



**Exploring the Emergence of Collaborative
Practices in Globally Distributed Agile
Software Development**

A thesis submitted for the degree of Doctor of Philosophy

By

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ABSTRACT

Agile software development approaches have emerged as a response to perceived frustrations of more heavyweight plan-driven methods, and have now become well established within the information systems field. More recently, there has been a tremendous growth in applying agile methods in globally distributed settings.

In light of this, there is a pressing need to understand how agile practices are adapted which were originally conceived for collocated settings, and now actually being used in globally distributed settings, taking into account the challenges posed by such contexts. The aim of this thesis is to contribute to this research gap, with a quest to better understand and unpack the “black-box” of how collaborative practices evolve within global agile settings. The value of this research lies in improving and advancing our understanding of the challenges the team members go through in adapting agile practices in global contexts. The research also explores how collaborative practices can support agility in globally distributed settings.

In order to contribute to knowledge and increase conceptual clarity, there is a need to carry out in-depth and in-situ research within an organisational context. By taking a socio-technical perspective this study intends to extend our existing knowledge on how collaborative practices are evolving in real-time practice within globally distributed agile settings. The empirical evidence is drawn from a globally distributed team, operating in a global financial bank with offices based in London and Delhi. Interpretive research methods including semi-structured interviews and observations are used to understand team members’ experiences of developing collaborative practices in a globally distributed context.

Although existing literature on agile software development acknowledges the intrinsic significance of collaboration for effective functioning of agile methods, current studies fail to demonstrate a situated practice perspective on how collaborative practices are adapted in globally distributed settings. This study enlists the analytical concepts of boundary objects and Pickering’s “mangle of practice” to better understand the process of how collaborative practices evolve in globally distributed agile teams. The resulting analysis provides us with a much

more nuanced understanding of how interactions take place in developing collaborative practices in globally distributed contexts.

The findings reveal that collaborative practices within such settings tend not to follow from pre-set expectations of how agile practices should work, but are temporally emergent. Team members have to revise collaborative practices through an ongoing process of mutual “tuning” within their situated contexts, in order to achieve a gradual state of interactive stability or a steadiness of practices. The results demonstrate how actors address the challenges in developing shared understandings to drive forward the joint software development process across global locations and move towards supporting agility within the projects.

The thesis presents a pluralistic conceptual framework called the Collaborative Tuning Approach, which aids in gaining critical insights of issues related to adapting agile practices and also demonstrates how collaborative practices can act as enabler to achieving agility in such settings. The framework explains the challenges the team members face and how these are overcome when attempting to modify practices and indeed how these evolve through an ongoing state of flux and uncertainty leading to hybrid agile practices.

Keywords: *agile practices, globally distributed agile teams, collaborative practices, boundary objects, mangle of practice*

DEDICATION

Dedicated to my family for their unconditional love, understanding and continuous encouragement during all these years. In loving memory of Dipak.

Above all for Lord Sri Hanuman's grace

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I would like to express my gratitude and appreciation to all those who have supported me in one way or another during my doctoral research.

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DECLARATION

The following papers have been published as a direct result of the research discussed in this thesis:

Paper 1 : (Modi, Abbott and Counsell, 2012)

Modi, S., Abbott P. and Counsell. S, “*Exploring Communication Challenges associated with Agile Practices in a Globally Distributed Environment.*” (2012) In RAISE (Researching Agile development of Information SystEms) Conference, October 2012, London, UK.

Paper 2 : (Modi, Abbott and Counsell, 2013b)

Modi, S.; Abbott, P. and Counsell, S, "*Raising Awareness In Distributed Agile Development - A Case Study Perspective*" (2013). UK Academy for Information Systems Conference Proceedings 2013.

Paper 3: (Modi and Abbott, 2013)

Modi, S and Abbott, P. "*Understanding Collaborative Practices in Distributed Agile Development: Research Proposal*", Global Software Engineering Workshops (ICGSEW) 2013 IEEE 8th International Conference on, pp. 74-77, August 2013

Paper 4 : (Modi, Abbott and Counsell, 2013a)

Modi, S; Abbott, P. and Counsell, S. “*Negotiating common ground in distributed agile development: A case study perspective*”. In 8th International Conference on Global Software Engineering, ICGSE, pages 80–89. IEEE, Aug 2013

Paper 5 : (Modi, Abbott and Counsell, 2017)

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British Computer Society: **Hybrid Agile for Global Teams** (13th June 2016)

Invited Research Presentation

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ABBREVIATIONS

ANT	Actor Network Theory
CTA	Collaborative Tuning Approach
DSD	Distributed Software Development
GSD	Global Software Development
GSE	Global Software Engineering
IS	Information Systems
ISD	Information Systems Development
STS	Science Technology Studies
TDD	Test Driven Development
XP	Extreme Programming

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Chapter 1: Introduction

“To thrive in this turbulent environment, we must confront the business need for relentless innovation and forge the future workforce culture”(Highsmith and Cockburn, 2001)

1.0 Definitions related to the research area

Before discussing scope of the research, it is important to set out the some important definitions related to the research area. The definitions for information systems, information systems development, information systems methodologies and information systems development (ISD) methods are presented below – see figure 1.1

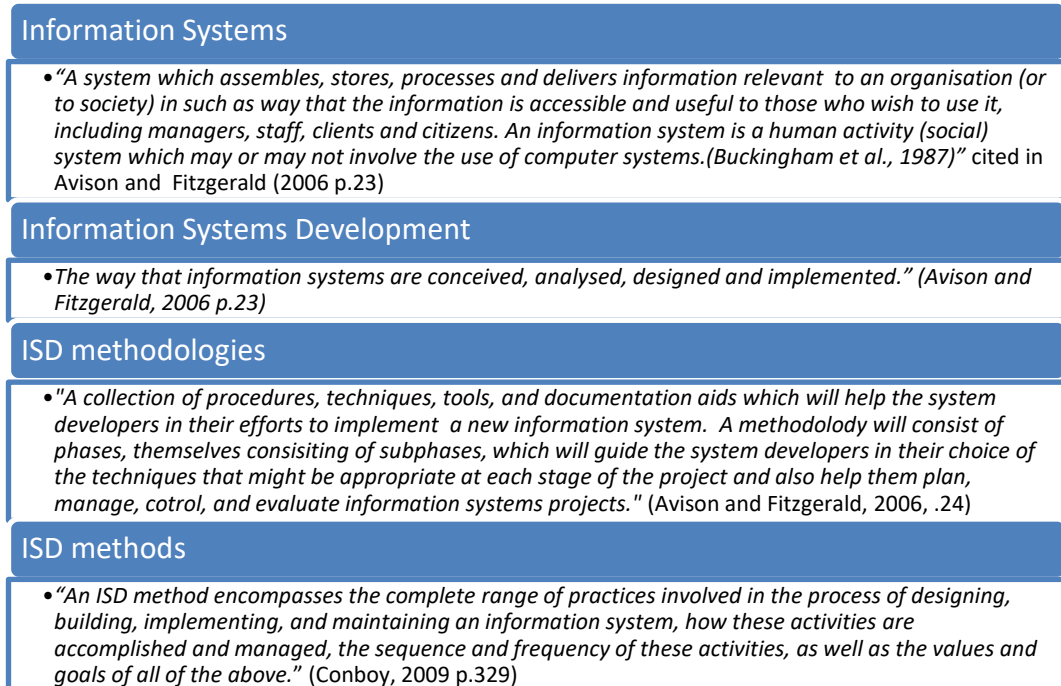


Figure 1.1: Important definitions related to the research area

1.1 Scope of the Research Area

The use of agile methods and practices in information systems development (ISD) has significantly altered the software development process within many organizations (Dybå and Dingsøy, 2008; Dingsoyr *et al.*, 2012; Wang, Conboy and Pikkarainen, 2012). The pace of transition from traditional plan-driven waterfall methods to iterative agile methods has been increasing dramatically. Agile methods fall under the ISD methods definition in figure 1.1 as they provide a range of practices and techniques to aid in designing, building and implementing an information system. A survey carried out by VersionOne ‘11th Annual State of Agile Report’, reported that the three main reasons for adopting agile were: i) accelerated product delivery, ii) enhanced ability to manage changing priorities and iii) increased productivity (VersionOne, 2017). Agile methods have become widely accepted because they provide flexibility and foster close communication with users.

According to Highsmith and Cockburn (2001) agile methods can be seen as “*a perspective that mirrors today’s turbulent business and technology change*”. In other words, whilst the plan driven methods like Waterfall follow a sequential path by seeking stability through heavy use of documentation and predetermined routes, agile methods and practices add value to the dynamic business environment by using iterative and incremental approaches of delivering software to the business environment. Hence, agile methods attempt to provide the flexibility needed as well as enough rigor to the software development process, by accepting “*feedback and change*” and “*embrace[ing] rather than reject[ing], higher rates of change*”(Williams and Cockburn, 2003, p.40).

A number of different agile methods have been put forward, some of the most popular being Scrum, Extreme programming (XP), Lean Software Development, Dynamic Systems Development (DSDM) and Test Driven Development (Dybå and Dingsøy, 2008; Conboy, 2009; Dingsoyr *et al.*, 2012). The practitioners who proposed these agile methods formalised this transformative movement under the

umbrella of the Agile Manifesto¹ in 2001, which advocated four core values and twelve principles to be followed by agile teams. The core values have become the fundamental pillars of agile methods and have been specified as:

- Individuals and interactions over processes and tools
- Working software over comprehensive documentation
- Customer collaboration over contract negotiation
- Responding to change over following a plan

The agile values and principles essentially emphasize that in order to develop and deliver software in an iterative and incremental manner, it is crucial that there is close proximity of the team members, so that frequent face-to-face interactions and extensive collaborations can take place easily, which in can allow shared understandings to be developed.

In recent times however, this aspect of having collocated teams has been overlooked such that agile methods are now gaining prominence in globally distributed contexts, where agile teams are being set up in different geographical locations. Globally distributed teams have an additional set of challenges usually due to time and space separation, cultural differences and knowledge gaps, which can lead to communication misunderstandings (Kotlarsky and Oshri, 2005; Ramesh *et al.*, 2006). Building collaborative relationships with their team counterparts becomes much more difficult or in some cases, impossible to accomplish. Yet, the survey carried out by VersionOne (2017) reported that 86% of respondents had at least some distributed teams practicing agile. Currently, little is known about how collaborative agile practices are carried out jointly across locations in globally distributed teams. Therefore, it is timely and important to study this area, this research will seek to contribute deeper insights of how global agile team members

¹ <http://agilemanifesto.org/>

onshore and offshore carry out collaborative practices for their particular context – see figure 1.2 for the research focus.

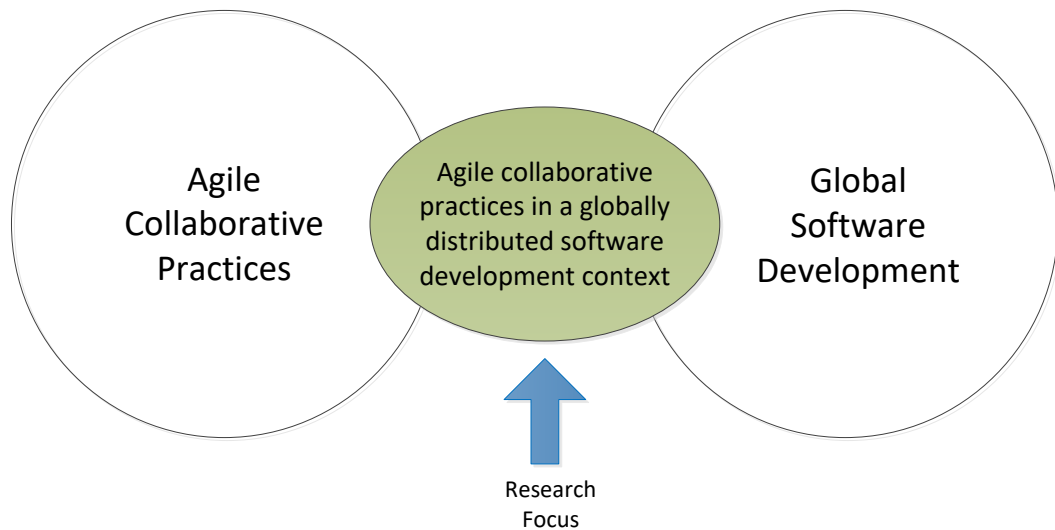


Figure 1.2: Research focus for this study

1.2 Research Motivations

This thesis was inspired by exploring the issues and difficulties of translating agile values and principles within global contexts. Although agile methods have grown in popularity, the existing literature within this domain still lags behind what is actually happening in practice. For example, a number of systematic reviews within the agile domain (Dybå and Dingsøyr, 2008; Dingsøyr *et al.*, 2012; Hummel, 2014) report that agile methods make a huge impact within industry and whilst there are a growing number of empirical studies on agile methods within the collocated context (Fitzgerald, Hartnett and Conboy, 2006; Sharp and Robinson, 2008; Mangalaraj, Mahapatra and Nerur, 2009), there is still a pressing need for more empirical studies of the use of agile within globally software teams. Jalali and Wohlin (2010) carried out a systematic review which focused specifically on the use of agile in globally distributed contexts .where they reviewed 81 studies. They established that the area is not well investigated and there are several challenges in shifting agile methods within globally distributed contexts. Again they indicated

that there was a clear need for more in-depth studies which examine the challenges and benefits of applying agile practices within real world contexts.

In summary, these reviews highlight that a number of themes need further research, one of them being the use of agile practices across projects and across organizations. They also conclude that future researchers investigating agile methods should embrace a more theory-based approach. This emphasizes that applying theoretical perspectives would “*help us glean the essential concepts, or the ‘truths’ of software development that are methodology-independent*”(Dingsoyr *et al.*, 2012, p.1219). In other words, having an improved theoretical understanding would allow both researchers and agile practitioners to gain deeper insights of this growing area.

Hence, to bridge this gap and respond to the imperative call for further research, the current study empirically and theoretically seeks to build a more in-depth understanding of how collaborative practices are adopted across global software agile teams. At one level, it aims to unpack how these collaborative patterns evolve in a real world context, such that the team members across locations start developing shared understandings. At another level, it aims to address this important research gap by applying a theoretical perspective as this could help researchers by providing a richer and more comprehensive understanding of this complex phenomenon.

As noted earlier from VersionOne survey which reported that the use of agile in distributed teams has grown tremendously due to demands of temporal organisation structures. Therefore, studying and shedding light in this area involves theorizing and unravelling the reality of what actually happens in practice would be beneficial. Having deeper insights would be vital for project or programme managers who are planning to set-up globally distributed agile teams, in terms of how team members across locations, interact and build collaborative practices within such contexts.

1.3 Research Aim and Objectives

The overarching aim of the study was concerned with exploring and capturing the complexity and tensions of translating agile values and principles to globally

distributed agile teams, to understand how the global team members develop collaborative practices within such settings, so that work is carried out in a continuous manner, and a sense of agility is achieved. This aim can be further developed into research objectives and research questions: Specifically, the research objectives for this study are:

Research Objectives

- RO.1 To unpack and understand the phenomenon of global software agile teams by carrying out an in-depth empirical study of one global agile team.
- RO.2 To examine the role of objects and technology that support collaborative practices within an agile team across different geographical locations.
- RO.3 To analyse the findings using theoretical concepts as a scaffold to better understand the relationship between the actors and the technology in order to reveal greater insights about how collaborative relationships are formed in globally distributed configurations.
- RO.4 To respond to the call for more empirical theory-driven research of the use agile methods within information systems development and contribute to the debate.
- RO.5 To explore how developing collaborative practices can lead to supporting agility within projects in globally distributed contexts

These research objectives led specifically to the following research questions:

Research questions:

RQ.1: *How do collaborative agile practices evolve in a globally distributed software team?*

RQ.2: *How can we conceptualise the collaboration process to better understand the underlying issues and challenges that a globally distributed agile team faces?*

RQ.3: *How can collaborative practices support agility within globally distributed agile projects?*

Three research questions have been formulated to focus the study and in order to achieve the overarching aim of the study. The research objectives and research questions provide a framework for conducting this study in terms of its boundaries and development of the data collection methods. In keeping with the above research objectives and research questions, the study uses the empirical findings to understand the participants' interactions and enactments in using the technology to cultivate the patterns of collaborative practices within the contextual landscape. These results of analysis would aid and inform researchers and project managers who are planning to employ globally distributed agile teams.

1.4 Research Approach

In order to address the above research questions, an empirical investigation was conducted within the context of global distributed teams, capturing the team members' interactions across locations and the challenges they face in the process of developing collaborative practices.

A broadly interpretive longitudinal case study approach was adopted for the research (Walsham, 2006) with the aim of understanding the complex interactions between the actors and with the technology to support these contextual settings. This study was carried out in an exploratory way with the aim of understanding meanings from the participants' lived experiences. In other words, as a researcher accepting that reality is 'socially constructed' and the participants' enactments occur within their own social, cultural, historical and personal contexts (Hennink, Hutter and Bailey, 2011). An interpretive approach was chosen in order to develop a rich understanding of the phenomenon, believing that the social world is a subjective reality that cannot really be measured from an objective stance.

The empirical context of the research was based on two globally distributed teams located in London and Delhi within a global financial bank. The study focuses on how collaborative practices develop in such contexts. It does not specifically focus

on the role of national or organizational culture, though with regard to the geographical landscape, the researcher needed to be fully cognizant of the intercultural contexts and complex relationships between people from different cultural backgrounds (Cohen and Ravishankar, 2012). This meant ensuring that there was a nuanced understanding of the cultural sensitivity throughout the study.

The data collection period was over a two and a half year period from 2012-2014 through a longitudinal case study design approach. The data collection was conducted via semi-structured interviews and observations. Thematic analysis was used to analyse the data (Braun and Clarke, 2006).

1.5 Theoretical Approach

The study is theoretically based upon applying two theoretical concepts as a scaffold, the first being boundary objects (Star and Griesemer, 1989; Star, 2010), this concept can aid in unpacking and understanding the use of artefacts where boundaries exist. The second concept stems from engaging in practice within an organisational socio-technical context, where different approaches of practice perspective exist. In the literature, there is an ongoing debate about how we should conceptualise the relationship between technology and actors within an organisational context (Orlikowski, 2007). This study specifically draws on Pickering's theoretical concept of mangle of practice which seeks to provide a real-time understanding of how practice unfolds over time (Pickering, 1995). Pickering contends that material and human agency are emergent and entangled, which he refers to as "dance of agency" (Pickering, 1995, p.21). In other words, actors may have intentions of utilising technology or material agency in certain ways, but these intentions are not always realised and the actors would have to accommodate these resistances by revising their intentions or plans. This study proposes using a combined theoretical lens of boundary objects and mangle of practice as an analytical tool, to unravel the underlying reasons for the challenges that globally distributed teams face and how these are overcome in order to build and develop collaborative practices across geographical locations.

1.6 Expected Contributions

The research envisages contributing theoretically and practically to the research domain of globally distributed agile contexts specifically by:

- Unpacking and providing an understanding of how collaborative practices evolve in globally distributed agile contexts.
- Expanding the scope of the globally distributed agile studies through the use of the combined conceptual framework of boundary objects and mangle of practice.
- Adopting an interpretive approach, highlighting that there is a need to re-conceptualize the existing topology where actors and technology are viewed separately. Hence, by proposing a more relational perspective where the actors and technology are in a situated entanglement where the collaborative practices are an ongoing process, this yields more thorough insights into interactions and how collaborative practices are ongoing.
- Contributing to the debate in using theoretical perspectives within the field of agile software development, by suggesting an alternative way of considering actors within globally distributed agile contexts based on the empirical findings of the case study research.
- Providing practical insights and suggestions for agile practitioners as to how current collaborative patterns within globally distributed agile teams can be assessed which in turn can be used to further cultivate and foster greater collaborative developments in line with the agile core values.

1.7 Thesis Structure

An outline of the remaining chapters is presented follows:

Chapter 2 - Literature Review

This chapter gives an overview of the challenges of plan-driven development methods which led to the emergence of agile methods. This is followed by a review of the literature within the agile domain which focuses on the importance of collaborative agile practices and the challenges of defining the concept of agility.

Next, it centres on a critique of the existing literature on collaborative practices from three different viewpoints: use of agile in collocated contexts, a parallel stream literature of collaborative practices in conventional global software development, and finally globally distributed agile contexts. Following this, the chapter concludes with the research gap and the research questions. Hence, it draws attention to the current study and the value of researching how collaborative practices evolve in global agile contexts.

Chapter 3 - Theoretical Framework

This chapter, focuses on the theoretical concepts underpinning this study by first exploring the importance and relevance of the theory to IS research. Next, it draws on the theoretical concept of boundary objects. Then it discusses the different perspectives of practice from a workplace or organizational standpoint, where it specifically draws attention to the concept of mangle of practice (Pickering, 1995) and its main tenets. The chapter concludes by proposing a combined framework of boundary objects and mangle of practice and how it could prove to be a valuable tool, for unpacking the dynamism and complexity of how collaborative practices are constructed within globally distributed teams.

Chapter 4 - Research Approach

This chapter starts with providing a rationale of the research approach for this study. The main strategy adopted for studying collaborative practices within global agile teams is through an interpretive in-depth longitudinal case study, in order to answer the research questions. The chapter includes the research paradigm, the justification of an interpretive case study approach, and a description of how the data was collected and how the data analysis was carried out.

Chapter Five – Case Description

This chapter provides a historical background to the case study, and why there was a need for the PRIME project (pseudonym) within a global financial bank and how the globally distributed team was set-up across London and Delhi.

Chapter Six - Theoretical Analysis

Chapter six presents the thematic analysis of the research findings of the longitudinal case study by applying the concepts of boundary objects and the key tenets from mangle of practice that serve as a framework. The resulting analysis provides us with a much more nuanced understanding of the complexity of how collaborative practices develop through mediated interactions in globally distributed contexts. The results demonstrate the challenges that actors face in developing shared understandings to drive forward the joint software development process and move towards achieving agility within their projects. The results also allow us to gain a deeper understanding of how collaborative activities are constructed and reconfigured between the actors through the use of technology taking into account spatial and temporal factors.

Chapter Seven – Discussion

The penultimate chapter critically discusses the empirical results from the previous chapter and it is used to synthesise the primary contributions made. It shows how this study has significantly improved our understanding of globally distributed agile teams, in terms of how collaborative patterns are developed across geographical locations. The research proposes applying a pluralistic theoretical framework (Collaborative Tuning Approach), which explains how actors engage in activities which are not pre-set but evolve over time, moving towards tuning and reconfiguring agile practices to become hybrid agile practices in order to respond to contextual changes. This in turn, creates a valued interactive stability and a sense of agility within such complex contexts. The research contributes to a deeper understanding of how collaborative relationships manifest in globally distributed agile contexts through a performative perspective which previous literature has overlooked.

Chapter Eight – Conclusions

Finally, chapter eight concludes the thesis by providing a summary of the study, highlighting implications of the main theoretical and practical contributions of the thesis, developing the relevance of research within the domain of distributed agile contexts. The chapter acknowledges the limitations of the research approach while

making suggestions for future work within globally distributed agile contexts. See Figure 1.2 for thesis structure map against the research objectives (RO).

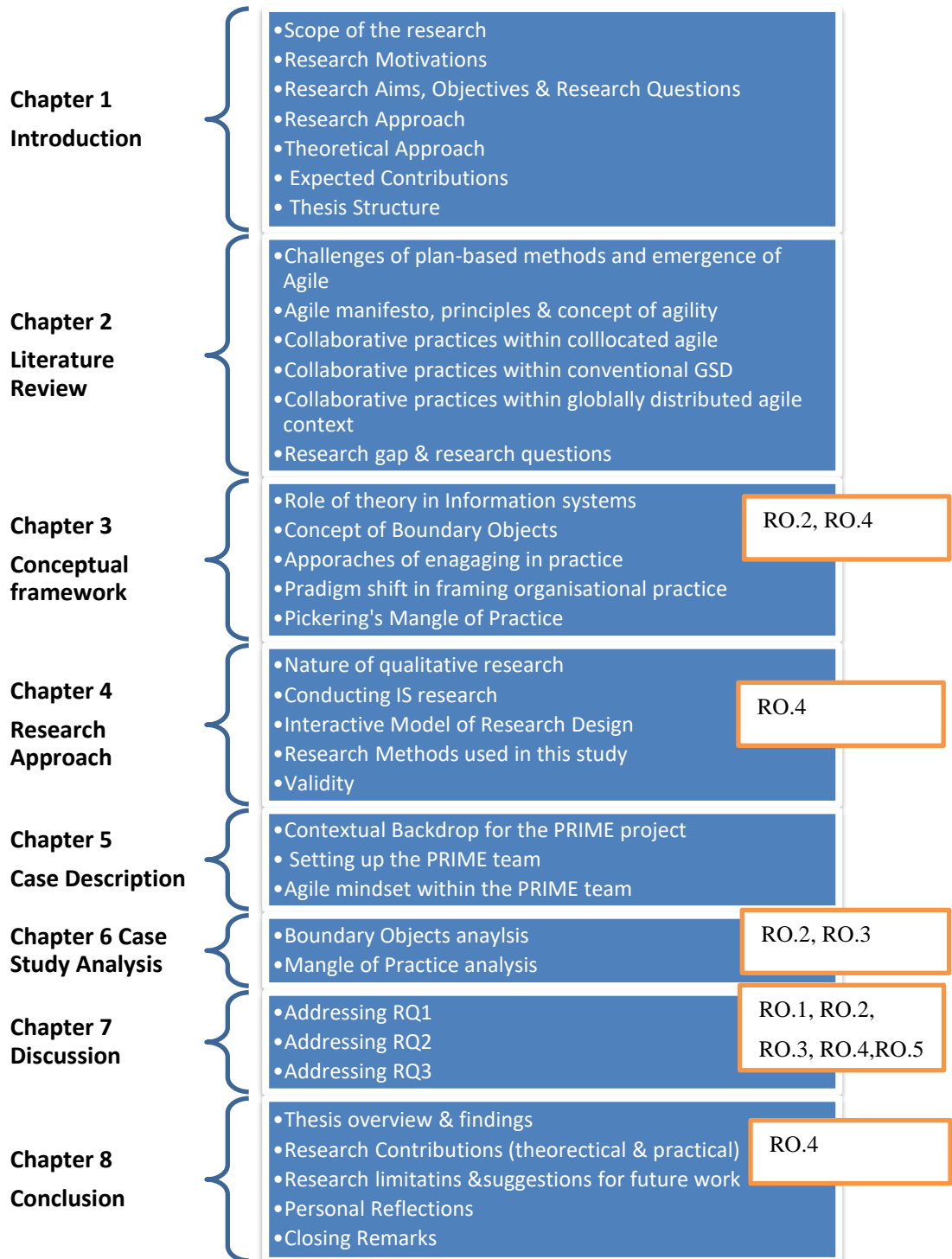


Figure 1.3: Thesis Structure Map

Chapter 2: Literature Review

2.0 Chapter Overview

The aim of this chapter is to explore and critically review the existing body of literature on the use of agile methods in globally distributed software development contexts. It starts off with a brief outline of the emergence of agile methods within the field of information systems development (ISD). Moving forward, it examines the existing literature on collaborative practices within collocated and globally distributed settings and identifies the research gaps within this area.

The chapter is segmented into six main parts. Section 2.1 sets the backdrop of this study, providing a brief overview of problems and criticisms with plan-driven methods, leading to the paradigm shift in thinking and emergence of agile methods. Section 2.2 presents the Agile Manifesto and the agile principles where they emphasise collaborative practices for developing software. In addition, this section discusses the challenges of defining the concept of ‘agility’ within the context of software development. Section 2.3 delves deeper by examining previous studies which have explored collaborative work practices within a collocated agile context to assess what insights can be gained from the previous studies.

Section 2.4 considers a separate strand of research related to this study namely: conventional global software development (GSD) and global software engineering (GSE). The aim here is to review existing work on collaborative work practices within the conventional global context and how these studies can inform the area of global agile contexts. Section 2.5 focuses specifically on existing studies which have considered collaborative work practices within globally distributed agile contexts. Finally, Section 2.6 concludes by identifying the “research gap” and framing the research questions for this study. A literature review map is illustrated in Figure 2.1.

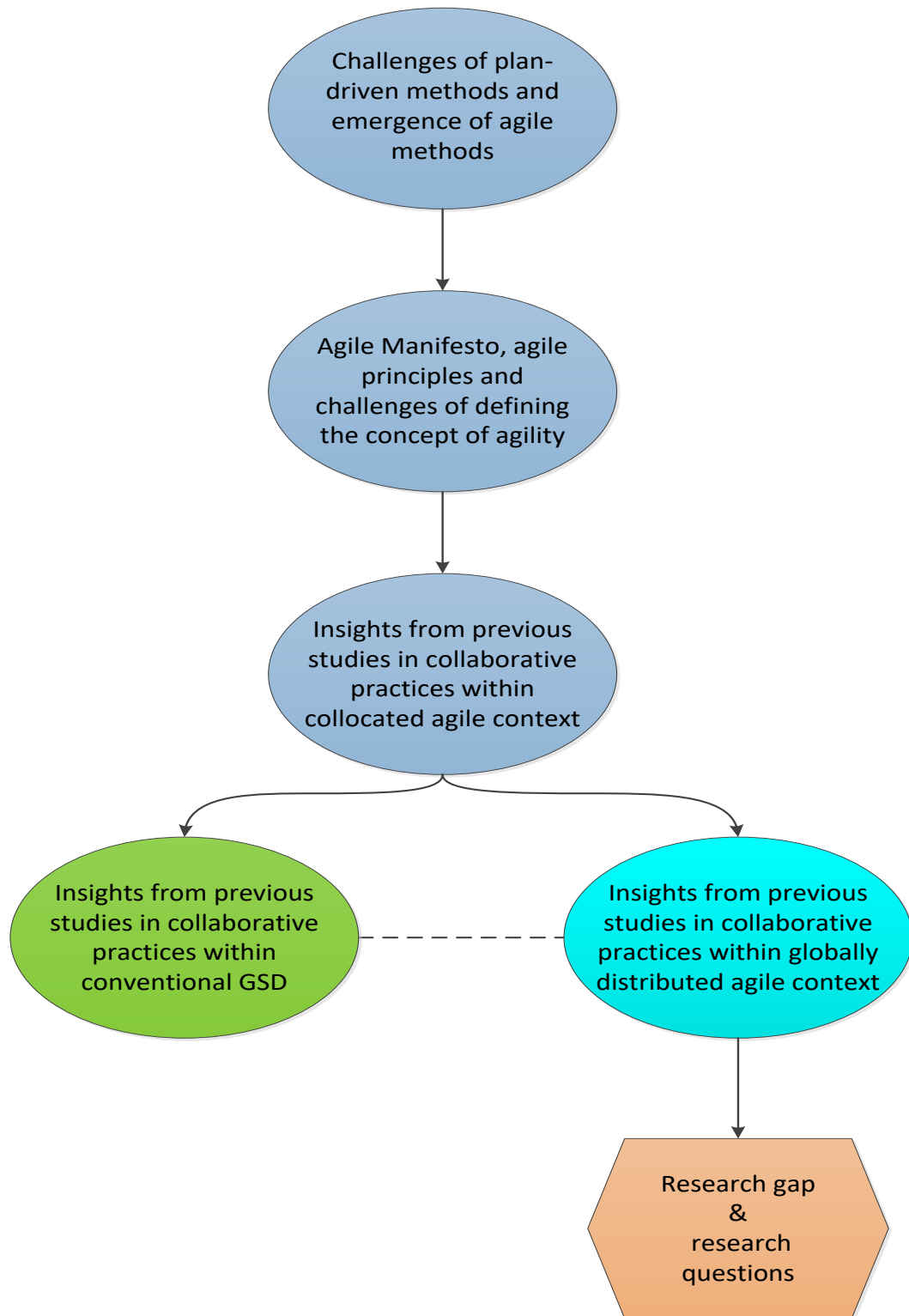


Figure 2.1: Literature Review Map

2.1 Challenges of plan-driven methods and emergence of Agile

The discipline of information systems is fundamentally linked to information systems development (ISD) (Bacon and Fitzgerald, 2001; Baskerville and Myers, 2002; Sidorova *et al.*, 2008). Indeed, Sidorova *et al.*, (2008, p. 475) posit that: “*Information Systems academic discipline focuses on how IT systems are developed and how individuals, groups, organisations, and markets interact with IT.*” Similarly, Baskerville and Myers (2002) and Davis (2000) outline five bodies of the knowledge² developed in the information systems discipline, one of them being information systems development concepts.

All software methodologies are intended to enhance the IS development process to understand and communicate the knowledge aspects, improve the development process; hence they try to improve the productivity of the programming and testing phases and make IS systems easier to run and maintain (Avison and Fitzgerald, 2006). However, some methodologies differ in terms of the techniques they offer. In some cases they consider the whole perspective of IS, while others concentrate on particular phases and offer specific techniques for those phases (Nandhakumar and Avison, 1999).

A review of ISD from a historical perspective was also carried out by Avison and Fitzgerald (2003) who viewed information system development methodologies in four different time eras (see figure 2.3).

² Five bodies of knowledge which are part of information systems discipline are: information systems management processes, information systems development processes, information systems development concepts, representation of information systems and application systems (Source: Baskerville & Myers, 2002).

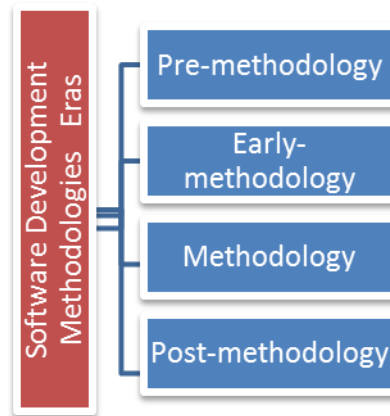


Figure 2-2: Software Development Era (Source: Avison & Fitzgerald, 2003)

The historical roots of many of the agile methods stem from the drawbacks of plan-driven methods or the “Waterfall Model” (Royce, 1970), based on the principles of engineering or hard systems thinking where the software developers were unable to deliver the software on time. These methods were criticised for being inflexible, having excessive documentation and being unable to adapt for unpredictable or turbulent environments (Highsmith and Cockburn, 2001). Additionally, they could not cater for changing requirements within the project timespan (Highsmith and Cockburn, 2001; Nerur et al., 2005). This led to a critical juncture where organisations were reappraising and reflecting on the usefulness of the earlier chosen methodologies and looking for alternative solutions. This was recognised by a field-study of a large scale development which concluded that “*traditional methodologies are too mechanistic to be of much use in the detailed, day-to-day organisation of developers*” (Nandhakumar and Avison, 1999, p.197). Truex et al.(1999) additionally highlighted that the organisations were becoming “emergent” as they were continuously adapting to shifting environments and the pace of organisational change was in a constant flux, being driven by rapid development of commercial technology and global markets. The authors suggested that traditional information systems development (ISD) goals have to be revoked for an alternative ISD goal set where “*systems should be under constant development, can never be fully specified and, like the organisations for which they are built are subject to constant adjustment and adaptation*” (Truex et al., 1999, p. 121).

In parallel, the research community started to examine how ISD methodologies were actually being used in practice (Fitzgerald, 2000; Russo and Stolterman, 2000; Lyytinen and Rose, 2003). Fitzgerald (1997, 2000) using empirical findings, confirmed there was strong evidence of an altered software development environment; experienced developers were reporting that projects of long duration were not acceptable as the underlying business needs could have changed radically in the meantime. Additionally, existing systems development methodologies were not being used per se, but were being tailored or adapted to particular development environments. Hence, to leverage these very different business environments, there was a need for ‘new’ methods which needed to suit such organisational environments. Fitzgerald’s research indicated that developers should have high-level building blocks rather than prescribed low-level steps to be followed in a sequential manner and allowing for more rapid systems delivery rather than monolithic development approaches. There was a need to have broader guidelines which could help integrate and adapt software packages for outsourcing and propose practices such as time-boxing for ‘frequent tangible returns’. These findings also concur with another qualitative study (Lyytinen and Rose, 2003) where eight systems development firms developed internet-based systems. These organisations felt that traditional methodologies were heavy and useful for legacy systems, and they could not be applied to developing internet-based systems which needed “very lightweight” processes. Fowler (2001) indicated that as a reaction to the traditional heavyweight methodologies, a group of new lightweight methodologies emerged providing “just enough process”. The two main differences between heavyweight and lightweight methods were that the latter are: (i) “adaptive rather predictive” and (ii) “people-oriented rather than process-oriented”.

From these insights into ISD methodologies in the late 1990s and early 2000s, it can be seen that there was a distinct paradigm shift questioning the utility and efficacy of traditional or plan-driven systems development methodologies in a faster-paced business environment. There were tremendous changes due to the influx of new technological changes such as the use of the internet, web-based applications and expanding global competition; leading to raised expectations for users and stakeholders for the availability and immediacy of services. Additionally,

the use of ISD methodologies in practice were often adapted or tailored for contextual use. Therefore, as a reaction to the bureaucracy of the heavy methodologies, new lightweight methods started to emerge in the information systems development arena.

Further, other responses to alternative information systems methods were also suggested such as McCracken and Jackson (1982), who proposed an “evolutionary software development method” where users’ experience was incorporated in the software development lifecycle in different stages. Boehm, (1988) suggested the “spiral method” which had important influence on software development methods - an iterative approach compared to the sequential approach. In this method, the lifecycle is understood as a spiral where the start of the project is based within the heart of the spiral and the project stages develop in an iterative manner. Additionally, the method introduced a risk driven approach compared to the previously document driven and code-based approach in the plan-driven methods (Misra *et al.*, 2012).

The ongoing debate presents the strengths and weaknesses of traditional or plan-driven and agile based methods; however, they can be seen as different approaches at the opposite ends of the spectrum (Boehm, 2002). Where traditional plan-driven methods drew parallels to the industrial revolution and their efforts to better organize the software production process, agile methods are based on “intensely iterative processes” allowing for flexibility and adaptability (Austin and Devin, 2009). However, they have been well received by information systems development communities (Conboy, 2009), as within agile methods , the design phase is not as prescribed or formal as in plan-driven methods; agile allows software developers to work towards shorter milestones and deliver and release software to the users far more frequently. Usually, the development of the project proceeds without much loss in productivity. Advocates of traditional plan-driven approaches however, would argue that the key to developing a good software product is time spent wisely in writing the specification and developing the design which would lead to a better end product.

Agile methods encourage a focus on user needs, a necessity in turbulent business times and they try to embrace customer request changes in the next iteration (Cockburn and Highsmith, 2001; Lindstrom and Jeffries, 2004). However, this can be at the expense of trimmed down functionality. Supporters of agile have argued that plan-driven methods are far too bureaucratic and inflexible (Beck, 2000). Other researchers argue that it depends on the situation and the context (Boehm, 2002; Boehm and Turner, 2004; Harris et al., 2009) and the methodology must be tailored to suit the needs of the project or the organization (Fitzgerald, Russo and O’Kane, 2003; Fitzgerald, Hartnett and Conboy, 2006; Conboy and Fitzgerald, 2010).

It can be said that the movement from the static plan-driven methods towards the more dynamic collaborative approaches was driven by recognition of the importance of user involvement, accepting changing requirements and the need for stakeholders to be satisfied with the output of the project. This movement also shifted the need for an emphasis on up-front design, documentation processes and more towards delivering high quality software projects on time.

2.2 Agile manifesto, agile principles and defining agility

This section focuses on the Agile Manifesto, agile principles and how collaborative work practices have been articulated in the manifesto and principles. It is essential to understand the challenges of defining the concept of agility, especially in a globally distributed context where the barriers of time, space and culture come into play.

2.2.1 Agile manifesto and Agile principles

In 2001, 17 agile practitioners who shared this agile philosophy and values and who practiced various different agile methods came together to form what is now known as the Agile Manifesto which advocates to define “better ways of developing software” (Highsmith and Cockburn, 2001). The Agile Manifesto provides an encompassing framework for all agile methodologies by specifying agile values -

see Table 2.1. These values are supposed to govern the agile software development process. They are popular because they offer several advantages; for example, they provide flexibility and establish close communication with users. They also minimise risk of delays in output, since working software is delivered in increments and priorities can be re-evaluated at the end of each cycle. Continuous code integration in this approach allows feedback on continuous testing and errors are thus eliminated far earlier in the project lifecycle. The modular nature of Agile lends itself to object-oriented designs and tasks can be mutually shared between teams (Ambler, 2002). As agile methods provide flexibility, they are more suited to dynamic business environments where user needs and requirements are constantly changing and evolving.

Table 2.1: Agile Manifesto (Source: Agile Alliance, 2001)

Agile Manifesto	Description
Individuals and interactions over processes and tools	Enhance communication within teams and remove barriers
Working software over comprehensive documentation	Developers should spend more time coding and testing than writing extensive documentation
Customer collaboration over contract negotiation	Strong focus on the customer needs rather than developing formal contracts
Responding to change over following plan	Software teams should be able to respond to customers' changes due to changes in the business environment.

Underpinning the Agile Manifesto are twelve associated principles (Fowler and Highsmith, 2001) which provide guidelines of good practice for agile teams. These principles emphasise creating certain work environments in teams, so that the values and principles influence each other – see Figure 2.3.

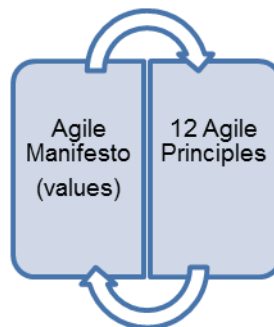


Figure 2.3: Influence of core agile values and agile principles

Table 2.2 : Agile Principles (Fowler & Highsmith, 2001)

Agile Principles	
P1	Our highest priority is to satisfy the customer through early and continuous delivery of valuable software.
P2	Welcome changing requirements, even late in development.
P3	Deliver working software frequently, from a couple of weeks to a couple of months, with a preference to shorter timescales.
P4	Business people and developers must work together daily throughout the project.
P5	Build projects around motivated individuals. Give them the environment and support they need and trust them to get the job done.
P6	The most efficient and effective method of conveying information to and within a development team is face-to-face conversations.
P7	Working software is the primary measure of progress.
P8	Agile processes promote sustainable development. The sponsors, developers and users should be able to maintain a constant pace indefinitely.
P9	Continuous attention to technical excellence and good design enhances agility.
P10	Simplicity - the art of maximizing the amount of work not done is essential.
P11	The best architectures, requirements and designs emerge from self-organizing teams.
P12	At regular intervals, the team reflects on how to become more effective, then tunes and adjusts its behaviour accordingly.

The agile philosophy advocates emphasis on customers or users, by providing the important parts of the working software earlier in the software development lifecycle. This places high prominence on productivity and delivering in an incremental manner, as opposed to providing a finished product at the end of the lifecycle. While consenting that dynamic business environments are the norm and that plan-driven or traditional waterfall methods are known for a slow adaption to constantly changing requirements, as a result, they nearly always have a tendency to exceed budget and have fewer features than specified (Boehm, 2002; Fruhling and Vreede, 2006). Agile methods provide the flexibility in the software development process by accepting “*feedback and change*” and “*embrace, rather than reject, higher rates of change*”(Williams and Cockburn, 2003, p.40). This is one of the significant differences between agile and plan-driven methods. In plan-driven methods however, the requirements are frozen in the initial stages of the project.

Due to volatility of the changing requirements, it is imperative for the software development team and the users to work with each other through the entirety of the project for a successful outcome. In agile software development, communication plays a great part and the nature of communication also becomes a vital issue. The principles specifically state face-to-face conversations are the most effective and efficient way. In plan-driven software development, the main vehicle of communication is the documentation produced not verbal communication. On the other hand, practitioners of agile software development depend on motivated individuals working together in a supportive environment, where they can implement and deliver successful project outcomes. In addition, equal importance must be paid to the quality of the design and yet provide a well-defined approach for the development process. To obtain the best design and quality in teams, the agile philosophy encourages self-organising teams with flatter structures that communicate often and offer flexibility of roles and responsibilities. In this way, they become more innovative and able to deliver the software project in increments successfully.

Ågerfalk and Fitzgerald, (2006) point out that one of the difficulties in trying to resolve the differences between agile methods and plan-driven methods is that agile methods are ahead of research and that they need to be better “conceptualised and theorised”. In trying to compare traditional systems development methods against agile methods, Nerur et al.(2005) highlight the differences from a management perspective - see Table 2.3; where control within agile teams is seen as people centric and management style is through collaboration.

Table 2.3: Differences between Traditional & Agile methods

(Source: Nerur et al.; 2005)

Concerns	Traditional	Agile
Fundamental Assumptions	Systems are fully specifiable, predictable and can be built through meticulous and extensive planning	High-quality adoptive software can be delivered by small teams using the principles of continuous design and rapid feedback and change.
Control	Process centric	People centric
Management style	Command and control	Leadership and collaboration

Knowledge management	Explicit	Tacit
Role Assignment	Individual – favours specification	Self-organising teams- encourages role interchangeability.
Communication	Formal	Informal
Customer’s Role	Important	Critical
Project Cycle	Guided by tasks or activities	Guided by product features
Development Model	Life cycle model(Waterfall, Spiral or some variation)	The evolutionary delivery model
Desired Organizational Form/Structure	Mechanistic (bureaucratic with high formalization)	Organic (flexible and participative encouraging cooperative social action)
Technology	No restriction	Favours object-orientated technology

2.2.2 Collaborative practices in Agile

The agile philosophy stresses the importance of collaborative work in a number of ways. Indeed, within two of the four values of the Agile Manifesto, collaboration is implied within: “Individuals and interactions over processes and tools” and “customer collaboration over contract negotiation”. Both these values encourage collaboration, working across teams and functionalities rather than working in silos. Interactions with the customers or stakeholders should be in essence seeking for flexible collaborative agreement, rather than having an inflexible contract. Collaborative work is also advocated in the agile principles (P4, P5 and P6 – see Table 2.2); there is an emphasis on working together daily and face to face conversations both of which engender trust. However, in order to develop this collaborative culture, there is a caveat put forward in P6, of providing a suitable supportive environment for the team. Additionally, P8 states that collaborative agile working teams should be working at a constant pace and have sustainable development schedules, rather than having teams which work excessive hours. The latter could be detrimental to the efficiency of the team members.

Surprisingly though, as part of Agile Manifesto and the agile principles, the term ‘collaboration’ or ‘collaborative work practices’ has not been clearly defined. This lack of a universal definition has led to varying interpretations about what is meant

by ‘collaboration’ within the agile context. Though, Sharp and Robinson, (2010, p.1) have put forward a definition of collaboration as: “takes place when two or more people are working together on a task”. However this definition seems to be rather limited, as it does not take account how the developers would come to create a shared understanding or of the importance of communication when team members are collaborating. Therefore, to utilise a more comprehensive definition for collaboration would be beneficial. Examining the literature more broadly, Bedwell *et al.*, (2012) have synthesized conceptualisations of collaboration across various disciplines and provided a comprehensive definition of collaboration which emerges from a multidisciplinary view and defines it as “*an evolving process whereby two or more social entities actively and reciprocally engage in joint activities aimed at achieving at least one shared goal*” (Bedwell *et al.*, 2012, p. 130). They argue that collaboration is an active evolving and improving process. Second, collaboration requires two or more social entities; this could be at individual or team level or beyond, such as organisation level. They also emphasize that collaboration is a reciprocal process and cannot be one sided as it requires active mutual engagement. Furthermore, collaboration requires participation in joint activities and it is aimed at achieving a shared goal.

Overall, this definition of collaboration is more detailed and would be useful within the agile context as it focuses on an evolving process where there is active engagement in joint activities, in order to achieve a shared goal. Though it does not fully capture the creative tension between the individual and the collective interest, the degree of tension would vary within each of the interactions.

This thesis draws on the Bedwell *et al.*(2012) definition on collaboration in the following sections. The next section discusses different agile methods under the general broad term of agile.

2.2.3 Different agile methods

Under the umbrella of agile methods, a number of distinct approaches exist which share the common values and principles mentioned above. A summary of those

which are considered to be the most referenced (Dybå and Dingsøy, 2008) are given in Table 2.4.

Table 2.4: Most referenced agile methods

(Source: Dyba & Dingsoyr (2008))

Agile Method	Acronym	Key reference
Dynamic Systems Development Method now AgilePM	DSDM	Stapleton (1997) DSDM Version 2 (Stapleton, 2003) DSDM Atern (Agile Business Consortium,2014))
Extreme Programming	XP	Beck (1999) Beck (2000) 1 st Edition Beck & Andres (2003) 2 nd Edition
Crystal Methods	Crystal	Cockburn (1998) Cockburn (2002)
Scrum	Scrum	Beedle, Devos, Sharon, Schawaber & Sutherland (1999) Scwaber & Beedle (2002)
Adaptive Software Development	ASD	Highsmith (2000)
Feature Driven Development	FDD	Coad & Palmer (2002)
Lean Development	LD	Charette (2003) Poppendiek & Poppendiek (2003, 2006),
EVO	EVO	Gilb (2005)
Agile Unified Modelling	AgileUP	Ambler (online 2005, 2008)

Although these agile methods have different focuses, they do share much in common, in terms of the collaborative practices within the phases of the project lifecycle, the short iterative lifecycles and frequent feedback from customers. Among them, Extreme programming (XP) and Scrum are considered to be most commonly used agile methodologies with practitioners. From a very large recent survey 68% of the organisations still adopted Scrum and XP/Scrum hybrids in the past decade (VersionOne, 2017).

The next section considers the challenges of defining the concept of agility from the ISD perspective and the challenges of achieving agility.

2.2.4 Challenges of defining the concept of agility

The most commonly accepted description of agile stems from the Agile Manifesto (Fowler and Highsmith, 2001), where a number of approaches and similar objectives of planning and developing software were unified under one umbrella of a common set of high-level goals and values. However, one ongoing major issue within agile research is concerned with differing views about the concept of ‘agility’. (Abrahamsson, et al., 2009 p.281) highlight that “almost every piece of research adopts a unique interpretation of agility”. Conboy (2009) corroborated this finding and further argued that the literature within ISD on agile methods suffered from a number of problems; one of these was a “lack of theoretical glue” around agile methods. Although the concept of agility links these methods together, there is a general lack of clarity as it is a “highly multi-faceted” term used by many people to refer to a number of different things.

The agile principles are seen as recommended guidelines for delivering high-quality software, implying that at the core of the principles there was the necessity of agility entailing the ability to rapidly and flexibly create and respond to changing business needs (Highsmith and Cockburn, 2001; Henderson-Sellers and Serour, 2005; Dingsoyr *et al.*, 2012). Boehm and Turner (2004) did not define the concept of agility, but they identified five critical factors which can affect agility within a project as: (i) size of the team, (ii) criticality of the project, (iii) dynamic environments, (iv) personnel within the team and (v) culture of team in terms of degrees of freedom.

A summary of the studies which focus on defining the concept of agility has been illustrated in time order in Table 2.5.

Table 2.5 : Differing definitions of agility within ISD

Authors	Definitions of Agility within the ISD literature
Sambamurthy, et al.,(2003, p. 245)	Have defined agility as “ <i>the ability to detect opportunities for innovation and seize those competitive market opportunities by assembling requisite assets, knowledge, and relationships with speed and surprise</i> ”.

<p>Henderson-Sellers, B; Serour, (2005, p. 6)</p>	<p>Offered dual-dimension of agility as: <i>“A dual - agility method must be flexible enough to be reengineered to suit different projects, organizations, or even domains. A dual-agility method must be able to adapt rapidly to requirement changes even at later stage, and environmental changes such as the project size, scope, and domain.”</i></p>
<p>(Erickson, Lyytinen and Siau, 2005, p. 89)</p>	<p>Associated agility with concepts such as <i>“nimbleness, suppleness, quickness, dexterity, liveliness or alertness”</i> and they clarified it further by stating <i>“to strip away as much of the heaviness, commonly associated with traditional software-development methodologies, as possible to promote quick response to changing environments, changes in user requirements, accelerated project deadlines and alike”</i>.</p>
<p>(Overby, Bharadwaj and Sambamurthy, 2006, p. 122)</p>	<p>Defined agility as <i>“types of environmental change that firms must be able to sense and the types of responses that firms can implement.</i></p>
<p>(Lyytinen and Rose, 2003, p. 183)</p>	<p>Examined agility from the context of organisational learning and ISD, they defined it as: <i>“agility to sense and respond swiftly to technical changes and new business opportunities.”</i></p>
<p>(Lee <i>et al.</i>, 2006, p. 50))</p>	<p>Refer to information systems agility <i>“the ability of information systems development and deployment methods to swiftly adapt to the changing business requirements”</i></p>
<p>(Cockburn, 2007, p. xxvi)</p>	<p>Borrowed Goldman <i>et al.</i> (1995) definition of agility as <i>“dynamic, context specific, aggressively change embracing and growth orientated. It is about improving efficiency, cutting costs, or battening down the business hatches to ride out fearsome competitive storms. It is about succeeding and about winning profits, market share and customers in the very centre of competitive storms that many companies now fear</i></p>
<p>(Qumer and Henderson-Sellers, 2008, p. 280)</p>	<p>Defined agility as: <i>“Agility is a persistent behaviour or ability of a sensitive entity that exhibits flexibility to accommodate expected or unexpected changes rapidly, follows the shortest time span, uses economical and quality instruments in a dynamic environment and applies updated prior knowledge and experience to learn from the internal and external environment.”</i> Using this definition of agility they developed a four dimensional framework focusing on attributes of agility: flexibility, speed, leanness, learning and responsiveness.</p>
<p>(Conboy, 2009, p. 340)</p>	<p>Define software development agility as <i>“the continual readiness of an ISD method to rapidly or inherently create change, and learn from change while contributing to perceived customer value (economy, quality and simplicity) through its collective components and relationships with its environment.”</i></p>

(Sarker and Sarker, 2009)	Defined agility as the ‘ <i>the capability of a distributed team to speedily accomplish ISD tasks and to adapt and reconfigure itself to changing conditions in a rapid manner</i> ’. The authors also proposed an understanding of agility as having three dimensions: (i) <i>resource agility</i> - which consists of people-based and agility and technology-based agility; (ii) <i>process agility</i> which consists of methodology-based agility, temporal-bridge based agility and environmental awareness based agility; (iii) <i>linkage agility</i> which consists of cultural-mutuality based agility and communicative-relationships based agility.
(Lee and Xia, 2010, p. 88)	Defined software development agility as: “ <i>software team’s ability to efficiently and effectively respond to user requirement changes</i> ”. They used two dimensions of agility to see the effect of software development performance in terms of on-time completion, on-budget completion and software functionality.
(Zheng, Venters and Cornford, 2011))	The authors proposed a term ‘ <i>collective agility</i> ’ “ <i>...is about accepting what is unpredictable and uncontrollable, while actively enacting those organizational dimensions that generate capabilities to perform under such circumstances.</i> ”

Roots of agile are set in manufacturing Sarker and Sarker (2009) and the initial definitions of agility are far too general, implying a lightweight methodology which does not necessarily consider all the characteristics of agility (Erikson et al.; 2005).

Although the Lytinen & Rose (2006) study considers the context of ISD in their definition of agility, their focus was specifically on refining the concept of agility from an organisational learning perspective. Cockburn (2007) cites a widely quoted definition of agility which stems from manufacturing and a management domain, but it is still not clear whether this definition of agility is most suitable within the context of ISD. Lee & Xia (2010) have defined the concept of agility within the context of software teams; however, their focus was solely on efficiency and effectiveness.

Taking a different perspective, Conboy (2009) presents a systematic analysis of the concept of ‘agility’ by comparing and contrasting the terms flexibility vs. agility and leanness vs. agility, and highlights the differences in the terms before proposing a nuanced definition of software development agility. The study went through an incremental concept development method where the final definition of ‘flexibility’ was specified as “*the ability of an ISD method to create change or proactively,*

reactively, or inherently embrace change in a timely manner, through its internal components and relationships with its environment” (Conboy 2009, p.336). Conboy stresses that although the terms ‘flexibility’ and ‘agility’ are very similar and closely related, such that some authors have used the terms interchangeably, there is however, a subtle difference between them. For instance, agility is concerned with the assumption that embracing change in a continuous manner is an ongoing activity. The literature on flexibility does not make reference to continuous or ongoing change (Conboy, 2009). Similarly, the study defines the term ‘leanness’ as the contribution of *“perceived customer value through economy, quality and simplicity”* (ibid, p.339). Although the terms lean and agility are closely related, ‘lean’ is more about delivering fundamental value to the customer. Hence, the term ‘agility’ is defined as *“...the continual readiness of an ISD method to rapidly or inherently create change, and learn from change while contributing to perceived customer value (economy, quality and simplicity) through its collective components and relationships with its environment”*. (ibid, p.338). In addition, the study provides a taxonomy of ISD agility which could suggest ways of contributing to agility – see Table 2.6.

Table 2.6: Taxonomy of ISD Agility (Source: Conboy, 2009)

Main ways contributing to agility/being agile	Aspects of agility
An ISD method must contribute to one or more of the following:	(i) creation of change (ii) pro-action in advance of change (iii) reaction to change (iv) learning from change
An ISD method must contribute to one or more of the following, and not detract from any:	(i) perceived economy (ii) perceived quality (iii) perceived simplicity
An ISD method component must be continually ready i.e. minimal time and cost to prepare the component for use.	

Though Conboy's (2009) definition of agility and the taxonomy are thorough and beneficial in that they provide overarching categorisations for ISD agility, they do not address how the agility concept could be translated within globally distributed settings, where the challenges of geographical, temporal and socio-cultural aspects

come into play. Second, it does not consider the importance of how collaborative work could be an aspect of agility.

Within the domain of globally distributed contexts, Sarker and Sarker (2009) have explored and analysed the concept of agility and proposed that agility has **three** dimensions:

(i) **Resource-based agility** has the elements of people-based agility and technology-based agility. This form of agility arises from the need of multi-skilled people with understanding of globally distributed contexts and also the technology-based resources needed for such contexts.

(ii) **Process-based agility** has the elements of methodology-based agility, temporal-bridge agility and environmental-awareness based agility. Methodology-based agility is concerned with the use of agile methods and practices guiding the project within global contexts. Temporal-bridge based agility deals with how a team can collaborate across locations and time zones seamlessly so that developmental work can be carried out without delays. Environmental-awareness based agility is related to the team's ability to monitor the project and recognise and react to changes within the project, so that developmental work does not get delayed within the global setting.

(iii) **Linkage-based agility** has the elements of being culturally sensitive and communicative-relationship based agility. The cultural mutuality-based agility consists of the team/s ability to create a mutual cultural sensitivity which in turn aids to develop a shared understanding across the global locations. Communicative relationship-based agility refers to the team's ability to communicate effectively so that there is continuous awareness and visibility of all the team members; it should also maintain close collaboration with key stakeholders.

Indeed, Sarker and Sarker 's (2009) study is comprehensive, as it examines the concept of agility from three different perspectives, for globally distributed agile contexts and it refers to the need for close collaboration with actors within the constituents of temporal bridge-based agility and communicative-relationship

based agility. However, the authors point out that there exists a lack of formal understanding of how collaborative practices should be carried out within globally distributed settings to support and enhance agility. One key challenge that still needs to be explored further is how collaborative practices support agility within globally distributed contexts.

From a more abstract perspective Zheng et al. (2011) explored the concept of agility within a distributed setting. The context of the study was the UK's computing grid for particle physics, which was a large scale distributed development setting. The authors focused on performance and organizational improvisations and they coined a term 'collective agility' which could be seen as an emergent and improvised performance of multiple collective organisational practices. In other words, actors draw on their past experiences to cope with uncertainties and undertake a trial-and-error approach until a solution emerges along the way. The findings of this study indicate that agility within distributed settings can be defined by performance of how the individual actors manage new tasks depending on their previous experiences. One of the limitations of this study is that the context of the study was quite distinctive and unique in terms of an experimental physics community. Therefore, one question that arises is whether globally distributed agile teams set-up in commercial contexts are able to sustain this trial-and-error method, since they would have to adhere to tight deadlines and work within set budgets. Moreover, the study did not really offer solutions as to how this collective agility could be translated into commercial environments.

It can be seen from the existing scholarly literature that there is no agreed definition for the concept of agility and it becomes a multifaceted term especially within globally distributed settings, as it requires a number of elements to all work in synergy to enhance agility within an agile team. However, within a globally distributed context, the challenge of supporting and enhancing agility becomes even more challenging due to the geographical, temporal and socio-cultural distances, exploring and understanding how collaborative practices are developed and cultivated within global settings becomes an important endeavour.

The next section reviews the literature which has examined collaborative work and practices within the collocated agile software development.

2.3 Collaborative practices within collocated agile contexts

Drawing on Bedwell *et al.*'s (2012) definition of collaboration can be useful in examining collaborative practices within the collocated agile context. Agile team members would usually start with initial communications and interactions which may contain degrees of tension between the individuals. These interactions move on gradually to building a shared understanding leading to developing shared goals through the use of agile processes and practices. Collaborative practices within the collocated agile literature have in principle, been examined from three key standpoints which influence and support collaborative practices: (see Figure 2.4)

- i) Communication
- ii) Coordination and artefacts used
- iii) Agile practices and techniques

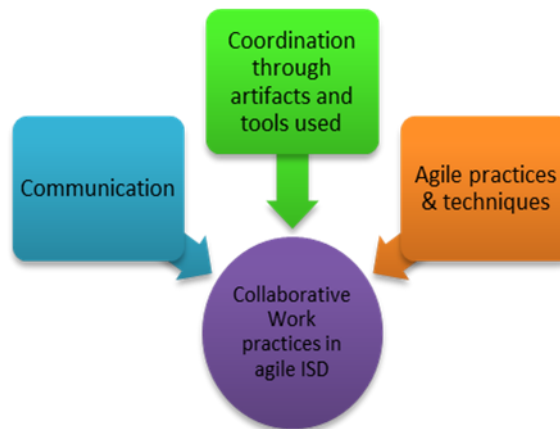


Figure 2.4: Main perspectives influencing collaborative work within agile

Although each of the above elements is discussed in turn below, they should not be seen in isolation but from a holistic perspective, where each one influences collaborative practices within agile.

2.3.1 Communication standpoint

In general, the agile literature suggests that communication plays a pivotal role within agile software development, which in turn has a major impact on collaborative work in agile teams. When the agile manifesto and its principles were articulated in 2001, the fundamental role of informal communication with agile software development was emphasised for both team members and when interacting with clients or users. Most studies seem to concur that face-to-face is the most effective and efficient means of communication (Melnik and Maurer, 2004; Fruhling and Vreede, 2006; Pikkarainen *et al.*, 2008; Misra, et al.; 2009).

According to Melnik and Maurer (2004), the role of conversation is one of the key elements for knowledge sharing and they propose that direct face-to-face communication offers richer communication channels due to the multiple cues. The authors point out that communication enables continual realignment of the team's developmental goals and they drew on Media Richness Theory (Suh, 1999) suggesting that physical presence, voice inflections and body language increase collaborative teamwork and shortened the knowledge transfer chain. Korkala, et al. (2006) emphasised the importance of meaningful communication in decreasing a number of misunderstandings - it can be crucial for effective collaborative work to develop shared understandings so that it "improves opportunities for learning".

Other studies focus on techniques which would enhance communication and collaboration. Robinson and Sharp (2005) convey that the pair-programming technique enables collaboration through conversation as "...a complex structure with identifiable episodes of exploration, creation, fixing & refining, overlaid with explaining, justifying & scrutinising" (p.105). Another study reported that within collocated XP teams, communication was far more efficient due to the physical proximity of the team members. This allowed team members to collaborate using whiteboards and shared open spaces. It also allowed team members to "*pull together to solve time-critical problems*" (Fruhling and Vreede, 2006, p.61).

Another important aspect of communication is the form in terms of 'formal' or 'informal'. Pikkarainen *et al.*, (2008) distinguishes between the two types of

communication and categorises ‘informal’ communication as face-to-face discussions in a collocated context and in distributed teams this would be done using the telephone, video or audio conference calls. On the other hand, formal communication is categorised as group meetings such as the Scrum daily stand-ups and other team meetings. The authors utilise dependencies from Coordination theory of Malone and Crowston (1994) to analyse the impact of agile practices in communication: (i) task-resource dependency, (ii) producer-consumer dependency, (iii) task-subtask dependency, (iv) feature–requirement interdependency. The study attempts to explain the interplay between communication mechanisms and agile practices within a collocated environment. It confirmed that the use of agile practices has positive effects on external communication and it aids in facilitating a more productive software development environment.

From a physical space perspective, Misra et al. (2009, 2012) examine communication within agile software development and found that the physical open working environment workspace plays a significant role in developing effective communication, collaboration and coordination in agile teams.

More recently, Hummel et al. (2013) carried out a systematic review on the roles of communication within the agile context. The authors argue that the majority of previous studies on the role of communication within agile research have provided a very broad understanding of communication and have not unpacked the process of communication. In a follow-up study, they specifically examined direct and indirect communication in two collocated agile teams (Hummel et al.; 2015). Their findings suggested that six agile practices could be categorised as “a set of social Agile practices”, and pointed out that these social practices could amongst the team members enhance collaborative practices. However, they also stressed that in certain situations there was also a need for indirect or formal communication as well. Their study extended the findings of Robinson and Sharp (2005), Maruping, et al., (2009) and So and Scholl (2009).

2.3.2 Coordination standpoint

Coordination is another influencing factor in promoting the collaborative agile practices. Sharp and Robinson (2008) studied collaboration and coordinating activities of three different collocated mature XP teams from a distributed cognition perspective (Hutchins, 1995). They considered three themes: the physical layout, information flow and the artefacts used by the team. They found that the physical layout of the office environment or the 'Wall' where the story cards or artefacts are organised as well as the actual medium of the story cards, had a great impact on the information flow, coordination and collaboration activities. The Wall not only provides the focal point for creating a coordinating structure and general awareness of the team's progress being tracked, but also promoted visible cues for each of the story card or user stories where the requirements or units of functionality were captured and written in a standardised manner. The authors argue that the physical nature of the Wall and the cards create a physical permanence and this could aid in coordinating collaborative practices, as it allows all individual actors to fully engage in the daily stand-ups and improve communication aspects. In a follow-up study, they developed this further emphasising that the coordination and collaboration activities depended on the strength of the interactions and communication (Sharp and Robinson, 2010).

Other researchers have studied coordination in agile teams based on Malone and Crowston's (1994) Coordination Theory (Pikkarainen *et al.*, 2008; Strode *et al.*, 2012). Pikkarainen *et al.*, (2008) study use dependencies from Coordination Theory dependencies to examine the coordinating and communication process within agile teams as previously discussed. This was followed by Strode *et al.*'s (2012) study where they examined coordination within agile software development collocated projects. They proposed that a coordination strategy exists within agile projects which consist of: synchronisation, structure and boundary spanning and that these mechanisms together enhance the coordination effectiveness. In other words, agile teams have to synchronise through activities like daily stand-ups to discuss or plan and through artefacts such as user stories created during these sessions. The second mechanism of the coordination strategy consists of the

structure achieved through proximity, availability and substitutability of the team members. The boundary spanning mechanism consists of activities, artefacts or a coordinator role which allows or aids interactions with people outside the agile team.

Although this study focused on coordination aspects of agile software development, it highlighted that coordination problems lead to difficulties in collaborative work within collocated agile contexts. Another coordination perspective examined by researchers is the challenge of inter-team coordination (see Section 2.5)

2.3.3 Agile practices and techniques standpoint

Previous studies in the agile literature points out that certain agile practices and techniques seem to have a greater prominence compared to others. For example, Abrahamsson *et al.*, (2003) advocated that agile methods take a people-centric view and were not suitable for solving all software engineering projects. The authors indicate that unless scalability of agile methods is not resolved they would not gain serious attention. Building on this, they develop an analytical framework comparing various agile methods to the software project lifecycle and identify the support agile methods provide for project management. The authors establish that not all agile methods offered complete project lifecycle coverage and support in project management. Therefore, development teams should consider methodological quality for each project undertaken.

There is an ongoing debate on whether XP practices facilitate more collaboration than Scrum practices. The literature points out that some XP practices such as pair-programming develop a collaborative relationship, as a method where two developers work together in a collocated setting sharing a workstation and taking turns in the defined roles of a driver and a navigator (Williams and Kessler, 2003; Beck and Andres, 2005).

MacKenzie and Monk (2004) argue that overall, XP practices are based on greater collaboration from team members perspective and they describe the pair-programming technique “*as intense and stressful*”. They highlight the importance

of conversation within pair-programming. Robinson and Sharp 's (2005) study takes this one step further and states that the pair-programming technique enables the collaboration process through conversation as “...*a complex structure with identifiable episodes of exploration, creation, fixing & refining, overlaid with explaining, justifying & scrutinising*” (p.105). Other studies identify a number of other XP practices which aid the collaboration process such as collective code ownership, refactoring, small releases, unit testing (Melnik et al., 2006; Conboy et al., 2007; Pikkarainen *et al.*, 2008). According to Balijepally *et al.* (2009) pair-programming can be viewed as collaborative programming as well, as individuals work in a collaborative manner on a particular programming task. They found that collaborating pairs had higher levels of performance and satisfaction compared to individual programmers. Plonka *et al.*(2012) found that although pair-programming is a collaborative activity there can be instances where it can foster disengagement, where a developer “drops out” and is not focusing on their partner’s activities. More recently Coman *et al.*(2014) contend that pair-programming is a formalisation of usual developer interactions and argue that mandatory pair-programming may be less inefficient, and suggest that other cooperative and collaborative team interactions which they identify as ‘back up behaviour’ or informal pair-programming should also be considered as a complementary technique in the software development process.

Other agile literature highlights that certain Scrum practices enhance communication and in turn collaboration such as the daily stand-ups, iteration planning meetings, sprint review and retrospective meetings (Pikkarainen *et al.*, 2008). Overall, the existing studies so far within collocated agile software development contexts, the process of collaboration has been examined but only as part of studying particular agile practices like pair-programming. What is surprising that hardly none of the studies so far, have really fully focused on unpacking how collaborative agile practices are carried out within agile contexts except for Sharp and Robinson (2008; 2010) studies, which examine collaborative practices within a collocated contexts only and not in globally distributed contexts. In addition, none of the studies so far within the agile domain examine how

collaborative agile practices can support or reinforce agility of a software development project.

The next section focuses on reviewing a parallel stream of literature which examines collaborative practices within conventional global software development (GSD) and global software engineering (GSE) contexts.

2.4 Collaborative practices in conventional global software development (GSD)

Issues on collaborative practices have been explored within the conventional global software development (GSD) and global software engineering (GSE) sub-fields, and it is necessary to review these studies to see what insights can be gained that can be applied in a global agile context.

Developing software within globally distributed contexts have increasingly become a norm for many companies due to accelerated deadlines of dynamic business environments. However, this phenomenon comes with its own set of challenges due to time, space separation, cultural differences and knowledge gaps. In addition, there are number of synonyms and these are often used interchangeably, such as global software development (GSD), global software engineering (GSE), distributed software development (DSD), global sourcing, offshore sourcing and the general term of global information systems development. Previous research has explored several key aspects related to globally distributed settings. This section considers the different perspectives of GSD research, with the aim to identify related research on collaborative work practices within this field.

2.4.1 Model-based perspective

Within the literature, some authors argue for a stringent model of ‘global software processes definition’ (GSPD) where processes and the documentation are defined and imposed by the headquarters of an organisation and they have to be followed by all the sites (Vanzin *et al.* 2005). However, this can prove to be problematic from

a number of perspectives, as not all global sites may understand or need all the prescribed processes. A prescribed model can undermine the need for a joint collaborative practice approach across locations, as in some globally distributed development teams' suitable processes dynamically evolve over time suiting onshore and offshore actors. Other researchers have studied the conventional phenomenon of global information systems development from a number of different perspectives.

2.4.2 Infrastructure-based perspective

One main perspective of IS literature has been based on providing a technical infrastructure for globally distributed IS teams (Herbsleb *et al.*, 2002; Carmel, 1999; Prikladnicki *et al.* 2003; Herbsleb, 2007). Carmel's (1999) seminal work on global software teams proposes a model based approach where he outlines five key challenges or 'centrifugal' forces for global software teams as: geographic dispersion, loss of communication richness, coordination breakdown, loss of 'teamness' and cultural differences. He proposes a centripetal forces model which offers a method of making global software teams more effective, where telecommunications infrastructure would be underpinning all the approaches and where the use of collaborative technologies was suggested as one of the main methods to support such teams.

2.4.3 Tool-based perspective

A number of authors (Prikladnicki *et al.*, 2003; Herbsleb *et al.*, 2007; Lanubile *et al.*, 2010; Portillo-Rodríguez *et al.*, 2012) take a tools-based perspective. Herbsleb *et al.* (2007) suggest that tools could aid in distributed interactions and in building the collaborative process. Lanubile *et al.* (2010) puts forward that collaborative development environments provides projects a workspace with a standardised toolset for global software teams, however currently no tools supports all the activities needed for a global software team. Portillo-Rodríguez *et al.* (2012) performed a systematic mapping review of GSD tools and concluded that most tools

support informal communication but there is a need for an evaluation of these tools in terms of wider usefulness.

More recently, Jimenez *et al.* (2017) states that global teams do have access to more advanced tools for collaboration such as Slack, Trello, Dropbox, GoogleDocs, however the authors emphasise that our understanding of the role of work and collaboration platforms needs to be extended and improved. Additionally, some of these tools may have issues of compatibility across locations and therefore agile methods used in collocated projects cannot be directly transferred for orchestrating global software environments, hence further work is needed to deepen our understanding in this area.

2.4.4 Distance-based perspective

Focusing on physical or the geographical distance perspective, Herbsleb and Mockus, (2002) and Mullick *et al.* (2006) point out the constraints this causes in terms of reduced intensity of the communication, cultural differences, challenges of coordination and control mechanisms in a globally distributed IS context. Sarker and Sahay (2004) argue that time-zone differences limit the opportunity for real-time collaboration, especially when the working hours of distributed locations did not overlap.

2.4.5 Human and social aspects perspective

Another set of the studies have focused on the human and social aspects of the globally distributed IS teams. For example, Kraut and Streeter (1995) argue that informal communication can play a critical role in coordinating activities which in turn can lead to successful collaboration. According to Herbsleb and Moitra, (2001) the geographical separation among project members has a number of diverse effects at many levels, where ineffective information, knowledge-sharing mechanisms and poor documentation can lead to unproductive collaborative development practices. Kotlarsky and Oshri's (2005) study focuses on human and social aspects of globally distributed software teams, but specifically on how successful collaboration can be

achieved within globally distributed contexts. They argue that collaboration is a complex, multi-dimensional process and they defined ‘successful collaboration’ as *“the process through which a specific outcome, such as a product or desired performance, is achieved through a group effort”* (Kotlarsky and Oshri, 2005, p. 38); this is broadly similar to the Bedwell et al.’s (2012) definition of collaboration as discussed earlier. However, their findings suggest that collaborative tools are insufficient for building successful collaborations. They propose a theoretical model where the key to successful collaboration draws on the concepts of knowledge sharing and social ties. The concept of social ties draws on the underlying constructs of rapport and trust and the concept of knowledge sharing draws on the constructs of transactive memory and collective knowledge. They argue that collaboration could be understood from a socio-constructivist perspective where social ties have to be developed and renewed and that through this participation knowledge sharing takes place.

2.4.6 Suggested practices needed for GSD

Noll et al. (2010) reviewed previous studies within conventional GSD domain to identify what practices can aid collaborative work. They determine that four practices are needed for collaborative work in conventional GSD:

- i) identifying common goals and objectives
- ii) collaboratively establishing and agreeing product ownership
- iii) collaboratively establishing interfaces and processes
- iv) collaboratively developing work plans which need to be carried out by the distributed teams

These practices support Bedwell et al.’s (2012) definition of collaboration in a general sense as discussed earlier. The authors pointed out that delays, lack of trust and not developing a shared understanding can impede collaborative practices. Their review also outlined the key potential barriers in such contexts; not surprisingly, these are geographic, temporal and cultural distances and the studies offered some potential solutions. Their study concluded that not all the projects are suited for an offshore model, and, at the outset of a project a number of factors

should be considered such as complexity, coordination requirements, organisational issues and the risks of the project.

Although this study is somewhat useful, the authors did not carry out an empirical study to validate their assertions. Furthermore, another systematic review within global software engineering (GSE) carried out by Šmite *et al.* (2010), revealed that one single solution or recipe does not exist for companies wishing to start successful global collaborations. Their research suggests best practices which could be used in globally distributed contexts such as:

- i) face to face meetings, exchange visits;
- ii) centralised project repository;
- iii) frequent synchronous communication and interactions;
- iv) reliable and rich communication infrastructure;
- v) consideration of task distribution and dependences and
- vi) incremental short development cycles

These best practices would also affect the quality of collaborative practices in globally distributed contexts.

Overall, as discussed above, conventional GSD studies have attempted to address different perspectives which can affect collaboration, but they tend to lack theoretical orientation and so far, only one study has offered us a theoretical framework for how successful collaboration can be achieved from a social ties and knowledge sharing perspective (Kotlarsky and Oshri, 2005). A number of authors have suggested best practices for collaboration within global contexts but these have not been empirically tested and the research tends to overlook how actors actually overcome the challenges and tensions within a global context. In summary, a number of authors have called for more empirical studies to be carried out to deepen our understanding of collaborative work within globally distributed environments from a socio-technical viewpoint.

The next section focuses more narrowly on reviewing previous studies within global agile contexts which have considered collaborative practices to see what insights have already been drawn.

2.5 Collaborative practices within globally distributed agile contexts

Although the general perception is that agile methods should be used within collocated environments, this assumption has been increasingly challenged, as more and more agile methods are being employed within globally distributed contexts. As discussed earlier in Chapter 1, a recent industry survey highlighted that the use of agile methods in distributed settings has risen dramatically to 86% (VersionOne, 2017)

A number of researchers have highlighted that the literature for globally distributed contexts is lagging behind practice (Ågerfalk and Fitzgerald, 2006; Ramesh *et al.*, 2006; Paasivaara *et al.*, 2008; Hossain *et al.*, 2009; Sarker and Sarker, 2009; Ramesh *et al.*, 2012). Therefore, it is essential that the research community investigates this area further so it is better theorized for a deeper understanding of how agile methods are adapted for global settings. Introducing and adopting agile methods within a globally distributed context brings about an additional set of challenges due to temporal, geographical and socio-cultural distances (Ramesh *et al.*, 2006). According to Shrivastava and Date (2010) globally distributed agile teams face a number of challenges in the following areas: documentation, pair-programming, different working hours, training in agile practices and distribution of work. They highlighted that the distribution of work is the most challenging as the teams would need think in terms of user stories and not system components and this would mean that team members would need to work more closely across the geographical boundaries. Furthermore, they emphasised that agile development is “hard” and distributed development adds to difficulty in software development, therefore it is important to examine how collaborative practices are carried out in globally distributed agile teams.

As discussed in Section 2.4, collaborative practices within an agile context can be examined from three main tenets which can influence and support collaborative work:

- i) Communication perspective
- ii) Coordination and artefacts perspective
- iii) Agile practices and techniques perspective

These perspectives should not be seen as mutually exclusive but overlapping each other and contributing to collaborative work within the agile context.

2.5.1 Communication standpoint

Previous studies have identified the critical role of communication and the challenges of collaboration within globally distributed agile contexts, mainly stemming from geographical, temporal and sociocultural distances. Ågerfalk and Fitzgerald (2006) reported that within globally distributed settings the communication problems are “exacerbated” and they propose that agile methods have to be tailored for such environments. Ramesh *et al.* (2006) proposed that within agile distributed contexts there is a communication need vs. communication impedance. In other words, how can the balance of formal and informal communication be achieved within global contexts? They suggest that using a broad range of communication channels and having an adequate structure aids in the coordinating and collaborating practice. In a follow-up study (Ramesh *et al.* 2012) proposed a conceptual framework which examined the conflicts of using agile practices within distributed settings from an ‘alignment vs. adaptability’ perspective in a distributed context – a conflict of needs between formal and informal communication needs to be addressed and mitigated in using agile practices. Their study revealed that agile teams tried to cultivate informal collaboration supplemented by documentation of critical artefacts. The participants in the study also used communication tools to support the collaborative endeavours. Although this study is useful as far as highlighting the challenges of communication in distributed agile contexts and how this can be mitigated with a semi-formal structures and adaptability, it did not take into account the interplay between communication and collaboration within distributed settings.

In a similar vein, Paasivaara, *et al.* (2009) and Hossain *et al.* (2009) focus on examining communication challenges in Scrum methods. Paasivara *et al.* (2009) suggest that in a distributed context, communication and collaboration could be enhanced by having multiple communication modes and having frequent visits across sites. They emphasised seeding visits, marinating visits and rotating visits;

these would give team members a number of opportunities to collaborate in person and could be carried forward to distributed environments. Hossain et al. (2009) highlighted that (i) distributed settings involving actors with cultural and linguistic diversity would not necessarily voice their views fully and could lead to miscommunication and misunderstandings and (ii) communication tools could be slow or have poor transmission quality thus leading to hampering of communication across distributed locations

Ali Babar et al. (2009) argue that within a global agile context one of biggest problems is cross team communication. A number of studies (Ali Babar et al.2009; Downs et al., 2010; Martini et al., 2013) point out different strategies to overcome these team challenges, such as promoting training on collaboration and coordination tools, providing multiple communication channels and tools to support synchronous face-to-face communication and promoting informal interactions. Where new projects are starting, encourage face-to-face meetings are also encouraged in order to reduce tensions and develop trust.

Alzoubi and Gill (2014) point out a number of different themes related to communication challenges in the context of global agile: people differences, distance differences, team issues, technology issues, architectural issues, processes issues and customer communication. They further identified that the people differences and distance differences were highly reported challenges. Other studies have argued that having large distributed agile teams wishing to work in a collaborative manner has an adverse impact on communication speed between the different distributed agile team members as there are different processes, practices and values across locations and sometimes this results in less collaboration (Martini et al. 2013).

Thus, so far, existing studies examining communication within global agile context have argued the importance of it and have identified that communication challenges can impede collaborative work practices; some of these studies have also identified possible ways of reducing some of these challenges. Moreover, the previous studies do not expand how collaborative work evolves and how communication can shape collaborative practices. Alzoubi and Gill (2014) and other studies have reported that

there is a vital need for more empirical agile studies within the domain of global agile software development.

2.5.2 Coordination and artefacts standpoint

Lee *et al.* (2006) suggest that within globally distributed agile contexts, four skill sets are necessary for agile project management: system localisation, task division and coordination, partnership management, and decentralised knowledge management skills. They argue that since the team members are globally distributed and culturally diversified, the tasks should be divided and coordinated in terms of culture and local expertise for successful development. There are a number of problems with this suggestion.

First, in practice this may not be easy to implement since not all software developers with the necessary skill set may be based in one location and therefore the tasks may not be easily divided. Second, this moves away from the agile philosophy of working in a collaborative manner.

A number of researchers (Hole and Moe, 2008; Hossain *et al.*, 2009; Li and Maedche, 2012) have examined coordination within a globally distributed agile context by using coordination mechanisms and coordination theory. Hole and Moe (2008) carried out a study which examines how coordination was carried out in three globally distributed agile teams. Their study used three coordination mechanisms as proposed by Mintzberg (mutual adjustment, direct supervision and standardization). In their study, all projects attempted to use Scrum for the first time and none of the remote teams had been trained in using Scrum, which resulted in a lack of understanding of agile methods and the philosophy of agile. This meant that all the projects relied on direct supervision due to a lack of understanding of the Scrum method. The study revealed that none of the projects succeeded in implementing the mutual adjustment mechanism and that a high level of trust is needed in order to reduce direct supervision and enable mutual adjustment.

Along similar lines, Hossain *et al.* (2009) study based on using Mintzberg's theory on coordinating mechanism revealed that a globally distributed team faces a number

of challenges and that the team does not use one agile method per se but a combination of practices from XP and Scrum. Their study reported that certain agile practices helped to maintain standardisation such as sprint planning meetings, retrospective meetings, coding standards, test driven development and refactoring. Direct supervision of teams and mutual adjustment were achieved through virtual daily stand-up meetings and various other meetings. Collaborative practices were initiated through different meetings. This study gave some insight into how global agile teams had started to adopt agile methods and selected a mixture of agile practices from different agile methods. Furthermore, Li & Maedche (2012) highlights that certain situational factors (task routineness, team empowerment and customer requirements) within the global agile context are different compared to conventional GSD. Their study findings also report that there are more coordinative mechanisms to be considered within global agile contexts and the impact of coordination effectiveness within such contexts is far greater than in the conventional GSD context.

Focusing on coordination within large-scale agile development, researchers suggest that an overarching coordination strategy could be implemented to manage multiple teams (Sutherland and Schwaber, 2007; Sutherland *et al.*, 2008; Paasivaara *et al.*, 2012; Scheerer *et al.*, 2014; Bass, 2016). Whereas within one team, a program lead or product owner would participate in what Sutherland *et al.* (2007) classifies as “distributed Scrum-of-Scrum”. This model attempts to manage the inter-team coordination needed for multiple projects. Similarly, Hossain *et al.* (2009) and Passivaara *et al.* (2012) have identified that inter-team coordination is challenging. Passivaara *et al.*'s (2012) findings reveal that the practice Scrum-of-Scrum gets severely hampered when there are too many participants taking part as it was difficult to keep everybody interested and suggest the use of small focused inter-team meetings where the participants would have joint interests and goals.

In a more recent study, Bass (2016) reported the use of artefacts for coordination purposes within a large-scale complex offshore distributed agile context; he found that organisations were not only using agile artefacts such as user stories, new feature requests, test criteria, but distributed teams were also adopting the use of

conventional plan-based artefacts such as reference architectures and risk assessment. He reported that these globally distributed large teams were blending in some aspects of plan-driven artefacts for coordination purposes in such large-scales distributed contexts.

In summary, existing research highlights that coordinating within globally distributed agile contexts is a complex and demanding activity and suggests the importance of using additional coordinative tools. Furthermore, certain artefacts in these contexts are not just as a mechanism for coordinating for individual team members but also aid across teams and therefore the visibility of the artefacts become crucial in such settings. The studies also highlight that coordination strategies have a major influence on how collaborative practices are carried out within global agile teams. However, so far existing studies have not specifically considered how actors within globally distributed agile teams overcome the challenges in order to carry out collaborative practices across locations.

2.5.3 Agile practices and techniques standpoint

Within collocated agile contexts, certain agile practices and techniques demand a greater emphasis on collaborative work compared to others and this seems to be also true within the globally distributed ISD context as well. A number of researchers have reported that within globally distributed agile contexts only certain agile practices are being used. For example, Kircher *et al.* (2001) recommend a Distributed eXtreme Programming (DXP) framework where only eight of the twelve XP practices could be applied to the GSD context, while the other four practices (planning game, pair programming, continuous integration and on-site customers) are dependent on having collocated teams. Holmstrom *et al.* (2006) found that XP and Scrum practices were both found to be beneficial for a global context as it helped reduce the socio-cultural distance of the teams in different locations. Furthermore, they specified that XP practices such a pair-programming were found to be more useful for the technical and programming aspects of the projects; on the other hand, Scrum practices were more useful as a framework for planning and tracking the progress of the project. The practice of pair-programming

is controversial within globally distributed context, where some researchers would say it is very challenging and increases communication overheads to perform in distributed settings (Kircher *et al.*, 2001; Sureshchandra and Shrinivasavadhani, 2008). However, others argue that pair-programming can stop collaborative work and can be a risk within globally distributed contexts (Canfora *et al.*, (2006). Whereas, other studies indicate that pairing sessions can be carried out in distributed settings using collaborative technology (Holmström *et al.*, 2006; Sharp, Giuffrida and Melnik, 2012)

Hossain *et al.*'s (2009) study focuses on the use of Scrum methods within globally distributed contexts and emphasising that it is one of the most popular approaches within a global context, as it offers rich collaborative work practices. However, they also point out that Scrum methods could be challenging due to a lack of effective collaborative tools and therefore such tools are a necessity within such contexts. Also, having dedicated meeting rooms with network connectivity is also conducive for collaborative work practices. They concluded that although collaborative practices are challenging within global contexts, it is feasible if it is facilitated by the right tool support.

Jalali and Wohlin (2010) reviewed 81 studies in the globally distributed agile context and they reported that the most common agile practices which are used within such contexts were: daily Scrum stand-ups, pair-programming, continuous integration, retrospective meetings, Scrum-of-Scrum meetings and test-driven development (TDD). Arguably, combining XP and Scrum practices seemed to be the most popular within a globally distributed context and they indicated that practitioners and researchers have different perceptions of what exactly agile practices are and how they document them. They highlighted the need for further research within the global agile context, as it remains largely under-theorised and therefore further empirical studies are needed where theory has been utilised.

In summary, although there has been a gradual growing number of agile studies within the globally distributed context, where a combination of agile practices are preferred rather than one particular agile method, researchers broadly agree that using agile methods and practices within the distributed contexts is more

challenging due to the increased complexity of a number of factors including time, space and culture separations. According to Bass (2016) in some global distributed settings, some agile practices are being used in conjunction plan-driven ISD methods. In other words, it can be argued that global agile teams are adopting various different strategies to overcome some of the non-routineness of activities. Though, what is surprising is that so far there is a lack of studies which focus specifically on how collaborative work practices develop to overcome challenges within globally distributed environments. Therefore, the thesis attempts to address this gap in order to understand how global agile teams orchestrate collaborative practices across locations.

2.6 Research Gap and research questions

To summarise, the literature review presented in this chapter sets the backdrop for the current study within the domain of globally distributed agile contexts. It has identified that there has been a paradigm shift from traditional plan-based methods to the emergence of agile methods which led to overarching values of the Agile Manifesto and the agile principles. The emphasis of the Agile Manifesto is based on embracing change, focusing on customer needs and developing software in a collaborative manner.

In light of the increasing use of agile methods within globally distributed settings, having an appreciation of how collaborative practices and shared understandings are developed has become even more critical. The dichotomy between plan-driven methods and agile methods is more prevalent within globally distributed contexts. In addition, not having an agreed definition of the concept of agility means that it is open for different interpretations by global agile teams. A number of scholars have presented various definitions of agility, though this may be a reflection of the different interpretations from the agile practitioners' perspective and that the roots of agility are in manufacturing. Furthermore, the empirical research within global agile has been lagging behind the actual practice.

The emphasis of developing collaborative practices stems from the Agile Manifesto and agile principles, implying that effective collaborative work practices are needed within agile teams and it is core to the success of ISD projects. Arguably though, within the agile domain the term ‘collaboration’ has not been clearly defined and therefore it is open for different interpretations especially within globally distributed contexts. This chapter suggests adapting Bedwell et al.’s (2012) definition on collaboration within the agile domain.

Overall, the existing literature refers to a very broad understanding of collaborative practices in that it is a complex and challenging process where all the team members have to participate and that “communication and collaboration” are at the heart of agile software development. (Karhatsu *et al.*, 2010, p. 298). There has been little attention paid to how these collaborative practices unfold and how they are accomplished within a real-time practice perspective. This question becomes even more pertinent in globally distributed settings as a number of challenges come into play of time, space, culture, increased complexity of activities and non-routine tasks. What is missing is a clear articulation of specific actions that can facilitate collaborative work practices within global agile teams. In order to explore and understand this problem area further, the chapter first examined how the concept of agility is conceptualised, though the extant literature does not directly indicate how collaborative practices can support within globally distributed contexts. Second the review examines existing agile literature which has considered collaborative practices from two different perspectives: collocated agile contexts and globally distributed agile contexts.

From the existing research it can be argued that collaborative practices within agile domains cannot be viewed in isolation, but are affected by the processes of communication, coordination and the types of agile methods and practices which are undertaken by the software development team. Previous work within the collocated agile context has highlighted team members’ use of various types of informal and formal methods of communication to enhance collaboration (Pikkarainen, 2008). Studies have also contended that shared understandings and the efficiency of collaborative practices are enhanced by certain elements: the

physical proximity/the physical layout of team members, the information flow within the team and the artefacts used by the team (Melnik and Maurer, 2004; Robinson and Sharp, 2005; Fruling and de Vreede, 2006; Sharp and Robinson, 2008). Other studies have focused on agile practices like daily stand-ups which act as coordination mechanisms and improve collaboration within the team (Strode et al., 2012). Furthermore, certain agile practices have been identified as a set of social practices, as they foster interactions and aid in strengthening collaboration within agile teams (Hummel et al., 2015).

A parallel stream of research within the conventional GSD/GSE sub-field was reviewed to examine how collaborative practices are carried out within this context to see if additional insights can be gained. Research in this domain emphasised that collaborative work practices are complex and challenging to carry out due to the challenges of space, time and cultural distances. Kotlarsky and Oshri's (2005) study proposes a theoretical framework for successful collaboration which has the concepts of social ties and knowledge sharing. Other studies within the conventional global context have suggested best practices for globally distributed contexts which could enhance the collaboration within global contexts (Noll et al., 2010; Smite et al., 2010). Overall, there are only a limited number of theory-based studies which have explored collaborative practices within global agile settings, and in general researchers have called for further research to be carried out.

Drawing attention to the juncture of global software development and agile, or globally distributed agile contexts, the existing literature highlights conflicts existing between the need for formal and informal communication as some of the prescribed agile practices rely only on informal communication. Some studies have suggested multiple modes or channels of communication and the use of supplementary artefacts (Passivara et al., 2009; Hussain et al., 2009; Ramesh et al., 2012), while other studies have emphasised the use of collaborative tools to overcome these communication and coordination challenges (Ali Barber et al., 2009).

Moreover, within the globally distributed agile context, there does not seem to be a 'one-size-fits all' agile method, but there is a need to adapt and appropriate agile

practices to the contextual needs, such that in some cases they become identified as 'hybrid-agile'. For agile practitioners wishing to embark upon using agile methods within these settings this has considerable implications, therefore it is important to explore how collaborative practices evolve, how are they adopted into global teams, what problems and tensions that they cause and how they aid in building shared understandings.

Having effective collaborative practices between onshore and offshore agile teams is core to the success of global agile software development projects. So far, there have been no studies which examine the crucial role of how collaborative work practices within globally agile distributed contexts actually take place in terms of unpacking and understanding how these practices evolve, how they are appropriated and re-appropriated, what problems and tensions do the actors face in these settings. Furthermore, the one key motivational driver of unpacking collaborative practices within global contexts is the belief that developing successful collaborative practices can lead to having shared understandings across the locations and support agility within software projects.

Therefore, this study attempts to build on a more comprehensive view of how collaborative practices unfold and evolve within a global agile context. Hence, having an understanding of collaborative practices between onshore and offshore agile teams deserves a separate and special attention as the challenges of such contexts are far greater than collocated contexts and are further intensified due to a number of factors as mentioned earlier: time, space and social distances.

Hence, the main aim of this study as briefly explained in Chapter 1 is being able to contribute to a growing body of ISD agile research to explore and understand how collaborative practices are carried out and enacted within globally distributed agile contexts. This would allow researchers to gain critical insights about how collaborative practices within global agile can potentially aid agile practitioners in the planning process of developing software across globally distributed locations. From the discussion of the existing agile literature three key research issues emerge:

- To unpack the “black-box” of agile collaborative practices within a global software team context. In other words, understand how an existing global agile team carries out collaborative practices and adapt agile practices/techniques for these contexts.
- To qualitatively examine how a globally distributed agile team evolves in developing shared understandings and shared goals such that it leads to working together in software development projects.
- To explore how collaborative practices can support globally distributed projects.

To address the above issues, this study will seek to focus on the following research questions for this study:

RQ.1: How do collaborative agile practices evolve in a globally distributed software team?

RQ.2: How can we conceptualise the collaboration process to better understand the underlying issues and challenges that a globally distributed agile team faces?

RQ.3: How can collaborative practices support agility within globally distributed agile projects?

To answer these questions, the study will also highlight the problems which are caused within global contexts while team members attempted to carry out collaborative practices across locations.

The next chapter will introduce the theoretical framework underpinning this research.

Chapter 3: Conceptual Framework

3.0 Chapter Overview

Before undertaking an empirical study of global agile software teams it is important to discuss the theoretical concepts this study will draw upon. The chapter begins with a discussion of the debate based around the importance of the role of theory within the Information Systems (IS) field in Section 3.1. Section 3.2 introduces the concept of boundary objects as it explains areas of enquiry related to coordination, supporting knowledge flows and facilitating collaborative practices.

Next, section 3.3 considers a diversity of different approaches of engaging in practice within a socio-technical organisational context, where section 3.4 points out that a theoretical paradigm shift is needed when researching contemporary organisational practices. Following that, section 3.5 focuses on one particular practice-based perspective, Pickering's Mangle of Practice (1995), emphasising how human and non-human actors are entangled in practice and how this approach would aid in understanding challenges and tensions of real-time practice in globally distributed agile contexts.

Finally, section 3.6 summarises the chapter and proposes the use of a pluralistic theoretical framework to study collaborative practices within global agile software teams. An outline map of the chapter is given in figure 3.1.

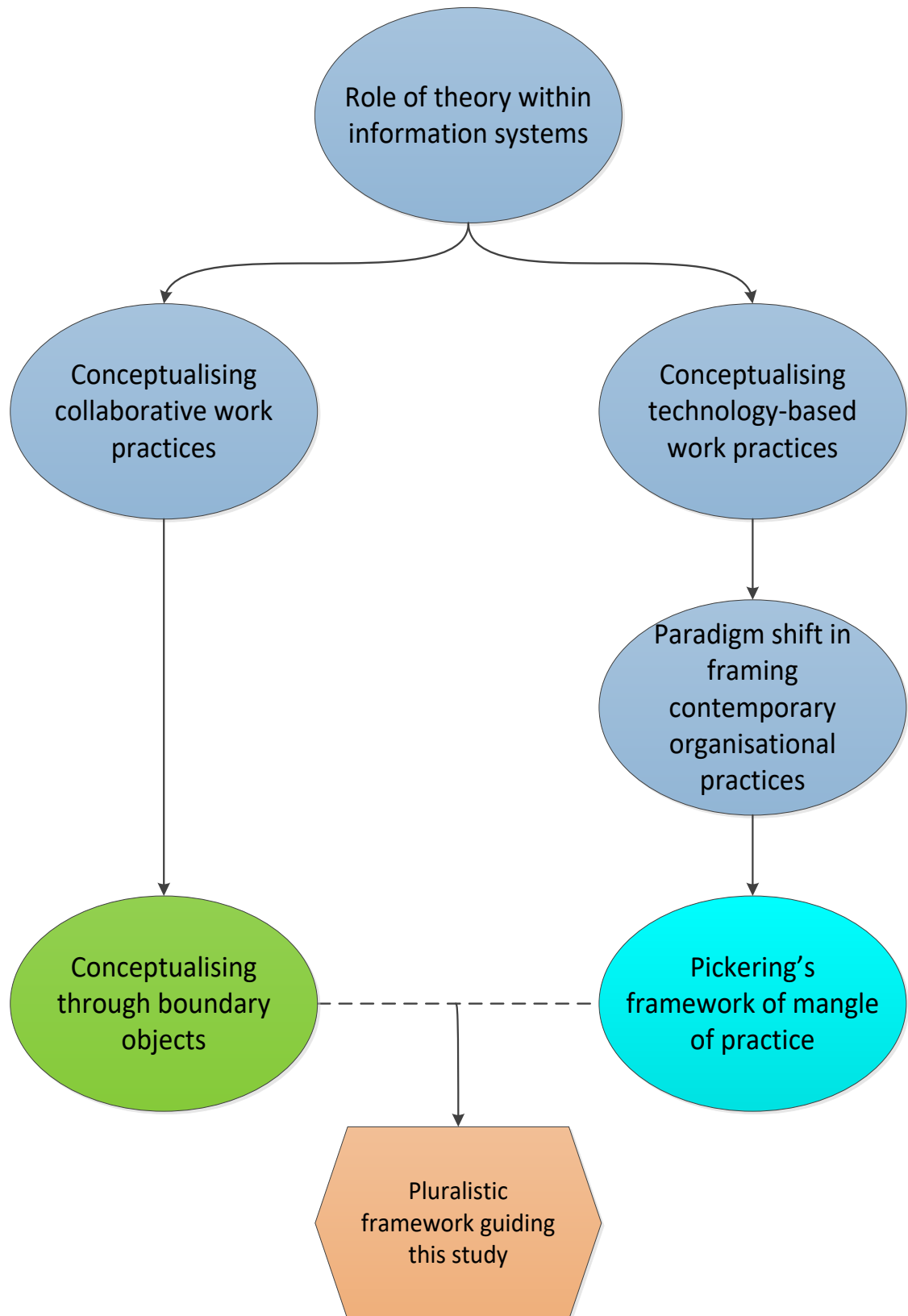


Figure 3.1: Overview of conceptual framework guiding this study

3.1 Role of theory in IS studies

Within the literature a number of definitions of ‘theory’ have been offered, one of the most common definitions has been offered by Leedy and Ormrod (2005, p. 4) where they posit that a theory “*is an organized body of concepts and principles intending to explain a particular phenomenon*”.

Within the field of information systems (IS), the importance of having theoretical foundations has been continuously discussed and emphasised since its inception (Weber, 1997, 2003; Lyytinen and King, 2004; Gregor, 2006; Markus and Saunders, 2007; Straub, 2012; Walsham, 2012). Gregor’s (2006) seminal paper on the nature of theories in IS research has intensified this discussion, where the paper sets out a taxonomy of five types of theory where each corresponds to a different contingent purpose (i) theory for analysing, (ii) theory for explaining, (iii) theory for predicting, (iv) theory for explaining and predicating and (v) theory for design and action. Focusing on theories that explain the phenomenon, type (ii) is where casual and conceptual links between the various constructs interact while the phenomenon is taking place. In other words, the role of theory is imperative as a basis for describing, explaining and predicting the phenomenon. The elements “what” and “how” constitute the subject of the theory, they describe what is happening and the “why” explains or is the “theoretical glue” that binds them together such that it gives a deeper understanding of the phenomenon (Whetten, 1989). The “who”, “where” and “when” are the contextual qualifiers which set the boundaries of generalizability and the range of the theory (Whetten, 1989). Grover *et al.* (2008, p.42) advocated that the “*essence of theorizing is not discovering significant correlations, but finding a deeper explanation*”. Thus, having a strong theory can provide a deeper analysis of a specific situational context, aiding in reducing the complexity of the empirical data and help advance knowledge within the field.

More recently, Jarrahi and Sawyer (2015) highlighted that IS research should be based around a sociotechnical premise consisting of: (i) mutual constitution of people and technologies; (ii) the contextual embeddedness of this mutuality and (iii)

the importance of collective action. The authors go further to argue that, given the broad scope of IS research, the sociotechnical perspective “*provides useful intellectual guidance to advance our theorizing on technological artefacts, and how people’s work practices and organisational arrangements are afforded by technological resources and inhibited by technological constraints*”.

Hennink, Hutter and Bailey (2011) argue that a conceptual framework maps the concepts and provides the reader with a focus and a structure of the study. It also provides clarity to the concepts that are being investigated in relation to the research questions and allows the researcher to reflect on the expected relationships between the concepts which are going to be explored in the study.

The rest of the chapter discusses two theoretical concepts: boundary objects and the practice-based theoretical approach of Pickering (1995) mangle of practice, leading to mapping a conceptual framework, which would aid in focusing and structuring the research.

3.2 Theoretical concept of boundary objects

The original concept of boundary objects was developed within the field of sociology by Star and Griesemer (1989), whilst investigating how diverse individuals within a museum environment manage to collaborate despite different backgrounds and cooperation between different groups. Boundary objects have been defined as “*plastic enough to adapt to local needs and the constraints of the several parties employing them, yet robust enough to maintain a common identity across sites.*” They are “*weakly structured in common use and become strongly structured in individual site use*” (Star and Griesemer, 1989, p. 393). The notion of boundary objects has been extensively applied in many different fields (Fox, 2011). Essentially boundary objects can be seen as entities that can enhance an idea, theory or practice across defined boundaries. In other words, in engaging practice, boundary objects can be seen as analytical tools which can be seen as conveyors of knowledge and expertise across and within communities, allowing communication and enabling collaborative work in developing new ideas. A number of scholars

(Wenger, 1998; Brown and Duguid, 2001; Fox, 2011) have pointed out that the boundaries themselves can play a critical role and can serve as barriers to the bodies of knowledge between different communities and the actors. These boundaries can lead to issues and problems in communication, coordination and knowledge transfer.

3.2.1 Boundary Object Typologies

Previous literature has identified the importance of boundary objects as a means of developing shared understanding across multiple groups. Star and Griesemer, (1989) developed the concept and categorised four different types of boundary objects as: (i) repositories, (ii) ideal types (iii) coincident boundaries and (iv) standardised forms. Star (2010, p.602) further clarified the concept by stating “*boundary objects are a sort of an arrangement that allows different groups to work together*”. Wenger (1998, p. 107) classifies boundary objects as “*artefacts, documents, terms, concepts, and other forms of reification around which communities of practice can organise their interconnections*”. Wenger (1998) synthesised Star and Griesemer’s discussion of the important characteristics of boundary objects being: (i) modularity - meaning that each group can relate to a different part of the boundary object and yet the object is still coherent; (ii) abstraction – denoting the regularity or commonness of the features without effecting domain-specific ones; (iii) accommodation – meaning that boundary objects are capable of lending themselves to a variety of interpretation and perspectives depending on the party concerned; and finally (iv) standardization meaning there is a unified format with regard to the content of information of boundary objects. The standardization of boundary objects allows several groups to deal with various issues in an effective manner.

Briers and Chua (2001) point out that between communities many boundary objects can exist such as “shared documents, tools, business processes, objectives, and schedules”, which can support coordination, record changes to create a “dynamic organisational coordination” (ibid, p.209). However, this can also cause disruption in communication, coordination and even lack of trust between the various

communities and therefore, they suggested that “intercommunal negotiation” is necessary where existing practices need to be reconsidered. Furthermore, the authors applied the concept of boundary objects to accounting packages and they suggested a fifth type of “visionary objects” and referred to them as “conceptual objects that have high levels of legitimacy within a particular community” (ibid, p.242). They gave examples of these as accountancy packages and tools that support change processes within organisations.

A number of studies have proposed alternative typologies for boundary objects. Wenger (2000) suggested a typology for boundary objects which covered three categories: (i) artefacts which covered entities such as tools, models and documents; (ii) discourses which included shared dialogues and communication across communities enabling them to negotiate shared meanings and (iii) processes which comprised of routines and procedures in order to achieve coordination across various groups.

Garrety and Badham (1999) differentiated boundary objects into primary and secondary objects. They classified primary objects as the technology utilised in the interactions across communities and secondary objects such as contracts which aid and assist in the communication across different communities.

Carlile (2002, 2004) applied the concept of boundary objects within the area of new product development to explore the transfer, translation and transformation of knowledge which can exist at boundaries. He proposed a framework for three types of knowledge boundaries namely: (i) syntactic, (ii) semantic, and (iii) pragmatic. A syntactic boundary is where a common syntax needs to be created between the actors so that the knowledge can be transferred. A semantic boundary is more complex since common meanings have to be developed in order to translate knowledge. Pragmatic boundaries can be viewed as the most complex as common interests need to be developed to facilitate processes for joint actions and can be viewed as transforming the localised embedded knowledge or “knowledge in practice”. Carlile's (2004) study focused not only on the knowledge boundaries, but also examined how a prototyping tool can be used as a boundary object and the role it plays in negotiations between the different actors. He pointed out that the capacity

of all the boundary actors cannot be assumed to be the same in understanding the common or shared knowledge.

Within the IS field, Levina and Vaast (2005) differentiate between two different types of boundary objects: ‘designated’ boundary objects are artefacts which are supposed to be valuable in accomplishing the boundary interactions due to their design and properties and boundary objects ‘in-use’ referring to artefacts which have actually been used within the “joint field of practice”. In other words, certain designated artefacts are being used by the actors who are engaging within the context of a joint practice. This differentiation between the two types of boundary objects is very significant as it highlights that certain artefacts may have specific features which potentially make them useful. However, these have not been necessarily adopted by the intended groups in the joint field of practice as they don’t meet the needs of both groups. Instead, other artefacts have emerged to become “boundary objects-in-use” which are more meaningful and useful to both groups, where they have a common identity in the integrated joint field of practice.

Nicolini et al. (2012, p.614) have defined boundary objects “by their capacity to serve as bridges between intersecting social and cultural worlds. Anchored in, and thus meaningful across, these worlds, they create the conditions for collaboration while, by way of their interpretive flexibility, not requiring “deep sharing.”

The above classifications highlight two essential aspects of boundary objects –first that they have an interpretive plasticity where they can adapt to the needs of the different communities or groups and act as knowledge vehicles or interfaces between two groups or communities. Second, they have the ability to retain a group or community’s identity or characteristics. Though, it is possible that in some cases boundary objects may act in an adverse manner such that they can act as an obstruction within the translation of knowledge.

According to Vakkayil (2013) the popularity of the analytical concept of boundary objects is that over time it has been applied in various disciplinary fields of inquiry, where studies have focused on different stances and perspectives. However, he points out that through the varied boundary objects literature three themes are

dominant: (i) enabling coordination; (ii) aiding knowledge flow; and (iii) facilitating collaboration differences - see figure 3.2 below.

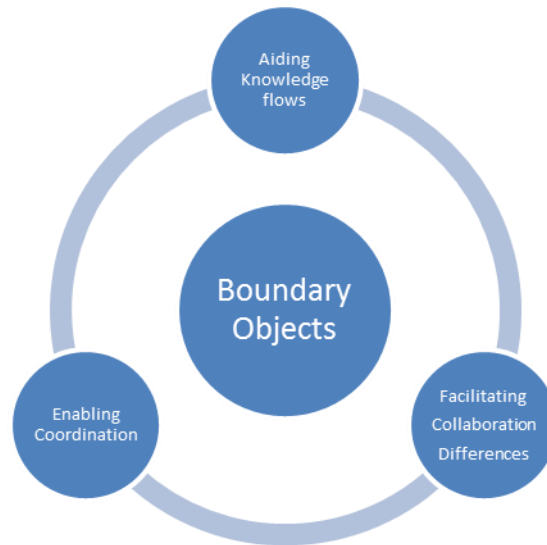


Figure 3.2: Three dominant themes using boundary objects

The next section discusses each of these three themes in turn.

3.2.1.1 Enabling coordination

A number of studies have emphasised how the theoretical concept of boundary objects has been used to theorise coordination between two groups. Indeed, Star and Griesemer (1989) original work, when introducing the notion of boundary objects, was to study the coordination mechanisms of scientific work between different communities within a natural history museum setting. Brown and Duguid's (2001) study identified boundary objects as architectural plans and blueprints and also extended the notion to technologies and techniques which are shared by various communities and they emphasised that these help in forging coordinating links. Yakura (2002) examined the use of Gantt charts within projects as “temporal boundary objects”. He proposed that timelines are a visual representation and they also have special narrative qualities which “distinguishes them from other organisational artefacts and explains some of their unique properties as tools for temporal coordination” (Yakura, 2002, p.956). Coordination

difficulties can arise due to differences in emphasised meanings, assumptions and different contexts which Carlile (2004) refers to as semantic. Kellogg, Orlikowski and Yates, (2006) explored how cross-boundary coordination was being carried out in fast paced or unpredictable work environments. They proposed a “coordination structure” and found that actors made their work more visible and legible to others by using common digital spaces. They referred to this as “display”, “representation” and “assembly” practices. This approach differed from Carlile’s (2002) boundary object framework, where the authors focused on the transformation process of adaption and ongoing alignment, having an emerging “collage effect” of loosely coupled contributions or work products. More recent literature on boundary objects discusses the use of “digital boundary objects” and how these can potentially aid enabling coordination activities and facilitate negotiating knowledge across organisation boundaries in large virtual engineering projects (Alin et al. 2013).

3.2.1.2 Aiding Knowledge Flows

The second theme considers how boundary objects aid in knowledge flows, where a number of studies have emphasised how boundary objects support and reinforce knowledge flows across various communities. Carlile’s work on boundary objects (2002, 2004) furthers this notion of knowledge flow where he differentiates the degrees of difficulty of knowledge sharing from syntactic, semantic to pragmatic. Carlile’s work was pivotal in advancing the understanding of boundary objects where he argues that they must be accessible by the different communities or groups and yet it should empower the actors within the different communities to develop their understanding of their knowledge over time. Taking this perspective further, Bechky’s (2003) study highlighted how boundary objects can be seen as vehicles to translate knowledge from one specialised knowledge domain to another. This study demonstrated the need for creating a common ground for communicating and invoking a knowledge sharing practice which re-contextualises local understandings.

Extending Carlile (2002, 2004) work, Swan *et al.*, (2007) examined the role of boundary objects within biomedical innovation drawing insights from symbolic

interactionism. In their study they found that semantic boundaries existed and actors imposed subjective meanings and different interpretations. They emphasised that although “not all objects are uniformly positive in the production of knowledge” (Swan et. al, 2007, p.1826), communities recognised this and accommodated for the differences in their interpretations in order to share knowledge.

Though in these studies the central concern has been to illustrate how boundary objects aid in knowledge flows, they have also pointed out controversy issues which can cause knowledge impediments such as power struggles between the different groups (Carlile, 2002; Levina and Vaast 2005; Swan et al, 2007).

3.2.1.3 Facilitating collaboration differences

Focusing on the third theme of collaboration, a number of studies have identified how boundary objects can aid in facilitating differences in collaboration across various boundaries. One of the main objectives of Star and Griesemer’s (1989) original work on boundary objects was to support collaborative work between various groups. However, some studies contend that the plasticity of boundary object concept is too loose, therefore it is difficult to establish agreement across communities whereas others argue that the flexibility of the concept allows for collaboration and negotiation within a project (Yakura, 2002).

Levina and Vaast’s (2005) study differentiated boundary objects as designated objects and boundary objects-in-use. Their study showed how boundary objects-in-use become more important and relevant within the joint field of practice enabling diverse groups to collaborate. In a further study, Levina (2005) expanded Schon’s ideas (1983) of reflective action and coined the term “collective reflection-in-action” which described the various conversations among the actors which brought about collaborative practices within the information systems design field. Taking this one step further, Barrett and Oborn (2010) examine the role of boundary objects within cross-cultural software teams where boundary objects at one point facilitate collaboration across knowledge boundaries and yet also contribute to conflict at other points which inhibited knowledge sharing. Their study also

introduces a term “culturizing” which refers to the process where negative cross-cultural difference occur and where cultural boundaries are “reified” when questions about the redistribution of power and authority arise.

Nicolini et al. (2012, p.614) assert that the different types of boundary objects are needed to address the challenges of a R&D project. They discuss that although the concept of boundary objects is very powerful and it plays an active role in collaborative practice, yet it has been increasingly stretched to explain “*all the types of work performed by material and symbolic entities*” across boundaries and therefore they contend that the stretching or plasticity actually distorts the usefulness of the concept. Hence, the authors propose that applying multiple theoretical lenses should be considered to develop deeper insights when considering collaborative work practices. In other words, taking a pluralistic approach with other theoretical concepts alongside boundary objects and “working these theories together” would provide deeper insights of cross-disciplinary collaborative work. The authors suggest that the role of objects is dynamic and transitional where an object may change its role and its status over time. Further, they suggest that when considering the collaborative practices, researchers should not only consider “what” objects are used, but also “when” and the probing for different meanings of the objects, as this in turn would aid our understanding when tensions arise due to objects. The authors acknowledge at present there is still a limited understanding of when and how boundary objects are useful in collaborative work and at what points do they cause tensions and conflict across boundaries.

A few studies have taken this approach of applying a combination of analytical concepts. Doolin and McLeod (2012) have applied the concepts of boundary objects and sociomateriality to analyse the development of a prototype. In line with Levina and Vasst (2005), the authors assert that boundary objects can hold different meanings depending on the context and that they exhibit a socialmaterial agency.

More recently, Levina and Vaast (2013) adopt a practice perspective suggesting that boundary objects take different roles, depending on the different types of boundary-spanning practices (transactive or transformative). In transactive mode the objects may help to map and aid in translating existing practices, whereas in the

transformative mode objects are used more to outline the differences in the contextual practices where new joint practices can be developed.

3.2.2 Motivation to use analytical concept of Boundary Objects

The motivation to use the analytical concept comes from the existing literature on the concept of boundary objects. The main reasons for using the concept of boundary objects as an analytical tool for this study are that:

- i) Previous studies within the IS field, have applied the concept of boundary objects and it has been shown to be valuable in providing greater insights of how distinct groups work together in coordinating and developing collaborative tasks (Yakura, 2002; Levina and Vaast, 2005; Barrett and Oborn, 2010).
- ii) As this study is based within a globally distributed setting, the challenges of the time and space come into play; therefore the reliance on artefacts becomes crucial, thus the need for artefacts to support the interactions and communicative links between team members to enable effective collaborative practices to take pace across the boundaries.
- iii) The artefacts or objects motivate the development of knowledge sharing activities across the boundaries.
- iv) To pursue collaborative practices across global locations objects aid in influencing and transforming new practices where a sense of co-development is formed.

More recent studies within the existing literature have combined the concept of boundary objects with other theoretical perspectives to gain a deeper insight into boundary work and boundary relations such as evidenced in Nicolini et al.'s (2012), Doolin and McLeod's (2012) and Levina and Vaast's (2013) studies. These studies highlight that the role of objects is dynamic in that it can change status and meaning overtime. Taking this viewpoint, the next section discusses the value of applying a practice perspective as a theoretical lens combined with the concept of boundary

objects to gain deeper insights of collaborative practices within the context of globally distributed agile settings.

3.3 Diversity of approaches of engaging in practice

The value of engaging in practice as a theoretical lens within organisational studies has largely been associated with acknowledging the social, historical and structural contexts in which the action or practice takes place (Corradi, Gherardi and Verzelloni, 2010). Feldman and Orlikowski (2011) emphasise that the central notion of a practice lens is “*that social life is an ongoing production and thus it emerges through people’s recurrent actions*” (p.1240). Current contemporary organisational structures can have complex, dynamic, distributed, mobile and other transient forms and are closely entwined with the work that people do. Therefore in order to develop accurate understandings and theorize such contexts, both the work and organisational forms have to be studied together (Ciborra, 1996; Barley and Kunda, 2001; Child and McGrath, 2001). The key idea behind practice-based studies is that it allows researchers to investigate empirically how contextual elements help shape the knowledge and the competence built around the doing of the actions. Gherardi (2009) and Corradi, Gherardi and Verzelloni (2010) argue that a single unified theory of practice does not exist. Orlikowski (2010) has differentiated between three prominent modes of engaging in practice: (i) practice as phenomenon, (ii) practice as a perspective and (iii) practice as a philosophy. Although these three modes are not mutually exclusive they do entail different assumptions of practice within the real world and they are considered in turn below.

3.3.1 Practice as phenomenon-based perspective

Within this mode of practice-based studies attention is rooted in the empirical approach, in trying to recognise and understand what practitioners do ‘in practice’ and what they gain in terms of practical and direct experience within the organisational structure (Orlikowski, 2010). The emphasis of this approach is

centred on the “what” of a practice lens focusing on the everyday activities of organising. It advocates that there is a large gap between theories and the “practice” lived reality. It endeavours to investigate practitioners’ social interactions, communications, challenges and breakdowns in detail by using techniques of ethnomethodology. This in turn helps to reveal a pragmatic accuracy or actual evidence which cannot necessarily be captured in theoretical models and frameworks (Schon, 1983; Brown and Duguid, 2001). Many of the studies from this perspective emphasise the importance of actors or human agency in producing the organisational practice without actually applying a theoretical lens.

3.3.2 Practice as theoretical-based perspective

In the second mode of practice-based studies the focus is centred on the theoretical approach which includes specific conceptual analytical grounding known as “practice theories” (Orlikowski, 2010). Although this practice perspective acknowledges having the focus on everyday activities, it is critically more concerned with explaining “how” the everyday activities are generated within the situated contexts and how they become reinforced or change over time (Feldman and Orlikowski, 2011). Postill (2010) distinguishes between first generation and second generation practice theories. The first generation key theorists were scholars such as Bourdieu (1977, 1990), de Certeau (1984), Garkinkel (1967), Foucault (1979) and Giddens (1979, 1984) who articulated the foundation of practice theories. Whereas the second generation (or more contemporary) scholars such as Ortner (1984), Latour (1987, 1995, 2005), Lave (1988), Pickering (1995, 2001), Engestrom (1999) and Schatzki (2001, 2002, 2005) have attempted to test and extend and build upon the concepts laid down by the first generation theorists. One of the key contributions of this perspective is considering practice as an analytical lens, can allow us to understand and articulate the theoretical relationships, which explain the dynamics of how everyday practices are generated, reinforced and changed within different contexts over time (Feldman & Orlikowski, 2011).

3.3.3 Practice as philosophy-based perspective

This third mode of practice-based studies is based on the philosophical approach focusing on a belief that social reality is primarily made of practices and rather than viewing the social world as separate and external to actors, it is constructed by and through the actors within everyday activities. This approach fundamentally attempts to answer the “why” of the practice lens perspective, critically focusing on the everyday activities which are the primary building blocks of social reality (Feldman & Orlikowski (2011). Compared to the other two modes, practice as a philosophy acknowledges a premise to a claim that “practices are a reality” and therefore studies in organisations “must be grounded ontologically, theoretically and empirically lived in practice” (Orlikowski, 2010, p. 27). Researchers using this approach focus on a distinct ontological belief that “practices are fundamental of the production of the social reality” (Feldman and Orlikowski, 2010, p.3).

3.3.4 Summary of engaging in practice

Overall, these three modes of practice-based perspective represent different interpretations of practice-lens research, which a researcher may undertake for a fieldwork study. For the purposes of this study, the second mode has been applied, the practice-based theoretical approach

The advantage of using a theoretical approach is that it can aid in explaining how everyday dynamic emergent activities and relationships are formed from a theoretical perspective. The research questions set out in Chapter 1 are based on finding out “how” do collaborative practices and shared understandings take place within globally distributed agile teams. Therefore the use of a practice-lens would be helpful as a guiding framework and could act as a conceptual scaffolding to gain a deeper understanding of how interactions are shaped and structured among the actors, activities, and the artefacts occurring within global agile contexts.

The next section explores the paradigm shift within the literature in framing contemporary organisational practices.

3.4 Paradigm shift in framing organisational practices

Rose, Jones and Truex (2005) contend that although theories like Giddens' Structuration Theory and Actor Network Theory (ANT) have been applied in IS studies; there are some concerns since these theories do not offer convincing accounts of the interactions between humans and technologies. Orlikowski (2005, p. 185) summarises that a structural perspective makes the "human subject the centre of action, where actor-network perspective adopts a post-humanist stance and decentring of the human-subject." Further, Orlikowski (2007)) argues that although existing studies have provided valuable insights of organisational practice, they are limited to some degree because they do not provide deep insights into how the organizing is bound up with material forms and spaces through which humans interact and practice. This is mainly due to the differing accounts of agency which make them difficult to integrate in a meaningful way and this poses a number of challenges when applied to the IS field. Existing views of materiality have either taken materiality for granted or have been downplayed.

Orlikowski (2007) points out that within the literature, materiality has been examined from distinct perspectives of technology adoption, diffusion and within and across organisations. This explicit focus uses a separate and distinct phenomenon occurring within organisations. Consequently, materiality is viewed as special cases and becomes problematic because it loses sight of how all organisational practices are bound up with materiality and integral to it. The second difficulty with this approach is that it focuses either on techno-centric perspectives or a human-centred perspective exclusively. The techno-centric perspective is interested in understanding how technology leverages human action, taking largely a functional view or instrumental approach, but this perspective ignores how technology is bound up with historical and cultural influences of the organisation. On the other hand, the human-centred approach focuses on how humans make sense of, and interact with technology in various circumstances. From this standpoint the focus is primarily on the human-side of the relationship, therefore Orlikowski (2005) posits that in order to gain a more insightful and analytical account of the

socio-technical perspective within the IS field we need to “move towards a perspective of constitutive entanglement in organisation practices as ‘social practices’” (Orlikowski, 2007, p.1438). Within sociology of science and technology studies, a number of studies have suggested theoretical frameworks for the recursive intertwining of humans and technology in practice. One such approach is mangle of practice (Pickering, 1995) which offers the recursive and intertwining relationship of the social and material as constantly ongoing and situated in practice.

Pickering’s work has also been categorised as “sociomateriality assemblages” which entails theorising the “inseparability between the technical and the social” (Orlikowski and Scott, 2008, p.454). Theoretical underpinnings of sociomateriality call for a distinct move away from an ontological separation of actors and technology as discrete separate entities or (even mutually dependent ensembles), and calls for a more focused approach on how actors, organisations and technology are inter-related through a temporally emergent entanglement of everyday organisational activities and relations in practice. In other words, from this perspective, actors and materiality (technologies and artefacts) “...start out and forever remain in a relationship”.

For the purposes of this study the concept of Pickering’s Mangle of Practice will be applied as a scaffold to explore the collaborative work practices within globally distributed agile teams, which is discussed in the next section.

3.5 Pickering’s Mangle of Practice

Pickering’s view of scientific practice is that it should not be viewed as facts or observations, but rather as a “performative idiom”, in other words what activities are achieved through practice. This approach focuses on “temporal unfolding” or “temporally emergent structures”, gaining a “real-time understanding of practice” (Pickering, 1995, p.3). Within the field of science and technology studies (STS), Pickering (1993, 1995) sets out to develop and build a theory within the realms of the “performative idiom”, by exploring how human and material agency (or nonhuman agency) are intertwined – thus his analytical focus is based on the

interplay between social (human agency) and technical (material or nonhuman agency). It differs from Actor Network Theory (ANT) in that Pickering does not assume that there is symmetry between human and non-human agency. Pickering's initial work was to consider scientific practice in terms of what scientists do, and the performance of the material world. He posits that they are interlaced with each other where there are performative struggles between the two. He then proposes that these struggles are not only seen in scientific practice but also in social settings between human and non-human agency. In his book *Mangle of Practice*, he refers to the "dance of agency" where there is a performative back and forth between human and non-human agency.

Mangle of practice is based on human agency having intentionality while the non-human or material agency does not have this intentionality, but has the power of performativity. Pickering uses the metaphor of a mangle within a laundry setting, where human and nonhuman agencies intertwine and emerge wrung through. Although his focus is based on the interaction of human and nonhuman (material) agency he acknowledges a disciplinary agency exists as a means of shaping the bodies of knowledge, which hold conceptual practice of particular disciplines. He gives an example of disciplinary agency as elementary algebra where recognising the symbols would be part of the discipline of algebra. The disciplinary agency provides the scaffolding and rules which are followed in a particular discipline. In addition, Pickering (1995) suggests that to analyse real-time practice it should not "pose no problem" and it "should be seen as part and parcel of the mangling process" (p.55).

Other prominent sociologists such as Callon (1984) and Latour (1987) have also discussed the notion of agency within Actor Network Theory (ANT). Though, within ANT, human and material (non-human) agencies are treated symmetrically; in other words human and material agencies are understood to be as equal partners. Jones (1998) argues that ANT, by treating social and material agencies symmetrically, gives capabilities to technology (or material agency), that are considered to be humans –and hence diminishing the potential for human agency. He further emphasises that in practice humans and machines are different, and both

deserve proper considerations. Leonardi and Barley (2008) concur with this and point out that the role of technology's materiality is not deterministic adding that the interactions between humans and technologies can lead to actors adapting their practices.

Pickering draws on ANT, but takes a different theoretical stance on agency, where the notion of material agency can exist but without the symmetry as it lacks intentionality. In other words, machines do not have a mind of their own but they do exert agency in terms of "doing things", which can influence human agency. He puts forwards an argument that human agency has the "domain of intentionality" (Pickering, 1995, p.20) or goals and intentions which come into play where "human intentions are bound up and intertwined ... with prior capture of material agency" (Pickering, 1995, p.20). Part of the intentionality is the process of modelling which Pickering defines as "an open-ended process with no determinate destination" (p.19), which provides future variants that could be constructed. This modelling could be seen as workarounds in order to achieve the intended goal.

Orlikowski (2005, p.185) suggests that it is more helpful to differentiate them as "human agency" and "material performativity", as it first helps us separate this notion of the material agency of the ANT perspective and second, it would allow us to clearly distinguish the differences and importance of each without equating them.

Pickering posits that human and material agencies intertwine and are temporally emergent in ongoing practice, which he names as "mangle of practice" (Pickering, 1995, p. 23). He refers to this intertwining of unanticipated conditions and consequences as an "intrinsically temporal dance of agency" (Pickering, 2008). As the intertwining is a dynamic process, it can be seen as a "dialectic of resistance and accommodation", where material agency such as material artefacts and technologies can offer resistance to actors' intentions. Pickering (1995, p.22) defines resistance as "the failure to achieve an intended capture of agency in practice". In turn, actors who exercise human agency can accommodate or harness technology's limitations in order to achieve their goals. Additionally, he proposes the metaphor of "tuning" in the sense of tuning a car radio to articulate the process

through which human and material agencies mutually adapt and thus interactively stabilise over time when actors' goals are aligned (Pickering, 1995). Therefore, through these complex interactions, the interplay of human actors and material performativity strategies are adopted and goals and intentions are revised and the technological (material agency) resistance is accommodated. Overall, Pickering's theoretical framework places an emphasis on real-time practice as an evolving ongoing emergent process. This paradigm shift in thinking allows us to recognise the role of technological and digital performativity and acknowledge that in order to acquire a deeper understanding of real-time practice, we need to examine the situated entanglement of both human and material agencies concurrently and it is difficult to separate them as they are so mangled together.

Within the field of information systems, Jones (1998) proposes the use of an extension of Pickering's model in the form of a "double mangle". He emphasises that in order to understand the relationship between information technologies and new organisational forms there is a need to examine the specific interactions within situated contexts. He further proposed that within information systems development, there is an ongoing process of marshalling material agency. In other words, the existence of technology or technical infrastructure (material agency) can influence how the interactions take place and determine what happens between the human actors and the technology. Hence, the material agency can permit the opportunity for interactions to happen, but it depends on the goal and intentions of the human actors and this can be open to interpretations (Jones, 1998). Furthermore, he suggests that within ISD there is a "double mangling" as where human actors seek to channel material agency in order to shape the actions of other human actors. This double mangle model is emergent in nature, in terms of the dialectic of accommodation and resistance between human and material agency, thus the doubling of the interactions are explored within the situated social/social and the social/technical context. In other words, Jones (1998) highlights that information systems should be seen as "*ongoing artefacts-in-construction through situated practice of knowledgeable agents rather than as the final product of predictable effects*" (p.299).

The next section discusses some studies which have used Pickering's framework as a theoretical lens within the organisational and IS field and why such a lens has proved to be useful.

3.5.1 Studies using Pickering's practice perspective

Previous research within the IS field has applied the use of Pickering's Mangle of Practice to examine the relationship between actors and technology from various different perspectives. A summary of these have been given below:

i) Chae and Poole (2005) considered the role of pre-existing information systems in the development of new IS systems. The theoretical foundations of their study were based on integrating elements of Mangle of Practice, structuration theory, and actor-network theory resulting in a framework which provides an understanding of how IS development can be seen as reconfiguring and emergent.

ii) Doolin and McLeod (2012) have explored the inclusive concept of sociomateriality and boundary objects, where Mangle of Practice was identified as one aspect of sociomateriality. The study highlighted that having two theoretical strands can complement the analysis of developing a small prototype within the domain of IS development and extend our understanding to the temporally emergent nature of boundary objects.

iii) Barrett *et al.*, (2012) applied Pickering's tuning approach within the context of robotic work in hospital pharmacies, within three different occupational groups – pharmacists, technicians and assistants. The authors claimed in extending Pickering's (1995) tuning approach to gain various insights into how actors and technologies are entangled in a multiple number of ways. The findings of the study, suggested that having an emerging relational-material perspective was useful where the boundaries in the workplace were reconfigured because of the robot's hybrid (digital and mechanical) materiality.

iv) Martini *et al.* (2013) examined the relationship between human actors and technology within the context of a social media platform, using Pickering's

theoretical model and Jones (1998) “double dance of agency”. Their case study examined different modes of entanglements of agency, the first one being the human agency of customers and the material agency of the social media platform; the second entanglement being the human agency where the organisational employees seek to channel the material agency, to shape the actions of other human agents or the customers.

v) Venters et al. (2014) studied digital coordination from a sociomateriality perspective within the CERN grid infrastructure. The authors applied mangle of practice and the concept of flow of time that advocates that agency is always “oriented towards the past, the future and the present” (p. 964) at any given time. Thus, their resultant framework highlighted that temporal dimensions can influence human and material agencies.

From these earlier studies, it can be seen that there is a distinct focus on understanding entanglement of human and material agencies by applying the concept mangle of practice, where neither human or non-human agency are given a priori status. In addition, Venters et al.’s (2014) study highlights the performative idiom or “doing things” giving an appreciation of how temporal emergence of real time practice unfolds itself within various situated contexts. However, what is not yet explored is how mangle of practice can aid our understandings of real time practice within globally distributed agile contexts where a number of additional challenges exist of time, space, culture and knowledge gaps.

Accordingly, this study seeks to address this gap in the literature, by using Pickering’s mangle of practice perspective on real-time practice and the theoretical concept of boundary objects to answer the overarching research questions for this study. The pluralistic conceptual framework guiding this study is discussed further in the next section.

3.6 Pluralistic framework guiding this study

Undertaking collaborative practices within globally distributed agile environments creates a dichotomy and tensions as on the one-hand there is constant desire of

keeping in line with the underlying prescribed agile principles and on the other hand there is continual struggle in adapting for situated global settings. Challenges exist at a number of levels, as a multiplicity of boundaries exist in knowledge sharing, updating artefacts and adapting processes for tasks to be completed within a given time period. These challenges are additionally exacerbated within such contexts as temporal, geographical, cultural and knowledge boundaries come into play.

To provide an empirical and theoretical understanding of collaborative practices within globally distributed agile contexts, this study draws two analytical concepts:

- i) Mangle of Practice would help us to understand and explain the complex dynamic structures and practices of global agile teams which are continuously being configured, and reconfigured within given real time contexts.
- ii) Boundary objects would allow us to understand how objects or artefacts support collaborative practices across locations and develop shared understandings.

Taking this pluralistic theoretical approach to analyse the empirical findings from the case, would provide greater insights of how collaborative work practices are developed and shaped. Table 3.1 below provides a summary of the components of the theoretical concepts which will be used as a basis for this study.

Table 3.1 : Key components of boundary objects and mangle of practice

Boundary Objects and Mangle of Practice: Key Concepts	
Boundary Objects	<ul style="list-style-type: none"> • Enabling in coordination • Aiding knowledge flows • Facilitating differences collaboration
Mangle of practice	<ul style="list-style-type: none"> • Analytical focus on the interactions between human agency and material performativity (material agency) • Domain of intentionality • Emergent nature of resistance and accommodation between human and material agency • Metaphor of Tuning: mutual adjustment leading to interactive stability

Chapter 4: Research Approach

4.0 Chapter Overview

The motivation of this research is to study global agile teams within a socio-technical context in order to deepen our understanding of how the actors within these contexts develop collaborative practices, in terms of their behaviour, perceptions and experiences. The previous chapter set out the theoretical perspective introducing a pluralistic framework for this study, which is situated within engaging in practice drawing on two concepts: boundary objects and mangle of practice.

The rationale of this chapter is to present the research approach for this study. The chapter is divided into five sections following the overview. Section 4.1 gives a brief overview of qualitative and quantitative research in general, and summarising the differences between them. It highlights that the nature of the research of this study favours the use of qualitative research, where the view of social reality is emergent and is being socially constructed by its participants. Furthermore, there is also a distinction made between what is meant by ‘Verstehen’ and understanding.

Section 4.2 provides an outline of how qualitative research is conducted within the IS field, focusing more specifically on the interpretive paradigm stance this has been considered the most appropriate for this study. This is followed by section 4.3 which considers the ‘Interactive Model of Research Design’ (Maxwell, 2013) consisting of five components: (i) goals; (ii) conceptual framework; (iii) research questions; (iv) methods and (v) validity. Each of the components within the model addresses is different issues related to the coherence of study. This model has been adopted for this study; as the essential features of this model do not treat the research design in a linear fashion, but rather an interactive relationship among the components exist, such that all the components are linked to form an integrated model where each component can affect other components as well.

Section 4.4 focusses on the methods component of the Interactive Model specifically relating to this study highlighting the use of an interpretive fieldwork case study approach as the most appropriate form for this research. The section discusses the data collection instruments deployed in terms of gathering the relevant data in order to develop a meaningful understanding of the phenomenon. The ethical considerations for the selection of the participants are given and data analysis approach adopted for the study is discussed.

Finally, section 4.5 discusses the validity component of the Interactive Model for this study. An outline of the research approach is given in figure 4.1 below.

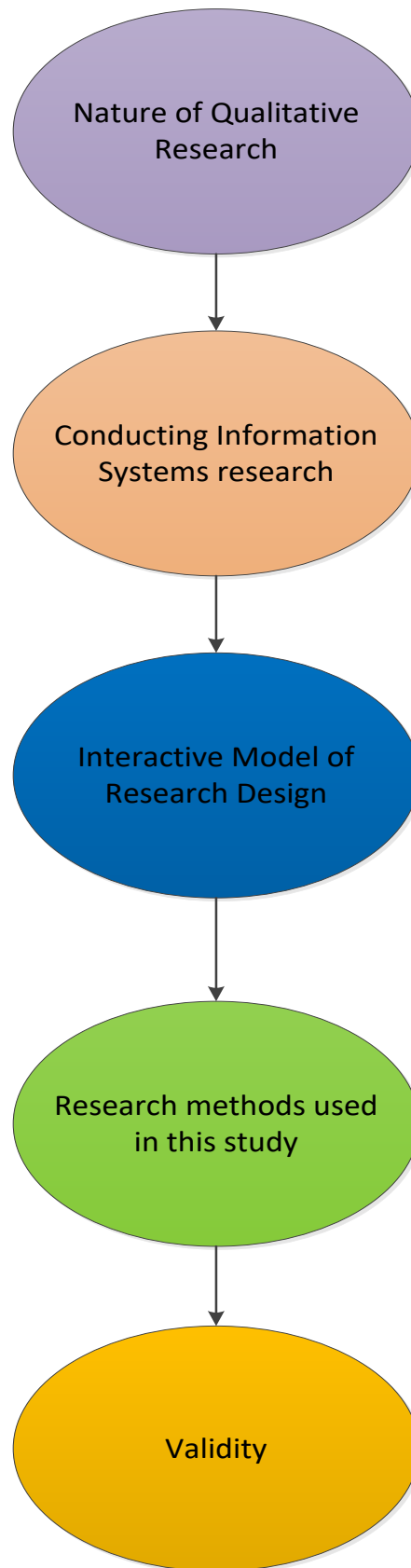


Figure 4.1: Overview of research approach adopted for this study

4.1 The nature of qualitative research

At a general level qualitative research is described as a naturalistic, interpretive approach where it is concerned with exploring the phenomena “from the interior” (Flick, 2009) which focuses on the perspectives and the accounts of the participants as a starting point (Ritchie *et al.*, 2013). Denzin and Lincoln, 2(011 p. 3) state that:

“Qualitative research is a situated activity that locates the observer in the world. Qualitative research consists of a set of interpretive, material practices that make the world visible. These practices transform the world.”

From the above quote we can see that qualitative research is a broad term and it can include a wide and diverse range of approaches and methods. However, the key focus of qualitative research is one of exploring the “what”, “why and “how” type of questions rather than the “how many” questions (Ormston *et al.*, 2014).

Ellingson (2009, p. 8) highlights that good qualitative research is like a crystal; it has various facets which represent the aims, the needs, and desires of the various stakeholders. She states that there is a qualitative continuum where the goals of middle ground are: (i) “to construct situated knowledge”, (ii) “to explore the typical” (iii) “to generate description and understanding” (iv) “to trouble the taken for granted” and (vi) “to generate pragmatic implications for practitioners.”

Overall, qualitative research is useful for exploring complex issues such as the social interactions among people, how they make decisions and negotiate, and the norms and values that are shared amongst them. Furthermore, qualitative research can aid in providing the depth, the detail and the nuances within the context of the study (Hennink, Hutter and Bailey, 2011). The key differences between qualitative and quantitative research are summarised below in Table 4.1 in terms of the following: (i) objective of research, (ii) the purpose, (iii) data (iv) study population (v) data collection methods (vi) data analysis and (vii) outcome.

Table 4.1 : Key differences between qualitative and quantitative research

(Hennink, Hutter and Bailey, 2011)

	Qualitative research	Quantitative research
Objective of the research	To gain a detailed understanding of underlying reasons	To quantify data and extrapolate results to a broader population
Purpose of the research	To understand why? How? What are the processes? What are the contexts?	To measure, count, quantify a problem. How much? How often? What proportion? Measure strength of relationships in data.
Data	Data is usually words	Data is usually numbers
Study population	Smaller no. of participants selected purposively	Large sample size of representative case
Data collection methods	In-depth interviews, observations, focus groups	Population surveys, opinion polls
Analysis	Analysis is interpretive	Analysis is statistical
Outcome	To develop an understanding, to identify and explain behaviour, beliefs and actions.	To identify prevalence, averages and patterns in data. To be able to generalise to a broader population.

As outlined above, the analysis of qualitative data is interpretive where the researchers attempt to seek and interpret the meanings from the participants' understanding. However, the analysis can be viewed from two different perspectives: 'understanding' and 'Verstehen', where, 'understanding' refers to the understanding of the social phenomena from the researcher's own interpretive framework or the outsider's perspective. Taking this one step further, 'Verstehen' refers to the subjective meaning of the contextual issues from the participants' viewpoint or the insider's perspective. Within qualitative research it is important for the researchers to discern the subjective meaning or the insider's perspective that participants attach to their experiences. This kind of interpretive understanding – or Verstehen is constructed by the researcher through interactions with the participants, allowing the researcher to delve deeper into the study moving beyond the surface and enhancing the understanding of the social world of the participants.

Myers (1997) argues that within the field of IS, there has been a general shift in research moving away from just technological issues to the relationship between IS

and organisational issues – hence there is an increasing focus on the application of qualitative methods. The issue of how the social world can be studied within the IS field raises a number of philosophical questions related to ontology and epistemology. The next section explores how these different approaches are adopted within the field of information systems.

4.2 Conducting Information Systems Research

Hirschheim and Klein (2012) has examined the 40-year old history of the IS field and how it has grown and developed in many ways, such that from the IS literature it can be said to be diverse and pluralistic, King *et al.*(2010) have referred to this as “harmonious pluralism”.

Within the field of IS one of the most popular ways of classifying research studies is based on one of the three epistemological perspectives: positivist, interpretive and critical (Orlikowski and Baroudi, 1991). Additionally more recently, another epistemological stance of critical realism has been applied to IS studies. These four philosophical viewpoints take different positions in terms of the assumptions made about the sources of data, the development of knowledge, the context of physical and social reality, and the relationship between the theory and practice.

4.2.1 Positivist research

Positivist research is characterised by trying to build knowledge of the reality that exists beyond the human mind which is independent of the research process (Weber, 2004). The social reality from a positivist perspective is governed by rules and causal relationships exist between variables, which can be proven and explained, such that social reality can be predictable and can be controlled.

Positivist studies are based on the premise of existence of prior relationships within the phenomena which can be tested via hypothesis. These relationships can lead to the basis of generalised knowledge and predict further patterns of behaviour within

the context of the phenomena. The positivist paradigm takes the stance that the physical and social worlds exist independently of humans. Hence, the researcher within this paradigm takes an objective neutral and passive role and does not intervene within the phenomenon. Researchers taking a positivist approach would use an objective lens or attempt to carry out value-free inquiry where the data is measured through quantifiable variables through experiments, surveys and field studies. They tend to collect large amounts of empirical data which can be analysed statistically to detect underlying patterns and behaviours and then inferences are drawn upon about the phenomenon from the chosen sample.

Although positivist research represents the most dominant paradigm within IS research (Orlikowski and Baroudi, 1991; Dubé and Paré, 2003), a large number of positivist studies fail to follow the methodological rigour needed to carry out IS positivist case research. Trauth (2001) contends that from the positivist perspective, if less is known about the phenomenon under study the more difficult it is to measure it. Therefore the degree of uncertainty surrounding the phenomenon can be an important influencing factor in the choice of the research methods. However, Weber (2004) argues that one should abandon the rhetoric of positivism versus interpretivism and researchers should choose research methods that fit the goal of improving our knowledge of the chosen phenomena.

4.2.2 Interpretive research

The development of an interpretivist approach has its origins in social/human sciences and is often linked to Max Weber (1864-1920), who suggested that within this domain the researchers are concerned with the interpretative empathetic understanding within its context (Verstehen) as against superficial understanding of numerical facts, as discussed earlier in this chapter. He believed that although positivist approaches are important, they do not provide a full understanding of the meaning of the social actions of the actors within the context of the study (Ormston *et al.*, 2014).

Schwandt (1994) points out that the interpretive approach provides a deep insight into the “the complex world of lived experience from the point of view of those who live it” (Schwandt, p.118). In addition, it is important distinguish between qualitative research and an interpretative approach as they are not interchangeable terms (Klein and Myers, 1999). Klein and Myers (1999, p.69) outline that within interpretive research “*our knowledge of reality is gained through social constructions such as language, consciousness, shared meanings, documents, tools and other artefacts*”.

Orlikowski and Baroudi(1991, p.5) within the field of IS, provide the following definition for interpretive studies “people create and associate their own subjective and intersubjective meanings as they interact with the world around them. Interpretive researchers thus attempt to understand phenomena through accessing the meanings that participants assign to them...”. Walsham (1993, p.2) provides an additional definition of interpretive methods where they “start from the position that our knowledge of reality, including the domain of human action, is a social construction by human actors and that this applies equally to researchers. Thus there is no objective reality which can be discovered by researchers and replicated by others, in contrast to the assumptions of the positivist science”. From these definitions it can be ascertained that the interpretivists believe that the researcher and the phenomenon observed cannot be separated from each other as they are intertwined within the contextual surroundings. Second, it is difficult to replicate an exact study which uses interpretive methods, as each study is conducted within a contextual space and a specific timeframe. Therefore each situation becomes unique for the individuals and the settings they are involved in, where the interpretive researchers recognise that experiences of the actors may differ across different groups and different social and cultural settings. Additionally, in such settings researchers have not identified predefined variables instead the correct meaning of the data is determined by the context and a good theory which helps the researcher to gain a deeper understanding of the meanings and intentions of the people being studied(Myers, 2013). Therefore, in such settings a law-like generalisation of a population can be problematic but interpretive researchers look to make generalisations which are more context bound (Myers, 2013), which then

could go towards supporting an emerging theory and supporting similar further studies.

Nevertheless, interpretive research continually faces criticism about the lack of generalisation and to overcome this Walsham(1995) extends the notion of generalisations for interpretive case studies by arguing that generalisations can be described as ‘notion of tendencies’ rather than predictions for a particular phenomenon (p78-79). He suggests four types of generalisations are possible from interpretive case studies: (i) the development of concepts; (ii) the drawing of specific implications; (iii) the contributing of rich insight and (iv) the generating theory. Developing generalisations from case studies can be challenging for IS researchers, but they can be invaluable to IS practitioners where learnings can be applied from one context to another. Angen (2000) argues that from an interpretive perspective the notion of validity has to change such that it is not based on a one-to-one objective reality. Through negotiated dialogue and “our intersubjective experiences” results can be a form of truth which has “negotiable features” such that the social interactions constantly inform and help to reformulate critical understandings.

4.2.3 Critical Research

Turning to critical research, Oates (2006, p. 296) defines critical research within IS and computing, which is “concerned with identifying power relations, conflicts and contradictions, and empowering people to eliminate them as sources of alienation and domination”.

Although interpretive research and critical research are similar in many ways, there is a distinct paradigm shift where critical studies assume that social reality is constructed historically and is continuously produced and reproduced by social actors and therefore it is under constant change. Critical researchers also believe that not all interpretations are given equal weighting in any given social setting. One of the main tasks of critical research is to be a social critique where the restricting and alienating conditions of the context are highlighted. Therefore, rather

than describing the current knowledge and beliefs the critical researcher would go a step further and try to challenge the existing beliefs, values and assumptions made by the actors and suggest possible social improvements (Myers, 2013).

4.2.4 Critical Realism

More recently there has also been growing interest in applying a theoretical paradigm based on the philosophy of science of critical realism from the foundational work of Roy Bhaskar (Bhaskar, 1975) within the field of IS; (Mingers et al. 2013). Critical realism paradigm is a relatively new approach which is seen as a middle ground between positivism and interpretivism, providing a new realist ontological perspective (Mingers et. al. 2013). Critical realism tries to confront the concerns of both positivism vs. interpretivism paradigms, where one of the main criticisms of a positivist stance is that the world exists independently of us and that our understandings of the world are limited and mediated by our theoretical lens.

One of the fundamental distinctions that Bhasker (1975) makes is between “intransitive” and “transitive” dimensions of knowledge, where intransitive objects of science are independent of human activity. Things we wish to study such as physical processes and the transitive dimension constitute our knowledge of the world in terms of theories or facts about the intransitive dimension. The transitive dimension can shift when we discover more about the world. Therefore, Bhasker points out that critical realism should not be confused with empirical realism. Overall the critical realism paradigm favours mixed methods research, thus combining quantitative and qualitative methods in order to gain a greater understanding of the real world. However, for novice researchers it does pose some problems related to combining the different ontological and epistemological positions, and having the experience and expertise in making value-based judgements based on the evidence found from research carried out.

4.2.5 Choosing a Research Paradigm

Orlikowski and Baroudi (1991) emphasise that IS researchers should ensure that their chosen perspective is compatible with their research interests, while remaining open to other perspectives. Therefore the IS researcher needs to ensure that he/she is aware of different research paradigms and selects the appropriate research paradigm which will aid in the goals of the study and the overarching research questions.

Choosing a research paradigm can be a complex and a difficult task for a researcher; it entails adopting a particular philosophical stance for the study undertaken. Orlikowski and Baroudi (1991) suggest that the researcher should draw upon Chua's (1986) classification framework which is based on a set of beliefs and questions which need to be considered:

- (i) Beliefs about physical and social reality: - Issues of ontology and a way of seeing and researching within the world – deciding whether the social and physical worlds are objective or subjective?
- (ii) Beliefs about knowledge: - considering criteria in determining what constitutes valid knowledge?
- (iii) Beliefs about the relationship between knowledge and the empirical world: – considering what research methods will generate the best evidence and ‘truth’ by exploring the relationship between the theory and practice and the role of theory within the realm of practice?

Overall the chosen research perspective should be governed by examining these beliefs for the particular research context and what are the overarching research questions which need to be investigated.

4.2.6 Theoretical perspective adopted for this study

The intention of this study is to develop a greater understanding of how global agile software development teams develop collaborative practices and what challenges they face in such settings? This requires a deeper understanding of their dynamic social world. In other words, the knowledge is socially constructed through

interactions between the researcher and the research participants' viewpoints. The research focuses questions related to the 'why' and the 'how' and requires detailed responses from the participants.

This subject matter also requires gaining a deep insight of how individuals (global agile team members) behave and influence each other through formal and informal interactions that they have on a continuous basis. Unlike positivist researchers who use a set of constructs and assume a single reality and truths; interpretivist researchers would try and understand a pluralistic world, which is based on the belief that people assign meanings and values to their particular situations or contexts (Oates, 2006). Therefore this study resonates towards an interpretivist paradigm as a context-bound approach, where in-depth rich understandings of the phenomenon of the meaning of the social action of the actors within their situated settings can be understood and there exists multiple subjective realities and not one single version of "the truth" (Oates, 2006). Gray (2014, p.34) emphasises that the "theoretical of interpretivism sees the world as too complex to be reduced to a set of observable 'laws'...". Taking this viewpoint, interpretive perspective generalisability plays a less important role than understanding the meaning behind the workings of 'reality'. Hence, the main goal of the interpretivist researcher is to understand the social situation and seek 'thick descriptions' from the participants' practices and lived realities. The researcher should then interpret the events through a process of meaningful constructions and reveal what meanings are embodied in the participants' action. Table 4.2 presents a summary of the aspects of the research process for this study.

Table 4.2 : Aspects of the research process adopted for this study.

Aspects of the research process to be considered	Features adopted for this study
Epistemology	Constructivism
Theoretical perspective	Interpretivism
Research Approach	Interpretive using thematic analysis
Research methodology	Longitudinal case study
Timeframe	Over a two and a half year period
Role of theory	As a guide to research design, data collection and data analysis

Type of theory	Theory for explaining (understanding)
Data collection methods	Interviews, observations and inspecting documents

The next section describes in detail how the Interactive Model of Research Design that was applied within this study.

4.3 Interactive Approach of Research Design

Maxwell (2013) argues that neither topological nor sequential models of research design are suitable for a qualitative study, because they attempt to establish in advance the essential steps of research. Instead he contends that qualitative research is “an ongoing process that involves 'tacking' back and forth between the different components of the design, assessing the implications of goals, theories, research questions, methods, and validity threats for one another (ibid, p.3). To support this argument further, Maxwell offers an interactive model of research design which consists of five components: goals, conceptual framework, research questions, methods and validity, see Figure 4.2 below for the relationships among the components.

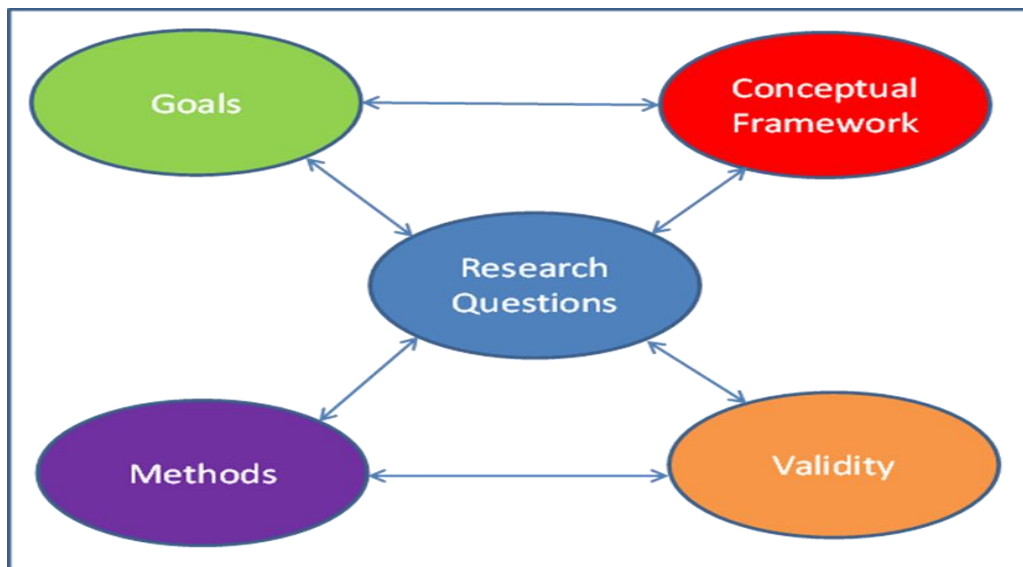


Figure 4.2: Interactive Model of Research Design (Maxwell, 2013)

The upper half of the model is more conceptual and the bottom half is the operational part of the research design, and the research questions form the core link between the two halves. The interactive model offers an iterative way to construct and reconstruct the research design. The starting point of the model is the goals of the study which can help in guiding the design decisions and more importantly they are the key to justifying the study.

The interactive model can be used as a tool for conceptually mapping the design for the actual study, where the five components are interlinked such that it forms an integrated research design map. Within the model the research questions do not form the starting point of the study, but they are at the centre or at the hub of the design map, as they most directly influence the other components and but are also affected by all other components (Maxwell, 2013).

This means that the interactive design map can be seen as an iterative model where the research questions are not necessarily fixed at the start of the study but can be revised or modified as a result of the changes to the other components in the framework as the goals and conceptual framework being applied. The interactive design framework also offers more flexibility to qualitative research design, where Maxwell uses a rubber band analogy to explain the connections and interactions which can offer a certain “amount of “give” and elasticity on the design” (Maxwell 2013, p.3) which is needed for a qualitative research. Maxwell further argues that the “interconnection and coherence” of research design can be seen as “pragmatic compatibility” as it links in with the current thinking of qualitative research.

Applying Maxwell’s (2013) Interactive Model of research design has been useful since the initial focus was on the research goals of the study and thereafter the research questions. Maxwell refers to the goals of the research as “motives, desires and purposes” for the research. For this study, the goals and justification for the study have already been previously discussed in Chapter 1. Second, the key issues of the different components of the research were identified in relation to the research questions. Maxwell suggests that the research questions are a key factor in the research design and links to all the processes in the Interactive Model. For this study the research gap and research questions have been discussed in detail in

Chapter 2. Third, the conceptual framework component is essentially considering the previous literature in terms of how researchers have studied the problem, identifying any gaps within the existing research and how your study can make original contributions. For this study the previous literature of the global agile teams was discussed in Chapter 2 and the theoretical framework adopted for this study was discussed in the Chapter 3. The methods and validity components are discussed in the following sections. Overall, the model allows for the ongoing flexibility needed for qualitative research in terms of the methods and the contextualisation of the study. The interactive model design map for this particular study has been given in Figure 4.3.

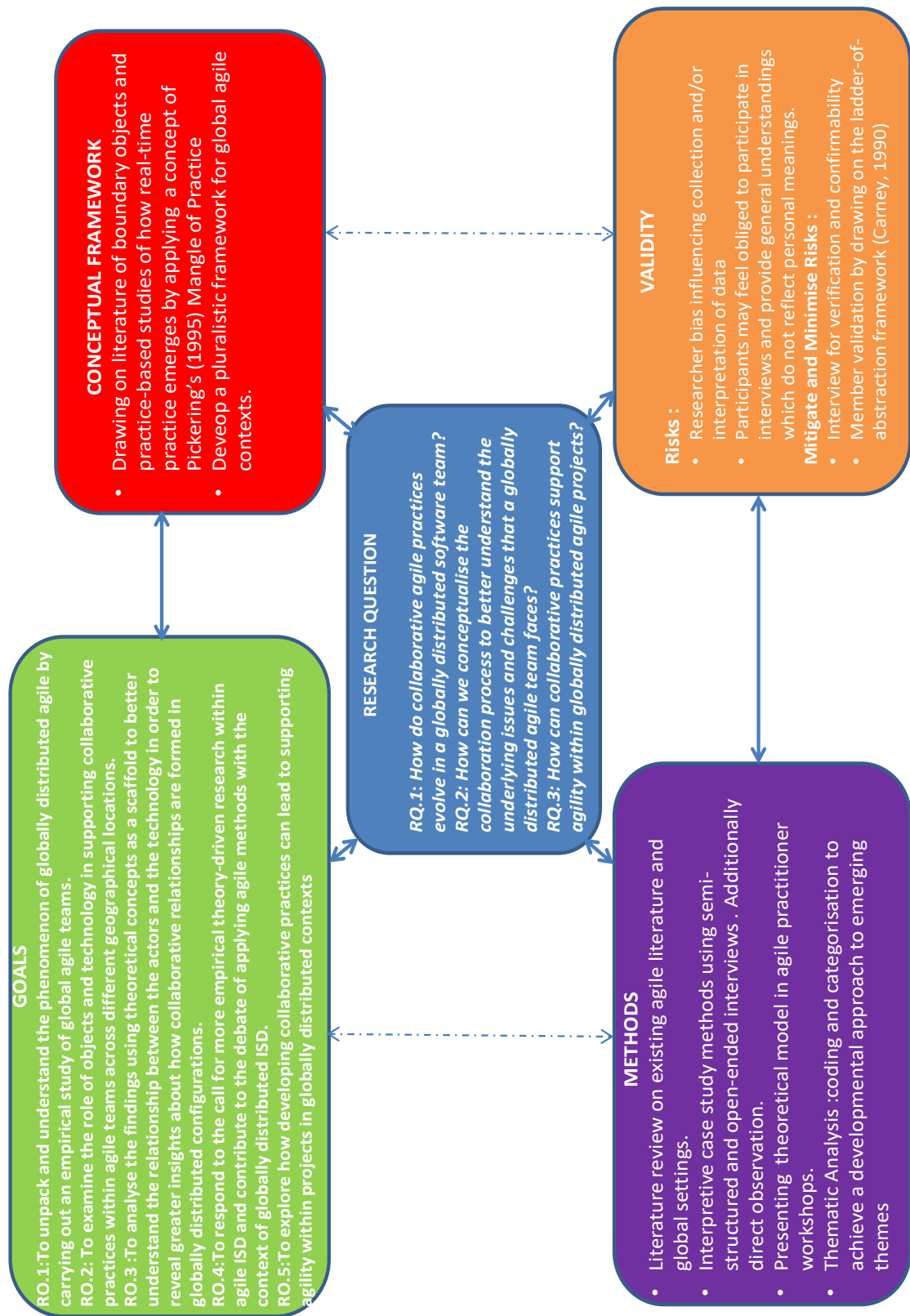


Figure 4.3: Interactive research design map for this study

4.4 Research Methods used in this study

Maxwell (2013) indicates that within the methods components one should consider four main elements:

- i. the research relationships that one establishes with the participants of the study;
- ii. site and participant selection - place of data collection and the participants;
- iii. the data collection methods used - how you gather the data to help answer your research questions;
- iv. the data analysis - what strategies and techniques are used to make sense of the data.

Each of these elements has been discussed separately below.

4.4.1 Role of the researcher and negotiating relationships

Negotiating research relationships can be a complex and a challenging task and sometimes participants can be seen as “gatekeepers” who can help facilitate or interfere with the study (Maxwell, 2013). More specifically, first line gatekeepers have the power to decide whether to grant access to the team within an organisation (Jones, 2014). Maxwell (2013) points out that the process of negotiating relationships with the participants is complex and ongoing. Therefore it is important that a number of steps are taken to ensure that the rapport and the nature of the relationship allows for the researcher to ethically gain the information required in order to answer the research questions. Walsham (1995) reminds us that an interpretive researcher has a difficult task of gaining access to other people’s interpretations, and then filtering them through their own “conceptual apparatus”, in order to provide an aggregated version of the events. He further highlights that the role of the researcher can be viewed on a continuum from an outsider observer to that of an action or involved researcher. The interpretive approach acknowledges subjectivity not only of the participants but also of the researcher. Therefore, the researcher has to make a conscious decision as to where they see themselves on this continuum. As a researcher I wanted to adopt an “interpretive sense making

method” as argued by Tsang (2013, p. 198) as they are “interested in seeking in-depth understanding of human experience embedded in a rich, real world context”. According to Hennik, Hutter and Bailey (2011), there is need for reflexivity which involves “conscious self-reflection”. Therefore, throughout the study I continually developed a greater sense of self-awareness in terms of any potential influence; I may be having in the research process. I wanted to develop a neutral impartial stance, a good rapport of trust and confidentiality with the participants in the interviews, so that participants would be able to share their views frankly regarding their roles and how they attempted to develop collaborative practices with their counterparts and what challenges they faced in doing so.

4.4.2 Site and participant selection

Maxwell (2013) points out that one of the main strengths of qualitative research is the ability to elucidate local processes, meanings and contextual influences within particular settings and cases. The process of entering a contextual setting allows the researcher to learn and develop an understanding about the phenomenon (Eisenhardt, 1989). Orlikowski and Baroudi (1991) argue that within the field of IS, use of the case studies has generated well-founded interpretative understandings of human-technology interactions in natural settings. Oates (2006) also concurs with this and emphasises that the case study research approach is particularly suited for research into the development and ongoing use of information systems, as it allows researchers to study the inter-relationships and group dynamics of teams. She also highlights that the case study approach deals with complex situations where it is difficult to study a single factor in isolation. Global agile teams have complex contextual settings which can have an influence on the study, therefore, a longitudinal case study approach was considered most suitable. Second, the longitudinal case study method was also selected in an attempt to attain rich and in-depth understandings, of the dynamics, tensions and motivations of the different team members in attempting to carry out collaborative practices across locations.

Thomas (2011, p.4) stresses that the case study allows the researcher to get closer to the “how” and the “why” something might have happened. Taking this approach,

it allows us to “drill down further” and it allows us to create a three-dimensional view thus giving a more rounded and richer understanding of the subject. Simons (2009,p.21) provides a definition of a case study method:

“an in-depth exploration from multiple perspectives of the complexity and the uniqueness of a particular project, policy, institution, programme or system in a ‘real life’ context. It is research-based, inclusive of different methods and is evidence-led. The primary purpose is to generate in-depth understanding of a specific topic (as in a thesis), programme, policy, institution or system to generate knowledge and/or inform policy development, professional practice and civil or community action.”

Walsham (1995) suggests by using theoretical constructs as a “scaffold” it allows the researcher to make sense of the interactions within complex socio-technical situations. Benbasat et al. (1987) consider that the case study approach is best suited for developing theories and concepts from the knowledge gained from the participants of the study. In addition, the exploratory case study approach allows the interplay between the theory and the empirical material, where an iterative analysis can be carried out as the fieldwork proceeds forward which guides the quest for modifying theoretical concepts to support the emerging frames of interpretations. Baxter and Jack (2008) point out that having a holistic case study can be a powerful and engaging way of analysing data and it can serve to illuminate the case in a better way, as the data can be analysed within the sub-units separately and across sub-units.

Although, the phenomenon of global software development teams is quite prevalent in large financial organisations, the use of agile methods in globally distributed context is still a relatively contemporary phenomenon. The use of a longitudinal case study research approach was applied within one organisation to seek out patterns of how collaborative agile practices adopted in a global software team.

Site selection for this study

The site selection for this study was in a global investment bank which has offices in two globally distributed settings (London and Delhi). The bank’s technology strategy was based on having software teams in London and corresponding partner teams in Delhi at bank offices. The London software teams would entail senior and

more experienced personnel, who would have access to the users to gather requirements and write up technical specifications, which then would be sent to their corresponding partner teams in Delhi. Prior to the PRIME (pseudonym) project, the software teams in London and Delhi adopted a traditional plan-driven approach for software development, where the technical specification would be written by the team members in London, as the key document for communication for the software development work to be carried out. The specification would then be sent to their corresponding partner team in Delhi, where majority of the software development would be carried out. The London team members would oversee the development of the work and share their expertise with their counterparts. In other words, the London team members could be seen as knowledge providers and the Indian counterparts could be seen as knowledge recipients.

For this research one particular globally distributed software team was chosen within the bank which had a number of unusual and interesting attributes. First, the PRIME project was critically important project for the bank, as the main goal to develop a real-time backend database system, specifically creating a central data store of all the bank's transactions – one 'golden copy' of the bank's activity. This involved connecting up all the bank's subsystems and migrating data from the subsystems correctly to the PRIME system without any duplication. The PRIME project was a core and critical project for the bank, as other subsystems would rely on the output of the data from the PRIME system. Second, within the bank it was the first project to adopt the use of agile methods across locations. The team was called the PRIME team and project started in 2011. Third, unusual trait of the PRIME team was that the software development would be carried out across both locations London and Delhi using agile collaborative practices. The initial testing would be carried out in Delhi and then the acceptance testing would be jointly done across both locations. Fourth, when the project first started the Indian team members were not at all familiar with use of agile methods. . Thus, choosing the PRIME project to research for combination the reasons stated would prove to be an interesting undertaking.

Within the PRIME project, the senior team members were based in London with the senior project manager, the business analysts, the principle tech. lead and the senior developers. In Delhi, the team consisted of the more junior developers and the test team. As the PRME project was a core project for the bank, there was an ongoing backlog of user stories or requirements which needed to be developed and there was not a set completion date for the project. Cohen and Ravishankar (2012, p.168), stress that researchers working in “emerging and changing forms of organisations”, have to be aware of complex relationships in terms of participants’ national/cultural backgrounds and their employment roles. Therefore, as researcher although I had opportunity to capture the ‘dynamism, complexity and the tensions’, of such a team, I also needed to be aware that in such settings there can be some research challenges.

4.4.3 Data collection methods used

Initially, within the PRIME case study purposeful sampling was applied to select participants who would be able to provide a greater insight into the general challenges of the using agile methods within global contexts. However, over time a number of different participants were chosen due to their various roles within their team. Maxwell (2013) highlights the importance of purposeful sampling, it can be used to achieve the ‘representativeness’ of the participants from the contextual settings and provide a greater confidence in the conclusions. Second, it can also be used to capture some sense of heterogeneity from the views of the chosen participants. Alvesson and Ashcraft (2012) outline two guiding principles which guide researchers to the participant selection: (i) ‘representativeness’ in terms of the breadth and variation among the participants so that their roles allow for coverage of the whole team; (ii) ‘quality’ in terms of interview responses, participants who could provide perceptive and insightful accounts

A total of 45 interviews (including repeat interviews) and 30 observations were conducted. Additionally, during the observations as part of the research process, I viewed documents that the team members were using during the collaborative practices. The overall goal was to unpack how collaborative practices were being

developed in globally distributed settings and how agile practices were being adapted over time. Therefore, it was necessary to uncover the patterns of team dynamics, the working practices and attitudes of the team over time and observe how their team collaborative practices evolved and adapted over time. Overall, the aim was to develop a more comprehensive and robust understanding of how collaborative practices evolved across locations—see Figure 4.4.

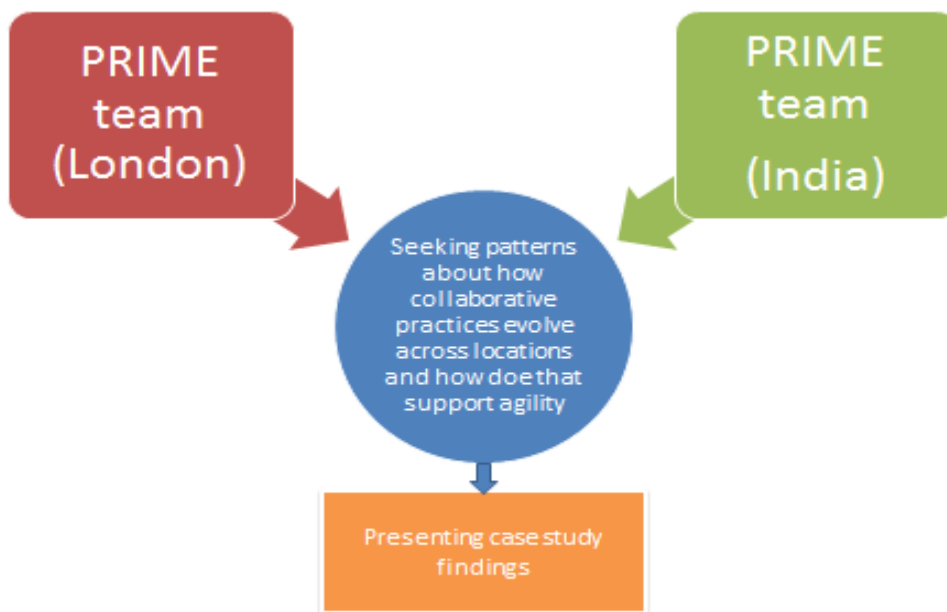


Figure 4.4: Seeking patterns of collaborative practices in the case

The primary source of data collection for this study was through in-depth interviews, observations and document analysis over a two and a half year period (2012-2014). A total of 38 participants were interviewed within the PRIME case where the average length of each interview was 60 to 70 mins. See Table 4.3 of the participants, their roles and their locations.

Table 4.3: Location and role of the participants

Location	Role
London	Senior Project Manager (managing the project) Senior Business Analyst Business Analyst

Delhi	Principle Tech. Lead
	6 senior software developers
	Testing Manager
	2 User acceptance testers
	Project Manager (managing the Delhi team)
	Business Analyst
	2 senior software developers
10 software developers	
1 QA senior tester	10 QA testers

The initial phase of the fieldwork, was based on Walsham’s guidelines (2006, p.325) of conducting interpretive case studies, where he describes a “looser approach” of doing interpretive research. Therefore after each set of interviews, the data would be examined, reflected and reviewed on what has been learnt, to create a more organised set of themes or issues which we wanted to explore for the next session of interviews. Using this method was beneficial and invaluable in developing the data-theory link later on in the process, and did not constrain me to any particular themes. It also allowed me to explore all emerging themes equally. An initial interview guide was created as suggested by Hennink, Hutter and Bailey (2011, p.109) where they recommend the following steps are applied as a guide to the interview process:

A semi-structured interview guide was used to prompt data collection;

- Establishing rapport (a trust relationship), between the interviewer and interviewee;
- Asking questions in an open empathic way;
- Motivating the interviewee to tell their story by probing

Additionally they stress that in-depth interviews are ‘conversations with a purpose’ where the interview settings allow the participants to share their story and it allows the interviewer to gain insight directly from the participants. Furthermore, being aware of the complex contextual settings of offshore and onshore teams, as a researcher I tried to develop an awareness of cultural sensitivity, though cultivating a neutral role in order to develop a rapport with the participants to gain credibility and trust within the setting. An interview guide was developed mainly as a checklist to ensure that the relevant themes were covered. However, this did not hinder me

in probing further in order to elicit further information relevant to the research. The initial interview guide was designed in the following manner:

- **Introduction** – where aims of the research were identified, and ethical issues (see section below) such as confidentiality, anonymity were covered. Background information of the interviewee’s role within the team, how long have they been in the team and their previous experiences of agile.
- **Key Questions** - The essential questions were focussed on the participant’s viewpoint of how collaborative practices were being developed and carried out within the globally distributed context. How were agile practices adapted within their team? What challenges were they facing due to the distributed nature of the team? What tools and techniques did they use to support their collaborative practices for onshore and offshore team members? How did they attempt to overcome the challenges to improve their experiences of carrying out collaborative practices within their particular context? How did the organisation support them in their endeavours of using agile practices? The full interview guide has been presented in Appendix C, all the interview questions focused on exploring what agile practices were carried out by PRIME project team members and how the collaborative practices were adapted and modified by team members.
- **Closing questions** – where broader questions were asked such as if they would use agile practices in other globally distributed project settings if they were given the choice. In addition, I also gave the participants the opportunity to add anything further to discussion. The interviewees were thanked for participation.

The full interview guide is given in Appendix C, as discussed earlier, essentially the interview guide was a toolkit, to make sure all the relevant questions and probes were dealt with. Second, it was important to establish a rapport and build trust so that the participants could speak freely and openly in the interview to discuss any challenges they were having in globally distributed settings. As a researcher I was interested in the ‘how’, ‘why’ and ‘when’ questions of how collaborative practices were being evolved and how the knowledge was being communicated through these contextual settings.

Ethical guidance aids researchers to translate ethical principles into practical advice which can be followed when planning their research (Jones, 2014). This study followed the ethical guidance for participants suggested by Oates (2006);

- Right not to participate
- Right to withdraw
- Right to give informed consent
- Right to anonymity
- Right to confidentiality

Before the interviews began the study was also approved by the Brunel University Research Ethics Committee. Further approval for the study to go ahead was also gained at the bank, subject to the name of the organisation and the participants' names being anonymised. Walsham (2006) also highlights that while carrying out interpretative research studies tensions can arise due to ethical issues, however they have to be resolved in a practical way. At the beginning of each interview permission was sought at the individual level providing information about the study so that the participants could decide if they were willing to take part in the study. Over time as trust was established with the London team members, this led to access being arranged to visit the Delhi team members, in order to carry out face-to-face interviews and carry out observations there as well.

During the period of the study some repeat interviews were also carried out in order to understand how the phenomenon of developing collaborative practices and adapting agile practices had evolved over time. Having this opportunity of further engagement, with the participants allowed me to have in-depth conversations with some of the participants about emerging patterns. Additionally, it also allowed for time for reflexivity to revise meanings and understandings which emerged from the initial interviews and observations and explore the guiding theoretical concepts. Thus, this process allowed for deeper insights to emerge of the findings leading to richer understandings and analysis of the phenomena.

In addition to the interviews, a number of observations were carried out when the team members were actively carrying out collaborative practices either onsite or across locations. According to Gray (2014, p.413) observation involves "...the

systematic viewing of people's actions and the recording, analysis and interpretation of their behaviour". Hennink, Hutter and Bailey (2011) highlight that observation falls under the interpretive paradigm, a method to interpret and understand the participants' socio-cultural context. Saunders (2012) differentiates between two categories of observation: participant and structured. Participant observation is based on seeking meanings that participants give to their actions, while structured observation focuses on a quantitative standpoint and the frequencies of certain actions. Within these two categories data can be collected overtly or covertly.

For this study, as a researcher I engaged in overt observations to complement the one to one interviews, as it allowed me to gain a different perspective on the issues and the social team setting, how the team members situated themselves within their globally distributed team context. From a non-participant viewpoint the observations were useful in that it provided me with detailed knowledge of how the participants were interacting and carrying out collaborative practices with each other. During the observations, I made field notes to capture the participants involved and the key words and phrases being used, the sequence of activities and events, the goals that the participants were trying to achieve and how these were being accomplished.

Furthermore, during the observations I also asked the participants if I could view the documents they were using during their mediated interactions. Bowen (2009) emphasises that document analysis is particularly useful to qualitative case studies in uncovering meaning and developing understanding. Furthermore, he indicates that documents can serve as: (i) providing background of the context; (ii) information within the documents can suggest some further questions for the participants; (iii) documents provide supplementary research data; (iv) documents can allow the researcher to observe the changes and the development of the document and (v) documents can be used to verify findings. Within the study examining the documents during the observations was invaluable, as the participants were carrying out collaborative practices across locations, where a number of digital artefacts were being utilised. Hence, this allowed me to develop

a deeper and fuller understanding of how the documents were being utilised, what meanings were being attached to the documents by the participants, how they were being updated and how the participants were tracking the changes and development of the project tasks. Overall the observations and viewing documents were an integral part of the data collection process as it allowed me to gain corroborative evidence in line with the interviews.

4.4.4 Data Analysis

Through my analysis of the interview data, observations and inspection of documents, I was able to draw out and present extracts that unpacked and captured how globally distributed agile team members faced and overcame challenges in adopting agile practices. The analysis demonstrated that in certain situations tensions existed between the team members about agile practices and then patterns of interplay between tensions and negotiations took place, before they started to develop shared understandings around the agile practices. While doing the analysis I was essentially working with the interview data and the observations carried out. My focus was based on Walsham's guidelines on conducting interpretative case studies (1995, 2006), where he describes it as a "looser approach" of doing interpretative research. Sarker and Sarkar (2009) have acknowledged it as "predominately inductive interpretative approach". Therefore after each set of interviews I was following guidelines as advised by Walsham (2006, p.325).

First, I was "learning from the data", after each interview I would review and write down my impressions about the team members' views, on the challenges they were having in adopting agile and how they were overcoming these, how they were collaborating in globally distributed contexts and how they were improving their shared understandings. This step was essentially about understanding and unpacking data from the participants' perspectives.

Second, I would generate a more organised set of themes and issues after a group of interviews. I was trying to analyse the interview data and observations through a

method of unearthing and refining through constant comparisons, in order to build and provide an analytical reasoned perspective.

Third, I would think about what I have learnt so far from the participants. I was aware that individuals in different positions and locations may bring different bias to the interviews. Therefore I would use a number of techniques to validate the issues to see if they have been raised through other interviews. As a researcher I initially viewed the data independently, but then organised data sessions with my colleagues and group presentations. I also shared my findings and analysis to my supervisor, who reviewed the process to see if the coding and themes were providing an analytical grounding of the understanding of the data.

Fourth, during this whole process I was “reading widely on different theories” to examine which theoretical perspective would offer a “broader basis” on which to choose and “gain good insights” from the interview data already collected. This process enabled me as a researcher to draw upon a suitable theoretical lens of boundary objects and the Mangle of Practice theory (Pickering, 1995) which was discussed in Chapter 3 (Theoretical Framework). Using a theoretical lens allowed me to make a “data-theory” link, in order to carry out a higher level analysis to provide rich insights into the challenges of translating agile values into global contexts and how the actors were developing collaborative practices to achieve shared understandings.

Using this method of interpretivism, Walsham (2006) argues can be a challenging process. However, for me it was beneficial and invaluable in developing the data-theory link later on in the process, as it didn’t bind me to particular themes and it allowed me to explore all emerging themes equally.

The qualitative data analysis was carried out by using thematic analysis as it provides a systematic way to group complex data into a number of themes or concepts. Two types of thematic analysis exist in the literature: theory-driven (Boyatzis, 1998) and data-driven (Braun and Clarke, 2006). Fereday and Muir-Cochrane (2006) have developed a methodological approach where inductive and deductive thematic analyses were used in an integrated manner to analyse qualitative data. Using this integrated approach as a basis for this study, a data

analysis method was accomplished where codes were developed from the literature and also from examining the raw data from the interviews. This was an iterative process as applying codes to raw data enabled the researcher to examine how the data supports or contradicts the theory that had been guiding the research. Lichtman (2013) suggests the “three Cs” method of data analysis which consists of coding, categories and concepts and she also provides six steps to follow as given below:

- i. Initial coding, going from responses to summary ideas of the responses
- ii. Revisiting initial coding
- iii. Developing an initial list of categories
- iv. Modifying the initial list based on additional reading
- v. Revisiting your categories and subcategories
- vi. Moving from categories to concepts (or themes).

For this study an extended version of the three Cs data analysis method was applied (see figure 4.5), where the initial code development was carried out in an iterative manner from the raw data and theoretical concepts from the existing literature. The initial codes were then used to do the coding, where the codes may be revisited or modified. Once the coding had been carried out, then initial categories were identified where certain codes were grouped together under one category, again there was period of moving back and forth from the coding to the categories. Once this was completed then the next step of recognising important concepts or themes took place where patterns started to emerge. These patterns were trying to capture the nuances at a deeper level of understanding and meaning within the data set and were later identified as concepts or themes. This whole process was iterative where each time I was improving and focussing my understanding and trying to shed light on the larger context of global agile teams. Overall, this method of thematic analysis enabled me as a researcher to gain nuanced interpretations of the data and provide a “bigger picture” by identifying patterns and relationships (Braun & Clarke, 2006).

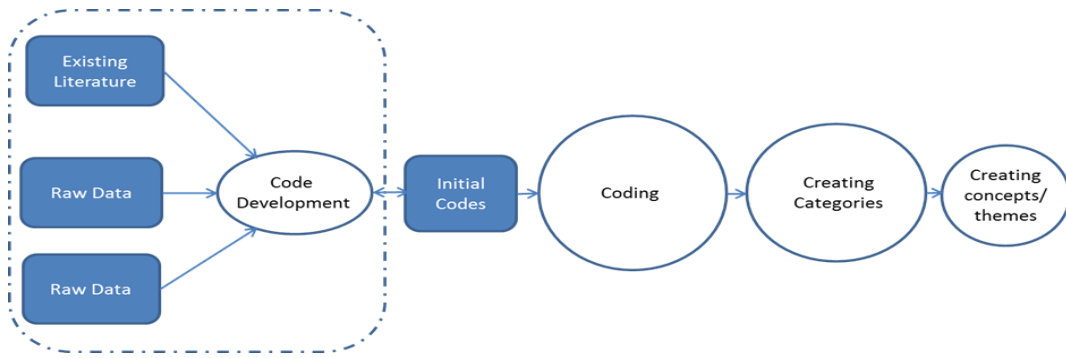


Figure 4.5: An extended model of the 3Cs Data analysis method (Lichtman, 2013)

4.5 Validity

This section addresses the validity within the Interactive Research Design framework. Maxwell (2013) reminds us that the concept of validity has been controversial in qualitative research and there exists an ongoing debate between quantitative and qualitative researchers on how to deal with validity. Some qualitative scholars have abandoned the concept as they see it too closely tied to quantitative research (Guba & Lincoln 1989; Denzin & Lincoln, 2005). They argue that the concept of validity has to be dealt in a different way depending on the type of research being carried out. Attempts have been made to resolve this by creating alternative criteria for qualitative research – see Table 4.4.

Table 4.4: Alternative criteria for judging trustworthiness of qualitative research

Positivist terms	Naturalistic Terms
Internal validity	Credibility
Generalisability	Transferability
Reliability	Dependability
Objectivity	Confirmability

With reference to the alternative criteria Symon and Cassell (2012) offer a number of different suggestions as to how ‘*credibility*’ can be achieved in qualitative studies such as ‘prolonged engagement’ with the research. In other words, spending enough time with the participants at the research site, where the researcher has gone beyond superficial observation and has immersed themselves in the research.

As this study was carried out over a two and half year period, a considerable amount of time was spent at the research site with the team members, such that they were all familiar with me and trusted me. Second, the authors suggest ‘peer debriefing’ and discussing the ongoing research with a colleague who can encourage reflexivity by challenging the assumptions and understandings of the data. Within the study, this debriefing was carried out on a regular basis with my supervisor, who acted as a sounding board for the development of the research and challenged my assumptions, which enabled me to become much more reflexive. Third, the authors suggest a ‘progressive subjectivity’, in other words keeping a record of initial understandings and how these have been challenged and improved demonstrating how the researcher’s understanding has been developed and refined during the period of the study. Within this study, a record of initial understandings were reviewed after each set of interviews as mentioned earlier using Walsham’s (2006) guidelines of carrying out interpretive studies. Finally, the authors also suggest ‘member checking’, where the researcher is testing the interpretation of the data with research participants to check if their views have been accurately captured. Within this study this was carried out where emerging results were discussed with some of the team members within the group.

Additionally, towards the end of the study a Breakfast Briefing event was organised at the university (see Appendix A), where a number of the participants from the study and other agile practitioners from globally distributed contexts were invited. At this event the researcher presented the findings of the study and there was an opportunity for the agile practitioners to discuss and provide feedback on the study’s findings. Overall, this approach enabled me as a researcher to verify if these patterns existed in other global agile teams and capture a sense of verification from other agile practitioners who worked in distributed agile teams.

As regards to ‘*transferability*’, Symons and Cassell (2012) suggest rather than trying to demonstrate generalisability of the results, the researcher should provide a thick description of the specific research case. For this case study, the next chapter provides the case description of the PRIME case. This is carried out in chapter 6 where the analysis of the case is presented, by providing thick description as

evidence. Chapter 7 presents the discussion in terms of how the findings of this study contribute to the existing literature within the domain of globally distributed agile settings.

The criterion of '*dependability*' refers to how the shifts in construction of the understanding was developed and refined in order to establish the study's trustworthiness. Within this study, the audit process was carried out in a number of ways: keeping notes in a research diary, through regular discussions with my supervisor regarding the research design and how it was implemented. Furthermore, discussions of any emergent processes and the decisions made to develop the understanding further. The meetings were also providing reflective appraisal of the project. Therefore, this whole process provided a chain of evidence which contributed as to how the study unfolded and in terms of the research logic. Similarly, the criterion of '*confirmability*' seeks to confirm objectivity. In other words, the findings stemmed from the results of the experiences gained from the study through the data collection process rather than the preferences of the researcher. Within this study, all the interviews were recorded as mentioned earlier and the data analysis process was carried out where the interpretations were rooted within the context of the study. Thus, a data-oriented approach was taken which led to the formulation of the conceptual framework is discussed in detail in chapter 7,

A number of authors argue that prescriptive criteria are inappropriate in qualitative studies and assessing validity through a certain criteria can lead to problems by making positivist assumptions (Angen, 2000; Saunders, 2012; Symon and Cassell, 2012). Angen (2000) emphasises that from an interpretative perspective the understanding of 'the truth' differs from what a positivist subscribes to. From the interpretive researcher's perspective 'the truth' is negotiated through dialogue and reality is constructed by the intersubjective experiences within the lived world and therefore the understanding cannot be separated from its context. Therefore, the concept of validity has to be reconfigured and reformulated in such a way that it is more appropriate for the 'lifeworld ontology' where interpretative research is rooted. The principal issue for interpretive research is the soundness of the research

in terms of the consistency and the integrity in design of the study. Indeed, Symon and Cassell (2012) argue that on one hand lists of criteria can be seen as guidelines for good practice, but on the other hand they can be detrimental in practice as they can create unachievable expectations. Therefore, they suggest that overall some kind of flexibility around the use of criteria is required and that researchers should draw on the elements of quality that are most relevant for the research at hand.

4.6 Research Approach Summary

To summarise, this chapter discussed the nature of qualitative research, focusing particularly on the interpretivist paradigm as the most appropriate method to achieve the objectives of the thesis in order to answer the research questions. The interpretive paradigm was chosen as it was based on the researcher's position that social reality is emergent and is being socially constructed by participants and it is a starting point for developing knowledge about the phenomenon. Namely, in order to understand the behaviour of actors it entails the researcher accessing and understanding the actual meaning and interpretations of actors about how they view their experiences. This study draws on Maxwell's interactive design approach as discussed earlier mainly because it does not consider research design in a linear fashion, but it allows the researcher to have greater flexibility and view the integral relationships among the different research components. Using a case study approach allowed me to gain a deeper and more comprehensive understanding of the whole phenomenon of globally distributed agile teams. Further, the chapter discusses how the data collection and the data analysis of the empirical data were carried out. Finally, in considering the validity of the study, as a first step towards this, a Breakfast Briefing meeting was arranged, which allowed me as a researcher to carry out initial member checking activities with other global agile participants.

The chapters that follow: chapter 5 will provide the case background to the PRIME. Next, the empirical findings and the detailed analysis by applying the theoretical concepts as scaffold are given in Chapter 6. The focus here will be to ensure that the analysis is presented in a clear and coherent manner to deepen our understanding of how global agile teams develop collaborative practices.

Chapter 5: Case Description

5.0 Chapter Overview

This chapter is guided by the study's overall research aim on how collaborative practices and a shared understanding are achieved in a globally distributed agile software development team. The chapter starts by presenting the contextual backdrop of the PRIME project in terms of how the need for the project came about. Next, the chapter provides a detailed perspective of the how the PRIME team was set-up, the motivation of the senior members for using agile methods and a need for having a similar mind-set. An overview of the chapter is given in figure 5.1.

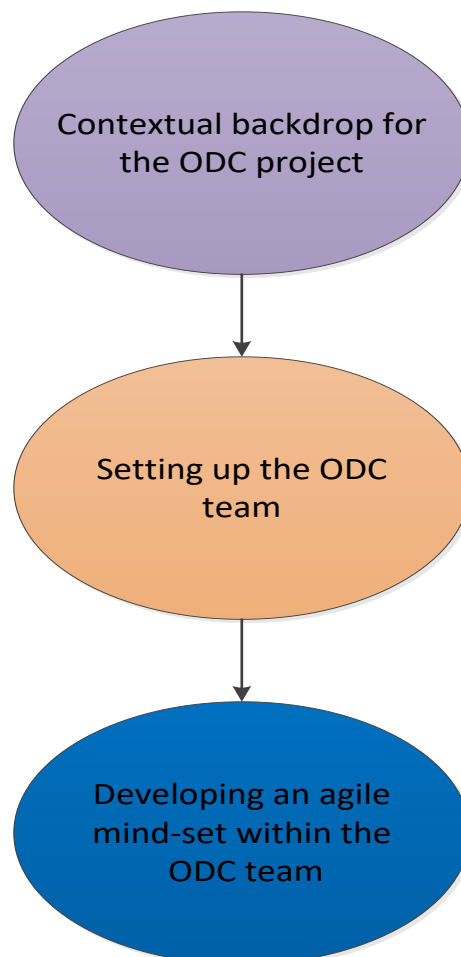


Figure 5.1: Chapter 5 structure map

5.1 Contextual Backdrop for the PRIME Project

The nature of the PRIME project came about as a result of the financial crisis in 2007-2008, where the imprudence of financial institutions caused catastrophic financial failures such as the bankruptcy of Lehman Brothers. (The Economist, 2013) This in turn revealed that the whole financial system was built on ‘flimsy foundations’ where global banks had allowed their balance-sheets to ‘blot’ and they had not set aside enough capital to absorb the losses (The Economist, 2013). The global bank at that point did not have one central method of looking at their exposure to complex chains of debt between counterparties and to various financial instruments, as figures were being brought together from a variety of sources (front and back office systems being different) which did not necessarily add up. Consequently, the bank needed to provide a unified way or a ‘single mandated golden source’, a single data source for all their transactions. Therefore, the overriding business objective for the PRIME project was to ensure that the bank’s internal consumers from all the departments such as the Risk department, Finance department and Operations department were all using one system for the bank’s transactions.

Historically, within the bank there were a number of different sub-systems providing a number of direct feeds – in other words, a number of source systems providing different data. However, this led to data inconsistencies from the sub-systems which caused problems with other sub-systems. This was partly due to some of sub-systems using different technologies.

In addition, when the trades were carried out in the past, the settlement time was T+2³ days or more as some systems within the bank took time in processing the

³ T+2 means transaction day plus two days

data. The financial markets were much more demanding and the clients needed the bank to respond and provide trade settlement information on the same day or a T+1⁴ timescale.

Through the initial meetings with the senior project manager, the importance of project was in terms of the development of the PRIME project to be correct and on time. The overall objective of the PRIME project was to deliver a real-time distributed database for the global bank, as a result provide a standardised model across the bank. Furthermore, it would enables the data to go through a number of stringent data quality checks, so that there was consistency across the bank. Second, there was a need to provide trade settlement information in a much more a timely manner. The third motivation was to provide one version of “the truth”, and to remove the situation that existed previously, where the different business streams within the bank were publishing different sets of data for the same clients. See figure 5.2 for the outline of PRIME project.

⁴ T+1 means transaction day plus one day

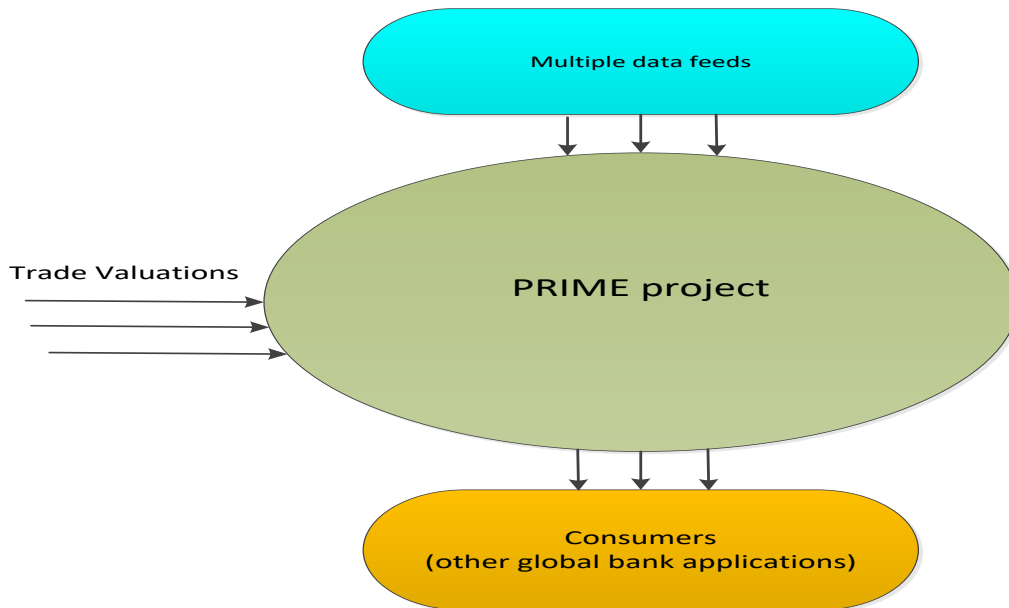


Figure 5.2: Outline of the PRIME project

5.2 Background of the PRIME team

As discussed earlier, the global bank's overall IT strategy was that the bank had offices in just outside Delhi in India, where software teams were located to support their overall operations. Each of the software teams in London would be aligned to a respective counterpart team in Delhi, while the overall project management role was usually carried out from London. Prior to the setting up the PRIME team, the protocol for all the software development teams was to work in a traditional offshore mode, where the requirements specifications would be written by business analysts in London and then discussed with their counterparts in Delhi. The software development would be carried out by the teams in Delhi using traditional plan-driven methods. These offshore teams were also seen as support teams to the London teams in looking after the bank's legacy systems and carrying out updates as required by the business. Once the software modifications had been made the user acceptance would be carried out jointly between both locations. Majority of the India teams would also carry out maintenance roles for existing systems.

For the PRIME project, the project manager and other senior team members joined the bank in 2010, specifically to set up the PRIME team. The team was formed as one team, which was going to be a globally distributed team across London and

Delhi, with a clear objective of developing the software jointly at both locations and not as a handover project. The PRIME London team members viewed the Delhi team members more as equals, compared to other IT offshore models which have been discussed in the literature, where power imbalances exist in the relationship between the West and the East (Ravishankar et al., 2013). See figure 5.2 for project organisation structure.

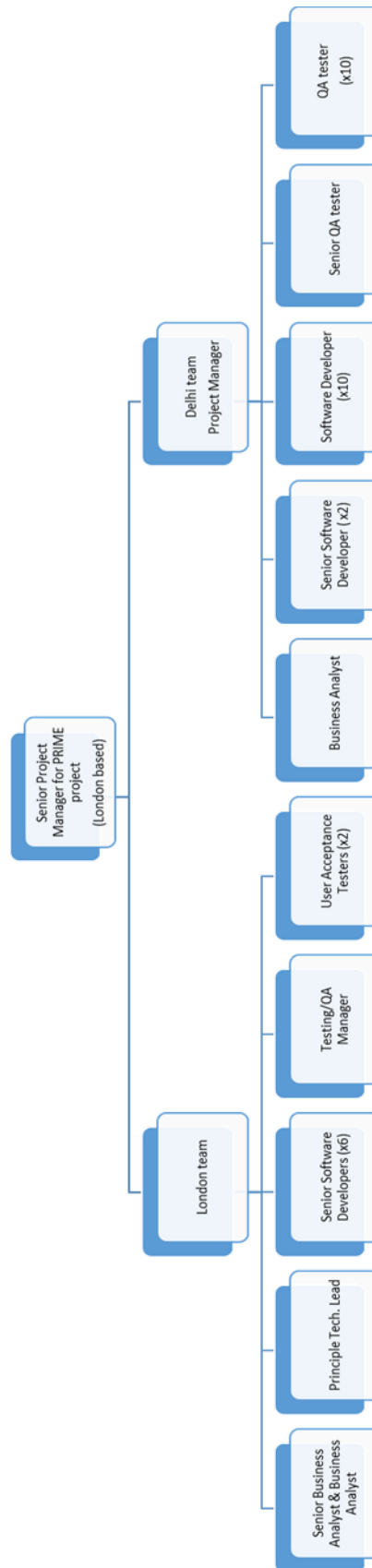


Figure 5.2: Project Organisation Structure

The roles and responsibilities of the London and Delhi team members have been summarised in tables 5.1 and 5.2 respectively.

Table 5.1 : Roles/Responsibilities of London team members

Role	Responsibilities	Participant No.
Senior Manager for PRIME project	Oversees that the PRIME project delivers its overall objectives for the stakeholders within the global bank. Liaise with team members as when required.	P1
Senior Business Analyst/ Business Analyst (BA)	Liaises with the users within the bank. Write user stories which are uploaded to the JIRA platform. To act as a product owner within the project and conduct iteration planning meetings. Initiate the daily stand-up meetings across locations. To participate in the demos within the PRIME team. Liaise with business analyst in India in the planning meetings	P2 /P3
Principle Tech. Lead	Plan and manage the overall architecture of the PRIME project Oversee and forge links between London and Delhi team members – arrange team visits and	P4
Senior Software Developers (x6)	Develop the user stories, initiate pair-programming sessions with Delhi counterparts. To liaise with tech. lead To participate in planning meetings with the business analyst/s. To organise and carry out the demo sessions once the user stories have been developed before they are passed on the QA team	P5/P6/P7/P8/P9/P10
Testing/QA Manager	Liaise with the Senior QA test person in Delhi. Liaise with the user acceptance test team members	P11
User Acceptance Test Team members (x2)	To plan and undertake user acceptance testing and liaise with counterpart QA team members in Delhi.	P12/P13

Table 5.2: Roles/responsibilities of Delhi team members

Role	Responsibilities	Participant No.
Delhi team Project Manager	Liaise with Senior Manager in London regarding any issues related to the progress of the project. Liaise with Business Analyst as when required regarding the next iteration of the project.	P14
Business Analyst	Liaise with the senior business analyst in London. Help write user stories and upload to the JIRA platform To participate in the demos within the PRIME team.	P15
Senior Software Developers (x2)	Develop user stories. Liaise with the software developers in India. Participate in daily stand-ups across locations	P16/P17
Software Developers (x10)	Develop the user stories, participate pair-programming sessions with London counterparts. Organise and carry out the demo sessions once the user stories have been developed before they are passed on the QA team	P18/P19/P20/P21/P22/ P23/P24/P25/P26/P27
Senior QA tester	Liaise with the Senior QA test person in London. Participate in daily stand-ups provide progress of testing to the rest of the team. Liaise with the user acceptance test team members	P28
QA testers (x10)	Carry out testing of user stories and participate demos of user stories. Liaise with senior QA tester and help carry out user acceptance testing as when needed.	P29/P30/P31/P32/P33 P34/P35/P36/P37/P38

The PRIME project was quite distinctive in nature for the bank, it was seen as a greenfield project as the code was being developed from scratch and it was a much

larger system compared to other systems within the global bank. Considering the importance of the PRIME project to the bank, I probed further as to why the PRIME project was set up as a globally distributed project and not as a collocated which would reduce the complexities of having an offshore team. According to one of the team member's views, this was mainly due to the bank's cost savings strategy:

“Overall, when you look at a project on this size you say clearly the sheer weight of numbers of people must mean there is a cost saving. But I am not sure if anyone's done anything along the lines of actually ‘how much better would it be if we had that unit of functionality based here?’ So you still get the cost saving because of the numbers, a lot of functionality has to be done in India because that is where most of the developers are, so that functionality would be done on a much cheaper basis, but no one's done that. I know from my own experience, when you've got smaller teams we have worked with a couple of developers who are offshore it just really slows that team down. I know that from previous experience, however there comes a point where the team size is so big, that actually it's worth it - you accept that there may be price to pay in terms of speed of development, aggravation, but the cost may start being worthwhile to do that.” [P1]

The bank's cost saving strategy for offshoring IT operations was in line with other large organisations (Rottman and Lacity, 2006). The informant reflects on the cost of unit functionality being developed, but also points out that prior to the PRIME project no one had used agile methods within globally distributed contexts in the bank.

One of the essential aspects of the PRIME project was its functionality where it had to be able to link up with other sub-systems within the bank. Therefore, the design of the architecture needed for the PRIME project was quite critical and it had to be planned in such a way that it would have the capability to adapt for the future needs of the bank.

5.3 Developing an agile mind-set within the PRIME team

The PRIME team was seen as being pioneering in terms of being the first globally distributed team within the bank to use agile methods, where the majority of the PRIME senior staff had experience of agile methods in collocated settings from

previous jobs and they had seen the benefits of working in an agile way. This in turn, helped to establish a similar agile mind-set for the PRIME project. Therefore, during the planning stage, the senior team members decided to adopt an agile way of working as they felt that they would be able to deliver software into the live environment far more quickly compared to the traditional plan-driven methods.

One of the initial challenges of the PRIME team was that their counterpart Delhi team members had heard of agile methods, but had no previous experience of using agile methods. Therefore, the London team members knew that they had to lead the way in developing an agile mind-set across the whole team and initiate activities for translating agile practices for global settings. This quote reveals one of the PRIME team member's views for using agile methods as compared to traditional plan-driven methods:

“In Waterfall you don't really have discrete task management, you don't have the ability to move ... if anybody asked me the difference between Agile and Waterfall I would say Waterfall is bold and it tends to remain static whereas Agile plan lives and breathes all the changes on a day to day basis and there is a lot of fluidity in the build cycle but ultimately you get an outcome. In the Waterfall approach it is much more difficult to track the fluidity so that you tend to build a plan, along you build an activity, not broken down to the correct level of detail and therefore difficult to track. If something slips you are not really able to measure the impact whereas in Agile we can.” [P1]

We can see how the informant describes the Waterfall or plan-driven method as a static method, compared to agile methods being much more dynamic in that it 'lives and breathes' accepting the fluidity of requirements and yet it also delivers the required outcome. He asserts that the agile approach provides the correct level of detail for the PRIME project, in terms of tracking the progress of a project where priorities can change.

Although, it was continuously challenging for the PRIME team to adopt agile methods within a global context, when the project manager was probed further if he would use agile methods again in other offshore settings, he said that he definitely would, as this quote reveals:

“I would certainly use this model elsewhere as it gives me a lot more interaction and visibility of what the offshore team are doing rather than giving them chunks and say you have four months to deliver it. I can literally say that we are always looking at this stuff over a two week period and so I get a constant measure of progress so that to me the beauty in it is that it starts to break down the deliverable into a series of tasks that you can get the visibility of it. I can get a feel of how well it is happening in London, how well its happening offshore, it doesn't really matter where it's happening but just that, to me that's less of an onshore offshore question, but that its more agile and it is a much better delivery approach and you can get a feel for the state of delivery – how good it is or how bad it is.”[P6]

The informant has emphasised the importance of interaction and visibility in the PRIME project, to being able to see the progress being made over a two week period. He also stresses that it is not about offshore or onshore settings, but more about assessing the progress of the delivery in two week iterations; therefore adopting an agile approach was a much better model for the PRIME project in terms of actual delivery of software.

5.4 Summary of Case

This chapter has focused on providing a broad background to the case study, in terms of the historical context and the need for the PRIME project. Second, how the team was set-up and how the London team members had a similar agile mindset from their previous roles having worked in collocated agile before. In addition, we can see the PRIME senior team members' commitment to work in an agile way, because they can easily track the progress made.

The next chapter will present the analysis of the PRIME case, using the theoretical concepts as scaffold.

Chapter 6: Case Study Analysis

6.0 Chapter Overview

The aim of the thesis is to take a socio-technical perspective to explore how globally distributed agile teams develop collaborative practices across the globally distributed locations and how the team members overcome the challenges so that shared understanding is developed.

The thesis is being guided by Walsham's (1993, 1995) view on theory, where he argues that theory should be considered as a "scaffold" or as a lens and it should not be regarded as a rigid structure but a valuable guide to empirical research. Furthermore, according to Walsham (1995) the motivation to use theory in interpretive case studies can aid in creating initial theoretical frameworks which take account of previous knowledge. Taking this into account, this study applied "thematic analysis" as a method, to allow for identifying potential new themes and issues for exploration. In other words, the data analysis was carried out as an iterative and incremental back and forth process for patterns or themes to emerge.

The chapter centres on applying two theoretical concepts: boundary objects and Mangle of Practice as a pluralistic analytical lens at a team level. The analysis should be seen as sensitizing the theoretical concepts allowing the researcher to shed light on the meanings from the informants within the PRIME case study. The rich narratives provided in this chapter are fragments which should be pieced together and be viewed as a whole, to see the overarching complexity of developing collaborative practices and challenges of actors within the social setting of globally distributed agile teams.

Section 6.1 focuses on the first phase of the analysis using the concept of boundary objects as an aid to understand how software development artefacts are used by team members. The analysis examines how the artefacts support collaborative practices between the team members. Taking this one step further, Section 6.2, attempts to unpack the findings from a practice-based perspective to reveal a more

in-depth understanding of the actors and their challenges in adapting agile practices in global contexts from a relational perspective. The emphasis here is to explore the emergent dynamic interplay amongst the actors, and also between the actors and the technology. Simply put, to explore what situations cause the tensions and challenges when actors were attempting to carry out collaborative work practices across globally distributed locations and how the actors overcome these. Finally, section 6.3 provides a summary of the chapter and discusses how undertaking this approach results in applying the theoretical concepts as scaffolding and a basis for gaining deeper insights of how collaborative practices are developed within globally distributed contexts. An overview of chapter is given in figure 6.1.

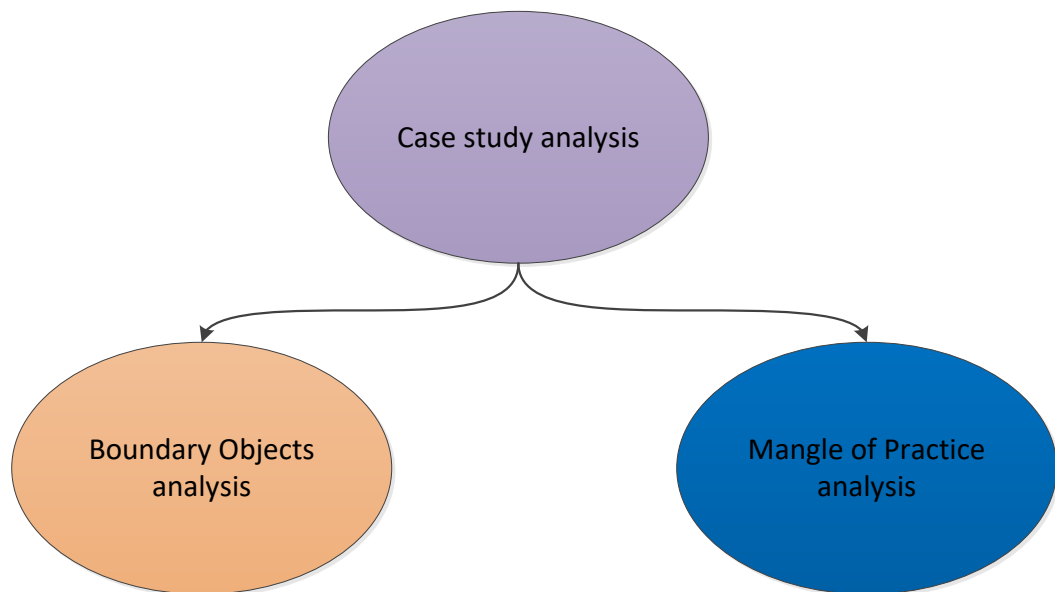


Figure 6.1 : Chapter 6 structure map

6.1 Analysis from Boundary Objects Perspective

This section presents the findings of the case from three different perspectives as identified by Vakkayil (2013): (i) enabling coordination; (ii) aiding knowledge flows and lastly (iii) facilitating in collaboration differences. In the sub-sections that follow the analysis is presented under separate headings, though they should not be

seen as mutually exclusive, but rather more holistically where there is interconnectivity and linkages between the sections.

6.1.1 Enabling coordination

One of the important characteristics within the PRIME case is that the majority of the interactions between onshore and offshore actors were based around digital artefacts or ‘digital boundary objects’ as described in Alin et al.’s (2013) study. These digital boundary objects were shared by the actors either through a digital platform or via email to support the coordinating process. The PRIME team utilised a proprietary issue tracking tool called JIRA, a software platform which helps create a digitally mediated environment – or in other words an intra-organisation workspace where all the actors can coordinate activities easily through this platform. The software JIRA platform could be viewed as a “boundary infrastructure”, where the infrastructure is embedded in a social structure and aims to create visibility (Vakkayil, 2013). JIRA allows the actors in the global context to access a number of tools to create a set of integrated digital boundary objects rather than stand-alone artefacts, where these could be easily modified and updated. Additionally, the JIRA platform provides the continuous real-time visibility of the digital artefacts to all the actors within the team, regardless of their location. This enables the actors to coordinate a number of their daily tasks around the platform, such as the daily stand-ups.

If actors are interested in the progress of particular user stories or functionality then they can set-up alerts within the JIRA platform so that emails are sent when changes have occurred. It was found that these digital objects played a significant role within the PRIME team in terms of sharing the objects which not only prompted the coordinating process, but also allowed for the collaborative practices to evolve across locations in terms of linking with their respective team members across the locations.

The first narrative is concerned with how the actors capture the user stories as digital boundary objects, as the JIRA tool allows the team members to upload their user

stories as issues – though the team members also refer to the user stories as ‘Jiras’ as well:

“JIRA’ is quite a keen part of our requirements capture and coordinating process. JIRA is the system we use to cache our requirements so we document those requirements that we are doing in the iteration so two week iterations. At the beginning of that I tend to meet with the BA (Business Analyst) and a few others and we go over the Jiras. So that’s basically the way we capture requirements so we try and have a finite story so that the story has the functional requirements for that piece of work. We use JIRA to capture our story requirements so it’s viewable in India and the UK. It tracks the progress in terms of you start work on a story, you work on it and you complete it. The other thing it enables our clients to look at stories that are of interest to them, to make sure they get pushed through or prioritised. You know when bugs are raised against them they can chase them up themselves as well. So really it completes the requirements tracking and you can also link items, and make them dependent on each other.” [P5].

The quote also illustrates that JIRA as boundary infrastructure creates a shared mediated space across the geographical boundaries so that boundary objects are accessible easily and there is a transparency within the team for coordination purposes. This can be compared to the ‘Wall’ where the user story cards are posted for the current iteration within collocated agile teams (Sharp & Robinson, 2008). Although, within the JIRA platform only designated actors within the organisations can login to the platform and see the user stories; this is unlike collocated teams where anyone within the office can see the user cards on the Wall. Therefore, within the PRIME project, by using JIRA platform, the stakeholders could see the progress made in the user stories they were interested in.

The JIRA’s coordinative role was essential to the PRIME team as it was used as an initial method to align the different interpretations of the user stories. Second, JIRA also provided a current representation of the work carried out by each of the team members, in terms of how many user stories had been completed, how many user stories were being actively developed and what user stories were outstanding for the current iteration. Beyond the immediate iteration, it was used as a planning tool in terms of what user stories were in the backlog for the following iterations. In other words, it provided a key point of reference for the team members, project

manager and the key stakeholders in terms of the milestones which needed to be achieved, and what resources were needed.

The user stories or digital boundary objects are also used as a key reference point by the actors during their conversations – see figure 6.2.

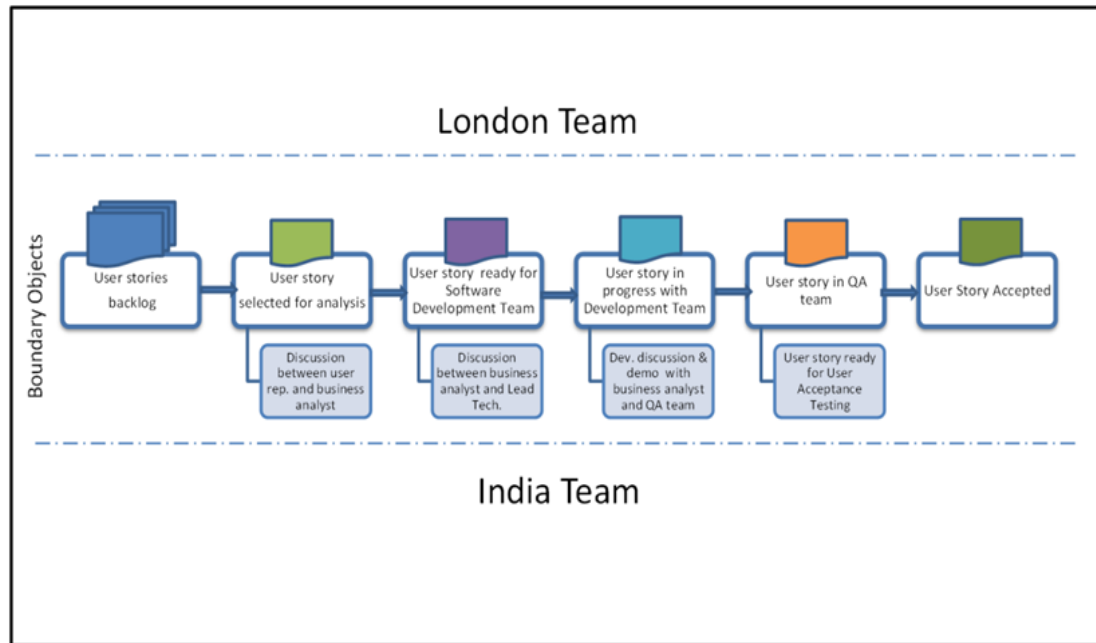


Figure 6.2: Reshaping of user stories within the PRIME project

For example, the PRIME team adapted an agile practice of daily stand-up meetings and communicated via audio conference calls across London and Delhi. As the team members could not see the visual cues of their counterparts, they heavily relied on the digital objects on the JIRA platform for their discussion. The senior business analyst based in London conducted the audio-conference daily stand-ups, where he would ask for a status update on the progress of the user stories and he would ask if they were having any problems which they needed help in resolving. The user stories on JIRA could be modified and additional documentation or notes could be attached, so these could be seen as boundary objects which had ‘plasticity’ or malleability in nature so they could be modified. The digital objects attempted to facilitate communication, but in the quote below, one of the informants emphasises the struggles in adapting daily agile practice of a daily stand-up due to the different locations and time zones:

“We are recording those and communicating them in a system called JIRA. How it works in terms of communicating, when the Agile way working does rely on a lot of verbal communication rather than things being written down, verbal communication tends to be more efficient I think in teaching people what’s going on. And also you can add these conversations, you should just be able to get up and have these conversations whenever you need. This becomes a problem when you’ve got people working a few thousand miles away in a different time zone. So our method tends to have a lot of checkpoints in it, where we enforce communication...”
[P7]

From this quote, one can appreciate the struggles and challenges that the team members have in terms of communicating and coordinating daily across time and space without any facial cues. Within a collocated environment, the stand-up meetings would take place face-to-face and therefore, they would not only help with the coordination but would also provide an opportunity to pick up on any visual cues to see if all the members have developed an understanding of the activities which are undertaken by the team.

Overall, during the fieldwork it was found that all the team members within the PRIME team relied heavily on the digitally mediated workspace environment as a central coordinative mechanism for their software development activities. This can be compared to the ‘Wall’ within a collocated agile environment where it becomes an integral part of the agile team workspace as it displays all the user stories, as discussed in Sharp & Robinson’s (2008) study.

While comparing the digitally mediated environment and the collocated environment there are similarities and tangible differences, in a collocated setting; the Wall is a physical component, therefore the information is immediately viewable to anybody passing by and it would display ‘*visible signs of progress*’ (Sharp & Robinson, 2008). From a materiality viewpoint the physical Wall becomes the central reference point where all the actors would meet on a daily basis to negotiate the progress and tracking of all user stories. In other words, the materiality of the physical Wall effortlessly enables the transparency of interactions, coordinative aspects and thus encouraging collaboration within the team. However, in a digitally mediated environment the materiality of the boundary infrastructure such as JIRA can provide the online coordinative aspects to all the

actors across locations, as long as they are given access to the JIRA platform. Yet the online nature can limit the visibility of the interactions and this in turn can have an effect on the group dynamics.

6.1.2 Aiding knowledge flows

Within the case, the difficulties of knowledge sharing across boundaries were observed. When the PRIME project first started, the majority of the senior developers within London had over ten years' experience in the software development industry, additionally they had experience of agile methods from their previous employment, whereas, their Indian counterparts were more junior developers, and were not really familiar with agile methods or an agile approach. In the planning stage, the senior developers had made a deliberate decision not to follow a Waterfall or plan-driven method as they felt that this approach would cause delays in the software development and implementation. Additionally, they did not want to constrain the functionality of the software development on one site and they wanted to disseminate their programming and agile experience beyond the London team members to their counterpart team members in Delhi as well. By undertaking this approach, the senior team members were putting in a great deal of effort in supporting knowledge flow activities across boundaries due to separation of space, time and knowledge differences.

The PRIME team decided not only to use the JIRA platform to view and access all the user stories across the geographical sites, but also to work on the same code-base in real time. The code-base could be seen as a digital boundary object as it is structured and yet sufficiently plastic enough (Star & Griesemer, 1989). According to Carlile's (2004) boundary object framework, three types of knowledge boundaries: syntactic, semantic or pragmatic exist. Within the case the syntactic boundary was established by sharing the same code-base as it provided a "common lexicon" between the actors to establish an initial shared understanding and to facilitate the joint field of practice. In the fragment below the informant discusses how the code was structured in a manner that aided the knowledge flows across the locations:

“We use the code as a way to describe what its doing. If you structure your code well enough it can describe exactly what it is, it can be a means of a communication mechanism, and it helps support the knowledge flows. Even if you change some code, checking it in the person at the other end of the line reading the code can see what it does from the fact by reading the actual code. So, I think we do value the code as the documentation quite highly as it helps spread the knowledge across the sites” [P10]

Although the team members from both locations used the code-base as a digital boundary object which could support the syntactic knowledge-flows easily, it was evident that knowledge boundaries still existed. From Carlile’s perspective (2004) semantic and pragmatic boundaries exist if the actors have different interpretations and translation of the common lexicon. Moreover, from Carlile’s (2004) perspective, the capability to enable knowledge flows fully depends on two things: the capacity of the boundary object and the ability of the actors. Within the case, semantic and pragmatic knowledge boundaries were much more difficult to overcome due to differences in knowledge as the developers in London were senior and more experienced compared to the developers in Delhi. The following quotes reveal different perspectives from both locations; the first fragment from the Delhi team member and second quote is from the London team member:

“From the implementation side we can check the code to see what has been updated etc. But the idea of what we are trying to achieve and having the shared vision and how this can be achieved is more challenging because of the geographical differences. We need to talk more with the team members in the London team and we need to improve on this. [P16]

Below a team member from London discusses how the knowledge sharing aspect is problematic and how he tends to focus on the ‘bad bits’ and communicating issues which will cause problems:

“It’s a struggle to get over the information. I think it probably was bad and I know it’s still awkward, I tend to only communicate if something is wrong or the bad bits and I tend to pick up on things that are a problem or things that are an issue and its communicating, how to communicate that in a ‘everything else is good but actually this is a bit wrong and this is going to create a problem’. So I do tend to look at a lot of the code and then only pick out the problems rather than picking out the good bits. [P8]

During the fieldwork it was observed that sometimes the junior software developers in Delhi would rather ask their respective colleagues for clarification of the code and preferred to have face to face interactions, rather than airing their questions on the audio conference calls.

For the team members within the PRIME project, to overcome the difficulties in semantic and pragmatic knowledge boundaries, it took time and effort at both locations, as different interpretations existed for what was considered good code. Gradually, over time the semantic and pragmatic boundaries were overcome, where similar interpretations and shared understandings were developed through the code-base. Though, audio conferencing and emails did not allow the actors to see the visual cues of their counterpart team members.

Apart from using the JIRA platform and the code-base, the team members created a number of additional tools similar to a Wiki to further support knowledge sharing flows. For example, they would upload essential documentation like the logical data model, the definitions and meanings of terms which were used by PRIME team. These could be seen as '*designated boundary objects*' as identified by Levina and Vaast (2005) which are considered as valuable across locations due to their design and properties. The goal of the senior team members was to develop a greater shared understanding by using a number of different tools, however, in the fragment below it can be seen that one informant is not sure if the offshore team members in Delhi actually access these extra tools:

"We have the logical data model published and put online on the intranet. There are certainly areas I use. I'm not sure whether the other guys use that so much. I know some of the testers have started using that as a way to read up about what the domain model is, the logical domain modelling team document, what is a product, what is be a source book, ledger book.. etc. I know when they have been reading it." [P4]

As the team members wished to preserve a sense of the agility; they decided they would not have any form of hard-copy documentation which would need to be maintained and updated regularly. In order to update important essential documentation, the team developed specific tools which would automatically

update essential documentation which would be held in a shared environment, where all the team members could have access to them. By working in this manner, they did not have to pass on any documentation during the handover periods to any of the other team members; this was critical as the software being developed by the team was fundamental to the global bank, as this informant reveals:

“We have JIRAs but we also have an automated release tool which is like a Wiki which we have developed. This informs us when the latest release was and the information about the different developer environments as well – this tool describes every piece of work we do and a number of acceptance criteria [P17]”

The documentation could initially be seen as designated boundary objects, but they transform to become boundary objects-in-use (Levina & Vaast, 2005).

6.1.3 Facilitating collaboration practices

Within the PRIME case, a number of challenges existed in carrying out collaborative practices within globally distributed contexts. The geographical and temporal differences meant that the team members could only communicate in the overlapping period during the day. In addition, differences in knowledge about agile methods and general experience of information systems development between the team members in London and Delhi meant that at times this caused frustrations with some of the London team members. They attempted to improve the collaborative practices through a number of different software tools. One example of a software tool they used was called ‘Bridgit’ which allowed screen sharing from their desktop and the use of phones; the team were not allowed to use off-the-shelf packages such as Skype, due to hampering security and client confidentiality of the global bank.

The senior team members were aware that misunderstandings of the user stories could occur because of distributed settings. Therefore, they adapted additional practices where the developer had to demonstrate what they had developed so far, to check if it met the needs of the users before passing the user stories to the testing team (QA team). These demos were carried out by using the Bridgit tool across the geographical locations where the software developers in Delhi would demonstrate how the software works to the BA in London, interested stakeholders and a member

of the QA team who was also based in Delhi. Having such software tools helped in facilitating the collaborative practices within the PRIME team, but the informant below discusses the challenges the team members had and how they attempted to ensure that the user stories are developed correctly before they were passed on to the test team. From a boundary objects perspective, it could be said that the software tools aided in achieving partial collaboration and developing a collaborative culture within the PRIME team.

A number of boundary objects do come into play when the team members are attempting to carry out complex collaborative activities, as this informant discusses:

*“...when the developer has finished the story, before we allow it to go into test, the developer must demonstrate what they have built and show that it is working and there is nothing obvious that is clearly broken. And those again are phone call meetings, but with shared screens. So when the developer might be India based, the QA might be India based, but the BA is over here [in London], and also there is certain people who depending on what part of the system it is, we have some people who are technical lead, so we’d make sure they’re involved and sometimes the project stream managers are also interested in seeing that as well. We are very much focused on those and we don’t let those slip, and so that is an area where we collaborating across both locations to make sure it is working. Sometime, there were times where you have to say **‘you’ve implemented that wrong, we’re going to have to re-open it and put it back in development’**, or sometimes there are circumstances where you say ‘Oh I see what you’ve done, I see why you’ve done it, but actually what was written down by the BAs were wrong Do we ask the developer to fix it or actually is it so much work that we need a new story. But also in that meeting we ask the QA are they ready to accept the story into test on the basis of what it is now. In the past, the developers would lob it over the wall into test and it didn’t even work.” [P2]*

During the fieldwork, most of the informants within the case agreed that software tools like JIRA and Bridget were useful in developing agile practices across locations, but they also emphasised that undertaking collaborative practices was most problematic and challenging, as they felt they were not aware of the background of the counter-team members in Delhi. Considering this from a boundary objects perspective, objects have certain plasticity and flexibility and they have the capacity to overcome the syntactic boundaries (Carlile, 2004). Developing a shared understanding or semantic knowledge (Carlile, 2004) about the business

context with the software developers in Delhi was hampered and to overcome this difficulty the senior team members tried to develop a number of extra collaborative activities or checkpoints such as the ‘demos’, which were not necessarily part of collocated agile teams.

Although these extra collaborative activities were meant to support the team members in developing a shared understanding, at times it created further frustrations due to the complexity of activities and the number of boundary objects the actors were dealing with. The informant discusses the dissatisfaction and frustrations of not being able to pick up on the visual-cues of the offshore team members and they feel that having the transparency through the code-base and JIRA was not enough at times, as it sometimes led to misunderstandings and misinterpretations about the offshore member’s intentions and the values they hold. As discussed in the literature review, Levina & Vasst (2014) suggest that two types of boundary objects exist, first, ‘objects of exchange’ which are used for transferring information from one context to another in a transactive mode. Second, in the transformative mode, boundary objects are used to represent differences amongst groups. Within the PRIME case the user stories held within JIRA could be viewed as dynamic boundary objects which are ‘objects of exchange’ as they provide a means of transferring information about the user requirements. One interesting finding within the PRIME case, was that the user stories being objects of exchange were used as a basis for development of the code-base which could be seen as a second type of boundary object in the transformative mode. In other words, transactive mode was enabling the development of transformative mode or new joint practices.

Within the case, having a number of objects is beneficial, but also still challenging from a number of perspectives in developing collaborative practices. For example, in a collocated setting, the actors would be communicating face-to-face and therefore the social ties would be developed far more quickly compared to globally distributed settings(Kotlarsky and Oshri, 2005). This in turn, would mean that the actors would be able to pick up on the visual cues far more easily as to whether the

knowledge sharing and understanding of the context has really taken place or not as an informant explains below:

“Working F2F just gives you a much better picture of who you’re working with, what they value and how they’re working and what concepts, otherwise you’re just limited to what’s in the code and what the code can express and what they’ve checked in. It maybe they were rushed, it maybe they had to go on holiday, you know they didn’t actually want to check in the work, they wanted to finish it off but you didn’t know that so what looks to you half completed and half done or badly named is actually because they’re meant to finish it off or is it the opposite, did they think it was perfect, they thought everything was brilliant and completely didn’t really realise it didn’t cover certain aspects so I guess you don’t get that context.”
[P9]

Indeed, over time some of these collaborative practices improved within the PRIME team, especially when some of the team members had travelled to India and physically spent some time with their counter team members, as an informant discusses here:

“Going over to India certainly helped me realise that a lot of it is communication barriers, it’s not ability barriers, but obviously the natural separation of a team you get those divides irrespective just because you’re physically separated, time, space, slight bit of culture but mainly physical separation. Certainly going over there helped communication if nothing else, just also getting an idea of people’s abilities as well. The other thing that has helped is kind of opening up more of an open culture where people if they have problems don’t mind sharing them. I think we’ve suffered a lot from people not wanting to say they’ve got a problem doing something or how do we do this? I think the guys here are a lot more open to asking questions about how we should do this? Is this the right way? Is there anyone else working in this area? Just making sure people are free to ask questions and open up basically”
[P10]

However, after the first year of the PRIME project the travel budgets were cut by the global bank and therefore this hampered their collaborative practices. As a result, the team members had a tendency to communicate and collaborate with team members they had previously met on visits and new team members would initially face difficulties in attempting to start collaborative practices. Though, during the fieldwork it was observed, that sometimes existing team members would ask new team members to observe and participate in collaborative practices which were

taking place across locations. From a boundary objects analysis, it reveals that the complexity of the knowledge boundary can cause challenges for developing collaborative practices and having face to face interactions helped resolve some of those boundaries.

Although the boundary objects concept is powerful and Carlile (2004) explains that the capacity of the boundary object and ability of the actors gives the capability or the know-how of managing the boundaries. However, the boundary object concept does not go far enough in explaining why sometimes misunderstandings develop and other times not, as the informant within the project states when a user story has not been correctly developed –

‘you’ve implemented that wrong we’re going to have to re-open ..’.

To determine how boundary objects at times facilitate collaborative practices and other times not, there is a need to probe further and to explore how the mediated interactions amongst the actors and also between the actors and the technology affect collaborative practices. In other words, it is important to consider the interplay between the social and technological aspects when examining collaborative practices across globally distributed settings.

6.1.4 From Boundary Object Analysis

Overall, from the analysis carried out so far, it can be inferred that within the PRIME case multiple boundaries exist and these have a bearing on how the team adapt and shape the agile practices for a globally distributed context.

Utilising the concept of boundary objects for analysis is useful, as it enhances our understanding of the role of boundary objects (Levina and Vaast, 2005) and the different types boundaries (syntactic, semantic and pragmatic) (Carlile, 2004). The boundary objects within the PRIME team to a certain degree aid the process of enabling coordination, developing knowledge-flows and facilitating collaborative practices, but from the analysis it is also evident that the semantic and pragmatic knowledge boundaries are the most challenging. Therefore, the PRIME team members attempted to develop a diversity of collaborative practices though this can

sometimes create further misalignments. For example, surprisingly the code-base as a digital boundary object can aid in facilitating knowledge flows, but at the same time it can cause frustrations for the software developers participating in collaborative practices. See table 6.1 for a summary from a boundary objects perspective.

Table 6.1: Summary from Boundary Objects perspective

Boundary Objects perspective	Examples within the PRIME case
<i>Enabling coordination</i> (from Carlile's framework – syntactic capacity of transferring knowledge)	Attempting to construct understanding: <ul style="list-style-type: none"> - Capturing the user requirements, clarifying and refining them into user stories (or digital artefacts). - User stories are uploaded on the JIRA platform to achieve transparency across both locations - Creating a digitally mediated infrastructure attempts to create a digital common ground of the user stories
<i>Aiding knowledge flows</i> (from Carlile's framework – semantic capacity of translating knowledge) (from Levina and Vaast (2005) designated boundary objects become boundary objects in-use)	Attempts to co-construct understanding: <ul style="list-style-type: none"> - sharing and checking the code-base to aid in negotiations - Shared space for the logical data model - Automated release tool and acceptance criteria
<i>Facilitating collaborative practices</i> (from Carlile's framework – pragmatic capacity of transforming knowledge) (from Levina and Vaast (2005) designated boundary objects become boundary objects in-use)	Attempts to build collaborative practices and remove differences: <ul style="list-style-type: none"> - Using various tools to aid and develop collaborative practices further - Asking critical questions during the demo sessions - Addressing the differences and asking the developers to act on the comments made during the demo sessions

Although the boundary objects concept is beneficial, yet the theoretical concept does not go far enough in fully explaining why sometimes the interactions can be successful in supporting collaborative practices and at other times not so. As a result, a pertinent question comes to the forefront: how do the actors work within these entanglements to resolve the tensions and frustrations to create a sense of orchestrating adapted agile work practices which allows them to continuously work within globally distributed contextual settings? In other words, the research

question moves beyond the general interest of the artefacts as boundary objects, to further explore the different relationships and interplay between the artefacts and the actors, amongst the different actors across locations and the interplay between the actors and the technology. Hence, it is necessary to carry out a further stage of analysis to explore the various different interactions amongst the actors and artefacts which can lead to how agile practices are being adapted within a practice based context. The next section presents the analysis from the concept of Mangle of Practice perspective.

6.2 Mangle of Practice Analysis

This section presents the analysis of the case from a Mangle of Practice perspective as discussed in Chapter 3. The analysis shifts from considering the artefact perspective to focus on the situated interactions of the actors within globally distributed settings. In other words, the emphasis of the analysis is now based on a relational perspective, on how interactions unfolded and were constructed within the team within a digitally mediated setting. It is important to unpack and understand the collaboration process from a relational perspective within globally distributed settings and to examine how the team members adapt and modify agile practices. Examining the complex interactions within this case would enable us to gain deeper insights into how agile practices are shaped and adapted within a globally distributed context. The subsections that follow present the analysis of three agile practices which were carried out by the team members from a Mangle of Practice perspective. Table 6.2 briefly summarises the dimensions of Mangle of Practice (see Chapter 3 for in depth discussion).

Table 6.2: Overview of Mangle of practice

Dimensions of Mangle of Practice	Pickering's viewpoint
Human intentionality	Human agency has 'intentionality' which could be seen as specific plans or goals. These goals and plans are not fixed, but they are liable to revision in real-time practice.
Resistance and accommodation	Material artefacts and technology can offer resistances and therefore human agencies would attempt to make

	accommodations in order to achieve their goals.
Temporal emergent patterns	Human and material agencies are intertwined and are temporally emergent in ongoing practice, producing a ' <i>mangle of practice</i> '.
Ongoing process of tuning	Pickering proposes the metaphor of "tuning" similar to tuning a car radio to articulate the process through which human and material agencies mutually adapt.
Interactive stability	Over time through the mutual alignment an 'interactive' stability or stable state is achieved.

The above dimensions should be seen as interrelated and interlinked to each other, see figure 6.3.

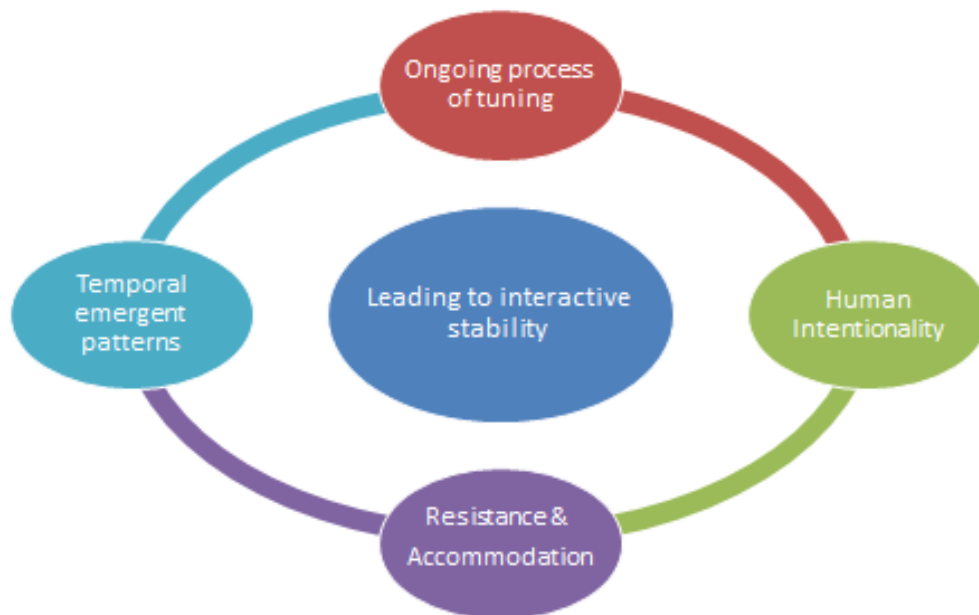


Figure 6.3: Dimensions of Mangle of Practice

6.2.1 Pair-programming within the PRIME team

During the planning stage the senior team members of the team decided to use agile methods as discussed earlier as they felt that this would help reduce the software delivery time and they would have a working system delivered much earlier than using plan-driven methods.

When the team was formed, the London team members knew that their India counterparts were more junior developers and were not really familiar with the agile approach. Therefore, the senior team members wanted to try to develop collaborative practices to support the software developers in Delhi. One of the agile practices they attempted was pair-programming sessions across locations to aid knowledge flows and to develop a greater understanding of agile practices of the Indian developers.

The overall goal of the working in an agile way could be viewed from the human intentionality dimension. Furthermore, wanting to adopt the practice of pair-programming could be seen as an overall example of 'human intentionality'. As discussed in the literature review, within a collocated environment pair-programming is a collaborative activity where the developers sit next to each other and work on one workstation where they would take turns in developing the code (William and Kessler, 2002; Beck and Andres, 2004).

Within the team, the London team members had initiated to use pair-programming practices and develop code by using the test-driven development (TDD) method, where the test cases are written prior to code implementation. They had planned to carry out the pair-programming sessions by using telephone calls and screen-screening software. However, this created a number of tensions and frustrations as explained by the informant below:

I'm sure it would benefit those with less experience, but the thing about pair programming is that you are supposed to be worrying about stuff together, as you're typing in lines of code, your partner can comment. When you're pairing across locations someone has already done 5 1/2 hours of work before the other one has come across the office, then you have a couple hours of overlap therefore I

don't know how well pairing across a location would work, and if the London developer tends to be the more senior of the two, he's looking at the code written 5 ½ hours earlier and finds fault in the first couple of bits, you are picking bits that have and Indian developers would go home and London developer continues working. Indian developer comes in the next day and they don't understand the changes and reverts the changes. So you can see how pair programming doesn't work across split locations, so it works best when you have developers sitting next to each other.” [P3]

From the Mangle of Practice perspective these challenges could be viewed as resistances and accommodations from multiple perspectives: (i) the actors, (ii) the geographical and temporal distances, (iii) the technology and (iv) the code. From the actors' perspective, the Indian developers felt a certain sense of ambivalence as they lacked the experience doing pair-programming and they had not worked and written code using TDD in this sharing manner. These resistances in turn developed tensions within the London team members as they felt their intended goals were not being met or going according to plan. Therefore, several accommodations and workarounds were being made at both locations. Second, another occurrence of resistance and accommodation came due to the geographical and temporal distances, as the Indian developers would have already developed some code prior to the overlap time. During the overlap time the actors would carry out the remote pairing sessions where the code would get securitised and unpicked by the London developers to improve it. From a technology perspective the actors had to deal with further resistances due to the infrastructure, as during these sessions the actors were using screen sharing software, the Internet and telephone lines. Therefore, when some of these aspects failed or were slow, it caused delays and these in turn triggered points of frustration for the developers as explained by the informant below:

“The technology was standing in the way to get the understanding the crappy phone lines sometimes good and sometimes bad.” [P5]

From the code-base perspective, the code was being written and rewritten, this could also be seen as episodes of resistances and accommodation, as it was destabilising the code and existing understandings causing the developers to reconsider and tune themselves in relation to each other, where hybrid practices and

new shared understandings were being developed. Due to the complexity of the collaborative tasks and the entanglement of work, both actors had to interact with each other through the technology constantly modifying their actions in order to sustain the shared practice. In other words, within this joint-practice entanglement there was back and forth between cycles of resistances and accommodations, which eventually led to a reconfiguring of their initial goals. As these pair-programming sessions were carried out on a daily basis, initially temporal emergent patterns started to evolve which led to tuning where the collaborative practices were not prescribed in advance, but they were evolving from the ‘mangling’ or interplay between human and non-human actors.

When the interviews took place the remote pair-programming sessions were not being carried out on a daily basis, only as and when needed as developers at both locations felt that key understandings of developing code manner had taken place. During the interviews the London informants reflected back on the remote pair-programming sessions as a challenging and frustrating period during the project. However, when the Indian software developers reflected back on these sessions, they referred to them as initial training sessions, which helped them to reduce the knowledge gaps, as the informant explains below:

“At the start there was a skills set gap as the team here [Delhi] is much younger than the team there [London]. Guys there [London] have done projects like these over and over again and for most of us it was a first time experience and hence there was a very big skill set gap therefore we did P_P and catch ups. The team here now has grown in experience and size and now we understand how things should be done. It is also about developing the knowledge and experience and understanding of what needs to be tackled right now and what can be differed for later. It was a kind of training and now we have been through a period of training we understand how things should be done and therefore we do not need the intense pairing and now we agree on how most things should be done”. [P18]

Overall, these modified pair-programming practices had a performative aspect which involved a complex interweaving of actors and technology at different locations attempting to focus and work together. This meant disrupting existing understandings and promoting new emergent practices stemming from ongoing

process cycles of tuning and mutual adjustment leading to a sense of ‘interactive stability’ where the progress of the development of the code was evident.

6.2.2 Daily stand-ups within the PRIME team

A daily stand-up meeting is one of the essential practices for agile teams as it allows all the team members to synchronize and provides a brief update of the progress made by the team (Strode et al., 2012). Within a collocated environment the team members would stand near the ‘Wall’ as this would give them a clear focus in discussing the progress of the user stories (Sharp & Robinson, 2008). The duration of a stand-up meeting would be usually be about 15 minutes long, where the team members would be asked about the progress they are making in terms of what has been accomplished, what they are working on currently and if there are any blockers which are impeding their progress. Overall, the daily stand-up meetings are meant to enable collaborative practices and reinforce a shared commitment from the team members.

The difficulty comes in translating this practice for a globally distributed context, due to the lack of having the physical ‘Wall’. From the human intentionality angle this daily stand-up practice could be seen as initial goals, but due to the geographical and temporal distances the actors have to go through cycles of resistances and accommodations. During the planning stage, the team members decided to have early-morning catch-ups on the phone, or remote daily stand-up meetings, between London and Delhi at 8:00 am (London time) with phone calls on but on a one-one basis with the developers in Delhi and follow up calls if needed. Gradually, this remote stand-up practice moved forward to using audio-conference calls where a number of key team members were involved collectively in resolving issues raised by the Delhi team members. In other words, temporal patterns emerged and through the process of tuning and aligning they adapted the agile practice to suit their needs and their technological platforms/affordances. The London based project manager explains the main objective of the daily stand up from his perspective:

“In the daily meeting, my role is to ensure that I’m on top of the burning issues in any of the blockers on any of the stories, any cross consideration between particular

stories where one may be blocking another or that one is dependent on another. If the discussion cannot be resolved, where the guys in India have a question about how they should be doing something... We would do on the back of that checkpoint call, there needs to be a follow-up call at 10 o'clock, once the appropriate London developer is in the office" [P2]

As the PRIME team matured and as the team size grew in Delhi, this practice changed again, the remote daily stand-up took place at 9:30 am London time, and the discussions were based on viewing the user stories thorough the JIRA platform. From the Delhi side, only the senior team members were involved in the daily stand-ups across locations as the informant explains below:

"I think it's getting to a point now where it wouldn't be a stand up meeting if all the developers in UK and India met, the idea of a stand up meeting is 15 minutes to get the main issues out, there comes a point where team size too large it starts getting quite an expensive thing to have and there is diminishing returns and so they don't do an overall one. They rely on the 2 developer leads from London and India to get together to exchange and summarise what's going on. I think the QAs also have a call, every day for functional areas but also for particular disciplines.[P3]

From a mangle of practice perspective rather than viewing the daily stand-up practice as an established structured activity, due to resistances of space and time, it was evident that the team went through a number of evolutions, where various workarounds or accommodations were tried in order to best modify the stand-up practice for the contextual setting of the team. Over time temporal patterns arose which were not necessarily known in advance but emerged through a process of trial and error or through a mangle. As the practice was being carried out daily, a team went through a process of tuning which involved working together in reconfigured structures underpinned by the technology infrastructure provided which created a sense of interactive stability.

Interestingly, from the field observations carried out, in addition to the remote daily stand-ups across locations, other hybrid agile practices started to emerge. For example, the Delhi team members started to embrace agile methods and have face-to-face local stand-up meetings. Here, the emphasis was not just on reporting the progress made, but more on a learning stand-up where the local team members were sharing their knowledge collectively about the whole project. The senior developers

would use white boards to give more detailed explanations to any questions or issues raised by the local team members. This could be viewed as further tuning in order to achieve an overall stability of working in an agile way.

6.2.3 Iteration planning within the PRIME team

Within a collocated agile environment, the iteration planning meeting would take place every two to three weeks. The team members would meet with the users to decide which features needed to be developed in the next iteration. The developers would have discussions and refine these and estimate how long each of the user stories would take to develop (Lindstorm & Jeffries, 2004). The user stories would be written and posted on the whiteboard or the ‘Wall’ as backlog. Once the user stories are selected for development, sometimes the software developers would need clarification before developing the story so further communication would take place with the users.

However, iteration planning within a globally distributed context is challenging from a number of different angles. Within the project the senior business analyst in London, took the role of the product owner within the team, as he liaised with the users for further clarification of their requirements. Hence, he was playing a key role and acting as a bridge between the users and the software developers, as explained in a quote below:

“As part of the analysis, with a user story it’s not just a reflection of requirements, from a BA perspective, as we want to understand what the real requirements are from the various stakeholders, and understand what they expect [PRIME] to do and when they expect [PRIME project] to do it, and you understand from that what the real requirements are”. [P15]

In addition, the senior business analyst would discuss the user stories with the software developers in terms of estimating how long it would take them to develop them. Due to the distributed nature of the team, greater planning was required, where they would have weekly meetings rather than fortnightly meetings. As part of these meetings they would invite the team members from Delhi through phone call participation. Following the meeting, the user stories would be modified and

updated for the JIRA platform by the business analysts. However, over time these meetings fragmented into two separate meetings, London based and Delhi based, as explained by the informant below:

“We tend to write out user stories, we tend to have these sessions, once a week we sit down and it’s a phone call meeting, so people from London and from India, we go through a set of stories, they’ve been written, we review with other BAs, if some of them have been in London, some in India. We always get development and QA involvement in there as well. Unfortunately, that part tends to be represented by people in London, but we do it on the phone, so that encourages people from India as well. So, through that kind of thing, we encourage people what’s coming-what’s in the pipeline, what’s coming down for development in the next iteration. In the iteration itself, if when we are following a very good form of Agile discipline, we have had sessions where the developers have come together and had meetings and the next thing we are going to be working on is these stories, have a good chat about what the stories are, thoughts about development approach and that kind of stuff. Unfortunately that disintegrated into split meetings where there was an India focused one for example and a London focused one. I don’t think those meetings are happening any further right now which is shame.” [P3]

Examining this practice from a mangle of practice perspective, the initial goal of the team was to create a planning structure for the next iteration. However, the team went through a number of resistances and accommodations in terms of actors not being in the same location, the senior BA taking on the additional role of the product owner. Initially this practice started off well where team members from both locations were participating, however gradually this planning practice fragmented into two separate meetings and this triggered further instances of resistances and accommodations. To ensure that shared understanding was being achieved, an additional practice was introduced called the ‘story huddle’ where the developer, the tester and the BA would have a five-minute conversation to clarify the exact requirements of the user story.

“I’ve noticed that developer has picked up that story, quick story huddle, chat about the story with the BA, developer, QA because things might have changed since that story had been written. And your just having a quick 5 minute discussion to make sure we all understand, we have a shared understanding of what the story involves and that we are all on the same page and then the developer can say you might think it was going to be implemented like this, but just having done that last story

I'd implement it like that....' And you can make a quick discussion if that's viable. And hence you are all on the same page that becomes very awkward when you have a developer in India and the BA in London is still in bed..." [P2]

Considering this from a mangle of practice perspective, although there were indications of emergent patterns shaping and a tuning process where the actors were creating hybrid practices. There was also evidence of disconnect and fragmentation in the iteration planning practice and therefore the senior team members attempted alternative ways to develop greater shared understandings in order to achieve the overall goal working in an agile way.

6.3 Analysis Summary

This chapter has presented the findings from the case from two different conceptual models, boundary objects and mangle of practice. From a boundary objects perspective it can be seen as a valuable tool, where a digital boundary object exists in the contextual shared space which can aid the actors across locations in coordinating, aiding with knowledge flows and facilitating collaboration differences. Although the boundary objects conceptualisation is useful it does not go far enough in explaining fully how the actors adapt and shape collaborative agile practices in globally distributed settings.

Therefore, taking this one step further, and analysing the data from a practice perspective, it has aided in extending our understanding of the different interactions amongst actors and the technology. The chapter has focused on three agile practices to demonstrate how collaborative work practices unfold within a globally distributed setting. Overall, the process takes place over time through various dynamic interactions and entanglements or mangles where many frames of resistance and accommodation occur from several different sources, where the actors have to make several adjustments for the technological infrastructure and other actors as well. Through these interactions slowly emergent patterns or reconfiguring of agile practices start to manifest, this in turn led to an on-going process of tuning. During the tuning process hybrid agile practices are fine-tuned

further to suit the needs of the actors at offshore and onshore locations which gradually lead to a certain sense of stability or interactive stability.

The interconnectedness or intertwining relationship amongst the actors and the technology (materiality) was observed as constantly ongoing and situated in practice. This affected how the different practices were performed and the way the practices were shaped and reshaped. One example of this could be observed within the pair programming practice. The temporal emergent patterns for case specific settings can be seen in the daily stand-ups, the incremental development and delivery of the software in an iterative manner and this gradually started to influence the ongoing process of tuning which in turn led to a mutual shaping and reconfiguring of the agile practices to hybrid agile practices.

In other words, rather than being a recipe for chaos, the incremental software iterations aided and supported the emerging interactive stability, as it gave the actors an opportunity to reflect on what was working and what was not working within their specific context. The hybrid agile practices were aiding the team members and they fine-tuned them even further and continued using them in the next iteration. However, certain practices such as pair-programming practices, which were creating greater conflict within the team were modified within the next iteration.

The entanglements of humans (team members) and non-humans (the technology) unfolds in practice and are being continually transformed, yet through these transformations the ongoing process of tuning materialises and brings about a certain interactive stability or a type of equilibrium in achieving a goal. The interactive stability is heavily reliant on all the elements discussed earlier – the human intentionality and the continuous willingness to overcome the instances of resistance and accommodation, to mutually adapt and actively participate within the contextual space and engaging in the process.

By applying both these theoretical concepts, they help to explain how within a globally distributed context the collaborative practices are shaped by the actors and

the technology, where they are co-produced and are never entirely fixed or pre-set but moving towards a stable state or an interactive stability.

The next chapter presents a discussion of these interpretations in more detail.

Chapter 7: Discussion

7.0 Chapter Overview

The research aim of this thesis has been to explore how globally distributed agile teams develop collaborative practices. This chapter focuses on discussing the implications of the analysis outlined in the previous chapter on the case study.

The analysis in chapter 6 provided in-depth accounts of one specific case of a globally distributed agile team in a global bank. Section 6.1 focused on how digital artefacts as boundary objects can aid in coordinating, bridging knowledge flows and facilitating differences in collaboration across locations for the team members. The attention here was centred on the objects in terms of how they are constructed and managed within a globally distributed setting. This was useful as it considered how artefacts can act as facilitators and as objects for developing and negotiating joint collaborative practices within a globally distributed context. However, the analysis also revealed that sometimes the objects created points of tensions and contention. Therefore, the second part of the analysis (Section 6.2) shifts the emphasis to a practice perspective, drawing specifically on the concept of mangle of practice perspective and focussing more on the situated relational view, how the collaborative practices unfold and are dependent on entanglement of the actors and the technology. Here, the attention is based on a socio-technical perspective where collaborative practices are ongoing and moving gradually towards a state of stability.

Considering both these conceptual perspectives together provides us with a deeper and a more nuanced understanding of how collaborative practices evolve within a globally distributed context. The analysis thus highlights the importance of the context and the situated nature of the entanglements and how the agile practices are adapted for the particular settings.

In this chapter a discussion of the key insights from the analysis are presented in addressing the research questions which were posed at the end of Chapter 2. The research questions sought to unpack the ‘black box’ of how collaborative practices developed within globally distributed agile contexts.

***RQ.1:** How do collaborative agile practices evolve in a globally distributed software team?*

***RQ.2:** How can we conceptualise the collaboration process to better understand the underlying issues and challenges that a globally distributed agile team faces?*

***RQ.3:** How can collaborative practices support agility within globally distributed agile projects?*

Each of the research questions are addressed in turn, discussing the value of the interpretations provided in the current study. An overview structure of the chapter is given in figure 7.1.

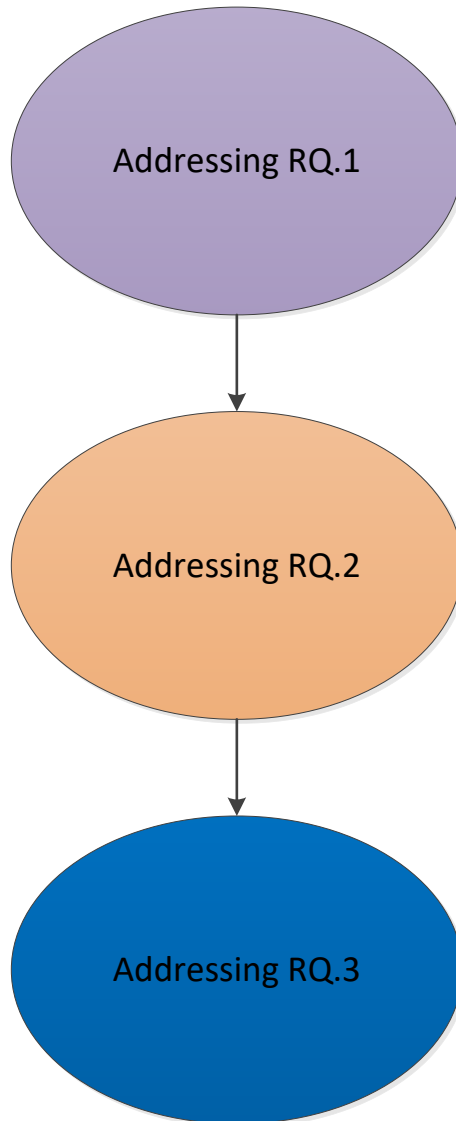


Figure 7.1: Chapter 7 structure map

7.1 Addressing RQ.1

Regarding the first research question, “*How do collaborative agile practices evolve in a globally distributed software team?*” The emphasis of collaboration in agile methods has been given in the Agile Manifesto and the principles, and the previous literature has also discussed the importance of collaborative practices within collocated contexts (see Chapter 2 – section 2.2.1).

Currently, there is a lack of a precise and unifying definition of collaboration within the agile research domain, which can lead to difficulties in identifying best practices for enhancing collaboration within globally distributed agile contexts. As discussed in Chapter 2, studies within collocated agile research, such as Sharp and Robinson (2010)'s study, have put forward a definition on collaboration, which refers to two or more people to work together on a task. Although this definition is useful, it does not go far enough in explaining how collaborative practices take place in globally distributed agile contexts and how the team members create shared understandings for a mutual goal in such contexts. Looking more broadly at the literature, the literature review (Chapter 2) proposes utilising Bedwell et al.'s definition (2012) as it emphasises that collaboration is an evolving process, which is carried out by two or more social entities who are actively engaged in joint activities in order to achieve a shared goal. This definition of collaboration is more useful within globally distributed contexts as it gives prominence that collaboration is an evolving process. Apart from the existing challenges of time, space and culture (Noll et al.; 2010), within globally distributed contexts, there are also further challenges due to the complexity of the tasks, difficulties in knowledge sharing aspects and the structural aspects in terms of the technological infrastructure which has been provided to the team members. From this study, it is evident that collaborative practices are continuously evolving within globally distributed agile contexts, and multiple contextual aspects do come into play and these aspects have an influencing effect on the collaborative effort to develop shared understandings. This study extends previous work on collaborative practices within globally distributed agile contexts by exploring how shared understandings are developed over time through an overlapping of enactment of human and non-human actors. By taking a pluralistic perspective of boundary objects and a performative perspective it is evident from the longitudinal case that the collaborative practices are emergent from a 'mangling' of human and non-human agencies (Pickering, 1995). The contributions made by this study are further explored below.

The existing agile literature examines the development of collaborative practices from three separate standpoints, from a communication standpoint (Melnik and Maurer (2004), a coordination standpoint (Strode et al. (2012) and from an agile

practices and techniques standpoint (Mackenzie and Monk, 2004; Robinson and Sharp, 2005; Coman et al., 2014), as discussed in Chapter 2. This study develops on previous work and moves the debate forward by offering an alternative perspective of viewing collaborative practices within globally distributed contexts, where each of these three standpoints should be considered together in an integrated manner. Using this approach of a connected relational approach, the pluralistic framework of boundary objects and a mangle of practice perspective is considered together, providing three key assertions that demand a different approach when examining collaborative practices within globally distributed contexts:

- i) Globally distributed agile software development teams should be seen as a sociotechnical system which consists of multiple actors (human and non-human) which are entangled in attempts to co-construct collaborative practices across boundaries.
- ii) Tensions and contention points leading to unsettled and uncertainty periods are part of the phenomena and emerging from the multiple ongoing interactions and interpretations.
- iii) For collaborative practices to be effective, they require a process where actors interpret the current situation and attempt to formulate strategies of action for a particular context

These assertions are further explored below.

Sharp and Robinson (2008, 2010) point out that in collocated agile teams, user stories are written on cards or post—it notes; the walls and the physical layout of the office space help in developing collaborative practices. Continuous interactions take place daily on a face-to-face basis and therefore a synergy of all these elements comes into play. However, in globally distributed agile contexts, this synergy is very problematic to achieve as the team members are based in different locations and the material artefacts cannot be seen at all locations. The analysis carried out in Chapter 6 demonstrated that in globally distributed contexts digital objects become essential tools to enable the entanglements to take place. Within the PRIME case, a

digitally mediated environment or a boundary infrastructure (JIRA platform) existed, where the digital objects were uploaded, in an attempt to create the visibility of information flow. However, as previous studies have highlighted that although such platforms facilitate affordances of creating and modifying digital artefacts (Leonardi and Bailey, 2008), they also emphasise that knowledge sharing problems still exist within such contexts as was evident within the case analysis (see section 6.1).

The boundary objects concept is useful in drawing attention to different types of boundaries that exist (Nicolini et al.; 2012; Barrett & Oborn, 2010; Levina and Vaast, 2005; Carlile, 2004, 2002), where the challenges of coordinating, knowledge sharing and facilitating the collaboration differences across global locations are considered. Nevertheless, as demonstrated in the analysis, the boundary objects concept does not fully explain how the interactions are sometimes fruitful and effective and at other times not so, in developing collaborative practices. The findings of this study agree with the Levina and Vaast (2005) study in that one cannot pre-determine which objects become boundary objects in-use or perform boundary functions within a specific context. Further, this study is also in line with the Nicolini et al. (2012) study where they argue that objects cannot only support collaborative practices, but they can also create obstacles to successful collaborative practices. In other words, this study points out that boundary objects do not necessarily have a systematic orderly trajectory but a messiness and iterative path.

As suggested by Nicolini et al. (2012), taking a pluralist approach and having a combined theoretical approach would be useful in unpacking the 'black box' of collaboration as this provides us with a more nuanced understanding of how collaborative practices develop in a globally distributed agile context. It is important to shift the focus away from simply an object-based perspective and towards a practice-oriented view, and understanding the "doing" aspect of the participants. Leonardi and Barley (2008) argue that in order to gain a fuller understanding of organising, it is essential to understand "*how people deal with an information technologies materiality*" (p.172). Therefore, paying attention to a practice based approach (see section 6.2) where the interactions or enactments of

human actors and non-human (technology) actors were examined jointly was necessary.

This study specifically focuses on a performative perspective (Pickering, 1995) of how everyday practices are enacted in particular contexts, as this helps us understand how collaborative practices unfold in globally distributed contexts and how human and non-human agency reconfigures it for the shared goal so that a sense of interactive stability is achieved in enacting the collaborative practices.

In the analysis, examples of three agile practices are presented (6.2.1 pair-programming activities, 6.2.2 daily stand-ups and 6.2.3 iteration planning) within the PRIME team. From the analysis of the empirical data in each of the agile practices, the actors did not wholly determine how these agile practices were going to be adapted upfront with their colleagues, it was an emergent process through a number of entanglements which were configured and reconfigured over time. Putting it differently, the adapted or hybrid agile practices emerged through a performative stance. Also, it is important to emphasise that the emergent process does not follow a smooth linear path, but during the entanglements there were instances of resistances from the human and non-human actors followed by accommodations. Although the actors had intended goals (or human intentionality), resistances were observed either from other actors within the team, from the technology or from the contextual setting which led to tensions and frustrations. This meant pragmatic accommodations or workarounds had to be made and intended goals had to be revised or adapted. During the emergent or mangling process temporally emergent patterns transpired, which led to a process of tuning or appropriating towards hybrid agile practices where a sense of dynamic interactive stability was created.

Other researchers have also applied Pickering's mangle of practice lens; Jones (1998) proposed the idea of a double mangle and Barrett et al. (2012) have applied it within the context of pharmacy robotic contexts, where they proposed that the tuning process extended to multiple occupational groups. In this study, the mangling process could be seen from three different viewpoints:

- the actor-actor perspective (tensions between team members in London and India locations);
- the actor-technology perspective (tensions during the interactions with the technology);
- and technology- technology perspective (as various different technologies were being utilised at the same time to aid in developing collaborative practices).

Within the general field of global software development, Kotlarsky and Oshri (2005) posits that successful collaboration depends on two important constructs of knowledge sharing and social ties. This study agrees with these findings, but it also extends it in terms of elucidating the knowledge sharing process. Some of the informants had reported that travelling to India to meet their counterparts did help to develop social ties yet the knowledge sharing activities were still the most challenging, especially where there was greater complexity of tasks such as during the pair-programming practice. Although the actors struggled to develop shared understandings immediately, the pair-programming sessions did help in creating and facilitating dynamic capabilities of the actors where in essence a collaborative culture was built. During the sessions the team members initially contested and resisted the agile practice, but over time a hybrid pair-programming agile practice was created for the contextual setting.

In summary, this study contributes in developing our understanding of how collaborative practices within a globally distributed team evolve over time within a globally distributed agile team. Starting off with a human intentionality or goal, which leads to an overlapping and shifting of objects and processes where the actors have to go through frames of resistances and accommodation, where emergent patterns manifest. This is followed by a process of tuning which is steering towards mutual alignment where the agile practices are contextualised or hybridised for a specific globally distributed setting, so that an interactive sense of stability is achieved. In other words there is a steadiness being achieved within the globally distributed team regarding their collaborative practices. Though it also indicates that there is a degree of complexity, in how collaborative practices are enacted

within globally distributed agile contexts, where there is a certain level of messiness or mangle between human and non-human actors and what emerges may be through conflict and accommodation. The hybridity of agile practices is dependent upon contextual structures and the performative aspect has a key bearing on how the collaborative practices are shaped and enacted within a globally distributed agile team.

7.2 Addressing RQ.2

Regarding the second research question, ‘*how can we conceptualise the collaboration process to better understand the underlying issues and challenges that a globally distributed agile team faces?*’, it was evident that analysing the findings from the PRIME case study and applying the theoretical concepts of boundary objects and mangle of practice, have aided us to gain a deeper understanding of collaborative practices within the context of globally distributed agile teams. The boundary objects perspective is useful for providing insights from the perspectives of enabling coordination perspective, aiding knowledge flows and facilitating collaborative practices (Carlile, 2004; Levina and Vaast, 2005). The characteristics of boundary objects as project artefacts enables them to function across multiple groups, however, taking this one step further and considering a practice-based perspective alongside provides a greater nuance as to how collaborative practices are developed and adapted within globally distributed agile contexts.

The practice-based perspective enables us to view these real-time practices from an alternative standpoint – a new vantage point of ‘post-humanist’ space, that Pickering (1995, p.26) refers to as “*a space in which the human actors are still there but now inextricably entangled with the nonhuman, no longer at the centre of the action and calling the shots*”. In other words, the idea that the world around us is in a constant state of flux, where human and non-human actors are entangled, where there is a mutual constitution of human and material agency, where uncertainty and constant change are acceptable factors and emergent workarounds have to be created. By drawing on Pickering’s mangle of practice it allows us to have a more

detailed insight of construction and deconstruction of the complexity of entanglements within globally distributed agile contexts. Pickering (1995) argues that the point of intersection between human and nonhuman agency may be unclear, therefore delineating the collaboration process within a global agile team and pencilling in analytical boundaries is useful.

The series of interactions in essence could be seen as on-going processes rather than outcomes where shared meanings and drivers of collaborative work practices are socially constructed, as they facilitate the movement or a shift towards interactive stability. Within the case study, it could be seen that the processes create temporal emergence which unfolds over time where there is decentring and unpredictability of the outcomes and only through a definitional shift of succession of interactions, entanglements and workarounds the team members come towards the ongoing process of tuning and mutual adjustment where interactive stability starts to materialise. This can be seen in figure 7.2.

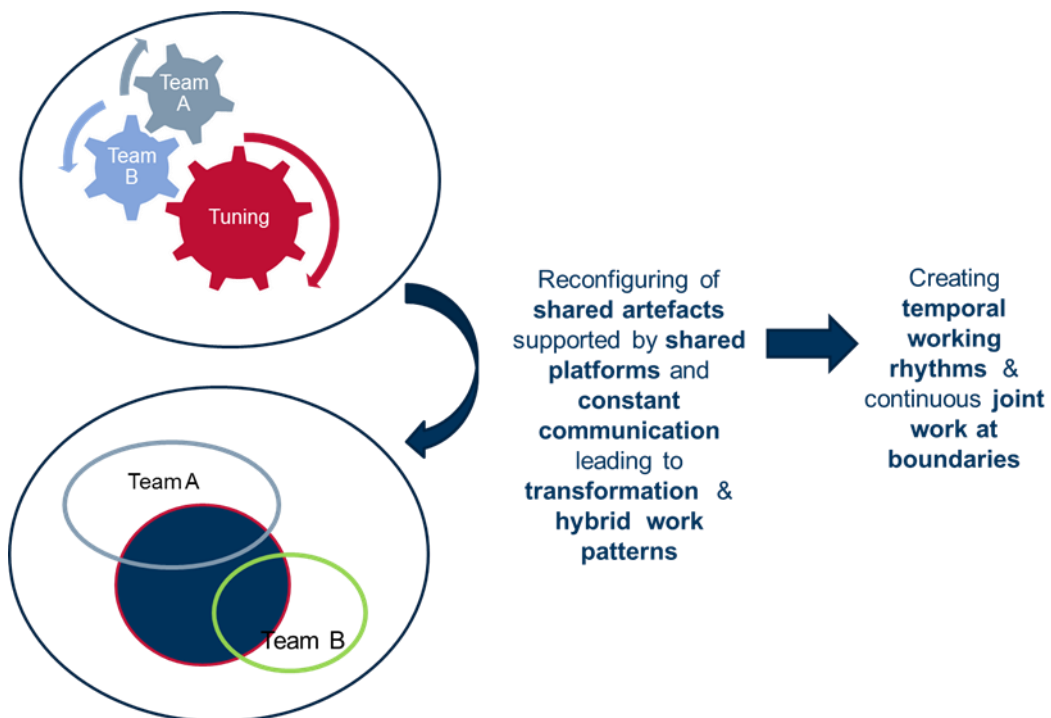


Figure 7.2: Illustration of teams temporarily unfolding and tuning

Based on the findings and analysis of the case study discussion carried out above, it enables us to conceptualise and propose a pluralistic framework which would

allow us to better understand and explain the challenges globally distributed agile teams face in real-time practice when collaborating and working together. This framework is called the “Collaborative Tuning Approach” or CTA (see Figure 7.3) which can be considered as an alternative theoretical framework in studying globally distributed agile teams. It consists of the boundary objects (B.O) as digital objects and they play an essentially important role in linking and supporting collaborative practices across locations. Although boundary objects enhance standardisation, they are still malleable in each instance of their use, and therefore they rely on the situated interpretations of the actors regarding their current state. The four interactive and interlinked processes (human intentionality, resistance and accommodation, temporal emergent patterns, and ongoing process of tuning) are an integral part of a globally distributed agile team environment. These processes explain how transformation of collaborative practices evolve and the relevance of the intersecting practices, into modified or hybrid agile practices. The entanglement of human and non-human actors in these processes leads over time to periods of interactive stability in which mutual shared understanding is achieved and hybrid agile practices are adapted that work for the distributed team in their particular work situations. It is through these periods of interactive stability that practices emerge as effective and useful and not through long-term planning.

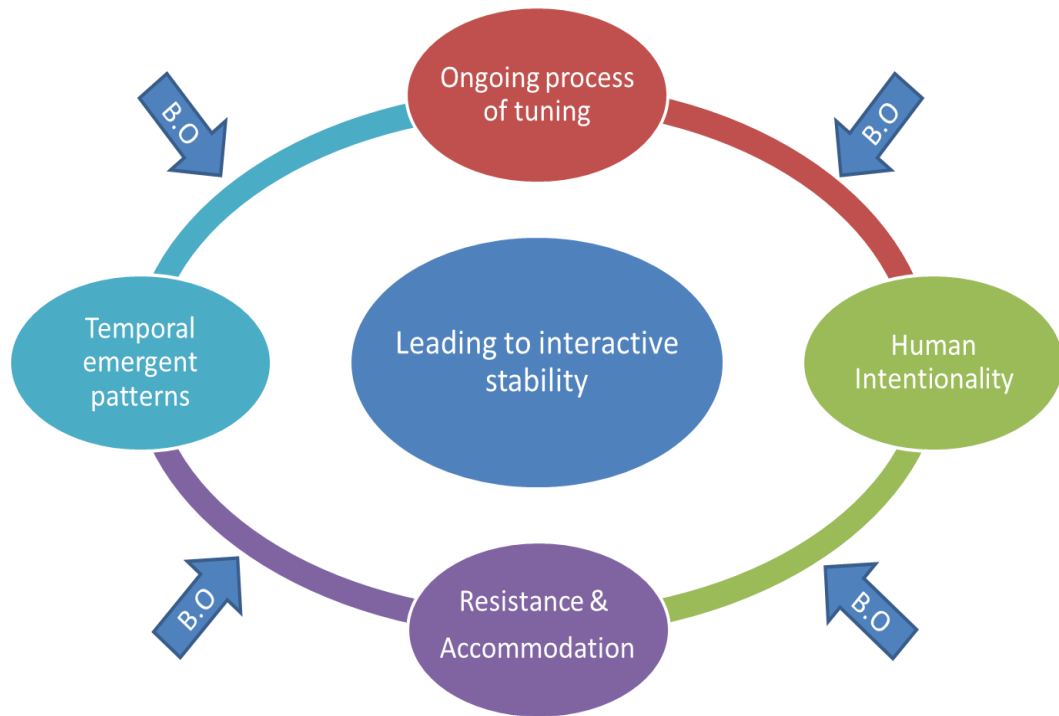


Figure 7.3: Collaborative Tuning Approach (CTA)

Integrating the conceptualisation of boundary objects and the mangle of practice provides us with a further enriched perspective of the dynamic interactions of a real-time practice within a globally distributed context. The objects provide a means of conceptualising the artefacts view used for the collaborative practices and “what” are their characteristics, while the mangle of practice provides us with a conceptualisation of a “how” and “when” perspective. In other words, the latter approach provides a performative perspective, pointing out that there can be tensions and conflicts during the enactment of the practices. This study illustrates that collaborative practices within globally distributed agile contexts are emergent from the complex entanglement of human and non-human actors or a mangling process. The CTA framework is a useful sensitizing conceptual framework, when thinking critically about what actually happens in practice within the context of globally distributed agile teams. In essence, the CTA approach provides us with a real-time perspective offering useful and deeper insights, providing a more complete story of the entanglement and intertwining of the multiple actors and technology and how their practices are shaped.

In summary, the pluralistic framework provides an understanding of how collaborative work practices are evolve beyond the use of artefacts for communicating, coordinating and knowledge sharing from a linear viewpoint to an integrated comprehensive standpoint. It highlights that contextual structures can put constraints and demands on the relationship of the actors and the technology utilised. Through the state of flux the actor's participation and performative aspects are shaped by internal dynamics of the contextual structures where practices and processes are challenged or resisted and are open to (re)adjustment through accommodations or workarounds creating a temporal emergence. A process of mutual tuning results over time creating a relative sense of interactive stability. A sense of cooperative synergy is achieved where collaborative work practices are developed to support hybrid agile methods within specific globally distributed contexts.

7.3 Addressing RQ.3

Regarding the third research question, '*how can collaborative practices support agility within globally distributed agile projects?*' from the existing literature a unified all-inclusive definition of agility does not exist and agility is a multifaceted concept (Conboy, 2009; Sarker and Sarker, 2009; Zheng, Venters and Cornford, 2011). Previous literature has specifically focused on examining agility within a globally distributed agile context where agility has been as '*the capability of a distributed team to speedily accomplish ISD tasks and to adapt and reconfigure itself to changing conditions in a rapid manner*' (Sarker and Sarker, 2009). The authors have proposed that agility needs to be considered from three different perspectives:

- i) Resource-based agility (consisting of IT personnel and technological resources);
- ii) Process-based agility (consisting of using appropriate ISD methodologies, appropriate methods for bridging temporal distances and having an environmental awareness);

- iii) Linkage-based agility (based on being culturally sensitive and forming communicative links and developing links across locations).

Within this study, the agility of the project manifested gradually as the team were delivering the software in iterations. When reflecting back on their processes of what worked and what did not work, on a spectrum from plan-driven (at one-end) and agile methods (at the other end), the PRIME project was gradually moving towards becoming agile as the software was being delivered through iterations into the live environment.

Reflecting on the findings of this present study, they are in general agreement with the three different perspectives identified by Sarker and Sarker (2009) above. In view of resource-based agility perspective, it was observed that there were a number of entanglements between IT personnel and the technological resources, pertaining to a performative aspect - a certain messiness or mangle through the collaborative practices where the team members were attempting to build capability across the locations, so agility could be achieved within the project. However, the team had problems with building resource-based agility, as they were trying to use a number of different technologies at the same time while embracing collaborative practices as discussed in Section 6.2 This caused frustrations with the team members, but they persevered by continually participating emergent collaborative practices as their goal or human intentionality was to work towards becoming agile.

Regarding the process-based agility perspective, within the team agile practices were adapted and appropriated for the particular context so hybrid agile practices were formed. The team members did not necessarily know in advance the form and shape of these hybrid agile practices; these emerged through the enactment of the collaborative practices across the locations. The process entailed having trade-offs between a predictable stable environment to a dynamic complex environment where the team was attempting to become more agile through a balancing act.

In considering the linkage agility perspective, this is supposed to be achieved by forging communicative links and developing cultural mutuality. However, within

the case while the actors were attempting to build these links through collaborative practices, where they went through points of tensions and conflicts during the collaborative relationships. At the beginning of the project the PRIME team had travel budgets which allowed the team members to travel to Delhi and spend time with their counterpart team members, which enabled them to have face-to-face interactions and develop trust. This in turn helped to develop communicative linkage and a better understanding of the cultural aspects. However, year after the project started the global bank announced travel cuts on all projects, which caused several problems for the team members within the PRIME project as it hampered the aspect of linkage agility. Although at this point most team members had met face-to-face, they felt having a travel budget was invaluable in terms of enhancing the communicative links within the team and developing a similar understanding regarding the project goals. Therefore, in general, extending linkage agility, was at times, challenging within the project across locations, as it took time to bridge the temporal and cultural distances.

Overall, this current study demonstrates that agility manifests itself and it does not necessarily follow a straight-forward trajectory. This study also brings to light that in continually participating in emergent collaborative practices, as discussed in the Collaborative Tuning Approach, this can act as an enabler in working towards attaining agility within globally distributed ISD contexts, though sometimes the aspects of agility cannot be easily observed immediately, only at points of reflection. For example, within the PRIME project when the team members were reflecting back on the delivery of previous software iterations, they acknowledged that persisting with the goal of working an agile way and by participating in emergent collaborative practices across locations, did help in enhancing the agility of the PRIME project. The team members measured their success of agility through a number of ways:

- i) the number of user stories completed within an iteration
- ii) The number of iterations being delivered in the live environment compared to other projects within the global bank.
- iii) The stability of the project in terms of the delivery of planning and working on the next iterations

- iv) Overall success of the PRIME project within the bank compared to other projects, in terms of being a high profile project being delivered on time and using agile methods.
- v) Another, indirect measure of success of PRIME project was by leading the way within bank by encouraging and supporting other software teams to use agile methods.

Hence, the overall the fine tuning of emergent collaborative practices as discussed earlier, in the Collaborative Tuning Approach leads to forms of agility being manifested in different ways. In other words, the enactment of collaborative practices as discussed earlier acts as an overall enabler for developing agility in global agile software contexts. Though, one cannot differentiate which kind of agility as discussed by (Sarker and Sarker, 2009). See figure 7.4...

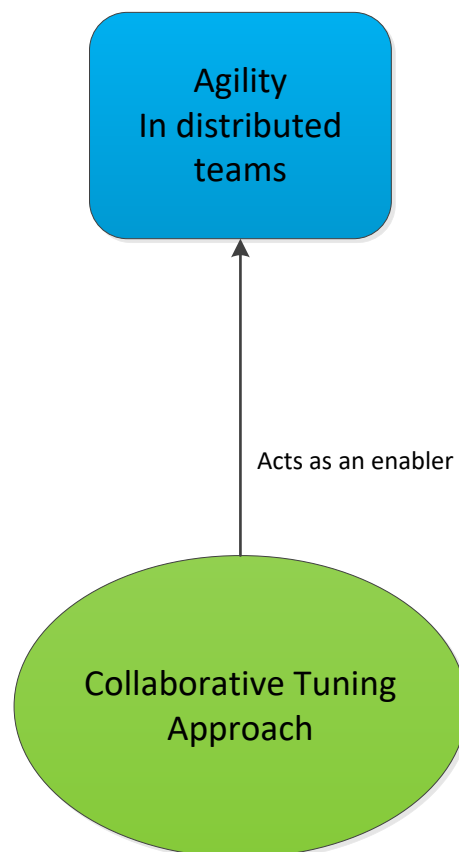


Figure 7.4 : CTA acts as an enabler of agility in global agile contexts

Zheng et al. (2011) have also studied agility within a large globally distributed context and they propose that ‘collective agility’ can be achieved through improvisations or a trial-and-error approach, where the actors draw on their past experiences of what worked and did not work. This current study has some similarities to Zheng et al.’s (2011) study, as the team does develop some form of collective agility by having an overall goal or human intentionality of becoming more agile and therefore, all the sub-goals were drivers towards developing and adapting collaborative agile practices. However, this study also differentiates from Zheng et al. (2011) research, where the role of improvisations was mainly played out from the London team members, where they would initiate adapting agile practices and if these adaptations did not work they would make further modifications, whilst keeping in mind the intentionality of becoming more agile. This was mainly because the London team members had previous experience of agile methods within a collocated environment. Therefore, the overall instances of the resistances and accommodations within the PRIME team increased until hybrid agile practices were acknowledged and fine-tuned further to achieve a sense of stability. From this study, it is evident that collective agility was initially instigated by the team members who had previous experience of agile methods, but they also had to take into account the contextual structural constraints of the setting and the capability of their counterparts.

7.4 Discussion Summary

To summarise, this chapter has discussed how the study’s findings have addressed the research questions set out at the start of this thesis. The empirical data analysed in Chapter 6 has enhanced our understanding of how collaborative practices are developed and enacted in globally distributed contexts. The analysis suggests that the enacted entanglement is complex, dynamic and contextualised in nature. The utility of the pluralistic conceptual framework – Collaborative Tuning Approach (CTA), consisting of boundary objects and mangle of practice has been useful in gaining deeper insights. Although the concept of boundary objects is useful, in global agile contexts, it is also important to recognise how the enactments shape the

collaborative practices that take place across locations. Therefore, drawing on Pickering's (1995) mangle of practice helps us to see how these hybrid agile practices evolve through the mediated interactions. Using the CTA framework has helped us to understand the critical role that context plays in shaping and reshaping collaborative agile practices, it also deals with the problem of the under-explored relevance of the conflicts and tensions in such contexts. As discussed earlier, emergent collaborative practices are also an enabler for supporting agility within a globally software team context.

The next chapter discusses the contributions of this study, the practical implications to agile practitioners who are planning to develop collaborative practices in globally distributed contexts, and the limitations of this study. Finally, directions of future research are also discussed.

Chapter 8: Conclusion

8.0 Chapter Overview

This closing chapter presents the contributions of the study from theoretical and practical perspectives, following with a discussion of the limitations and suggestions for future work; in addition a personal reflection on the PhD journey and some closing remarks are made.

The literature review presented in Chapter 2 highlighted that within the agile software development domain, a number of gaps exist, in terms of how agile methods are applied in practice within organisations. The majority of the existing studies within the agile domain tend to focus on colocated agile teams. However, in light of increasing use of agile methods within globally distributed settings, it has become even more critical for researchers to explore and examine the use of agile within globally distributed contexts. In particular, it is important to focus on issues related to translating agile values and principles in globally distributed settings. Taking into account the complexity of the real-world context of global software teams, the purpose of this research has been to unpack the “black-box” of collaborative practices within a globally agile distributed context. The value of this study lies in improving and advancing our understanding of the challenges globally distributed team members face in developing collaborative practices in such settings.

This thesis addresses the scarcity of relevant in-depth research within the globally distributed agile context and explores how collaborative practices develop within such settings, through a range of digitally mediated interactions from a practice-based perspective.

8.1 Research Contributions

Despite the tremendous growth of agile methods in globally distributed settings, empirical research is lagging behind in this area as discussed earlier. This thesis set

out to develop a better understanding of agile practices in globally distributed contexts and more specifically how collaborative practices are carried out in such contexts. With this in mind, this section discusses the key contributions this study has made. The research focused on one particular longitudinal case study, and has examined the nature of how collaborative practices are evolve in such settings. The contributions are categorised into two areas: theoretical and practical, below.

8.1.1 Theoretical Contributions

The current literature reviews of use of agile methods in information systems development (Dybå and Dingsøy 2008; Jalali and Wohlin 2010; Dingsoyr *et al.*, 2012; Hummel 2014) all emphasise that not enough attention has been paid to establishing theoretical underpinnings and have urged researchers to embrace more theory-based approaches. Hummel (2014) reported that in previous agile studies, three most popular theoretical perspectives have been: (i) complex adaptive systems theory; (ii) control theory and (iii) coordination theory. Other less widely used theories that have also been applied are: (i) adaptive structuration theory; (ii) home ground theory; (iii) transactive memory systems and iv) distributed cognition for teamwork. Overall, these studies stress that there is still an urgent need for developing other theory-based approaches within agile studies to enable us to gain a thorough understanding of how agile methods are used in practice. Furthermore, specifically the studies within globally distributed agile contexts (Jalali & Woolin, 2011, 2012; Alzoubi *et al.*; 2016) have also echoed the previous calls for more research to be theoretically underpinned.

First, the study demonstrates in a generalised form, the difference between collocated and globally distributed collaborative development environments – see figure 8.1. Second, the study presents one specific case of a globally distributed case that is the PRIME project.

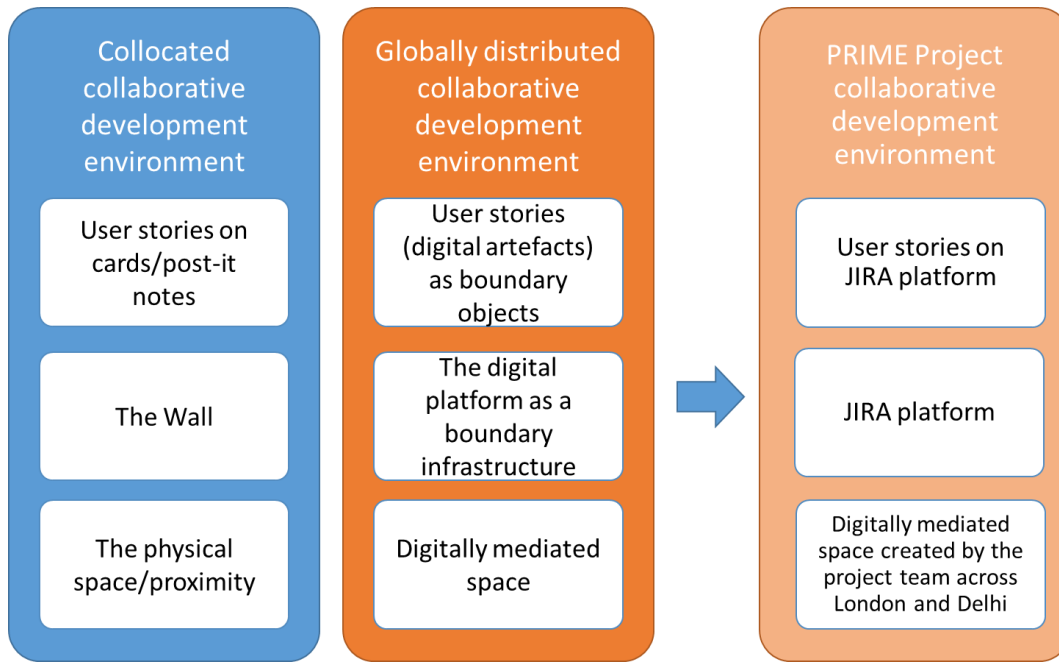


Figure 8.1: Differences in collocated and globally distributed collaborative environment

Third, this study goes some way in addressing the research gap of how collaborative practices are carried out in globally distributed agile contexts. The study attempts to make a meaningful contribution towards developing a conceptual understanding of how collaborative practices are emergent within a global software team context. In particular, this study acknowledges that contemporary organisation structures have complex, dynamic and distributed structures, where the work carried out by actors and organisational forms are closely intertwined (Feldman and Orlikowski.2011). The findings from this case, demonstrate having a real-time awareness of entanglements of human and non-human actors while attempting collaborative practices, is useful, as it provides an understanding of how agile collaborative practices are destabilised and disrupted. It is here that the instances of resistances and accommodations come into the foreground, which leads to temporal emergent patterns being formed. As the research approach took a single in-depth case study approach, one cannot directly generalise and comment about other contexts. Although the study can contribute by adding one particular perspective of a practice-based standpoint to the broader picture of collaborative agile practices in global distributed agile contexts.

According to Eisenhardt and Graebner (2007) each case has persuasive power and richly describe the phenomenon under investigation. In other words, each case has a specific role in helping to understand the larger pattern of the phenomenon. Ridder (2017) suggests that potential advantages of a single case study are to gain a better understanding of “how” and “why” things happen and this can lead to identification of patterns and relationships.

In general within this case, the concepts of boundary objects (Star and Griesemer, 1989) and mangle of practice (Pickering, 1995) have been operationalised within the context of globally distributed agile settings. The analysis carried out earlier from two standpoints – first Carlile's (2004) boundary object framework and Levina and Vaast's (2005) boundary objects-in-use (or in action) aided in explaining coordination and conveying knowledge flows activities across locations within a globally distributed agile team (see table 6.1). However, focusing solely on objects alone downplays the actions of the actors in terms of the interactions during the collaborative practices. Therefore, this study offers an alternative practice-based perspective, which seeks to readdress the balance between human and non-human agencies, which not only considers the globally distributed contextual settings where the challenges of space, time, and cultural can come into play, but also the different interpretations of the actors to develop shared understandings within globally distributed settings.

By utilising the concepts of boundary objects and Pickering's practice-based perspective (1995) as a combined framework, as a scaffold, one can appreciate and develop accurate understandings of how the relationships are co-constituted through various “mangles” and it extends on previous work on globally distributed agile contexts. The pluralistic conceptual framework adopted: Collaborative Tuning Approach (CTA), - see Figure 7.3, demonstrates the inseparability of human and nonhuman agencies in globally distributed agile contexts, how initially the collaborative practices are destabilised and disrupted and then new patterns evolve and emerge over time. The interrelations between boundary objects and Pickering's performative perspective suggest that researchers should take an integrated view of how collaborative relationships can be developed and sustained in globally

distributed agile settings. The analysis from this study (see Chapter 6) suggests that the tensions and frustrations are a necessary part of the process in attempting to modify and translate agile practices to globally distributed settings.

The study presents a dynamic view of a practice-based perspective where the outcomes are not wholly determined by the team members or the technology, but through ongoing interactions where there are instances of resistance and accommodation. These ongoing patterns can lead to temporally emergent outcomes, which may be further tuned to form hybrid agile practices within global agile settings (Modi, Abbott and Counsell, 2017).

Hence, the central aspect of the CTA framework allows us to refine our knowledge of the phenomenon of globally distributed agile settings and explains how collaborative practices go through transformations where the digital objects can aid, but are not necessarily enough in creating shared understandings in collaborative practices. This study highlights that within globally distributed agile contexts, the actions of the actors are interconnected and entangled in multiple ways with the technology and with the other actors across locations. This framework can be seen as a ‘sensitising device’ which allows us to view collaborative practices in globally distributed agile contexts in a certain way and contributing to an increased conceptual clarity.

Taking this performative practice perspective explains how the outcomes are not pre-set, but evolve through practice, where there are instances of resistance and accommodation, which lead to temporal emergence patterns which are shaped by the contextual constraints. These are further tuned so that hybrid agile practices are formed, which results in a sense of interactive stability within the complex dynamic globally distributed setting. For example, within the team, the team members had to go through multiple attempts of tuning with the technology, with the code-base and with other actors.

The study also adds to previous literature which has applied Pickering’s (1995) tuning approach (Barrett et al., 2012; Martini et al; 2013 and Venters et. al, 2014). Taking this relational perspective, explains that although global boundaries from

one standpoint can be seen as barriers in translating agile practices, from another standpoint, the boundaries can also be seen as potential opportunities to reconfigure and reshape boundary relations, which could result in hybrid agile practices.

Furthermore, this thesis adds to the existing agile literature, by using an interpretive case study approach (Walsham, 1995, 2006), where a social constructionist perspective of the world is taken. This has allowed me as a researcher to make sense of the reality of globally distributed agile contexts from the participants' subjective viewpoint, and to interpret and explain from their point of view. In other words, taking an interpretive approach has enabled me to consider the research questions in an in-depth manner, by providing thick descriptions, which contributes in giving a unique perspective of how collaborative agile practices evolve within the context of global software team. It aids in generating new insights and understanding how collaborative practices are orchestrated in globally distributed agile settings.

8.1.2 Practical Contributions

The findings of this study make a timely contribution to managers and teams who are planning to set up globally distributed agile software teams. This study provides agile practitioners with a framework and a vocabulary guiding them on how collaborative practices develop within globally distributed contexts.

Organisations wishing to set up collaborative practices across global agile teams as part of their strategic planning would benefit in having an appreciation of the CTA framework and its associated vocabulary, as a discursive resource. The framework does not wholly rely on providing financial resources, but having an understanding of how agile practices in globally distributed settings evolve to become hybrid agile practices where they do not necessarily follow a straight-forward trajectory. The findings of the study also indicate that global agile teams should not be just provided with several technological resources with the expectation that collaborative practices would follow, but also other support mechanisms to build trust across locations, which in turn would encourage and foster collaborative practices.

The CTA framework encapsulates and conceptualises how collaborative practices evolve in globally distributed agile contexts. As part of the member checking activity for this research the findings of the case and the CTA framework was presented at a Breakfast Briefing event at Brunel University (see Appendix A) and at a British Computer Society Agile Methods workshop (see Appendix B), where agile practitioners working in globally distributed settings were invited. The practitioners verified that orchestrating collaborative practices within a globally distributed setting is a complex and challenging activity. They agreed that the CTA framework is a beneficial tool, as it resonated with their attempts of practicing agile within globally distributed environments. Some practitioners revealed that reflecting on their current agile practices, they could see points of tension, instances of resistances and accommodations and tuning in terms of becoming agile or 'hybrid agile'. Furthermore, the practitioners indicated that the CTA framework would be valuable not just as planning tool, but also as part of team retrospectives where team members have to reflect, discuss their current practices and what changes they would like to make in the next iteration. Overall, the feedback from the practitioners was insightful; where they confirmed that the CTA framework is a beneficial tool, as it highlights issues of translating the agile values and principles to a globally distributed context and how it can be valuable in developing collaborative relationships across locations so that effective hybrid agile practices can be developed to support agility from different perspectives, within globally distributed contexts. Organising these two workshops, justified the importance of conducting research in a real-world context.

A key realisation which came to the forefront from these workshops is recognising globally distributed agile contexts are complex and dynamic settings. Developing collaborative practices in such contexts puts multiple demands on the actors and it evolves out of numerous interactions taking place in a specific context. Therefore, the collaborative agile journey cannot be pre-determined and it differs from team to team and even on a project to project basis. For existing global agile teams, the CTA framework maybe of great interest as it could be used as a tool to map out and evaluate their existing collaborative practices, to see if they would benefit from further adjustment and tuning within their own particular context. In turn this could

lead to discussions on how greater agility could be achieved within the existing agile project.

Furthermore, organisations planning to set up globally distributed agile teams should provide enough financial support for regular visits to the distributed locations. From the PRIME case study, it was noted that when there was a travel freeze, this caused greater problems in developing trust and apprehending the needs of the team members in Delhi, which in turn escalated the instances of resistances and accommodations. Therefore, as part of the overall project planning, senior project managers should set aside appropriate travel budgets for the team members to have face-to-face contact time, as this would be beneficial in developing trust and in developing hybrid agile practices.

There is much work still to be done in endorsing and validating the CTA framework for globally distributed globally agile practices, so the findings so far are specific to this research. However, they can be indicators or patterns for other global agile contexts. For example, when senior managers are planning globally agile distributed teams, as part of the agile preparation and training the team members should be made familiar with the CTA framework, in terms of paying particular attention to the roles of individuals and how they can influence the development of greater collaborative practices and thus increase agility within their global agile projects. Taking this approach would empower globally distributed team members to generate more collaborative relationships so that they could engage in discussions about how collaborative practices could be developed in their particular settings, and how agility could be improved in their contexts. The CTA framework would make some headway into aiding globally distributed agile practitioners in identifying that team members would have to be through ongoing mediated interactions, in order to move towards a certain interactive stability. Interactive stability can be viewed when there is a degree of stabilisation of collaborative practices within the global context.

Taking this standpoint, would allow practitioners to reflect and to draw on their previous agile experiences, and software development expertise so that through negotiated dialogue around different agile practices could be explored in order to

develop more cohesive collaborative practices thus leading to greater agility. Furthermore, by establishing collaborative relationships and having an understanding of the CTA framework at the start of the project, when team members come across points of tensions and frustrations during project they would be more responsive and develop a willingness to make accommodations.

8.2 Research Limitations and Suggestions for Future Work

As the globally distributed agile area is growing significantly, different facets of agile research need to be explored. This study has focused on one important aspect of developing collaborative practices and a discussion of theoretical and practical contributions from this study have been presented, yet it is important to acknowledge the research limitations and suggest areas to explore for further research.

This current study involves a longitudinal case study where the globally distributed team was based in London and Delhi. The empirical data gathered from the interviews and observations from the case were over a long period and they provided critical insights of how collaborative practices were being developed across locations. While it can be assumed that the CTA framework proposed in this study is transferable to other similar contexts, the reader should also bear in mind the limitation of the analysis in that it cannot be generalised for all types of globally distributed contexts. Therefore, carrying out a systematic comparison of different globally distributed contexts/industry sectors and countries would be beneficial in terms of validating the CTA framework. Further cases could test the applicability and the usefulness of the CTA framework. First steps have been taken in this direction, where the CTA framework has been presented to other agile practitioners in workshops as discussed earlier.

Future research, could also take into account different types and sizes of the organisation and how in these contexts globally distributed teams attempt to develop collaborative practices. For example, applying the CTA framework within

a large-scale globally distributed agile development teams could prove to be useful. Additional work could be done to explore how different technology platforms can enhance or constrain collaborative agile practices in globally distributed environments. Future research could also explore the motivational drivers of offshore and onshore agile teams, to see how this can influence the intentionality of moving towards becoming agile and creating agility within the project.

8.3 Reflections on the PhD journey

Reflecting back on my part-time PhD journey, over the period I have realised there have been many parallels between the experience of change and transformation within the case and my own process of change and development. The experience of doing a longitudinal interpretive case study was challenging at times in terms of making sense of the complexities in globally distributed agile contexts. I was attempting to seek understanding of the participants' experiences from their subject viewpoint to gain rich insights and yet at the same time trying to maintain objectivity as a researcher. The process of gaining access, becoming oriented to their environment, listening to the participants' stories and observing them gave me a number of opportunities to reflect and develop an empathic stance, to seek understanding from their perspective without judging. However, at the same time I was witnessing changes in myself, where I was learning to interpret and understand the data by coding, categorising and further refining categories. Through this process, I was learning to voice the experiences of the participants from their stories and seeking to interpret patterns, in order to gain an in-depth understanding of the whole phenomenon and not just certain elements. By organising the two workshops and reflecting on the agile practitioners' comments and insights, it further verified that I was interpreting the patterns from the case correctly, and this gave me greater confidence that as a researcher I am on the right track. In essence, carrying out this study has contributed to my own development and transformation in becoming a better researcher and this will no doubt have a significant impact on how I engage in future research projects.

8.4 Closing Remarks

This current study presents the results of an interpretive case study on how collaborative practices are developed within complex globally distributed agile contexts. It extends interest both for researchers of agile methods and for agile practitioners. The thesis draws on a combined perspective on the role of boundary objects and Pickering's mangle of practice (1995) and it concludes by emphasizing that the study of orchestrating multiple collaborative activities within complex globally distributed contexts cannot be separated from the context and there is intertwining between the human and non-human actors (the technology). Thus, employing a pluralistic conceptual framework provides enables us to gain nuanced understandings of the interactions and how practices are enacted in globally distributed agile contexts. The research teases out how collaborative practices evolve through the aid of digital objects and interactions, where there can be frames of resistances and accommodations which are followed, emergent agile practices which are fine-tuned, becoming hybrid agile practices within global contexts.

For project managers who are planning to use agile methods within global settings, the study provides a framework which demonstrates how conventional agile practices go through mangling processes to become hybrid agile practices. Therefore, the project planning phase becomes vitally important if global agile teams are involved, in terms of the technology infrastructure and decisions concerning what agile practices the teams are planning to use, as the context-specific nuances can either help or hinder potential collaborative practices.

The study does not claim that the CTA is the only approach, but it certainly does emphasise that the CTA framework illustrates the performative aspect of how collaborative practices are developed in such complex global settings. It highlights the way in which collaborative relationships evolve between the human and non-human actors, where they can be ongoing points of tension between the actors and the technology. This is followed by emergent improvisations of agile practices which are recalibrated further to become hybrid agile practices.

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Appendix A

Breakfast Briefing Flyer



Improving Your Global Agile Software Development Teams

Are you currently developing or planning to use agile methods in global project teams?

Free Breakfast Briefing

8.00am Wednesday 8th October 2014

Brunel University London

Uxbridge, UB8 3PH

If your company is planning to use or is currently using agile methods to develop software globally then you will benefit from this informative Breakfast Briefing. The Department of Computer Science at Brunel University London will showcase recent research providing real-world case studies of modified and improvised agile practices that help overcome the challenges of distributed collaboration. We realise that undertaking collaborative work in globally distributed environments can create significant challenges, especially as a number of agile principles and practices rely on physical proximity and face-to-face interactions. However, the research showcase will present models of working that can lead to better processes and techniques for globally distributed agile software development.

We will also advise how you may work with our researchers on similar projects aimed at improving your global agile software development performance.

What will you gain from attending?

- Learn about Brunel research on the use of agile methods in global collaborative projects
- Collaborate with our researchers to gain further practical and realistic insights.
- Network with other agile practitioners and share best practice advice
- Develop your own key "do's" and "don'ts" of doing distributed agile software development

For further details see QR code :



or email : sunila.modi@brunel.ac.uk

Looking forward to seeing you on the 8th October at Brunel University London

Appendix B

British Computer Society Workshop

Details available at: <https://www.bcs.org/category/5941>

Hybrid Agile for Global Teams

When: 13th Jun 2016, 18:00 - 13th Jun 2016, 20:30

Where: BCS, 1st Floor, The Davidson Building, 5 Southampton Street, London, WC2E 7HA

Town/City: London

Organiser: BCS Agile Methods Specialist Group

Price: Free to attend for both BCS Members and non-members

Further Information:

Workshop Summary:

More global teams than ever now are using agile methods (from 35% in 2012 to 80% in 2014, according to one report). However collaboration in globally distributed teams is difficult due to differences in time, space, culture and knowledge. Several techniques have been promoted to bridge these gaps, but sometimes agile practices have to be “tweaked” to work in such environments.

Our workshop will be aimed at agile practitioners working, or planning to work in, global agile teams and will use a highly interactive participatory approach to reveal new techniques in managing this process.

Workshop participants will:

- Generate their own global agile software team challenges “word cloud”
- Discuss among themselves their solutions to these issues
- Map their own teams’ experiences using a sliding scale and a bespoke card game
- Learn about the “Collaborative Tuning Approach” for hybrid agile teams
- Create their own hybrid agile management patterns
- Network with other practitioners who may have similar distributed agile challenges.

This workshop will demonstrate how hybrid agile patterns emerge and evolve creating interactive stability and synergy when working in globally distributed agile teams.

About the speakers:

Dr Pamela Abbott is an Information Systems lecturer at Brunel University London, with 10 years experience in researching offshore software service providers. Within the last 6 years she has worked on an international collaborative research project with UK and China based researchers investigating the competitive strategies employed by Chinese IT service provider firms (see [report on this project](#)). Part of this work included researching global agile teams in these Chinese IT service provider firms. The outputs produced a number of prestigious awards including [Best Information Systems Publication 2014](#).

Ms Sunila Modi is a part-time information systems researcher and is completing her PhD at Brunel University London, under the supervision of Dr Pamela Abbott. Her doctoral research has centred on global agile software development teams, studying a large UK-based financial institution with offshore development services in India. She has presented at a number of conferences including [UKAIS](#) and [IEEE Global Software Engineering Conference](#). She has also been an active member of the Agile Meetup community presenting aspects of her research. She is a visiting lecturer at University of Westminster teaching agile methods on a number of project management modules.

Appendix C: Interview Guide

Interviewee:

Date :

[Thanking the participant for participating in the interview. Provide a general introduction – about the research and investigation on how agile practices are adapted in globally distributed settings. Explain that I am keen to find out their views on the <<PRIME>> project. Request permission from the participant to record the interview.]

General Background Questions

1. What is your current role within the agile team and how long have you been working in this role?
2. How many years' experience do you have of within agile software development?
3. How many years'/experience do you have of working within globally software development?

Case Specific Questions

1. In the current project, how many team members are there at each location?
2. Overall what is the scope of the project and why were agile methods chosen over traditional waterfall method?
3. Which agile method does the team utilise locally and globally? (XP, Scrum)
4. How long are the iteration cycles with the project?
5. How is the work the divided and managed across the two locations?
6. What agile practices does the project team use and how are these adapted to suit global settings? (daily stand-ups, iteration planning meetings, retrospectives ..etc)
7. How often do the team members (locally and globally) communicate with each other on a formal and informal basis?
8. How is collaboration between the team members facilitated locally and across the locations?
9. What tools and techniques do you use to support the collaborative practices for the onshore and offshore team members?
10. What technologies are used by the team members for the work to be carried out effectively?
11. Does the technology help in agile practices across locations?
12. What are the challenges do you face in carrying out the agile practices because of the distributed nature of the team?
13. What project artefacts are shared between the local and global teams? (User stories, iteration planning document, source code?)

14. Are the user stories written at one location and passed to the distributed teams or are they written both locations? (If written at both locations then how is uniformity achieved?)
15. Is there visibility and transparency of all the project artefacts with all the team members?
16. How are shared understandings between teams constructed and how is it continuously updated?
17. How do the user stories help in creating a shared understanding?
18. What challenges do the team members face because of the globally distributed locations?
19. Would you say the work carried out by the team members considered to be pioneering or innovative for the organisation?
20. Is the knowledge of best practices from previous distributed agile projects conveyed to other project teams within the organisation?
21. What challenges do the teams face arising from different geographical locations, time zones and people collaborating together from different cultures and how are these challenges managed?
22. Have the staff rotation practices for the team members helped in terms of the work carried out?
23. What transformations have taken place to you work practices within your team?
24. Overall, how would you evaluate the success of how of agile practices within your project?
25. Would you use agile practices in other global software projects if you were given a choice?
26. Is there anything else that you feel is important about how distributed agile teams work that we haven't covered?