taken the need for colocation away, as such, people can participate in the process wherever they may be. It has equalised the environment for remote workers; some teams have members in India (a more inclusive way of working). Working dispersed has allowed flexibility into people's lives, encouraging work-life balance. According to AC-3, team members are mostly on time online, making it easier to work dispersed. AC-4, on the other hand, referred to the following as benefits: lowering travelling costs – fuel; ability to chat to everyone; executive management being more approachable and easier to access; and that most team members are comfortable reaching out a bit more often.

While responding to the preceding interview question, SM-1 responded, "Working in a dispersed environment makes it easier to move between meetings, unlike in a physical building where a meeting room requires more effort. *Productivity went up. People are happier as they manage themselves. Gave people more freedom and increased trust, aligning with some core values and Agile principles."* SM-2 said that a dispersed environment brings a better quality of life and more time at one's disposal since time spent commuting to the office is saved and can be used to exercise.

There are also financial benefits as you don't have to buy office clothes or spend on fuel to travel to the office. There is time to plan the week ahead which reduces anxiety. SM-3 appreciated not having to wake up early and do more work; people go the extra mile without being asked, saving on fuel costs. These findings show that team members do more than expected when working dispersed, thus, resulting in higher performance.

The finding about fuel saving is interesting as AC-4 also mentioned it. It can be argued that team members appreciate saving money and may be shared mental models. Thus, improving the team's performance. SM-4 likes that working dispersed for the benefit of flexibility such that both personal and work-related matters can be attended to. The next section delves into the theme of contextual factors and views of participants as this may contribute to the team's performance.

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### 4.5.2 Contextual Factors and Views

It is apparent that a performance of ASD teams working remotely is influenced by various contextual factors and can be subject to different views within various financial institutions, particularly retail and commercial banks. Contextual factors such as organisational culture, technology infrastructure, leadership support, team dynamics, performance measurement, and employee well-being all influence the perception and effectiveness of remote Agile software development team performance. Considering these factors and embracing remote work's unique opportunities and challenges can contribute to successful outcomes for remote agile software development teams. Participants in this study were asked to state any disruptions in their physical work environments that may influence their productivity. This study found that participants generally do not have any disruptions that may influence their productivity. Fewer participants highlighted that there might be minor disruptions. However, they do not necessarily affect their productivity. These findings are outlined in Figure 4.7.
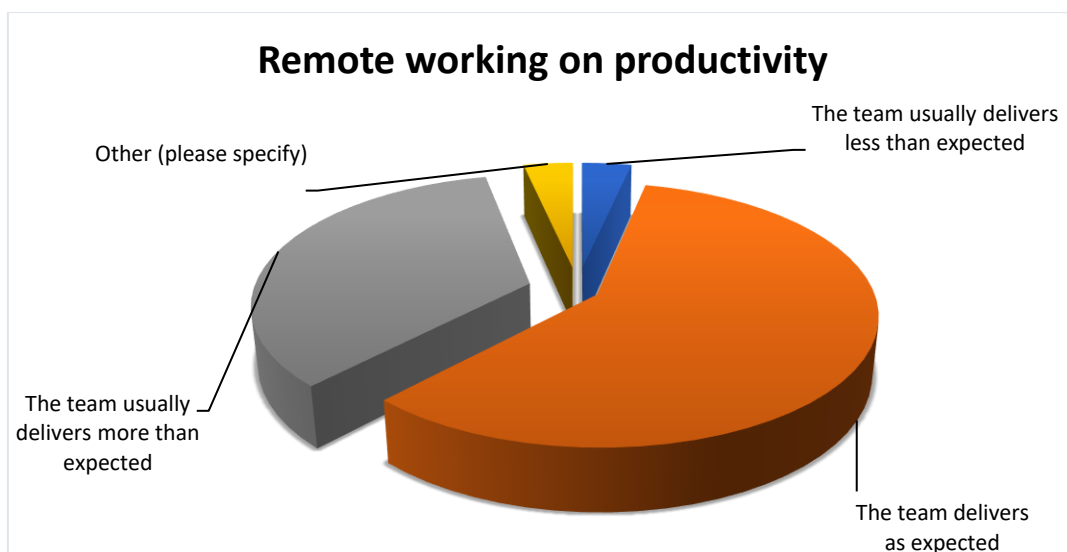


*Figure 4-8 Improvement suggestions for the remote Agility*

Most of the participants stated that the overall productivity of their teams remained unchanged when working remotely compared to when working together in a physical location. This indicates that working from home did not hurt team performance. Additionally, fewer of the participants reported that their teams exceeded expectations

regarding productivity while working remotely. This finding suggests that performance has improved for a significant portion of teams under remote work conditions.

Lesser participants indicated that their teams delivered less than expected. Consequently, this finding implies that performance may have decreased for some teams. An equal number of participants indicated that there were too many meetings as a result of working virtually. However, these participants did not elaborate on how this affects their teams' overall productivity. Thus, making it difficult to interpret this finding.

*What communication challenges are the teams experiencing due to working dispersed?*

AC-1 and SM-2 stated that there are no communication challenges due to working dispersed since some team members were already working from other countries such as India. This finding shows that working dispersed was already partially in place for some teams. Therefore, it can be argued that there are no communication challenges that can hinder the team performance. AC-2, AC-4 and SM-1 said that there was a lack of physical human interaction and body language. He added by saying people mute, switch off cameras, and do not engage in meetings, particularly in meetings with a bigger audience.

AC-3 said: *"People are sometimes distracted, therefore don't pay proper attention. This is worsened by the fact that their cameras are off and facial expression does not come through."* Responses by SM-3 and SM-4 reiterated the same challenges which included load shedding (power outages). Taking naps during the day, some people take advantage. People are not transparent regarding their activities. People disappear without informing anyone. Struggling to find people. There are many different teams to collaborate with, there is usually a communication breakdown as teams are not proactive in keeping other teams in the loop about arising matters until they are asked."

These factors indicate that there is time lost trying to clarify what is being discussed by the lack of non-verbal communication queues. Time is also lost when power outages happen as the prevent communication from taking place. Lastly time is lost

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when matters are not dealt with because dependent people are not reachable at the time of enquiry. Essentially time that could be used productively is lost, thus impeding on performance.

*What collaboration challenges are the teams experiencing due to working dispersed?*

AC-1 said there are no challenges, he further stated that collaboration is easy and quick using Teams versus time wasted locating and finding available physical meeting rooms. Relevance of reporting this finding may be questionable since AC-1 said that there are no challenges. However, given the nature of the situation, it is the argument of this study that there challenges experienced by AC-1 are handled different due to AC-1 having more experience as an agile coach.

AC-2 said team sizes can present a challenge and should rather be reduced to ensure attentiveness. AC-2 further mentioned that some people work much longer hours, they don't know how to stop. This finding is interesting because it was mentioned earlier by SM-2, who rather saw it as a benefit. However, this study is cognisant that working longer hours may also be a challenge to some. Nonetheless, this implies that there is increase in performance. AC-3 said people do not speak up in virtual sessions when they are uncertain or confused.  AC-3 argues that lack of communication results in lack of collaboration. This can decrease performance.

Challenges mentioned by SM-3 include team members not being available to collaborate with others. When there are power issues, people are expected to go to any of the nearby company campuses where they can be able to connect and continue with work. This can result in losing time for working, which may result in poor performance for the team.

According to SM-4: *"When people are required in a working session and some excuse themselves for several minutes, it is never clear whether they are not taking part or whether their absence is work related or not. Another challenge is the lack of other stakeholders in working session, i.e., Architects, which are difficult to get hold of them due to availability. Other challenges include lack of acknowledgement of meeting invitations, and/or people not responding to whether they are able to attend a session*
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*or not; and lack of feedback and assistance from external teams which requires one to constantly make a follow up."*

This response indicates uncertainty and poor work ethic withing ASD teams. These may decrease team cohesion, team coordination and shared mental models. Thus, decrease team performance. The next section deals with a theme of work-life balance.

### 4.5.3  Work-life Balance

As one of the themes in this study, work-life balance refers to participants ability to balance personal life and work life. The work-life balance of Agile Software Development teams working remotely is a critical aspect to consider. While remote work offers flexibility and autonomy, it also brings challenges that can impact work-life balance. A balanced work-life is arguably important for a better performance.

Participants were asked how working remotely influenced their work-life balance. Figure 4.8 gives a perspective of the findings.
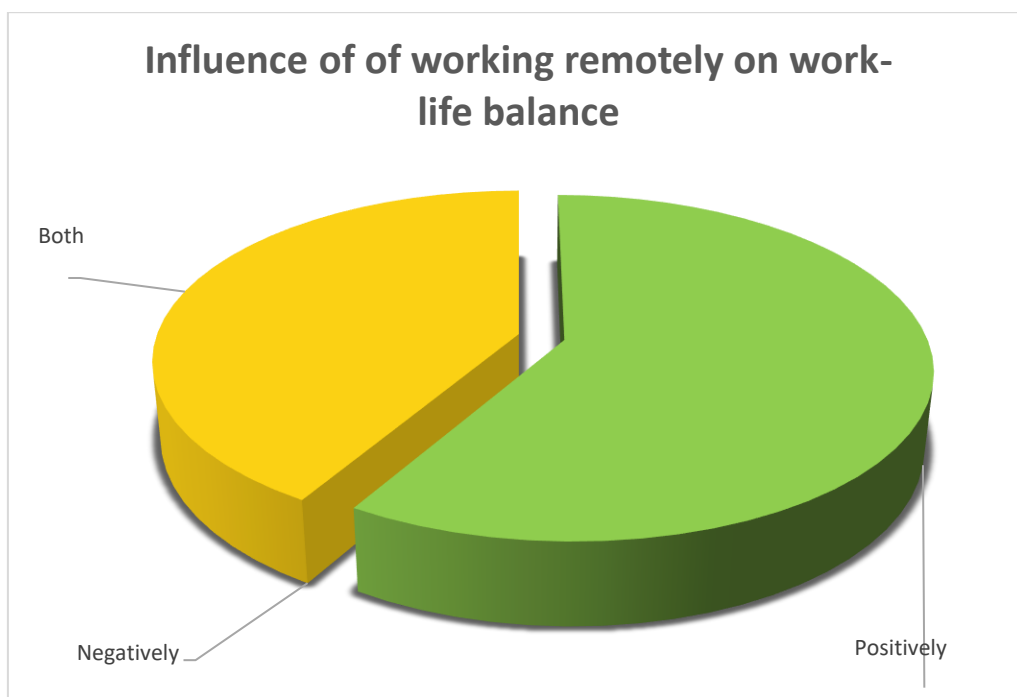


*Figure 4-9 Influence of working dispersed on work-life balanced.*

For this question most of the participants have experienced a positive work-life balance as a result of working remotely. The rest(fewer) of the participants had both positive and negative impacts on their work life balance due to working remotely. None of the participants reported a pure negative impact on work-life balance due to working remotely.

Figure 4.9 shows this study's participants views of aspects that the SA Retail Bank could implement to enhance their productivity while working remotely.
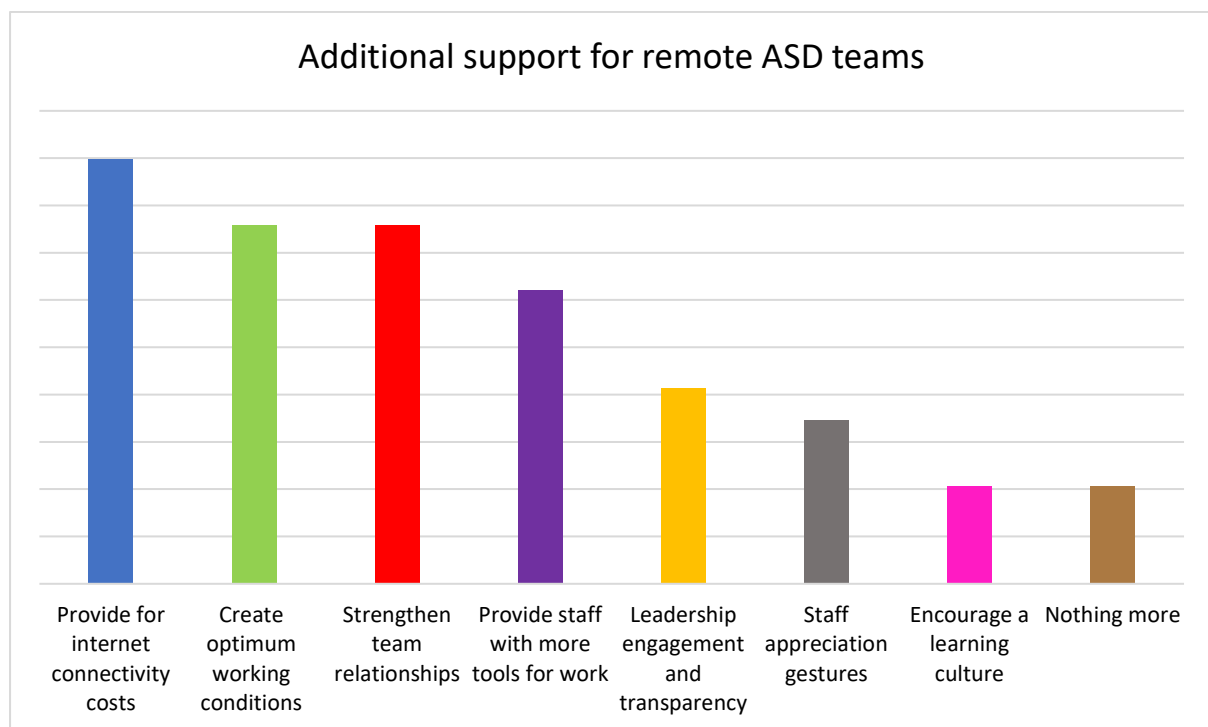


*Figure 4-10 Required aspects for team productivity while working remotely.*

Based on the inputs from the participants, 8 categories of improvements are required to further support agile teams that are working remotely. The most requested support by ASD team members 48,3% was for the organisation to provide for internet connectivity costs.

A smaller number of the participants indicated they want leadership to create optimum working conditions by enabling flexibility. Examples of optimum working conditions include fewer daily meetings, respect for personal time, and a better onboarding process for new team members. Strengthening team relationships through regular

interactions and engagements was indicated by an almost equal number of participants.

Some of participants indicated that they required the organisation to provide more working tools for staff, such as working-office furniture to be used while working at home. Leadership engagement and transparency was listed by fewer of the participants. A request for leadership to show staff appreciation via gestures was indicated by a small number of participants. Other participants also requested that leadership to encourage a learning culture. Some participants believed that no additional support was required for dispersed working ASD teams.

Figure 4.10 outlines participants' views of challenges of working remotely.
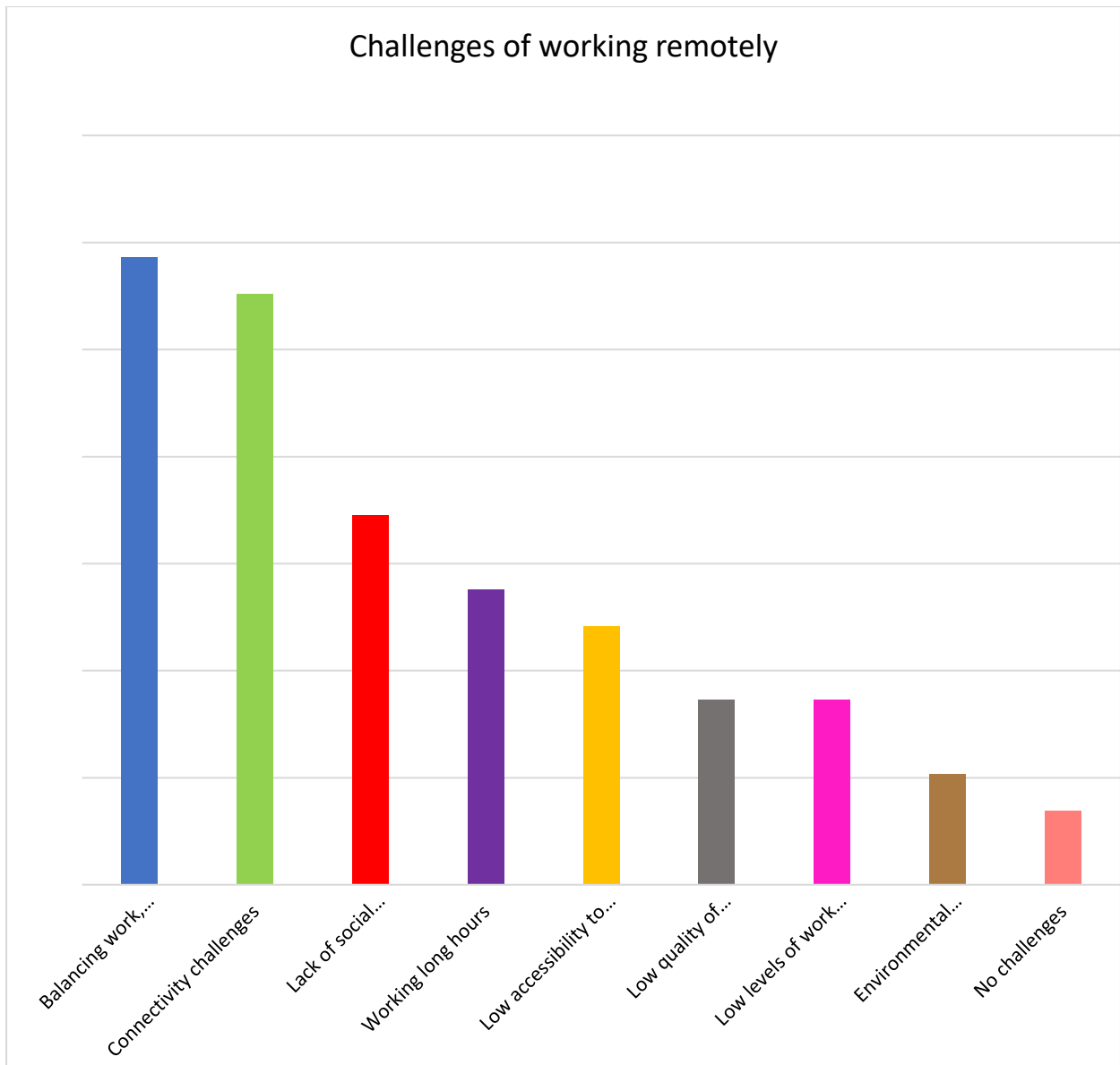
*Figure 4-11 Challenges which might affect ASD teams' productivity.*

Figure 4.10 shows 9 categories derived from the inputs provided for this question. Balancing work, personal duties and wellness were listed by 58,6% of the participants. Connectivity challenges were listed by 55,2% of participants. Lack of social interaction was indicated by 34,5% of participants. The 27,6% of participants reported that they worked long hours. Low accessibility to colleagues was indicated by 24,1% of participants.

Low quality of communication and collaboration and low levels of work commitment and were each listed as a challenge by 17,2% of participants. The 10,3% of

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participants indicated that they experienced disruptions when working from home. There were 6,9% of participants who indicated that they did not experience any challenges due to working from home.

*Are there disruptions you experience by working dispersed?*

During interviews, all Agile Coaches and Scrum masters said they experience disruptions such as load shedding, network connectivity issues, kids wanting attention, barking dogs, delivery services, and 'brb'. Brb is short for 'be right back', where people type "brb" on a meeting chat to excuse themselves from a meeting without explaining the reasons.

When asked how disruptions influence the team in carrying out and achieving their day-to-day tasks, AC-2 said: "In accepting teams, delivery and collaboration go unhindered, when other people experience disruptions, other team members step up and continue where possible. For example, pairing up with a colleague so that if there's a connection or power failure issue, the other person can continue with the presentation etc. So, preparation with a 'buddy' is key. This means there's continuity and minimal impact.

Teams that are not accepting of disruptions find it harder to cope, thus they get derailed by unplanned interruptions. Th's, there's a more negative impact." SM-3 highlighted that load shedding causes people to work back hours missed due to this. SM-3 further said that team members get tired and take too much leave, which reduces productivity.

When asked "*Do you believe that there's sufficient work-life balance for team members working dispersed?*"

AC-1 and SM-2: Yes, there is a reasonable work-life balance. However, some outliers work less and some overwork themselves as they might have extra time. SM-2 state', *"I don't believe that such a developer has a work-life balance due to the high demand on IP."* AC-2, AC-3, SM-1, and SM-3 argued that work-life balance is there, however, it depends on individuals. AC-4 and SM-4 think that there is no work-life balance. AC-
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4 said: *"No, people seem to work longer hours. Limited opportunity to walk, thus physical activity had significantly reduced during working hours. Impacts health negatively."*

According to AC-1 and AC-4 team productivity has not changed due to working dispersed. However, other six interviewed participants argued that their team productivity has changed since working dispersed. AC-2 and AC-3 argue that working dispersed increases the need to self-manage, disciplined and self-motivated individuals are more productive.

On the other hand, individuals who lack self-discipline and self-management skills have experienced a decline in productivity. These individuals tend to do the bare minimum to get by, resulting in decreased overall output.

According to SM-1 and SM-3, productivity is higher as everyone takes responsibility. SM-2 argues that there are fewer distractions than being in the office. This study's findings have shown that working in a dispersed environment increases team performance.

Findings of this study showed that remote work can provide numerous benefits for achieving work-life balance. Team members have the freedom to set their own schedules, allowing them to accommodate personal commitments and responsibilities. This flexibility can lead to increased job satisfaction, reduced stress levels, and improved overall well-being. Remote work also eliminates commuting time, providing additional time for personal activities or relaxation. Thus, promoting desirable performance. However, despite the potential benefits, remote work can blur the boundaries between work and personal life. Without clear boundaries, team members may struggle to disconnect from work, leading to longer working hours and a diminished work-life balance. The lack of separation between the physical workspace and personal space can make it difficult to mentally switch off from work.

Furthermore, findings of this study have shown that remote work can create expectations of constant availability and immediate response times. This can lead to increased pressure and difficulty in setting boundaries between work and personal life.
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Team members may feel compelled to be constantly accessible, compromising their work-life balance and well-being. ASD teams working dispersed may face challenges related to overworking and burnout. The lack of physical separation between work and personal life can result in longer working hours, decreased breaks, and difficulty in setting limits. Without proper self-discipline and time management, team members may find it challenging to maintain a healthy work-life balance.

To promote work-life balance in remote Agile teams for good performance, it is crucial to establish clear boundaries. Team members should define specific work hours, set aside time for personal activities, and communicate their availability to colleagues. Encouraging breaks and time for self-care is essential for avoiding burnout and maintaining well-being. Moreover, organisational culture and management support play a vital role in fostering work-life balance. Organisation should promote a culture that values work-life balance, supports flexible working arrangements, and encourages employees to prioritize self-care. Managers should lead by example, respecting boundaries and actively supporting their team members' well-being.

Achieving work-life balance in remote Agile Software Development teams requires intentional effort if the team wants to perform. While remote work offers flexibility, it also brings challenges related to setting boundaries, communication expectations, and avoiding burnout. By establishing clear boundaries, promoting a supportive culture, and prioritizing well-being, remote Agile teams can strive for a healthier work-life balance and enhance both individual and team performance.

### 4.6   Chapter Summary

This chapter presented, interpreted, and discussed the findings of this study for the three research sub-questions. Findings were presented in six themes generated using collected data and guided by literature. It is important to note that this study's findings may not be generalised but may be looked at within a similar context, particularly in the SA Retail bank context. Nonetheless, this study's three research sub-questions were answered in detail.

Answering this study's research sub-questions is expected to help answer the main research question. The main research question of this study is answered in the next

chapter. Chapter Five brings this study to a close by applying this study's theoretical and conceptual frameworks of General Systems Theory (GST) and TIPS and providing recommendations and conclusions.

# 5 CHAPTER FIVE

## CONCLUSIONS AND RECOMMENDATIONS

### 5.1 Introduction

This final chapter brings the study to a close by first answering the main research question of this research. The main research question is answered by findings from this study's research sub-questions. Furthermore, the theoretical framework of General Systems Theory (GST) underpinning this study is used as a lens when answering the main research question. In addition, the TIPS conceptual framework is used to support the theoretical framework that underpins this study. Subsequently, this chapter proffers recommendations followed by a general overview of this study in the conclusions.

This study aimed to examine the dynamics of working in a dispersed environment for ASD within the context of one South African bank. The exploration of the research problem and aim was important in articulating the research objectives. The research objectives which this study aimed to achieve are as follows:

i. To examine the dynamics of Agile Software Development teams working in a dispersed environment.

ii. To establish processes and tools utilised to assist Agile Software Development teams enhance delivery performance in a dispersed environment.

iii. To analyse the teams' delivery performance of dispersed Agile Software Development teams.

This study's research purpose and objectives were achieved following the research methods described in Chapter Three. The main research question and sub-questions of this study guided those.

The research sub-questions of this study were addressed in Chapter Four. This chapter answers the main research question of this study: How do ASD teams apply agile practices within the dynamics of a dispersed environment for performance?

## 5.2 Summary of findings: General Systems Theory and TIPS Frameworks in Answering the Main Research Question

To apply the theoretical framework, General Systems Theory (GST) as well as the conceptual framework, TIPS, this study was interrogated to indicate the relevance of this study's findings to answer the main research question of this study. As mentioned in Chapter Two, GST was introduced to understand a system by studying the interactions and relationships between the parts that make it up rather than the individual parts themselves (Wiener, 1948; Von Bertalanffy, 1950; Boulding, 1956). TIPS on the other hand facilitates an understanding of a system by demonstrating the output of different interactions in a system, Figure 2.2. According to the TIPS model framework, the interactions between tools and ideation produce agility. In addition, the interaction between ideation and people produce engagement. Lastly, the interaction between people and tools result in workplace integration. Agility drives performance and value returns, engagement drives performance output while alignment is the driver of workplace integration.

This study found that ASD team member-participants apply agile practice by collaborating and communicating using Microsoft Teams (one of the tools used), as provided by the SA Retail Bank. This study found that participants are more engaged and participate in ceremonies using Microsoft Teams in the process of creating value for the business through the products they build. Apparently, working in dispersed environments allows ASD team members to be more available regardless of the physical location. It was found that flexibility enables better work-life balance. This means they can create value using the tools they have available, enabling agility and enhancing performance as shown in the TIPS framework.

In line with the assertion by von Bertalanffy (1950), the impact of ASD team member participation on the communication and collaboration dynamics was examined by assessing other parts of the system such as the dispersed environment, tools, and work-life balance. As shown by Njomo (2017) in the pertinent literature, the support provided by agile coaches (and scrum masters) contributes to the ASD team's success. The TIPS framework also supports this assertion through the interaction of people and tools. This interaction creates alignment which creates workplace

integration. These tools help teams communicate and collaborate and build an aligned understanding, team learning and shared mental models which leads to a workplace integration for ASD teams working in a dispersed environment. This also contributes to team performance according to the team performance model by Dingsoyr *et al.* (2016), discussed in Chapter two of this study. How ASD teams apply agile practices within communication and collaboration dynamics are discussed further in the proceeding paragraphs.

As indicated in chapter two, Systems Theory is used in this study to enrich and support the application of GST. Systems Theory is fundamentally an approach to viewing and dealing with change and its complexity. The preceding chapter discussed how participants viewed working in a dispersed environment and the challenges associated with this kind of work environment. Systems Theory is a generic approach to dealing with and understanding complex systems, these systems can occur in different fields thus making the systems theory flexible and widely applicable. The systems theory focuses on the interrogation of individual components of a system and their interactions to identifying patterns of behaviour and feedback loops that influence system dynamics (Laszlo, 1972; Checkland, 1981).

This study found that for work-life balance, ASD team members gain additional time due to working dispersed. This is the influence of working dispersed on work-life balance. The pattern identified is that team members do not have to travel to work, thus, allowing more time to be productive and increasing team performance. Dingsoyr *et al.* (2016) team performance model supported the findings of this study regarding desirable team performance as a result of working in a dispersed environment. When considering the TIPS framework, the implication is that there is more opportunity for interactions between people and ideation as well as people and tools. These interactions imply positive influence Performance and output as well as workplace integration. In other words, dispersed ASD teams have more time to be innovative regarding the solutions they build, and they can achieve this enhanced innovation and performance by relying on the communication, collaboration, and other work tools that they have access to. The findings of this study are in corroboration with those of Ashmore (2012) and Whitworth (2006) which showed that ASD teams were consistent, competent, and productive at work.

It can be argued that findings of studies to which the current study's findings are juxtaposed, are relatively old. Instead, it is found interesting that ASD teams could work dispersed during those times. Furthermore, ASD teams in this study communicated effectively and collaboratively despite working in a dispersed environment and performed in a desirable manner. This indicates that the ASD teams can use the tools provided by SA Retail Bank efficiently in order to obtain the desired level of performance. This assertion ties in with TIPS, it shows that workplace integration is necessary for the ASD process to achieve top performance through the efficient use of technological tools available.

Lai and Huili Lin (2017) stated that Systems Theory aims to explicate dynamic relationships and interdependence between components of the system and the organisation–environment relationships. This insertion relates to the purpose of this study. The findings of this study showed that ASD team members' level of participation in virtual Agile ceremonies was generally higher. However, ASD team members' participation depends on various factors, one of which is network connectivity, which is sometimes unstable. When considering the TIPS framework, this impacts alignment, the implication thereof is that workplace integration suffers, and may ultimately impact performance if not dealt with efficiently.

The findings of this study showed that poor quality of the network connectivity hinders collaboration and communication efforts such as video calling, which is vital for ASD teams working in dispersed environments. After all, as agile communication is best done face-to-face, thus, when participants are unable to switch their cameras on, it is against agile principles and values. This finding might be seen to be in line with Mark (2002) and Teasley, Covi, Krishnan and Olson (2002) who advocate for ASD teams to work in collocated rather than dispersed environment.

However, some older studies, such as (Teasley *et al.*, 2002; Mark, 2002) were conducted about two decades ago. Therefore, this study argues that technology and working approaches are more advanced than a decade ago. Furthermore, this study argues that working dispersed is in line with the current skills of the 21st century. Teams depend on virtual tools such as MS Teams to communicate and collaborate effectively, tools depend on network quality to work efficiently, and these are a

dependency for performance jointly. Additionally, findings show that ASD team members mitigate poor network constraints by texting instead of voice or video calling.

To comply with the agile principles that encourage face-to-face communication mentioned in the Agile Manifesto (2001), it was found that ASD teams' resort to using video calls on one team member who is talking at a point during agile ceremonies.

In attempt to summarize the answer for this study's main research question, taking from the discussion presented both in this section and Chapter 4. By infusing general systems theory into the practices of dispersed agile software development teams, a holistic and adaptable approach can be fostered. This helps the team navigate the complexities of working remotely, enhance collaboration, and ultimately improve their performance in delivering successful software solutions. Furthermore, agile software development teams working in dispersed environments can leverage on the TIPS framework. By embracing collaboration tools, conducting virtual ceremonies, establishing clear communication channels, focusing on deliverables, seeking continuous feedback, fostering trust and empowerment, and cultivating team culture, dispersed agile teams can collaborate effectively and deliver high-quality software solutions despite physical separation. Agile software development teams can effectively apply Agile practices in a dispersed environment by considering the following strategies:

   i.  Clear and Frequent Communication
       Communication is key in a dispersed environment. Agile teams should establish clear and efficient communication channels to facilitate regular updates, information sharing, and collaboration. Utilizing video conferencing, instant messaging tools, and collaborative platforms can enhance communication and maintain team connectivity.
   ii. Agile Ceremonies and Synchronization
       Remote Agile teams should maintain agile ceremonies such as daily stand-ups, sprint planning, and retrospectives. These ceremonies enable synchronization, foster collaboration, and provide opportunities for team members to align their efforts, address challenges, and share feedback. Adapting these ceremonies to the remote context ensures that agile practices continue to guide the team's work.
   iii. Collaborative Tools and Platforms

Agile teams working remotely can leverage a range of collaborative tools and platforms to enhance productivity and transparency. Task management software, version control systems, and virtual whiteboards can facilitate task allocation, progress tracking, and visual collaboration. Shared document repositories and knowledge-sharing platforms ensure that information is accessible to all team members.

iv. Empowering Self-Organisation
In a dispersed environment, agile teams should emphasise self-organisation and empowerment. Providing team members with autonomy and decision-making authority allows them to take ownership of their work and contribute effectively. Empowered team members are more likely to be proactive, innovative, and motivated, leading to improved performance.

v. Continuous Feedback and Iterative Improvement
Agile principles emphasise continuous feedback and iterative improvement. Remote agile teams should establish regular feedback loops, conduct virtual retrospectives, and encourage open discussions to identify areas for improvement. This promotes a culture of learning, adaptability, and continuous growth. Consistent application of agile principles through the use of ceremonies as a good way of ensuring regular feedback loops among members of ASD teams.

vi. Trust and Collaboration
Building trust is essential for dispersed Agile teams. Team members should establish a foundation of trust through open communication, transparency, and delivering on commitments. Encouraging collaboration and fostering a supportive team culture through virtual team-building activities and social interactions can strengthen relationships and enhance performance.

vii. Performance Measurement and Accountability
Agile teams in a dispersed environment should establish clear performance metrics and accountability mechanisms. These metrics can focus on outcomes, such as the timely delivery of working software or customer satisfaction. Regular progress updates and tracking can ensure transparency and keep the team aligned with project goals.

By implementing these strategies, dispersed Agile software development teams can effectively apply Agile practices, maintain performance, and deliver successful

outcomes despite geographical separation. Adapting Agile principles to the remote context fosters collaboration, engagement, and productivity within ASD teams.

## 5.3    Value of the Study

The significance of conducting a research study lies in deriving value from it. In this study, the value is demonstrated through its Return on Investment (ROI) on various levels: personal, professional, organizational, and societal (refer to Figure 5.1). It is essential to recognise that this value, like Agile Software Development (ASD), is systemic in nature, with the levels interconnected and mutually influencing each other.
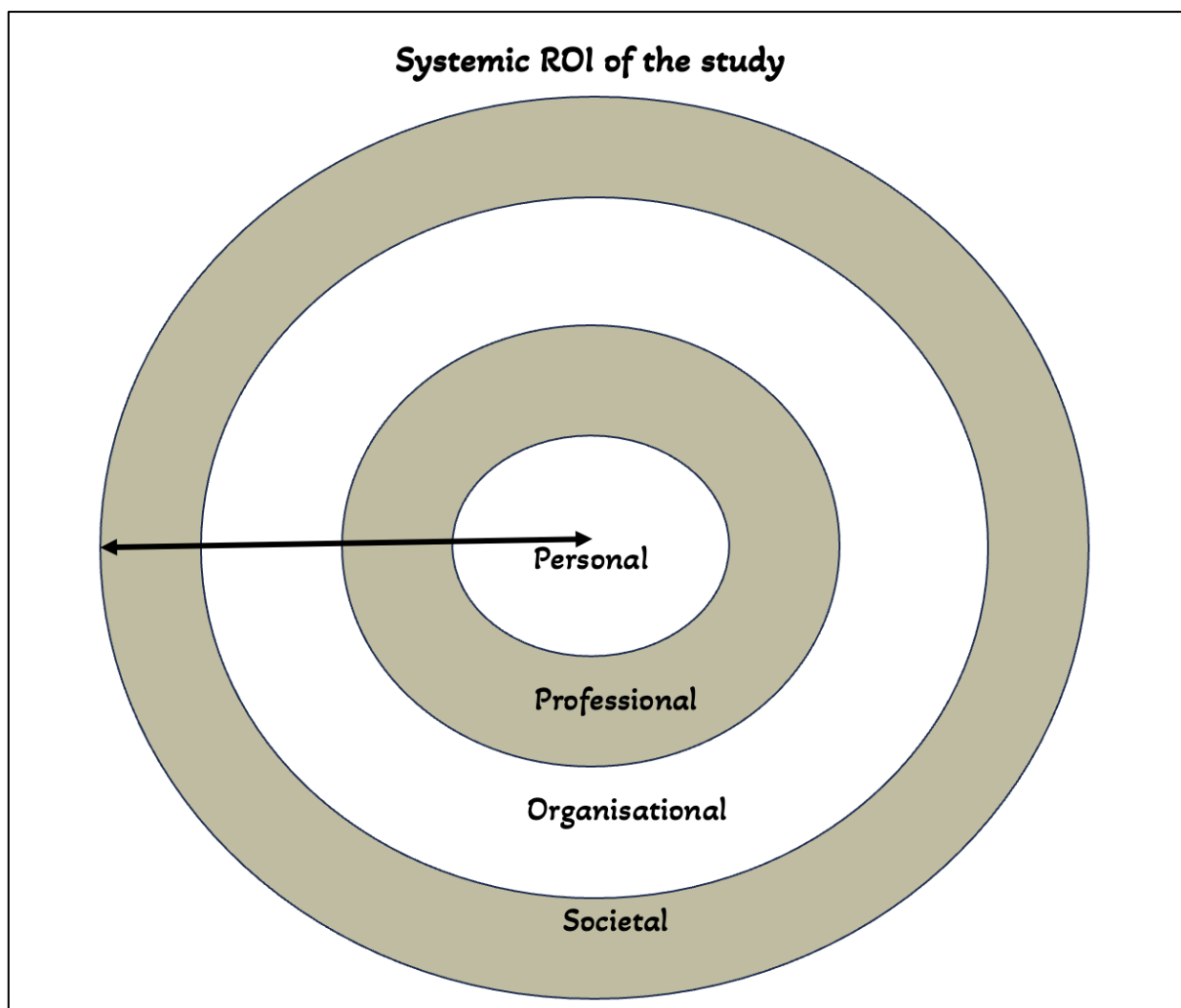


*Figure 5.1 Systemic Return on Investment of the Study*

Figure 5.1 depicts the systemic nature of the Return on Investment (ROI), showing the relationship between the different levels of ROI that will be discussed. In the centre is the personal ROI, which influences professional, which in return influenced organisational which then influences the societal level.

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### 5.3.1 Personal Return on Investment

At the centre of the ROI system is people, in this study the focus is on the personal value that researcher has derived through conducting this study. The researcher got an opportunity to conduct this study; and submit a dissertation which is a requirement the attainment of a master's degree of Management of Technology and Innovation. This journey contributes towards the researcher personal goal achievement. In addition, through this research journey, the researcher has gained important insight relating to the views of colleagues regarding the environment of operation within SA Retail Bank. This understanding will bring in a higher level of empathy and understanding when interaction with colleagues in future.

### 5.3.2 Professional Return on Investment

The personal ROI has an influence and is influenced by the professional ROI. Although the researcher is not part of an ASD team, she works closely with these teams on a day-to-day basis and works in a dispersed manner. She could relate to some challenges and benefits which were articulated by the participants. In addition, she was able to gain more understanding and appreciation on how these dynamics influence the day-to-day achievement of tasks, the delivery process and performance of teams. This understanding will assist the researcher to better support ASD teams in practicing the agile methodology.

### 5.3.3 Organisational Return on Investment

The ASD teams in SA Retail Bank were forced into working in a dispersed environment due the unpredictable circumstance within business environment caused by the COVID-19 pandemic. This meant that the organisation had to quickly enable the continuation of business and without losing much of their competitive advantage. The ROI for the organisation includes a better insight of the ASD teams which contributes to the delivery of products and services to the market. These ASD teams are responsible for the actualisation and maintenance of digital product, services and platforms that are used by the bank to service customers. Any inefficiency or delivery delay to the market of these digital offerings may results in unfavourable outcomes for the bank. Thus, the provision of the proper tools, processes, culture, leadership support and work environment are critical for the competitive advantage of the bank.

It is clear from the study that from a tooling and technological perspective the bank seemed to be well prepared for this transition, however a closer look has revealed some gaps that if addressed will help the organisation achieve a more robust dispersed work model and achieve agility at an organisational level. The insights provided in this study, if considered, will assist the organisational leaders formulate strategies on how to create a culture and an environment that support the ASD teams journey in becoming more agile by addressing the gaps. On the other hand, when the organisational leaders understand what works well, they can enhance on those to maintain and enhance their competitive advantage.

### 5.3.4 Societal Return on Investment

What is done within the boundaries of the hypothetical organisational walls has an impact on and is impacted by the society. The bank provides products and services which are consumed by the members of the society. Understanding the challenges and circumstances that the society operates and survives within is key. This understanding helps the bank innovate and offer products that are relevant and create real value for the society. Since ASD members form part of society, some of their concerns, for instance, loadshedding and network infrastructure challenges apply to society in general. Thus, these circumstances provide the bank with the opportunity to innovate on creating solutions that take advantage of this context, increasing the competitive advantage of the bank. In addition, the bank may make meaningful contributions to the underprivilege part of society by easing some of their burden to this regard as part of their existing outreach programs.

## 5.4 Conclusion

This study's findings have shown an inconsistent application of agile software development framework; some teams do not fully adhere to the SCRUM ceremonies. Further, this study found that several challenges hinder the proper implementation of agile software development. The inability to connect to the internet or poor network quality internet is the biggest challenge due to inadequate infrastructure or rotational power cuts (load-shedding).

The theoretical framework of General Systems Theory (GST) presented in this study generates new and significant insights for understanding and conceptualising how

ASD teams apply agile practices within the dynamics of a dispersed environment for performance. In addition, the TIPS conceptual framework supports and emphasises on the insights generated by the theoretical framework. This could provide insights to the banks, policymakers, and employees regarding agile software development.

This study was conducted within SA Retail Bank, one of the banks in South Africa. It recommends more-or-less similar studies where larger samples on various banks are conducted on ASD. It also recommends a longitudinal study for the same phenomenon. Finally, this concluding chapter discussed and addressed the major findings for answering this study's main research question. Limitations and recommendations of this study were also discussed.

## 5.5   Recommendations of this Study: for practice and for the future research

For the improvement of practice, the following recommendations are proffered based on what this study found:

i. This study recommends that the bank conducts multiple professional development training workshops on working in dispersed environments. The needs of the employees must mainly guide those workshops.

ii. This study recommends that the bank provides employees with additional resources and support to practice agile more effectively and productively.

iii. This study recommends that ASD team members be more accountable and transparent.

iv. This study recommends that ASD team members should try to uphold agile values and principles through their actions.

v. This study recommends that the top-level leadership get more involved and participate in the Agile journey so as to roll it out into the entire origination. Lessons learnt from the ASD teams can help the organisation position itself for a transformation towards becoming an agile organisation.

## 5.6   Limitations of this Study

The study was completed successfully within some limitations that existed. These limitations include the site of the study. The study cannot be generalised as it was conducted in one bank. However, the results may be applicable within a similar context. Another limitation is that observation could not be used as a data collection

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method as all team's work was dispersed. Although there is some data on virtually distributed teams in the literature, data are limited on fully dispersed agile software development teams in the literature. Another limitation of this study is that it was conducted within a short period which did not allow for the investigation of the dynamics of dispersed ASD teams over a longer period.

## 5.7   Areas for Further Research

Several empirical explanations and inferences were made in both Chapter Four and the current chapter, some potentially creating opportunities for further research. Areas which can be potentially explored are as follows:

i.   This study recommends for study which focuses on a hybrid model of working on ASD team in which teams may observe performance when dispersed and when collocated.

ii.  This study recommends a bigger study that may use mixed methods approaches across multiple sites. That may provide a clear picture and generalise results on ASD teams working in dispersed environments.

iii. This study recommends that a longitudinal study be conducted to investigate the dynamics of dispersed ASD teams over a longer period across multiple sites, on an international scale. That may provide a deeper insight into this phenomenon on a global scale taking into consideration different cultures, business and home environments of the organisations and participants. This should lead to the discovery of emergent properties related to agile software development teams working in a dispersed environment.

This study recommends a bigger study that takes a closer look at the dynamics of Agile organisations on a global scale.

# 6 REFERENCES

Abdalhamid, S. & Mishra, A., 2017. Adopting of agile methods in software development organizations: systematic mapping. *TEM Journal,* 6(4), pp. 817-825.

Adonis, L. & Kabanda, S., 2019. *Virtual work in developing countries: the case of South African call centres.* New York, ACM Digital Library.

Agile Alliance, 2020. *Become an agile alliance member today.* [Online] Available at: www.agilealliance.org [Accessed 29 December 2020].

Alaa, G. & Fitzgerald, G., 2013. Re-conceptualizing agile information systems development using complex adaptive systems theory. *Emergence: Complexity and Organization,* 15(3), pp. 1 - 23.

Aliyu, A., Singhry, I., Adamu, H. & Abubakar, M., 2015. *Ontology, epistemology and axiology in quantitative and qualitative research: elucidation of the research philophical misconception.* Abekuta, Proceedings of The Academic Conference: Mediterranean Publications & Research International on New Direction and Uncommon.

Allmark, P. & Machaczek, K., 2018. Realism and pragmatism in a mixed methods study. *Journal of Advanced Nursing,* 74(6), pp. 1301-1309.

Al-Riyami, T., 2015. Main approaches to educational research. *International Journal of Innovation and Research in Educational Sciences,* 2(5), p. 2349–5219.

Al-Saadi, H., 2014. *Demystifying ontology and epistemology in research methods,* Sheffield: University of Sheffield.

Al-Saqqa, S., Sawalha, S. & AbdelNabi, H., 2020. Agile software development: methodologies and trends. *International Journal of Interactive Mobile Technologies,* 14(11), pp. 246-270.

Altexsoft, 2016. *Agile Project Management: Best Practices and Methodologies,* Carlsbad: AltexSoft.

Altvater, A., 2020. *What is SDLC? Understand the software development life cycle.* [Online] Available at: https://stackify.com/what-is-sdlc/ [Accessed 9 April 2023].

Anney, V., 2014. Ensuring the quality of the findings of qualitative research: looking at trustworthiness criteria. *Journal of Emerging Trends in Educational Research and Policy Studies,* pp. 1-20.

Arifin, R. M., 2018. Ethical considerations in qualitative study. *International Journal of Care Scholars,* 1(2), pp. 30-33.

Ashmore, S., 2012. *The impact of process on virtual teams: a comparative analysis of waterfall and agile software development teams,* Ames: Iowa State University.

Behrens, K., Kichko, S. & Thisse, J.-F., 2021. Working from home: too much of a good thing?. *CESifo Working Paper,* Issue 8831, pp. 1-46.

Biedenbach, T. & Jacobsson, M., 2016. The open secret of values: the roles of values and axiology in project research. *Project Management Journal,* 47(3), pp. 139-155.

Bird, D. K., 2009. The use of questionnaires for acquiring information on public perception of natural hazards and risk mitigation – a review of current knowledge and practice. *Natural Hazards and Earth System Sciences,* 9(4), p. 1307–1325.

Bliss, L., 2016. Phenomenological research: inquiry to understand the meanings of prople's experiences. *International Journal of Adult Vocational Education and Technology,* 7(3), pp. 14 -27.

Boejie, H., 2002. A Purposeful approach to the constant comparative method in the analysis of qualitative interviews. *Quality & Quantity,* Volume 36, pp. 391-409.

Boulding, K., 1956. General system theory: the skeleton of science. *Management Science,* 2(3), pp. 197-208.

Brezočnik, L. & Majer, Č., 2016. *Comparison of agile methods: scrum, kanban and scrumban.* Ljubljana, Information Society.

Brownlee, J., 2007. Complex adaptive systems. *CIS Technical Report,* Issue 070302A, pp. 1-6.

Business Tech, 2020. *Business Tech.* [Online] Available at: www.businesstech.co.za [Accessed 22 September 2020].

Campbell, S., 2015. Conducting case study research. *Clinical Laboratory Science,* 28(3), pp. 201-205.

Charlier, S. D., Stewart, G. L., Greco, L. M. & Reeves, C. J., 2016. Emergent leadership in virtual teams: a multilevel investigation of individual communication and team dispersion antecedents. *The Leadership Quarterly,* 27(5), pp. 74-764.

Checkland, P., 1981. *Systems thinking, systems practice.* Chichester: John Wiley.

Coetzee, C., 2016. *Towards a complex adaptive systems paradigm of disaster resilience: a study of Southern African subsinance agriculture communities.* Potchefstroom: North-West University.

Connelly, L. M., 2016. Trustworthiness in qualitative research. *Medsurg Nursing,* 26(6), pp. 435-436.

Conradie, W. J. & De Klerk, J. J., 2019. To flex or not to flex? Flexible work arrangements amongst software developers in an emerging economy. *SA Journal of Human Resource Management,* 17(0), pp. 1-12.

COVID-19 South African Online Portal, 2020. [Online] Available at: www.sacoronavirus.co.za [Accessed 24 September 2020].

Cresswell, J., 2013. *Qualitative inquiry and sesearch design: choosing among five approaches.* 3rd ed. London: SAGE Publications.

Page 123

Creswell, J., Hanson, W. & Morales, A., 2007. Qualitative research designs: selection and implementation. *The Counseling Psychologist,* 35(2), pp. 236-264.

Creswell, J. W. & Creswell, J. D., 2017. *Research design: qualitative, quantitative, and mixed Methods.* 5th ed. New York: Sage Publiations.

Creswell, J. W. & Creswell, J. D., 2018. *Research design: qualitative, quantitative, and mixed Methods.* 5th ed. New York: Sage Publiations.

Dávideková, M. & Hvorecký, J., 2017. *Collaboration tools for virtual teams in terms of the SECI Model.* Cham, Springer International Publishing.

Deshpande, A., Sharp, H., Barroca, L. & Gregory, P., 2016. *Remote working and collaboration in agile.* Dublin, Open Research Online.

Dikko, M., 2016. Establishing construct validity and reliability: pilot testing of a qualitative Interview for research in Takaful (Islamic Insurance). *The Qualitative Report,* 21(3), pp. 521-528.

Dinca, L. & Voinescu, C., 2012. *Coss-functional teams and their role in increasing competitiveness of the organizational partnership.* Galati, EIRP Proceedings.

Dingsøyr, T. et al., 2016. Team performance in software development: research results versus agile principles. *IEEE Software,* July/August, 33(4), pp. 106-110.

Eby, K., 2016. *Physical scrum board vs. smartsheet online scrum board.* [Online] Available at: https://www.smartsheet.com/physical-scrum-board-vs-smartsheet-online-scrum-board
[Accessed 17 September 2021].

Eccles, M. et al., 2010. The impact of collocation on the effectiveness of agile teams. *Communications of the IBIMA,* pp. 1-11.

Eckstein, J., 2010. *Agile software development with distributed teams: staying sgile in a global world.* New York: Dorset House Publishing.

Elshafie, M., 2013. Research paradigms: the novice researcher's nightmare. *Arab World English Journal,* 4(2), pp. 4-13.

Fleming, J. & Zegwaard, K., 2018. Methodologies, methods and ethical considerations for conducting research in work-integrated learning. *International Journal of Work-Integrated Learning,* 19(3), pp. 205-213.

Fox, N. J., 2008. Postpositivsm. In: L. M. Given, ed. *The Sage encyclopedia of qualitative research methods.* Thousand Oaks: Sage Publications, Inc., pp. 659-654.

Gliksona, E. & Erezb, M., 2020. The emergence of a communication climate in global virtual teams. *Journal of World Business,* 25(6), pp. 1-10.

Grant, C. & Osanloo, A., 2014. Understanding, selecting and integrating a theoretical framework in a dissertation research: creating the blueprint for your "House". *Administrative Issues Journal : Connecting Education, Practice, and Research,* 4(2), pp. 12-26.

Page 124

Hassell, M. D. & Limayem, M., 2017. Media impacts and performance in dispersed teams. *Journal of Computer Information Systems,* 60(1), pp. 18-25.

Heylighen, F., 1998. *Basic concepts of the systems approach.* [Online] Available at: http://pespmc1.vub.ac.be/SYSAPPR.html [Accessed 20 April 2023].

Highsmith, J., 2001. *History: agile manifesto.* [Online] Available at: http://agilemanifesto.org/history.html [Accessed 24 September 2020].

Hill, S. & Bartol, K., 2016. Empowering leadership and effective collaborationin geographically dispersed teams. *Personnel Psychology,* 69(1), p. 159–198.

Hoda, R., 2011. *Self-organizing agile teams: a grounded theory.* Wellington: Victoria University of Wellington.

Holden, M. T. & Lynch, P., 2004. Choosing the appropriate methodology: understanding research philosophy. *The Marketing Review,* 4(4), pp. 397-409.

Holmes, A. G. D., 2020. Researcher positionality:-a consideration of its influence and place in qualitative research: a new researcher guide. *International Journal of Education,* 8(4), pp. 1-10.

Jesson, J. & Lacey, F., 2006. How to do (or not to do) a critical literature review. *Pharmacy Education,* 6(2), pp. 139-148.

Kabir, S. M. S., 2016. *Methods of data collection.* Chittagong: Book Zone Publication.

Kassu, L., 2019. *Assessment of training practices in the case of Addis Ababa city administration finance bureau,* Addis Ababa: Addis Ababa University.

Kaushik, V. & Walsh, C. A., 2019. Pragmatism as a research paradigm and Its implications for social work research. *Social Sciences,* 8(9), pp. 1-17.

Khan, S., 2014. Qualitative research method: grounded theory. *International Journal of Business and Management,* 9(11), pp. 224-233.

Kivunja, C., 2018. Distinguishing between theory, theoretical framework, and conceptual framework: a systematic review of lessons from the field. *International Journal of Higher Education,* 7(6), pp. 44-53.

Lai, C. H. & Huili Lin, S., 2017. Systems theory. *The international encyclopedia of organizational communication,* pp. 1-18.

Langley, N., 2008. *Hot skills: extreme programming.* [Online] Available at: https://www.computerweekly.com [Accessed 11 September 2021].

Laszlo, A. & Krippner, S., 1998. Systems theories: their origins, foundations, and development. In: J. S. Jordan, ed. *Systems theories and a priori aspects of perception.* Amsterdam: Elsevier Science, pp. 47-74.

Laszlo, E., 1972. *Introduction to systems theory: toward a new paradigm of contemporary thought: the rise of general theories in contemporary science.* 4th ed. New York:: Harper Torchbooks.

LaVogue, T., 2020. *Why I scrum: using a project management tool for PBL.* [Online] Available at: https://www.pblworks.org/blog/why-i-scrum-using-project-management-tool-pbl
[Accessed 17 September 2021].

Leech, N. & Onwuegbuzie, A., 2007. An array of qualitative data analysis tools: a call for data analysis triangulation. *School Psychology Quarterly,* 22(4), pp. 557-584.

Li, J., 2012. Agile software development. *Computer Science,* pp. 1-10.

Lopes, I., Oliveira, A. & Costa, C. J., 2015. Tools for online collaboration: do they contribute to improve teamwork?. *Mediterranean Journal of Social Sciences,* 6(6), pp. 511-518.

Lopez, V. & Whitehead, D., 2013. Sampling data and data collection in qualitative research. In: *Nursing & midwifery research: methods and appraisal for evidence-based practice.* 4th ed. Mosby: Elsevier, pp. 123-140.

Mack, L., 2010. The philosophical underpinnings of educational research. *Polyglossia,* Volume 19, pp. 5-11.

Magni, M., Ahuja, K. M. & Maruping, L. M., 2018. Distant but fair: intra-team justice climate and performance in dispersed teams. *Journal of Management Information Systems,* 35(4), pp. 1031-1059.

Management Solutions, 2019. *From Agile Delivery, to an Agile Organisation.* s.l., s.n.

Management Solutions, 2019. *From Agile Delivery, to an agile Organization.* [Online] Available at: https://www.managementsolutions.com/

Manifesto for Agile Software Development (MASD), 2001. *Twelve principles of agile software.* [Online]
Available at: https://agilemanifesto.org/
[Accessed 10 September 2020].

Manjusak, S., 2019. *Co-located and distributed teams in software development projects: an evaluation of differences in terms of soft factors, performance and cost efficiency in co-located and distributed teams,* Karlskrona: Blekinge Institute of Technology.

Mark, G., 2002. Extreme collaboration. *Communications of the ACM,* 45(6), pp. 89-93.

Mason, P., 2014. *Researching tourism, leisure and hospitality for your dissertation.* Oxford: Goodfellow Publishers LTD.

Matharu, G., Mishra, A., Singh, H. & Upadhyay, P., 2015. Empirical study of agile software development methodologies: a comparative analysis. *ACM SIGSOFT Software Engineering Notes,* 40(1), pp. 1-6.

McCormick, M., 2012. *Waterfall vs. agile methodology,* Newburgh: MPCS, Inc.

Mircea, E., 2019. Project management using agile frameworks. *Economy Informatics,* 19(1), pp. 34-44.

Moe, N. B., Cruzes, D. S., Dybå, T. & Engebretsen, E., 2015. *Coaching a global agile virtual team.* Ciudad Real, IEEE 10th International Conference on Global Software Engineering.

Neuman, W.L. 2014. *Social Research methods: qualitative and quantitative approaches.* 7th Edition. Harlow: Pearson Education Limited.

Newton Suter, W., 2012. *Introduction to educational research: a critical thinking approach.* New York: SAGE Publications.

Njomo, M. E., 2017. *Influencers of enhanced performance in agile software development teams,* Johannesburg: University of The Witwatersrand.

Noble, H. & Mitchell, G., 2016. What is grounded theory?. *Evidence-Based Nursing* , 12 02.

OECD, 2020. *Productivity gains from teleworking in the post COVID-19 era : How can public policies make it happen?.* [Online] Available at: https://www.oecd.org/coronavirus/policy-responses/productivity-gains-from-teleworking-in-the-post-covid-19-era-a5d52e99/ [Accessed 2021 July 12].

O'Leary, Z., 2017. *The essential guide to doing your research project.* 3rd ed. London: Sage Publishing.

Olukotun, O. et al., 2021. An analysis of reflections on researcher positionality. *The Qualitative report,* 26(5), pp. 1411-1426.

Opie, C., 2004. *Doing educational research: a guide to first-time researchers.* New York: SAGE Publications Ltd.

Oxford Learner's Dictionaries, n.d. *Oxford Learner's Dictionaries.* [Online] Available at: https://www.oxfordlearnersdictionaries.com/definition/english/dynamic_2?q=dynamics [Accessed 16 December 2021].

Parizi, R. M., Gandomani, T. J. & Nafchi, M. Z., 2014. *Hidden facilitators of agile transition: agile coaches and agile champions.* Langkawi, IEEE.

Patton, M. Q., 2015. *Qualitative research and evaluation methods.* 4th ed. Thousand Oaks: Sage Publications.

Poscova, J., Bednarova, D., Bogdanovska, G. & Mojzisova, A., 2020. Implementation of agile methodologies in an engineering course. *Education Sciences,* Volume 333, pp. 1-19.

Prasad, A., DeRosa, D. & Beyerlein, M., 2017. Dispersion beyond miles: configuration and performance in virtual teams. *Team Performance Management: An International Journal,* 23(3/4), pp. 1-28.

Qin, D., 2016. Positionalty. *The Wiley Blackwell encyclopedia of gender and sexuality studies*, 30 April, pp. 1-2.

Reddy, S. & Ramasamy, K., 2018. Introspection of work-from-home in IT industry. *International Journal of Advance and Innovative Research,* 5(4), pp. 522-535.

Rehman, A. A. & Alharthi, K., 2016. An Introduction to Research Paradigms. *International Journal of Educational Investigations,* 3(8), pp. 51 - 59.

Rothman, J. & Kilby, M., 2019. *From chaos to successful distributed agile teams: collaborate to deliver.* 1st ed. Amstrerdam: Practical Ink.

Rouse, M., 2016. *Tech Target.* [Online] Available at: https://whatis.techtarget.com/definition/software-development [Accessed 29 December 2020].

Ruparelia, N. B., 2010. Software development lifecycle models. *ACM SIGSOFT Software Engineering Notes,* 35(3), pp. 8-13.

Saldaña, J., 2013. *The coding manual for qualitative researchers.* 2nd ed. Los Angeles: Sage Puplications.

Saunders, M. N., Lewis, P., Thornhill, A. & Bristwo, A., 2015. Understanding research philosophy and approaches to theory development. In: *Research Methods for Business Students.* Harlow: Pearson Education, p. 122–161.

Saunders, M.N.K., Lewis, P. & Thornhill, A. 2019. *Research methods for business students.* 8th Edition. Harlow: Pearson Education Limited.

Schwaber, K. & Sutherland, J., 2016. *The definitive guide to scrum: the rules of the game,* Burlington: The Scrum Guide.

Shannon-Baker, P., 2016. Making paradigms meaningful in mixed-methods research. *Journal of Methods Research,* 55(1), pp. 319-334.

Sharma, G., 2017. Pros and cons of different sampling techniques. *International Journal of Applied Research,* 3(7), pp. 749-752.

Sharma, H. & Sarkar, C., 2019. Ethnography research: an overview. *International Journal of Advance and Innovative Research,* 6(2), pp. 1-5.

Sharp, H. et al., 2016. *Remote working in an agile team,* Milton Keynes: Agile Research Network.

Shenton, A., 2004. Strategies for ensuring trustworthiness in qualitative research projects. *Education for Information ,* Volume 22, p. 63–75.

Siddiqui, S., 2019. Research paradigms: Their assumptions and relevance. *International Journal of Research in Social Sciences,* 9(5), pp. 254-265.

Sierra, J. J. & Hyman, M. R., 2016. Open-versus close-ended survey questions. *Business Outlook,* 14(2), pp. 1-5.

Simmons, G. et al., 1985. Computer hardware and software fundamentals. *Radiographs,* 5(1), pp. 11-29.

Sloan, A. & Bowe, B., 2014. Phenomenology and hermeneutic phenomenology: the philosophy, the methodologies and using hermeneutic phenomenology to investigage lecturers' experiences of curriculum design. *Quality & Quantity,,* 48(3), pp. 1291-1303.

Sommerville, I., 2011. *Software engineering.* 9th ed. Boston: Pearson Education Inc.

Srinivasan, B. N. & Mukherjee, D., 2015. Characteristics of agile teams: a discussion on technology and culture. *IMS Manthan (The Journal of Innovations),* 10(1), pp. 75-82.

Stadler, M., Vallon, R., Pazderka, M. & Grechenig, T., 2019. Agile distributed software development in nine central European teams: challenges, benefits and recommendations. *International Journal of Computer Science & Information Technology (IJCSIT),* 11(1), pp. 1-18.

Starman, A., 2013. The case study as a type of qualitative research. *Journal of Contemporary Educational Studies,* Volume 1, pp. 28-43.

Stralin, T. et al., 2016. *Software development handbook: transforming for the digital age,* Sandton: McKinsey & Company.

Stray, V., Memon, B. & Paruch, L., 2020. A systematic literature review on agile coaching and the role of the agile coach. *Compueter Science,* Volume 12562, pp. 3-19.

Stray, V., Tkalich, A. & Moe, N. B., 2021. *The agile coach role: coaching for agile performance impact.* Maui, Hawaii International Conference on System Sciences.

Sulaiman, A., Jeremiah, A. & Boateng, F., 2020. Perceptions of flexible work arrangements in selected African countries during the coronavirus pandemic. *South African Journal of Business Management,* 15 12, 51(1), pp. 1-10.

Taylor, P. C. & Medina, M., 2011. Educational research paradigms: from positivism to pluralism. *College Research Journal,,* 1(1), pp. 1-16.

Teasley, S. D., Covi, L. A., Krishnan, M. S. & Olson, J. S., 2002. Rapid software development through team collocation. *IEEE Transactions on Software Engineering,* 28(7), pp. 671-683.

Teherani, A. et al., 2015. Choosing a qualitative research approach. *Journal of Graduate Medical Education,* 7(4), pp. 669-670.

Theofanidis, D. & Fountouki, A., 2018. Limitations and delimitations in the researchpProcess. *Perioperative Nursing,* 7(3), pp. 155-163.

Thomas, D. R., 2006. A generaliInductive approach for analyzing qualitative evaluation data. *American Journal of Evaluation,* 27(2), pp. 237-246.

Von Bertalanffy, L., 1950. An outline of general system theory. *British Journal for the Philosophy of Science.,* 1(2), pp. 134-135.

Von Bertalanffy, L., 1972. The history and status of general systems theory. *Academy of management journal,* 15(4), pp. 407-426.

Walsham, G., 1995. The emergence of Iiterpretivism in IS research. *Information Systems Research,* 6(4), pp. 303-394.

Wheeldon, J. & Faubert, J., 2009. Framing experience: concept maps, mind maps, and data collection in qualitative research. *International Journal of Qualitatie Methods,* 8(3), pp. 68-83.

Whitchurch, G. G. & Constantine, L. L., 1993. Systems theory. In: P. Boss, et al. eds. *Family theories and methods emerging during 1960-1980.* Cham: Springer Nature, pp. 325-355.

Whitworth, E., 2006. *Agile xxperience: communication and collaboration in agile software development teams,* Ottawa: Carleton University.

Wiener, N., 1948. *Cybernetics.* New York: Wiley.

Willis, J., 2007. *Foundations of qualitative research: interpretive and critical approaches.* Thousand Oaks: Sage Pubblications.

Wolgemuth, J. & Agosto, V., 2019. Narrative researh. In: R. George, Rojek & Chris, eds. *The Blackwell encyclopedia of sociology.* Hoboken: JohnWiley & Sons, Ltd, pp. 1-3.

World Health Organisation, 2020. *World Health Organisation.* [Online] Available at: www.who.int [Accessed 3 October 2020].

Yilmaz, K., 2013. Comparison of quantitative and qualitative research traditions: epistemological, theoretical, and methodological differences. *European Journal of Education,* 48(2), pp. 311-325.

Young, D., 2013. *Software development methodologies.,* Huntsville: GDIT & Alabama Supercomputer Center.

Yu, J., 2018. Research process on software development model. *IOP Conference Series: Materials Science and Engineering,* 394(3), pp. 1-8.

Zima, D., 2015. Modern methods of software Development. *Task Quarterly,* 19(4), p. 481–493.

Žukauskas, P., Vveinhardt, J. & Andriukaitienė, R., 2018. Philosophy and paradigm of scientific research. In: J. Vveinhardt, ed. *Management culture and corporate social responsibility.* London: IntechOpen, pp. 121-139.

# APPENDIX A – ONLINE RESEARCH QUESTIONNAIRE

**Research Title:** "**AGILE SOFTWARE DEVELOPMENT (ASD):** DYNAMICS OF WORKING IN **A DISPERSED** ENVIRONMENT OF A SOUTH AFRICAN RETAIL AND COMMERCIAL BANK

**Questions**

1. Which discipline is your role in an agile team?
   a. Analysis
   b. Development
   c. Testing
   d. Scrum Master
   e. Other (Please specify).

2. Age Category?
   a. Under 30
   b. 30 – 39
   c. 40 – 49
   d. 50+

3. Gender?
   a. Female
   b. Male

4. Do you have children?
   a. Yes
   b. No

5. How long have you been with the organisation?
   a. 0 –1 Year
   b. 1 – 3 Years
   c. 3 – 5 Years
   d. 6 – 10 Years
   e. 10+ Years

6. How long have you been part of your current team?

    a. 0 –1 Year

    b. 1 – 3 Years

    c. 3 – 5 Years

    d. 5+ Years

7. Which of the following agile ceremonies does your team perform using virtual tools as prescribed?

    a. Stand Up

    b. Sprint Planning

    c. Backlog Grooming

    d. Sprint Review

    e. Retrospective

    f. Other (Please specify)

    g. None of the above

8. List up to 4 tools you use to enable and support the Agile practice while working remotely.

1.

2.

3.

4.

9. Are these tools sufficient to support Agile in a dispersed environment?

    a. Yes

    b. No

10. If "No" above, which other tools may be added to supplement or replace the existing ones, list up to 4.

1.

2.

3.

4.

11. In general, what is the quality of your network connection when communicating and collaborating with your team?
    a. Worst quality
    b. Bad Quality
    c. Good Quality
    d. Better Quality
    e. Best Quality

12. What is your level of participation in virtual Agile ceremonies?
    a. My participation level is generally high.
    b. My participation level is generally average.
    c. My participation level is generally low.
    d. Other (please specify)

13. Which method of communication is the most effective to communicate with your colleagues and stakeholders?
    a. Email
    b. Voice call using cell phone.
    c. Voice call using a communication tool provided by the organisation.
    d. Video call using a communication tool provided by the organisation.
    e. Other (please specify)

14. How frequently do you communicate and have conversations with your colleagues virtually?
    a. Very frequent throughout the day.
    b. Frequent through-out the day.
    c. Less frequent throughout the day.
    d. I hardly communicate with my colleague.
    e. Other (please specify)

15. Which method of communication is mostly used use to communicate among colleagues and business stakeholders?
    a. We mostly communicate using text-based methods like email etc.
    b. We mostly communicate using voice-based methods.
    c. We mostly communicate using video-based methods.
    d. Other (please specify)

16. Please rank the collaboration methods used by your team to perform agile ceremonies.

|  | High | Medium | Low |
|---|---|---|---|
| Video based |  |  |  |
| Voice based |  |  |  |
| Text based |  |  |  |

17. How does working remotely contribute to your ability to collaborate with colleagues on tasks?
    a. It is very easy to collaborate with my colleagues virtually.
    b. It is easy to collaborate with my colleagues virtually.
    c. It is challenging to collaborate with my colleagues virtually.
    d. It is very challenging to collaborate colleagues virtually.
    e. Other (please specify).

18. Are there any disruptions in your current physical work environment that influence your productivity?
    a. No disruptions, my productivity level is high.
    b. Some disruptions, minimal changes on my productivity.
    c. Too many distractions, my productivity levels have declined.
    d. Other (please specify).

19. How does working remotely influence your team's productivity?
    a. The team usually delivers less than expected.
    b. The team delivers as expected.
    c. The team usually delivers more than expected.
    d. Other (please specify).

20. List up to 4 benefits of working remotely.

| |
|---|
| 1. |
| 2. |
| 3. |
| 4. |

21. List up to 4 additional things that your organisation can implement to support you working remotely.

| |
|---|
| 1. |
| 2. |
| 3. |
| 4. |

22. How has working remotely influenced your work-life balance?
   a. Positively
   b. Negatively
   c. Both

23. If Positively, how? Please select one or more options that are applicable to you.
   a. I have more personal time because I no longer have to travel to work.
   b. I can get more done due to less interruptions from colleagues.
   c. I am able to work is flexible hours.
   d. I spend less money by working from home.
   e. Other (please specify).

24. If negatively, how? Please select one or more options that are applicable to you.
   a. I work more than 8 hours on most days.
   b. I struggle to focus due to disruptions at home.
   c. I feel isolated.
   d. I spend more money by working from home.
   e. I have regular connection issues.
   f. Other (please specify)

25. List up to 4 challenges of working remotely.

| |
|---|
| 1. |
| 2. |
| 3. |
| 4. |

26. How can agility be improved in a virtual setting, list up to 4 suggestions?

1.

2.

3.

4.

**List of Questions**

1. How long have you been in your role?
2. How long have you been with the organisation?
3. How many Agile software Development (ASD) teams do you work with in total?
4. What are some of your responsibilities towards these teams?
5. What support structures and tools are in place to enable you to carry on with your duties while working in dispersed?
6. Are these tools sufficient to enable proper agile practice in a dispersed environment?
7. Which of your agile ceremonies are held with videos on?
8. What communication challenges are the teams experiencing due to working in a dispersed environment?
9. What collaboration challenges are the teams experiencing due to working in a dispersed environment?
10. Which agile processes/ceremonies are challenging to execute when working in a dispersed environment, if any?
11. What are some of the benefits to of working in a dispersed environment, if any?
12. Are there any opportunities that can be leveraged to enhance the agile practice in a dispersed environment?
13. If yes, please elaborate.
14. Has team productivity changed due to working dispersed, if so, how?
15. What are some of the disruptions you experience as a result of working in a dispersed environment, if any?
16. If applicable, how do these influence the team in carrying out and achieving their day-to-day tasks?
17. Do you believe that there's sufficient work life balance for team members working in a dispersed environment?
18. What can the organisations do to further support you and agile teams while working in a dispersed environment?

19. What changes do you recommend for enhancing agility while teams are working in a dispersed environment, if any?

# APPENDIX C – EXAMPLE OF COMPLETED QUESTIONNAIRE

| | |
|---|---|
| Respondent ID | ███████████████ |
| Collector ID | |
| Start Date | 2022-01-28 13:25:30 |
| End Date | 2022-01-28 13:40:24 |
| Which is your role in an agile team? | Analysis |
| Age Category? | 29 - 39 |
| Gender? | Male |
| Do you have children? | Yes |
| How long have you been with the organisation? | 1 - 5 years |
| How long have you been part of your current team? | 3- 5 years |
| Which of the following agile ceremonies does your team perform using virtual tools as prescribed? Please select one or more options. | Stand up |
| | Sprint Planning |
| | Backlog Grooming |
| | Retrospective |
| | Sprint Review |
| List up to 4 tools you use to enable and support the agile practice while working remotely. | Microsoft teams |
| | Jira |
| | Confluence |
| | Gliffy |
| Are these tools sufficient for supporting the practice of agile when working dispersed? | Yes |
| If "No" above, which other tools may be added to supplement or replace existing ones; list up to 4. | |
| In general, what's the quality of your network connection when communicating and collaborating with your team and other stakeholders. | Best Quality |
| What is your level of participation in virtual agile ceremonies? | My participation level is generally high |
| Which method of communication do you utilise most to communicate with your colleagues and stakeholders? | Text using a collaboration tool provided by the organisation i.e. MS Teams, Zoom, etc. |
| How frequently do you communicate and have conversations with your colleagues virtually? | Very frequent throughout the day. |
| How does working remotely affect the way you communicate with your colleagues and business stakeholders? | We mostly communicate using text based methods like email etc. |
| Please rank the collaboration methods used by your team to perform agile ceremonies. | Video based - Low ranking |
| | Voice based - Mid ranking |
| | Voice based - Low ranking |
| How does working remotely contribute to your ability to collaborate with colleagues with tasks? | It is very easy to collaborate with my colleagues virtually. |
| Are there any disruptions in your current physical work environment that influence your productivity? | Some disruptions, minimal changes on my productivity |
| How does working remotely influence your team's productivity? | The team usually delivers more than expected. |
| List up to 4 benefits of working remotely. | Better work and home life balance. |
| | Less time traffic |
| | efficient time management and focusing. |
| | Less commuting time, saving on Petrol and car maintenance |
| List up to 4 additional things that your organisation can implement to support you working remotely. | better remoting tools |
| | UPS and home connectivity |
| | Respect lunch time and family time |
| | making working from home a new culture |
| How has working remotely influenced your work-life balance? | Positively |
| If Positively, how? Please select one or more options that are applicable to you. | I have more personal time because I no longer have to travel to work. |
| | I can get more done due to less interruptions from colleagues. |
| | I am able to work is flexible hours. |
| | I spend less money by working from home. |
| If Negatively, how? Please select one or more options that are applicable to you. | |
| List up to 4 challenges of working remotely. | power interruptions |
| | Kids school support |
| | Time management |
| | Different working hours with collogues. |
| How can agility be improved in a virtual setting, list up to 4 suggestions? | break between meetings |
| | schedule the morning or afternoon as no meeting times |
| | having a time schedule and remote working culture |

# APPENDIX D – SCREENSHOT OF INTERVIEW DETAILS
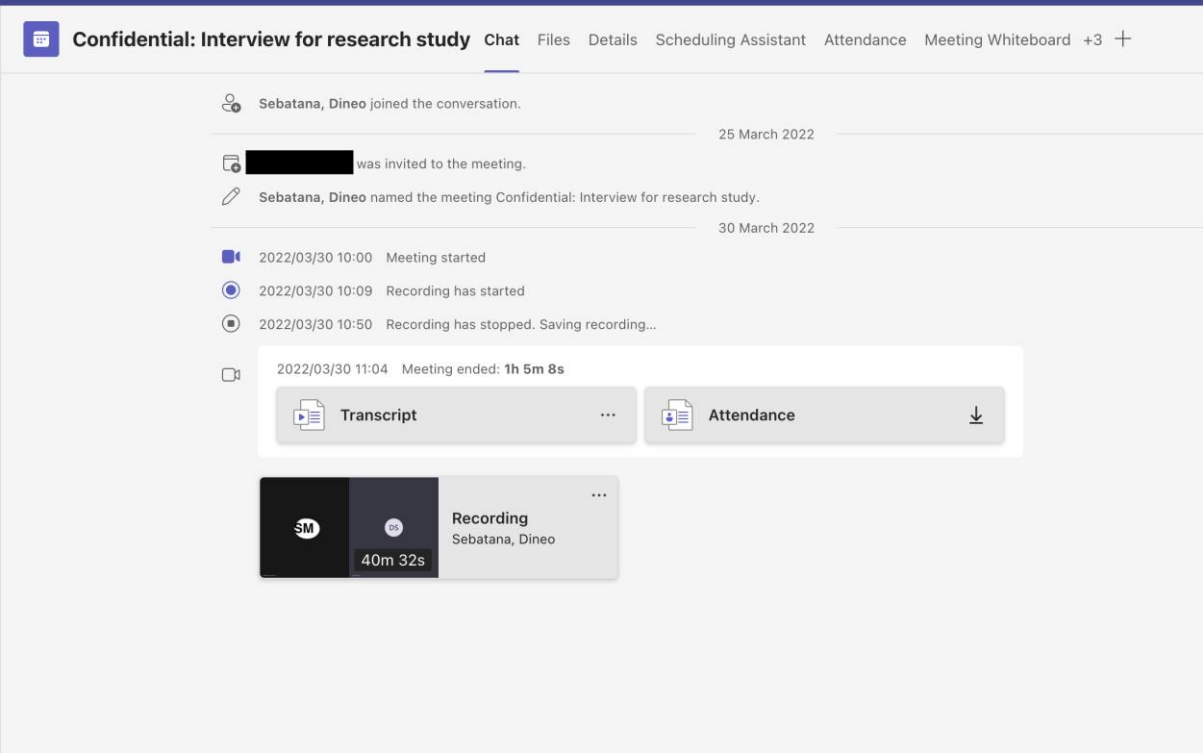
# APPENDIX F - ETHICAL CLEARANCE LETTER FROM THE DA VINCI INSTITUTE

**The Da Vinci Institute for Technology Management (Pty) Ltd**
PO Box 185, Modderfontein, 1645, South Africa
Tel + 27 11 608 1331 Fax +27 11 608 1380
www.davinci.ac.za

Reference: 03121
Date: 07 December 2021

### Ethical Declaration

I, the undersigned, hereby declare that the Masters Research of the student named below has received ethical clearance from The Da Vinci Institute Ethics Committee. The student and supervisor will be expected to continue to uphold the Da Vinci Institute's Research Ethics Policy as indicated during the application.

**Proposed Title**: Working from home: Examining the impact of the dispersed teams in agile software development

**Student Name**: Sebatana Dineo

**Student number**: 10926

**Supervisor**: Dr D Magadlela

**Co-Supervisor**: N/A

**Period**: Ethics approval is granted from 2021/12/07 to 2022/05/14

_____

Chairperson: Research & Ethics Committee

Prof HB Klopper
Executive Dean: Research and Institutional Partnerships

# APPENDIX G - AN APPROVAL FROM THE SA RETAIL BANK

**From:** M███████████████████co.za>
**Sent:** Thursday, 01 April 2021 13:45
**To:** M███████████████████co.za>
**Subject:** RE: Request for Permission to conduct research

Approved, conditions:

- M███████████████████- happy that she uses SA Retail Bank
- Invites staff to participate but not force/compulsary

Regards

█████████  M█████████████          Retail
            Head of Human Resources              █████████ Human Resources

# APPENDIX H - THE PARTICIPANT INFORMED CONSENT

**Consent return slip to participate in a study**

I, _____ (participant name), confirm that the person asking my consent to take part in this research has told me about the nature, procedure, potential benefits and anticipated inconvenience of participation.

I have read and understood the study as explained in the information sheet.

I have had sufficient opportunity to ask questions and am prepared to participate in the study.

I understand that my participation is voluntary and that I am free to withdraw at any time without penalty.

I am aware that the findings of this study will be processed into a research report, journal publications and/or conference proceedings, but that my participation will be kept confidential unless otherwise specified.

I agree to the recording of the interview.

I have received a signed copy of the informed consent agreement.
Participant Name & Surname (please print)

_____

_____          _____
Participant Signature                                      Date

Researcher's Name & Surname (please print)
**DINEO SEBATANA**

_____          _____
Researcher's signature                                   Date