Applying agile principles in enterprise architecture

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By

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ABSTRACT

Background: Modern enterprises, regardless of the type of industry, are operating in a dynamic global landscape characterised by rapid technological advancements, shifting regulations and customer preferences. In this complex environment, staying in business presents significant challenges for modern enterprises. Agile enterprise architecture (AEA) is considered a solution to these challenges. However, there is limited empirical evidence and theory to guide the application of agile principles (AP) in enterprise architecture (EA).

Objectives: The objectives of this study are to explain:

1. How can an enterprise apply AP in EA to reduce EA ambiguity?
2. How can an enterprise apply AP in EA to reduce enterprise complexity?
3. How can AP make an EA project adapt to the enterprise's needs and changes?
4. What are the barriers of applying AP in EA?

Design/methodology/approach: The study employed a cross-sectional explanatory qualitative multi-case study, utilising primary and secondary data. Two global financial services technology companies participated in the study. Primary data was collected by interviewing six research participants to address the research questions. Secondary data was obtained in the form of eleven documents. Thematic analysis was applied using a computer-aided qualitative data analysis software called NVivo.

Findings: The study explained the agile delivery process, emphasising essential concepts associated with its execution. A well-executed agile delivery process was found to decrease EA ambiguity, which, in turn, reduces overall enterprise complexity. With the proper processes to address challenges such as culture, skills, resistance to change, centralised control, as well as agile processes taking precedence over business value and EA serving as a bottleneck, AP were identified as a means to assist EA projects in adapting to changing enterprise needs.

Keywords: Agile, Enterprise Architecture, Complexity

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1 INTRODUCTION

Irrespective of their size, form and shape, sector (private or public), industry, nation or region they operate in, modern enterprises are operating in complex, turbulent and uncertain economic global competitive markets, characterised by customers with continuously changing demands, changing compliance regulations and exponential advances in technology (Lapalme et al., 2016; Schilling, 2018). This holds especially true for FSI companies, which have a global reach and are characterised by highly regulated financial markets, complex information systems and telecommunications networks that link financial institutions to households, businesses and governments (Van Wyk, 2019). The ability of these enterprises to react and adapt timeously to continuous and unexpected changes in a globally competitive market is now more essential than before (Hinkelmann et al., 2016). To achieve this ability, enterprises and their information systems should be more adaptive and responsive to their dynamic environments (Onik et al., 2017). This ability has been referred to as agility (Hinkelmann et al., 2016). It is believed that if this agility could be achieved, modern enterprises could stay relevant and remain viable with the capability of evolving as necessary in the face of changing conditions (Carter et al., 2016). An enterprise that possesses agility capability exhibits characteristics that align with the predictions of the Complex Adaptive System (CAS) theory (Onik et al., 2017; Sweetman & Conboy, 2018). CAS theory is a particular branch of Complexity theory (Onik et al., 2017) that explains dynamic systems (that is, enterprises) that can adapt to and co-evolve with a changing environment (Chan, 2001; Sweetman & Conboy, 2018).

Agile enterprise architecture (AEA) has been proposed as a strategic enabler to achieve agility in modern complex enterprises (Gill, 2015; Hazen et al., 2017; Zafar, 2016). AEA refers to applying agile principles (AP) in enterprise architecture (EA) (Kaddoumi & Watfa, 2016). Agile is a term that refers to a set of project management methodologies and practices that embrace and respond to the inevitable changes being experienced by modern enterprises (Beaumont et al., 2017). Although there are multiple epistemological views regarding EA (Saint-Louis et al., 2019), EA is widely used today as a continuous-change process in the alignment of different parts of the enterprise (a dynamic system), like strategy, mission, vision, structure, business processes and information technology (IT) systems (Aljlayel, 2016; Perez-Castillo et al., 2019). However, EA is characterised as a complex and challenging

endeavour (Dumitriu et al., 2019) with no shared meaning (Nurmi et al., 2019). For this reason, it has been reported that it is difficult to find a successful EA project that has delivered the promised benefits of EA (Hazen et al., 2017).

Although prior research has highlighted concerns about applying AP at scale, for example, in EA (Kaddoumi & Watfa, 2016; Uludağ et al., 2019), AP are believed to help in developing a shared understanding and the level of knowledge that is necessary for creating shared mental models that reduce EA ambiguity (Hummel et al., 2016), challenges and complexities (Banaeianjahromi & Smolander, 2019; Foorthuis et al., 2016; Lumor et al., 2019).

1.1 Purpose of the study

The central aim of this study is to explain how to apply AP in EA. To achieve this desired outcome, the study answered the main research question (RQ): *How do enterprises successfully apply AP in EA to address ambiguity, complexity, adaptability and what barriers exist?* RQ was decomposed into four literature-derived research sub-questions. These sub-questions were answered by conducting a multiple case study in two companies operating in the financial services industry (FSI) across the Asia Pacific, Europe, the Middle East and Africa and North American geographical regions. The four sub-questions are:

1. How can an enterprise apply AP in EA to reduce EA ambiguity? (RQ1)
2. How can an enterprise apply AP in EA to reduce enterprise complexity? (RQ2)
3. How can AP make an EA project adapt to the enterprise's needs and changes? (RQ3)
4. What are the barriers of applying AP in EA? (RQ4)

1.2 Rationale

There has been an increasing interest among researchers and practitioners concerning EA (Saint-Louis et al., 2019). This increased interest in EA has been due to its potential benefits, such as reducing complexity and realisation of business and IT alignment (Foorthuis et al., 2016; Nurmi et al., 2019). The EA benefit of the business and IT alignment, for example, with the enlightenment that today, every organisation (at least in part) is a software company (Knaster & Leffingwell, 2020), has ensured that it is possible to identify and specify business processes that are linked to business goals and requirements; information manipulated with

those processes; IT applications developed to create, read, update and delete information; and technological infrastructure required to support the IT applications (Alaeddini et al., 2017). Despite the evidence of these EA benefits, business leaders are demanding early investment returns and value realisation from EA projects (Kaddoumi & Watfa, 2016). As a result, business leaders are highlighting the urgent need to adopt AP in all management and business-related fields, including in EA initiatives (Onag, 2017). AP promises to deliver rapid and reliable business value desired by business leaders by engaging customers and continuously learning and adapting to their changing needs and environments in an iterative fashion (Ciric et al., 2018).

However, although practitioners are attempting to combine both AP and EA, most EA developments still adhere to waterfall principles (Kaddoumi & Watfa, 2016; The Open Group, 2019). It is believed that the myth that AP has no relevance to EA continues to persist (Santos & Blosch, 2018). With others even questioning if AP have already made their way into EA (Thummadi et al., 2017). This confusion in the industry on whether AP and EA can be used together is a result of limited knowledge in the current literature on how AP can be applied to EA (Canat et al., 2018; Hanschke et al., 2015; Thummadi et al., 2017). As a result, there is a lack of empirical evidence-based theory to show and guide how AP can be practically applied in the real world of EA (Thummadi et al., 2017). By acknowledging the lack of AP in systems architectural design and the role of architecture in agile environments (Duijs et al., 2018), academics have been recommended to investigate how AP can be incorporated into EA (Tripp et al., 2018). This study attempts to fill this limited knowledge gap and contribute to the body of knowledge as recommended by formulating a theoretical framework that explains how to apply AP in EA.

In addition to academic theoretical value, the findings of this study provide a practical foundational starting point for EA practitioners and individuals who would like to adopt AP in their enterprises. Enterprises have rising expectations for EA practitioners to focus on business and operating models that achieve business outcomes, placing greater emphasis on a broader business ecosystem for opportunity and innovation (Santos & Allega, 2019). To meet these expectations, EA practitioners are encouraged to apply AP in their work when collaborating with IT and business stakeholders (Brand et al., 2018; Kaddoumi & Watfa, 2016; The Open Group, 2019).

1.3 Research method

Due to the multiple interpretations of EA and conflicting views on AEA embedded in EA history, perspectives and realities (Berrisford, 2019; Kotusev, 2018), the study took an interpretivism and a combined inductive and deductive approach to purposely formulate a theoretical framework that explains how to apply AP in EA. To achieve the study purpose within this approach, a cross-sectional time frame qualitative multiple case study was conducted at two organisations. A total of six research participants from these organisations did provide meaningful explanations to the study by answering interview questions and providing supplementing documentation in the form of architecture descriptions that describes their respective enterprises.

1.4 Assumptions and limitations

The study assumed that every enterprise has an architecture, documented or not and that the human subjects working in these enterprises should be able to describe it at least. However, the reality is that all these people describe their enterprises differently from their own perspectives. These differences result from the different tools and methods used in the production, acceptance, use and maintenance of EA (Gong & Janssen, 2019). Although, with much passion for EA as a discipline, the researcher in his career never practised EA as a profession, which might have influenced this study outcome. To compensate for this limitation, the researcher took a practitioner-based examination related to EA with the British Computer Society and also enrolled in a course on The Open Group Architecture Framework, an applied industry certification (Dilnutt, 2022). Also, this study was only limited to the duration of master's degree enrolment at the University of Cape Town (UCT), South Africa. It was also difficult to secure interviews from the general population of organisations approached by the researcher. This resulted in the researcher only conducting two case studies instead of the four initially planned.

1.5 Ethical considerations

Within organisations, EA is at the centre of determining initiatives to pursue and how to plan, execute and monitor the selected initiatives. These decisions can have ethical, morally

neutral, or unethical implications for both the internal and external environments of these organisations. This ethical behaviour can come from knowledge of ethics, ignorance or a lack of concern for ethics. The same applies to ethical considerations of the researcher interacting with these organisations. According to the UCT Commerce Faculty Ethics in Research Policy, all research conducted for academic credit by Commerce Faculty students must be approved by the Ethics in Research Committee if it involves the participation of human subjects. The study falls within the Commerce Faculty and interviewed solution architects, technical architects, principal consultants and others. Therefore, it was compulsory to have Ethics approval before contacting anyone for interviews. Ethics approval was obtained by adhering to the UCT Ethics. Anonymity of information obtained from the participants and about the participants was preserved, and such information was referred to in this study by non-identifiable names.

1.6 Outline of the study

This study proceeds in five chapters. This chapter 1 introduced the research problem and justified the need for this study. Chapter 2 is the literature review, demonstrating the critical evaluation of the existing literature on AEA knowledge and understanding. Chapter 3 details the methods and ontological and epistemological assumptions that guided this study. The study findings, analysis and discussion follow in chapter 4, linking the employed research methods and ontological and epistemological assumptions to the literature review. Lastly, chapter 5 concludes the study by stating the learnt lessons from the formulated theoretical framework and recommendations for future research and to the EA practitioners and individuals planning to adopt AP in their EA practice.

2 LITERATURE REVIEW

Chapter 1 introduced the research problem and provided context, purpose and the significance of this study to academia and practitioners. This chapter highlights the gaps in the reviewed literature and shows how the research questions emerged from the existing literature. Different authors from different disciplines, including information systems, have brought forward many reasons for conducting a literature review (Webster & Watson, 2002). A literature review critically appraises the current collective knowledge on a specific topic

within a particular discipline (Winchester & Salji, 2016). For the purpose of this study, the reviewed literature relates specifically to AEA. The study adopted the eight-step literature review process proposed by Okoli (2015). However, because one researcher conducted the literature review process, step two of the process was omitted, that is, draft protocol and train the team. Figure 1 highlights the executed literature review steps concerning this study. The rest of this chapter proceeds as follows: first, AP is discussed, and its applicability to EA is examined. This is followed by an examination of EA as a discipline. Next, the current AEA landscape is discussed to motivate AP applicability in EA. The literature review summary then concludes this chapter.

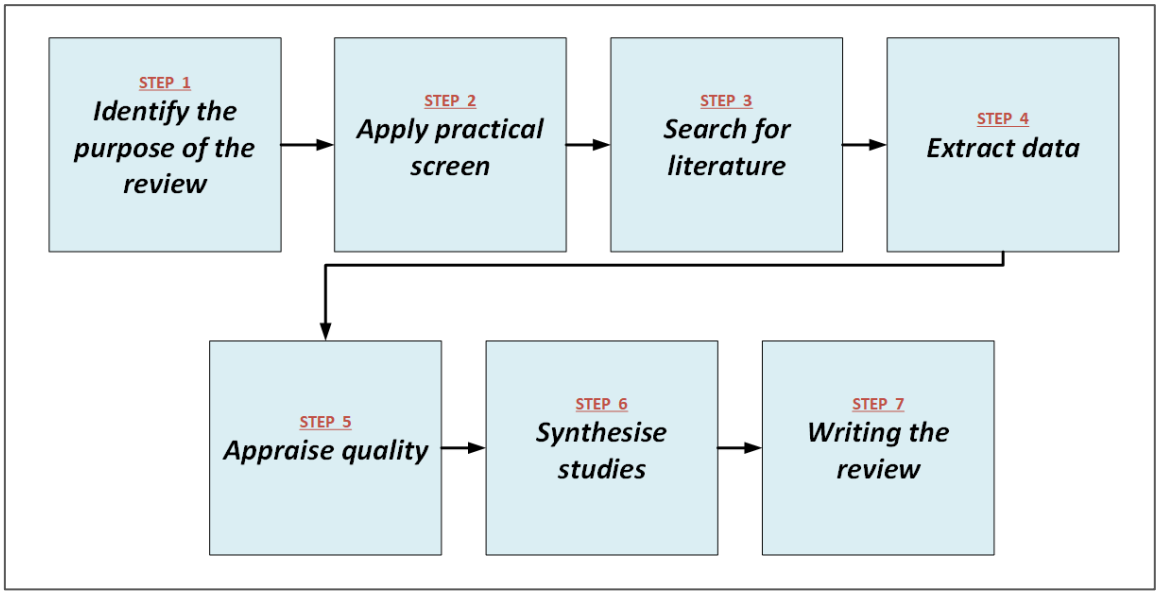


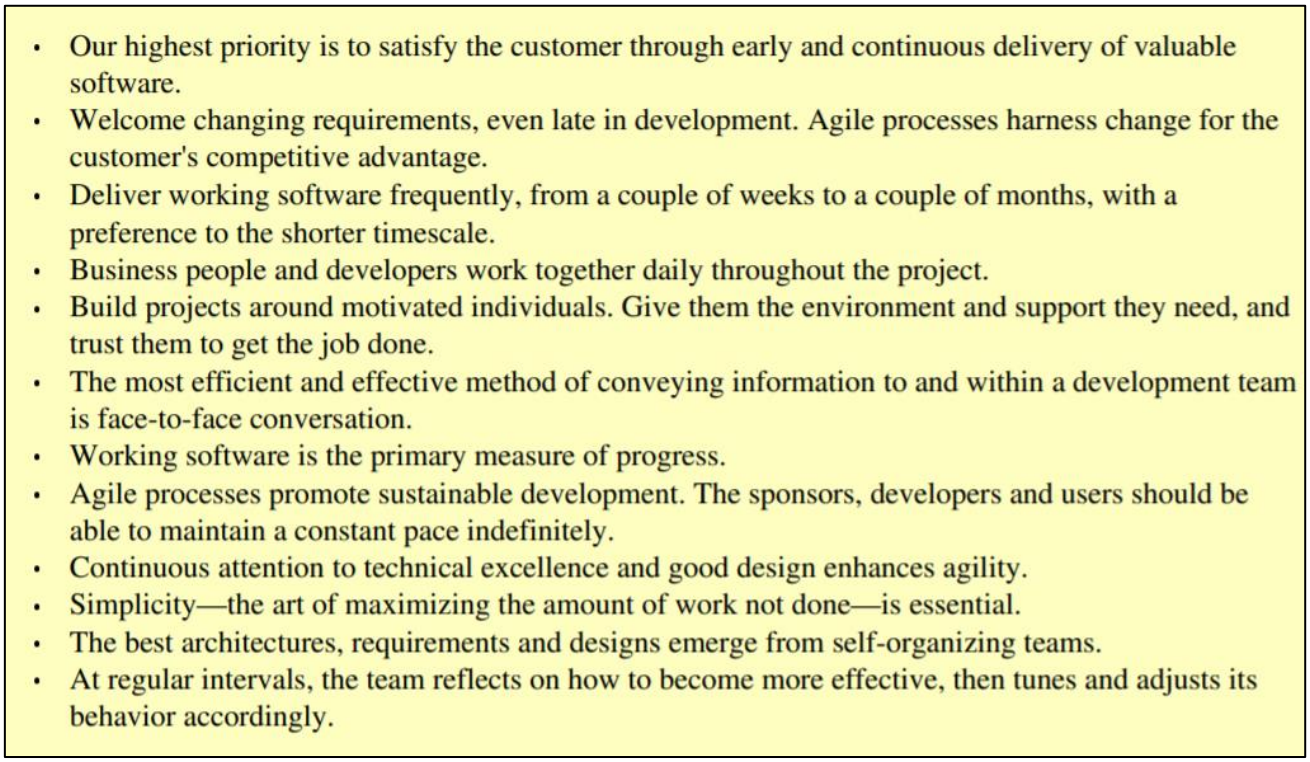
Figure 1. Literature review process

2.1 Agile principles

For many organisations reporting, they are practising a form of agile; AP are the new way of working (Duijs et al., 2016). AP originated from the software engineering industry and are documented in the Agile Manifesto (Ciric et al., 2018; Fowler & Highsmith, 2001). Compared to prescriptive traditional project management methodologies such as waterfall, AP provides a working environment that supports productivity and creativity, rapid adaptation to change, early and constant delivery of value into an enterprise (Hobbs & Petit, 2017). Successes in software engineering projects have been attributed to AP, and AP have featured prominently in information systems, software engineering and project management research communities

(Sweetman & Conboy, 2018). The popularity of AP has been linked to their successes in software projects (Canat et al., 2018). However, AP successes tend to be tightly coupled to types of projects that constitute collocated small teams (Tripp et al., 2018).

Figure 2 shows a list of the twelve AP documented in the Agile Manifesto (Ciric et al., 2018; Fowler & Highsmith, 2001). However, some scholars seem to mindlessly refer to AP as agile values, for example (Lovalt, 2022). This is incorrect (Fowler & Highsmith, 2001). Although AP and agile values are both fundamental components of agile and are outlined in the Agile Manifesto, they differ in scope and focus (Fowler & Highsmith, 2001). Agile values are core beliefs underpinning agile projects (Fowler & Highsmith, 2001). These values emphasise individuals and interactions, working software, customer collaboration, and responding to change. Contrarily, AP are the guidelines that agile teams use to implement agile values in their projects (Ciric et al., 2018).



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

Figure 2. Agile principles (Fowler and Highsmith, 2001, p. 34).

While little is known about whether AP can be applied to enterprise-level projects (Sweetman & Conboy, 2018), the adoption of AP on non-software projects is on the rise because today's projects are more complex with uncertain outcomes and goals changing over time (Ciric et al., 2018). The objective of this study was to explain how AP is applied in EA projects. EA is

seen as a key when connecting enterprise strategy and portfolio IT projects (Gellweiler, 2020). In real-world scenarios, experts have highlighted the Scaled Agile Framework (SAFe) as an example where EA is a critical component in establishing a road to a better future state grounded in an architectural runway that enables the portfolio's technology to evolve (Knaster & Leffingwell, 2020). SAFe is perceived as a set of structures and procedures designed to help large companies implement agile methods on a large-scale (Knaster & Leffingwell, 2020). However, EA is characterised as a complex and challenging endeavour (Dumitriu, Meșniță, & Radu, 2019). Because of the complexity and challenging EA nature, EA is carried out as a continuous project that cannot be done all at once but instead requires to be continuously updated at different periods based on the enterprise's needs and changes (Banaeianjahromi & Smolander, 2019). The need for EA to adapt to enterprise needs and changes matches that of a CAS, as Sweetman and Conboy (2018) described and justifies the need to use AP in EA (Duijs et al., 2016). However, there are still many open questions regarding leveraging AP in non-software projects, for example, in EA (Tripp et al., 2018). Based on this understanding, the main research question (RQ) arises: How do enterprises successfully apply AP in EA to address ambiguity, complexity, adaptability and what barriers exist? The following sub-section 2.2 is the literature review of enterprise architecture as a concept.

2.2 Enterprise architecture

Epistemologically, EA is characterised by the absence of shared meaning, and as a result, there are multiple understandings and views of EA from both practitioners and researchers (Nurmi et al., 2019). This is because each different organisation has its own understanding and view of EA and uses EA differently (Gong & Janssen, 2019). The reason for the absence of EA shared meaning is a result of EA drawing on several associated disciplines and domains, such as information systems, systems engineering, industrial engineering, and organisational science (Halawi et al., 2019). Others think the reason for the absence of shared meaning in EA is because EA originated outside theoretical foundations (Nurmi et al., 2019; Saint-Louis et al., 2019). However, the reality is that there are various understandings and views of EA, which are incomplete, complicated, incoherent and implicit (Saint-Louis et al., 2019). Multiple views of EA makes it challenging to talk about or practice EA as a discipline using a structured knowledge baseline (Nurmi et al., 2019). AP are believed to help

in developing shared understanding and the level of knowledge that is necessary for creating shared mental models that reduce ambiguity where it exists (Hummel et al., 2016). However, the researcher did not come across any prior research that has explored how AP can be applied in minimising the absence of shared meaning in EA. This gave rise to the first sub-research question (RQ1): How can an enterprise apply AP in EA to reduce the EA ambiguity?

Saint-Louis et al. (2019) and Nurmi et al. (2019) proposed that the concepts of enterprise and architecture should be defined separately to understand EA as a discipline better. Earlier, in addition to enterprise and architecture, Lankhorst (2017) had proposed an EA discipline conceptual framework which included stakeholders and architecture descriptions. Figure 3 highlights this conceptual framework. This inspired the discussion of the terms enterprise and architecture in the following two sub-sections, with an initial focus on the term enterprise. The terms stakeholders and architecture descriptions are discussed within these two sub-sections.

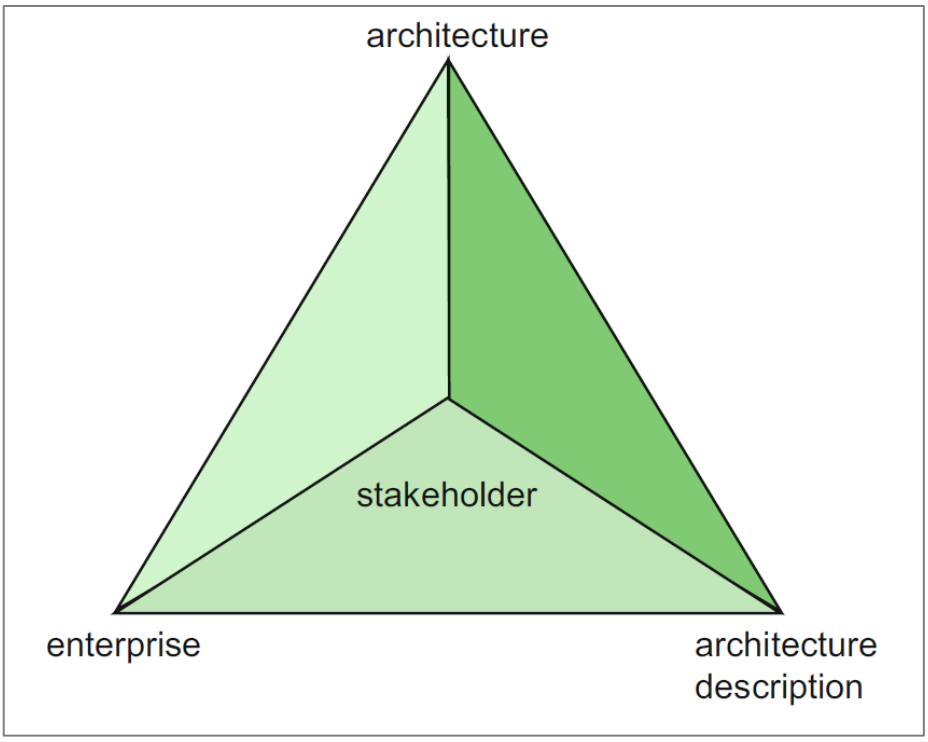


Figure 3: Relationship between enterprise, stakeholder, architecture and architecture description (Lankhorst, 2017, p. 47).

2.2.1 *Defining enterprise*

The understanding of what is an enterprise is a subjective perception of an observer, and as a result, there are multiple realities of how different people perceive an enterprise (Sousa et al., 2017). In this case, an observer refers to a business stakeholder (individual or collective), and multiple realities relate to the different concerns or interests of these different enterprise stakeholders (Lankhorst, 2017). To that end, Nurmi et al. (2019) systematic literature review analysis on systems approaches of the EA discipline identified multiple views of what an enterprise is, including the views that an enterprise is a kind of complex system, such as a complex socio-technical system, or complex network, or a CAS, or a system of systems (SoS). From other perspectives, an enterprise is regarded as a living system (Banaeianjahromi & Smolander, 2019; Korhonen et al., 2016). Viewing an enterprise as a living system implies the need to constantly re-architect the enterprise to achieve necessary agility (Banaeianjahromi & Smolander, 2019). However, Syynimaa (2017) criticised some of these views, for example, the complex socio-technical system view, citing that it is limited as it rules out, for instance, enterprises which are pure social organisations.

This study views an enterprise (the unit of analysis of this study) as a CAS, as this view considers the dynamic nature of modern enterprises and encapsulates all the other views (Onik et al., 2017). This view has been explained in the literature using the CAS theory (Kasemsap, 2016). The view implies that an enterprise is a complex system comprising heterogeneous agents interacting in a dynamic, complex environment (Onik et al., 2017). These heterogeneous agents' interactions are not always linear or predictable because each agent can act in ways that satisfy its goals (van de Wetering & Bos, 2016). If modern enterprises are made up of heterogeneous agents as described by the CAS theory, then it implies the importance of these enterprises to understand, reason and cope with the effects of one agent's actions on other agents and with the enterprise operating environment (Lapalme et al., 2016). Which is what AP advocates for (Duijs et al., 2016).

Regardless of one's view of what an enterprise is, all the views share the same knowledge that an enterprise is a complex system (Nurmi et al., 2019). A complex system is characterised by uncertainty, interdependence, complexity, ambiguity and emergence (Keating, 2015; Keating & Katina, 2019). Figure 4 summarises the characteristics of a complex system.

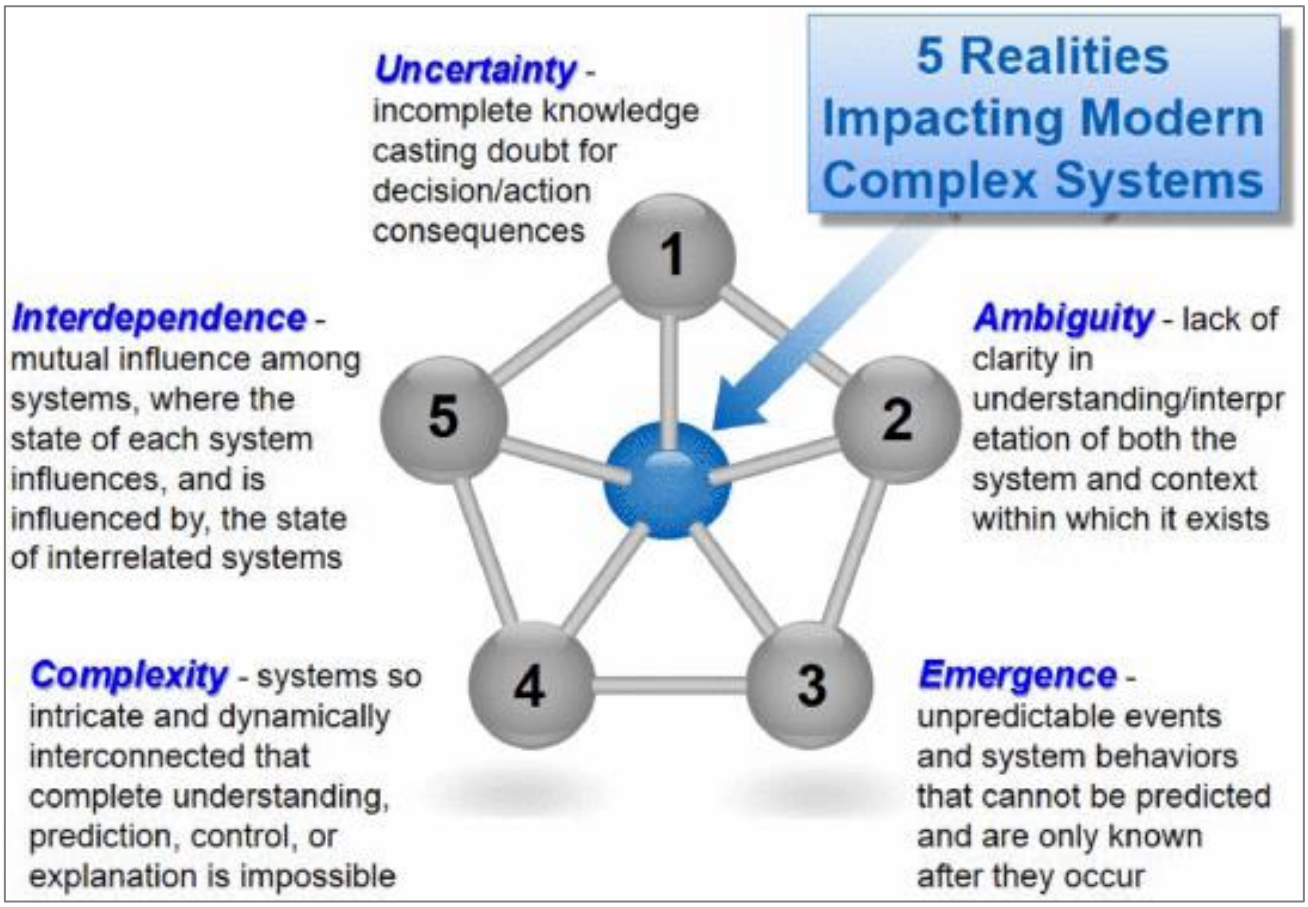


Figure 4. Characteristics of modern complex systems (Keating, 2015, p. 226).

Faced with these realities impacting modern complex systems shown in Figure 4, researchers are looking at contemporary complexity theories that inspire with ideas about adaptive structures and neural network-like self-organising enterprises (Kasemsap, 2016). Other researchers and practitioners have regarded EA as an avenue to manage and adapt to today's enterprises' complexity (Banaeianjahromi & Smolander, 2019; Foorthuis et al., 2016; Lumor et al., 2019). This has led to an increasingly prominent trend regarding the use of complexity theories within EA practice and research (Gampfer et al., 2018). Complexities theories such as Complexity Theory suggest that CASs change to adapt to their environments (Kasemsap, 2016). From another perspective, AP have been proposed as a possible solution to cope with this complexity (Sohi et al., 2016). Basing on this knowledge that EA and AP have the potential to deal with realities impacting modern complex systems, second sub-research question (RQ2) arises: How can an enterprise apply AP in EA to reduce enterprise complexity?

2.2.2 *Defining architecture*

The majority of prior EA research followed conventional wisdom and used the architecture definition provided by the ISO/IEC/IEEE 42010:2011 standard (Carter et al., 2016), which states that:

“architecture is a fundamental property of a system in its environment embodied in its elements, relationships and in the principles of its design and evolution” (ISO/IEC/IEEE, 2011, p. 2).

Some practitioners have questioned this definition and failed to find meaning in some of its words, for example, “a fundamental property” (Ignacio, 2021). This might be the reason why other scholars deviate from this definition and explain the term architecture using the General Systems Theory as an example by defending that the empirical world is a SoS (Syynimaa, 2017). This is in alignment with the general view that people tend to think of the universe (the world around us) as consisting of related elements (Lankhorst, 2017). In this view, every system, such as an enterprise and its components, can be described with formal descriptions (Syynimaa, 2017). These formal descriptions visualise the enterprise, its structure, components, and their inter-relationships that are necessary to guide its design, implementation and evolution over time (The Open Group, 2018). The definitions from ISO/IEC/IEEE 42010:2011 standard and Syynimaa (2017) can also be criticised for being too restricted only to systems perspective (Hensema, 2015). Other scholars even believe that the formal descriptions, referred to as just architecture, define EA as a discipline (Kotusev & Kurnia, 2021). In the context of this study and considering the EA conceptual framework at Figure 3, architecture is subjectively viewed as a discipline or set of activities concerned with the analysis and design of systems and the production of architecture descriptions (The Open Group, 2018). Figure 5 shows an example of architecture description elements from a business activity point of view (Berrisford, 2020).

Due to the high pace of change in the environments in which they operate, today’s enterprises are having difficulty maintaining explicit knowledge of enterprise reality, as presently observed that these descriptions seek to describe or represent (Sousa et al., 2017). As soon as the enterprise operating environment changes, these descriptions become obsolete and not fit for purpose in guiding the enterprise’s design, implementation and evolution (Gong &

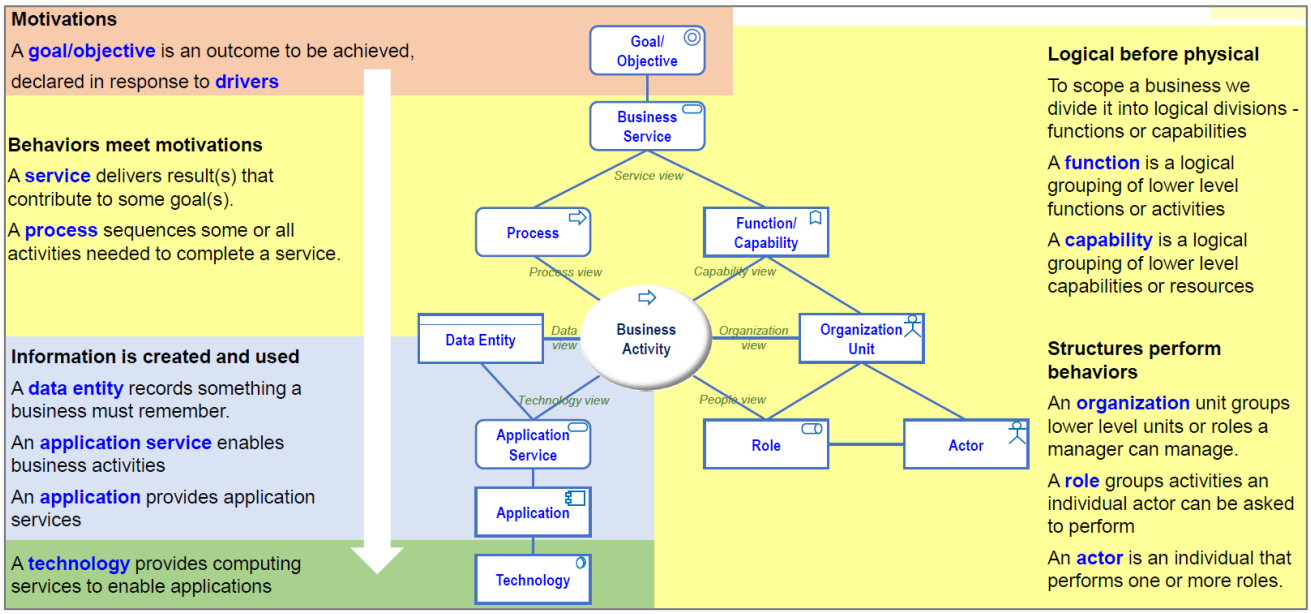


Figure 5. Business system elements (Berrisford, 2020, p. 15).

Janssen, 2019; Kaddoumi & Watfa, 2016). For this reason, current descriptions are more descriptive and prescriptive and lack agility, which is essential in today's complex environments (Korhonen et al., 2016). One of the AP, which states that 'architectures and designs emerge from self-organising teams' has been suggested in the literature as a solution for more adaptive architectural descriptions (Kaddoumi & Watfa, 2016). This gives rise to the third sub-research question (RQ3): How can AP make an EA project adapt to the enterprise's needs and changes?

2.3 Motivating for agile enterprise architecture (AEA)

Trends in the literature show an emerging reconceptualised EA whose architectures are more adaptive to the reality of complexities confronting modern enterprises (Gampfer et al., 2018). This reconceptualised EA has come in two names: agile or adaptive enterprise architecture (Gampfer et al., 2018). However, some practitioners do not believe there is any real thing called AEA, citing that AEA is the output of true EA that would enable enterprise "agility", which is the desired outcome (EACOE, 2022). Many authors have classified AEA under the Enterprise Ecological Adaptation (EEA) schools of thought on EA (Korhonen & Halén, 2017). EEA schools of thought on EA regard EA as a means for continued organisational existence, sustainability and innovation (Korhonen et al., 2016). In this view, similar to the characteristics of CAS, the enterprise co-evolves with its environment (Korhonen et al., 2016; Korhonen &

Halén, 2017). Although this study acknowledges the existence of two other schools of thought on EA, Enterprise IT Architecting (EITA) and Enterprise Integrating (EI), they do not deserve further detailed discussion as they are described in the literature as more traditional and grounded on closed systems perspective (Korhonen et al., 2016; Korhonen & Halén, 2017).

To manage the stated complexity and to advance AEA goals, several EA frameworks (EAFs) exist to guide the development, implementation and management of EA (Aljlayel, 2016; Iyamu, 2019). For example, the Efficacious Adaptive EA (2EA), a framework which uses CAS principles to explain adaptive success (van de Wetering & Bos, 2016), Adaptive Integrated EA framework which encompasses digital IT-related elements that use digital platforms to achieve digital transformation in an adaptive EA aligned with an IT strategy (Masuda et al., 2018) and Agile EA Framework which is made up of agility motivators, and agility disablers, agility enablers and EA (Kaddoumi & Watfa, 2016). A common theme to all these AEA frameworks is the need to have an adaptive EA that can lead to adaptative enterprises. However, Kotusev (2017) posed critical unanswered questions on whether these EAFs are necessary, valuable, useful and feasible for an EA practice or if they really represent best practices in EA. Another criticism of EAFs comes from the perspective that most EAFs are based more on waterfall methodologies, which do not address the agility needs businesses require today (Kaddoumi & Watfa, 2016).

Regardless of these criticisms, teams responsible for the development and management of EA are recommended to apply AP (Brand et al., 2018; The Open Group, 2019; Zafar, 2016). The main reason is that AP offers different company stakeholders a clear understanding of what is happening and finds reasons why sometimes goals are not met (Werewka & Spiechowicz, 2017). However, literature documenting the application of AP in EA is scarce (Canat et al., 2018), hence the importance and applicability of this study.

Other academics and practitioners have made various claims regarding the benefits that EA delivers for both individual projects and the organisation as a whole (Foorthuis et al., 2016). However, EA initiatives are often costly, with no desirable enterprise-wide effects yielded and the expected return on investment is never realised (Gerber et al., 2020; Hazen et al., 2017; Uludağ et al., 2019). Using the Structuration Theory, a social-technical theory, Iyamu (2019) looked at the causes of EA failures and found out that technology, social context, organisational structures, and process-oriented factors were a significant influence on EA

projects' success. Banaeianjahromi and Smolander (2019) identified a lack of communication and collaboration as the core factor affecting EA projects, hindering decision-making and information exchange between different EA stakeholders. Olsen (2017) found that the ambiguity and multiple views of the EA concept are some of the root causes of the many reported EA problems. Based on the realities of these challenges confronting EA projects, the fourth sub-research question (RQ4) arises: What are the barriers in applying AP in EA?

2.4 Literature summary

Literature has identified AP as the main mechanism that can enable EA to be responsive to enterprise's constant environment changes (Kaddoumi & Watfa, 2016). However, there is limited knowledge on how AP can be applied in EA (Canat et al., 2018), raising the need for a more detailed investigation. AP have been brought forward as the new way of working for many modern organisations. Enterprises have made many attempts to adapt AP in domains outside the software industry, including in EA. EA is seen as a complex project that sits within the project portfolio to link enterprise strategy to IT strategy. Other authors in the literature have referred to EA as a CAS.

It has been noted that there are multiple views and understandings of EA as a discipline, with different authors giving different reasons for these EA's multiple views and understandings. Because of EA's lack of shared meaning, the words enterprise and architecture have been discussed separately. Enterprises are seen as CASs that can be explained better with complexity theories. Architecture is seen as a system description that describes the current and future state of CASs. However, because of the nature of today's complex environments, the system descriptions are becoming outdated quickly. Traditionally, EA has not responded to the realities confronting modern enterprises, giving rise to the AEA. AEA is seen as the enabler to achieve agility and adaptability in modern enterprises. Gaps in literature have raised one main and four sub-research questions on how AP can be applied in EA to achieve the desired agility in modern enterprises. The following chapter 3 details the procedures used by the researcher to find answers to these raised questions.

3 RESEARCH METHODOLOGY

This chapter describes the research methodology that was followed to address the posed research questions in chapter 2. A research methodology refers to the overall process guiding an entire research project (Palvia et al., 2003). The goal of such a process is to clarify and justify all the steps required to achieve the research objectives (Al Kilani & Kobziev, 2016). Each step in the chosen research process flows from several philosophical assumptions a researcher makes regarding the research under study in order to achieve the research purpose (Saunders et al., 2015; Scotland, 2012). Philosophical assumptions are a set of beliefs or preconceptions relating to how knowledge can be acquired to answer research questions (Saunders et al., 2015). These beliefs result from several factors including the scholarly communities, research topic area, research questions, intended research audience and researcher's background (Creswell, 2019; Palvia et al., 2003). In the discipline of EA, these beliefs affect an architect's conceptions when describing an enterprise for different types of stakeholders who also have different views, interests, concerns or perspectives based on their different beliefs (Lankhorst, 2017).

Figure 6 illustrates the research process adopted as this study's methodology framework. Choices made for the study on each research step are circled in Figure 6. (Saunders et al., 2015). Section 3.1 describes the ontological and epistemological assumptions made to achieve the research purpose. Guided by the stated assumptions, the research purpose and approach to theory is given in sections 3.2 and 3.3, respectively. This is followed by the discussion and justification of the research method choice in section 3.4 and the research strategy in section 3.5. The research time frame is provided in section 3.6. Discussion of data collection, instrument design, target population and sampling are provided in sections 3.7, 3.8, 3.9, and 3.10, respectively. Section 3.11 argues for the appropriateness of the study's empirical context. Section 3.12 details the study access and ethical considerations. Data analysis in section 3.13 then concludes this chapter.

3.1 Philosophical consideration

Philosophical assumptions taken by researchers contain differing ontological and epistemological views regarding what reality is (ontology) and what constitutes knowledge

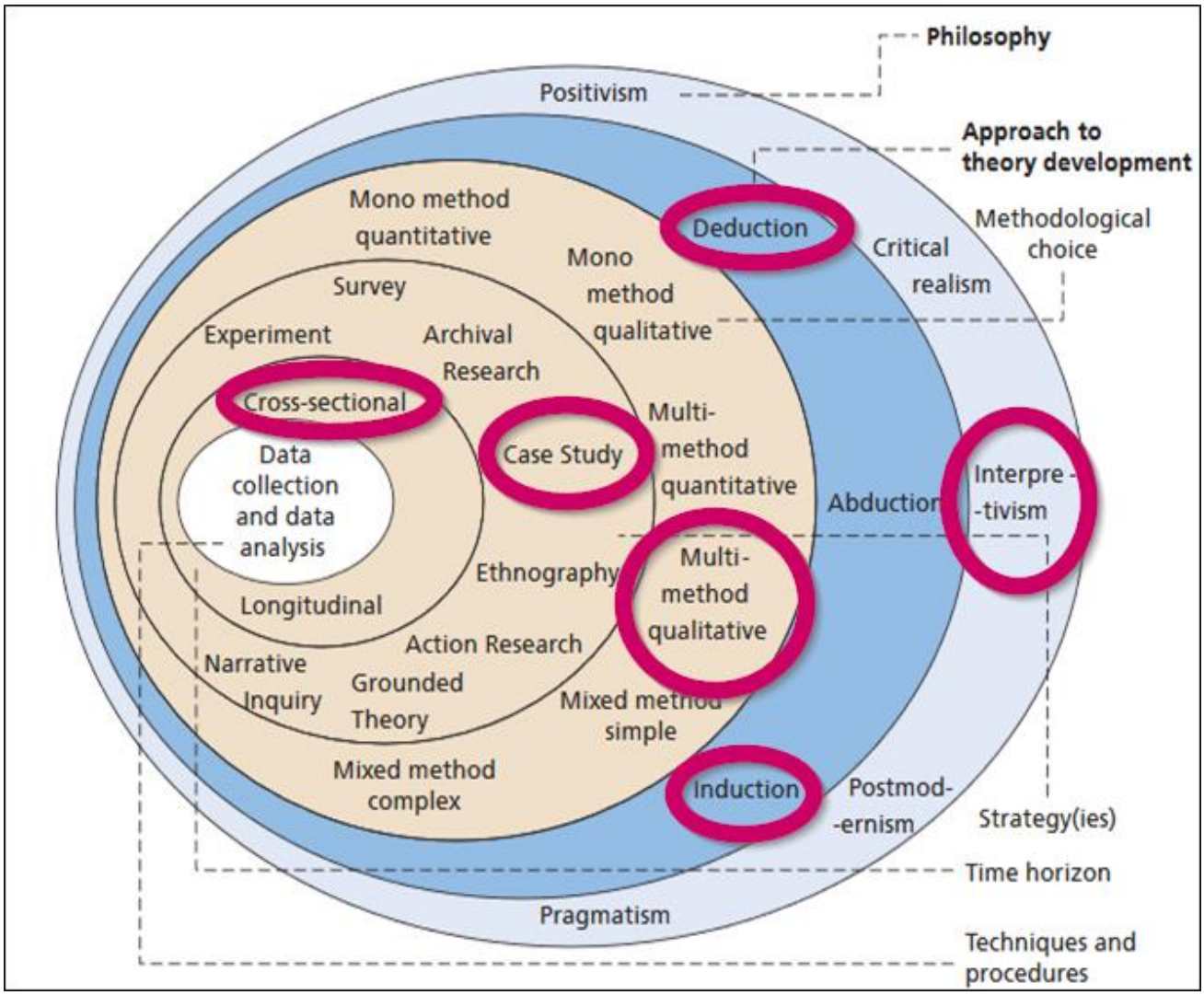


Figure 6: Research process (Saunders et al., 2015, p. 124).

(epistemology) (Scotland, 2012). Thus, ontological assumptions are concerned with what defines reality, and epistemological assumptions are concerned with knowledge creation, acquisition and communication (Saunders et al., 2015; Scotland, 2012). In EA practice, epistemological assumptions are important in understanding the relationship between reality and the architecture descriptions, and ontological assumptions are useful in providing a set of concepts and inter-relations necessary when describing systems (Wegmann, 2003). Variations of differing ontological and epistemological views exist, including pragmatism, positivism, postmodernism, interpretivism and critical realism (Saunders et al., 2015).

This study took the position of interpretivism in explaining how to apply AP in EA. The ontological assumption of interpretivism implies that reality is subjective, and the reality of each person is different (Scotland, 2012; Van Zyl, 2015). The epistemological assumption of

interpretivism is subjectivism, which implies that knowledge is constructed in and out of the interaction between humans and their world and is developed and transmitted in a social context; and this knowledge can only be understood from the standpoint of the social actors participating in the social context under study (Saunders et al., 2015; Scotland, 2012). The interpretivist view was appropriate for this study since it has been highlighted in the literature that there are multiple views of what is perceived as EA (Gong & Janssen, 2019) and that an enterprise is a subjective perception of an observer, and as a result, there are multiple realities of how different people perceive an enterprise (Sousa et al., 2017). These different people are the enterprise's stakeholders, who all have different views influenced by their particular interest in the observed enterprise, i.e., their concerns (Lankhorst, 2017). Regardless of one's view of what an enterprise is, Nurmi et al. (2019) show that all the views share the same knowledge that this observed enterprise is a complex system. Interpretivism is characterised by efforts that seek to understand such complex systems (Gummesson, 2003; Reksoatmodjo et al., 2012).

3.2 Research purpose

The purpose of this study was explanatory. The study aimed to explain how enterprises apply AP in EA. An explanatory study allows thinking about questions of explanation (Cornelissen, 2017). Explanatory research emphasises studying a situation or problem that seeks explanatory answers that are likely, to begin with, 'How' (Saunders et al., 2015).

3.3 Approach to theory development

Many challenges in EA, where AP is seen as a solution, are linked to EA's origins outside of formal theory (Nurmi et al., 2019). However, having a strong theoretical foundation is important in any field, including information systems research, as it helps describe, explain and predict the phenomena being studied (Mueller & Urbach, 2017). To contribute meaningfully to the EA field, this study developed a theoretical framework to explain how AP can be applied in EA. Building theory bridges the gap between research and practice and helps advance the maturity and professionalism of the field (Mueller & Urbach, 2017). Since the purpose of this study was explanatory, it focused on generating insights rather than testing predefined hypotheses. As such, it primarily used inductive reasoning to identify

patterns in the data and build a theoretical framework from observations (Saunders et al., 2015). While deductive reasoning is typically associated with testing existing theories, it was used cautiously in this study to interpret broader concepts in the world of EA, such as understanding enterprises as complex systems. The explanatory nature of this research means it is more open-ended, aligning with inductive reasoning as the primary method. By incorporating limited deductive elements, the study ensures a balanced approach that remains consistent with its explanatory research purpose (Mueller & Urbach, 2017).

The study also acknowledges other approaches to theory development, such as abductive reasoning. Abductive reasoning builds theory by using known premises to generate testable conclusions (Saunders et al., 2015). This approach is particularly valuable when exploring phenomena with incomplete data, as it allows researchers to generate reasonable hypotheses that can guide further investigation (Saunders et al., 2015). It is also useful for combining elements of both inductive and deductive reasoning to bridge the gap between theory and practice (Saunders et al., 2015). While these merits are acknowledged, abductive reasoning was not selected for this study as it did not align with the research objectives

3.4 Methodological choice

There are three ways a researcher can conduct research depending on the research purpose, approach to theory development and adopted philosophical position: qualitative, quantitative or a combination of both qualitative and quantitative (Flick et al., 2004; Saunders et al., 2015). Interpretivist ontological and epistemological views adopted by the researcher are generally associated with qualitative research (Saunders et al., 2015). Creswell (2019) argues for using qualitative research when the research approach is to formulate a theoretical framework that provides detailed explanations of complex issues. The enterprises that EA seek to describe are complex, with systems dynamically interconnected and so intricate that complete explanation or understanding is impossible (Keating, 2015). For these reasons, this study adopted qualitative research to explain how enterprises apply AP in EA. The literature pointed out that applying AP in EA helps enterprises reduce enterprise complexity. The qualitative research has also been used in related research (Banaeianjahromi & Smolander, 2019). Qualitative research is a broad umbrella term for research methodologies that describe and explain the behaviours, experiences, interactions and social contexts of a

person without the use of quantification or statistical procedures (Reksoatmodjo et al., 2012). In its simplest form, qualitative research refers to a combination of one or more data collection and analysis procedures that generate nonnumerical data (Flick et al., 2004; Saunders et al., 2015).

3.5 Research strategy

A research strategy refers to a plan that details how the end purpose of the research will be achieved by providing a link between a study's underlying paradigm and the methods to be used to collect empirical data (Reksoatmodjo et al., 2012). Many frameworks exist to guide this plan, such as case study, grounded theory, experiment, survey, action research, or others (Creswell, 2019). Other prior studies in EA taking the same philosophical assumptions and methodological choice as this study, have adopted the case study research strategy in answering their research questions (Thummadi et al., 2017; Kotusev, 2018). A case study refers to a detailed examination of a single example of an unexplored contemporary phenomenon in its natural settings and full complexity (Flyvbjerg, 2006; Kotusev, 2018). A case study strategy is useful for answering "how" questions (Diaz Andrade, 2009), which is the purpose of this study – answering how enterprises can apply AP in EA.

A case study strategy can include either single or multiple cases (Reksoatmodjo et al., 2012). Multiple case study develops a more convincing theory when the suggestions are more intensely grounded in several empirical evidence (Gustafsson, 2017). EA is characterised by the absence of shared meaning (Nurmi et al., 2019). This is because each different organisation has its own understanding and view of EA, and uses EA differently (Gong & Janssen, 2019). For the researcher to capture these multiple different views, understanding and uses of EA, multiple case study was adopted for this study. From the captured multiple different views, understanding and uses of EA, the researcher was then able to formulate a theoretical framework that explains how AP can be applied in minimising the absence of shared meaning in EA.

3.6 Research time frame

An interpretivist researcher sees the world strongly bounded by a particular time (Diaz Andrade, 2009). In the case of this study, the researcher was bounded by the duration of the master's degree program. For this reason, the study made use of the cross-sectional time horizon in scheduling the activities required to achieve the research purpose. Cross-sectional time horizon refers to a snapshot of time during which research can be conducted (Saunders et al., 2015).

3.7 Data / variables and data collection methods

A multiple case study strategy allows for diverse empirical observations and collections per case (Haverland & Blatter, 2012). Reksoatmodjo et al. (2012) identified two types of these observations that are necessary to answer research questions in the qualitative interpretive case study: primary and secondary data. Primary data refers to original data the researcher collects for specifically achieving the research purpose, and secondary data refers to data originally collected for a different purpose by the organisation participating in the case study but made available to the researcher to reuse in achieving the research purpose (Hox & Boeije, 2005). In Walsham's (1995) view, primary data in the form of interviews allows the researcher to best access the other people's constructions and interpretations regarding views and aspirations of themselves and other participants within their organisation and from other organisations. Based on Walsham (1995) view, the researcher adopted interviews as primary data to construct knowledge from other people's constructions and interpretations regarding how enterprises can apply AP in EA to adapt in and co-evolve with a changing uncertain economic global competitive market.

Reksoatmodjo et al. (2012) list documentation and artefacts as a form of secondary data. By viewing an enterprise as a complex system, enterprises possess formal descriptions, essentially forms of explicit knowledge of that enterprise, the structure, components and their inter-relationships that guides the enterprise design, implementation and evolution over time (The Open Group, 2018). These formal descriptions are the output documents and artefacts from the EA practice (The Open Group, 2018). However, due to the high pace of change in the environments they operate, today's enterprises are having difficulty maintaining explicit knowledge of enterprise descriptions that represent the enterprise reality as observed (Sousa

et al., 2017). Making it difficult in the understanding of both the system and context within which it exists (Keating, 2015). One of the AP, which states that ‘architectures and designs emerge from self-organising teams’ have been suggested in the literature as the solution to reduce enterprise ambiguity and uncertainty if applied in EA. Based on this understanding, the researcher adopted documentation in the form of enterprise descriptions as the study secondary data to explain how enterprises by using AP, are keeping their EA architectural descriptions up to date.

In order to get a deep insight into how AP can be applied in EA, the philosophical views, methodological choice and the research strategy adopted by the researcher (interpretive, qualitative and multiple case study respectively) allowed the researcher to be directly involved in the data collection process (Reksoatmodjo et al., 2012). Inherently in interpretive case studies is the need for in-depth data collection involving multiple data sources (Diaz Andrade, 2009). The interview method is the primary research data collection method used for this purpose (Ponelis, 2015). To facilitate data collection from multiple sources in an interpretive study, Walsham (2006) suggested that interviews should be supplemented by other forms of methods. Hence, for this reason, the researcher used documents to supplement the interview research method.

3.8 Instrument design

Semi-structured interviews allowed the researcher to subjectively choose critical questions or themes to be discussed (Saunders et al., 2015). Appendix A, “Research Instrument ” contains the semi-structured interview questions. The interview questions have been adopted from Bui and Sjölenius (2018), Canat (2018) and Velumani (2017).

3.9 Target population

Population is the primary source of data that influence research credibility on the basis of the researcher’s understanding, definition and choice of it (Asiamah et al., 2017). A population refers to a full set of cases from which a sample is taken to answer research questions (Saunders et al., 2015). The general population for this research design are enterprises that are using EA or providing EA consulting services. Cassell et al. (2017) made a distinction

between the choice of choosing a case for inclusion in a sample and selecting a sample. Although EA is seen as a key when connecting enterprise strategy and portfolio IT projects (Gellweiler, 2020), from the researcher's perspective, this does not imply every organisation around the world uses EA. In addition, although it has been reported that AP is the new way of working for many organisations (Duijs et al., 2016), it is not all organisations that apply AP in their EA projects. Hence the reason why little is known on whether AP can be applied at enterprise-level projects such as EA (Sweetman & Conboy, 2018). To formulate a theoretical framework that contributes to what can be known on how AP can be applied in EA, the research study's target population were FSI enterprises that are applying AP in their EA. The target population refers to a group of cases with specific attributes of interest and relevance refined from the general population (Asiamah et al., 2017). Section 3.11 of this chapter discusses the rationale for selecting the FSI as the empirical context for this study.

3.10 Sampling

Qualitative researchers draw their samples from the target population using general qualitative sampling methods depending on its complexity and size, and whether or not every selected case in it is willing to participate in the study (Asiamah et al., 2017). Sampling is the process of selecting a subset from the target population (Onwuegbuzie & Collins, 2007). Sampling is an essential ingredient for any research process because it legitimises interpretations of the research findings regardless of how good the research questions were and how the data was collected (Onwuegbuzie & Collins, 2017). Available sampling methods include purposive, snowball, convenience and so forth (Saunders et al., 2015). The interpretive case study mainly relies on purposeful sampling rather than random sampling (Reksoatmodjo et al., 2012). Therefore, this study adopted a purposive sampling method because it is mainly used in qualitative research in identifying and selecting the information-rich cases (Etikan et al., 2016). Other sampling methods were not selected for reasons that they are either not common in interpretive qualitative case studies or lack credibility; for example, convenience sampling (Onwuegbuzie & Collins, 2007).

In the purposive sampling method, the researcher makes a deliberate choice of cases due to the qualities the cases possess (Etikan et al., 2016). The researcher has made it clear in the target population section above that only enterprise that is using AP in EA will qualify for

selection. In addition, the purposive sampling method allows the researcher to decide on what needs to be known (Etikan et al., 2016), in this case, how enterprises can apply AP in EA. The researcher then sets out to find people who are willing to provide the information by virtue of knowledge or experience (Etikan et al., 2016). Within the purposive sampling method, they are multiple sampling strategies including heterogeneous, homogeneous, total populations and others (Etikan et al., 2016). To achieve a greater understanding of how to apply AP in EA, this study adopted the heterogeneous purposive sampling. Heterogeneous purposive sampling is appropriate if the sample pool is small (Etikan et al., 2016). Gentles et al. (2015) regarding the sample size estimate, suggest that multiple case studies should be between four and ten cases. Initially, during study design, the study aimed for four cases of sample size. However, this was not possible. It was very difficult for the researcher to get four cases. As a result the study was made up of only two cases. The number of units of data sources to be obtained within each case suggested by Gentles et al. (2015) were impractical for the researcher considering the cross-sectional time of the study. Given the cross-sectional design, which involves collecting data at a single point in time, the extensive data collection requirements recommended by Gentles et al. (2015) would have posed considerable difficulties and may not have been feasible within the study's time constraints. The study collected six interviews and eleven secondary data sources from the two cases, resulting in a total of seventeen data points. Table 1 provides a list of secondary data sources, and Table 2 shows a list of research participants and their roles, identified by non-identifiable codes used for analysis reference.

It has been acknowledged that qualitative studies are difficult to generalise and are characterised by external validity drawbacks (Diaz Andrade, 2009). To minimise these difficulties and drawbacks within each case in the target population, Asiamah et al. (2017) suggest the researcher to focus on participants who can best share experiences and thoughts to address the qualitative research goal. Canat et al. (2018) went further and suggest that research participants should come from different positions and from different departments within the case. These different departments are what Lankhorst (2017) referred to as any subset of a conception of the universe that is conceived of as being some 'aspect' or 'part' of the universe, in the case of this study the enterprise in the target population. For this reason,

Table 1. Secondary data sources

	SECONDARY DATA CODE	CASE	DESCRIPTION
1	C1D1	CASE 1	Business Continuity Roadmap
2	C1D2	CASE 1	Network Roadmap
3	C1D3	CASE 1	Security Roadmap
4	C1D4	CASE 1	[Hidden product name] Roadmap
5	C1D5	CASE 1	Platform Roadmap Areas – Technology Group
6	C1D6	CASE 1	Product Roadmap - Platform
7	C1D7	CASE 1	[Hidden Client Name] Project Kick-off Document
8	C2D1	CASE 2	[Hidden Product Name] Capability Matrix
9	C2D2	CASE 2	[Hidden Client Name] Application Portfolio Architecture
10	C2D3	CASE 2	[Hidden Product Name] Architecture
11	C2D4	CASE 2	[Hidden Client Name] Enterprise Architecture

Table 2. List of participants

	PARTICIPANT NON-IDENTIFIABLE CODE	CASE	PARTICIPANT ROLE
1	C1P1	CASE 1	Head of Consulting
2	C1P2	CASE 1	Chief Technology Officer
3	C2P1	CASE 2	Solution Architect
4	C2P2	CASE 2	Solution Architect
5	C2P3	CASE 2	Technical Architect
6	C2P4	CASE 2	Principal Consultant

in the initial study design, the researcher aimed at interviewing chief information officers, departmental directors, product owners, solutions architects, developers, agile team leaders, enterprise architects and SCRUM masters employed with enterprises in the target population. However, because of the difficulties encountered by the researcher in obtaining more than

two cases, the following are the roles of the participants interviewed: Head of Consulting, Chief Technology Officer, Solution Architect, Technical Architect and Principal Consultant.

3.11 Financial services industry (FSI) as the empirical context

The General System Theory stated in sub-section 2.2.2 of chapter 2 implies that the researcher lives in a world composed of nested hierarchical layers where each layer is a system on its own (Syynimaa, 2017). This world has many industries, such as manufacturing, education, entertainment, utilities, retail, financial services, healthcare, government and others (Carr & Else, 2018). The researcher is employed in the FSI at a specific organisation within a specific department and has a view of specific stakeholders of this industry, organisation and department. The FSI has been described as the most complex system with unique characteristics such as its complex regulatory environment, digital transformation efforts and dynamic nature (Van Wyk, 2019). The FSI comprises financial institutions that intermediate households, businesses, and governments' financial decisions and transactions (Van Wyk, 2019). These transactions include providing financial products and services, such as offering investments, lending, risk management services, wealth management and others (Ndoro et al., 2020). This made the FSI setting appropriate for the researcher to acquire knowledge on applying AP in EA and develop an understanding of the EA practice in a context that is practically relevant and applicable to the researcher. The researcher was also motivated by a recent state of affairs survey on EA, which indicated a significant and strong relationship between the FSI and the EA community (Carr & Else, 2018). From the researcher's point of view, this is a benefit to him and his social world. The researcher believes that this study context helps in creating an experienced, qualified and practising academic who knows EA and can guide information systems research efforts, which are essential in any modern nation (including African countries) as the role of information systems in society and commerce continues to grow significantly in South Africa where many marginalised people are excluded in the globalised FSI (Ndoro et al., 2020).

3.12 Access and ethics

In the practice of EA, ethics corresponds to the choices that an architect makes and believes are right when deciding on how to describe different stakeholders' perceived realities

(Wegmann, 2003). These choices, whether moral or not can be risk and the architect should be able to see this ahead of time and put in place appropriate mitigations (An Association for All IT Architects, 2021). This is applicable to any fieldwork within the interpretivist paradigm, where researchers need to gain and maintain good access to appropriate organisations that are part of the selected sample (Walsham, 1995). For the purpose of this study, the researcher obtained an organisation permission from each organisation that was willing to participate in the research (Walsham, 1995). An email was sent to each potential organisation, and an example of the contents of the email are in Appendix B.

It is believed that within interpretive research, research participants' privacy and autonomy can be compromised, especially when using the interview research method (Paradice et al., 2018; Scotland, 2012). The open-endedness nature of interview research method may facilitate the unintentional discovery of lies, secrets and oppressive structures (Scotland, 2012). Therefore, it is vital for the researcher to be ethically responsible (Paradice et al., 2018). For example, ensuring that research participants are not vulnerable to researchers' subjective interpretations and guarantee the protection of research participants real identities as well making right decisions on which information derived from the interview should be made public (Scotland, 2012). To protect research participants identities and their respective organisations, the researcher was guided by the University ethical, confidential information and data management policies. The first participating organisation in this study is referred to as C1, while the other organisation is referred to as C2. Here, "C" represents the term "case" Participants are designated as CXPY, where X denotes the case number, and Y represents the participant number. Secondary data sources are designated as CXDY, where X denotes the case number, Y represents the document number, and D represents the document data source type. Ethics approval was obtained from the University prior to data collection. Research participants and enterprises participating in the study are referred to with non-identifiable codes. All the data produced from the research activities was stored to the Microsoft OneDrive cloud services for protection and disaster recovery. The interviews were conducted via Microsoft Teams and participants were asked for permission to record the meetings at the beginning of the meeting.

3.13 Data Analysis

All case study approaches share one most crucial feature, that is, data generation (Haverland & Blatter, 2012). Data generation is the first step to do data analysis from case study research collected data (Haverland & Blatter, 2012). The interview recordings captured from the interview research method were transformed into data by transcribing the interview recordings into text. This final text and secondary data represents a social world constructed from the interactions between the researcher, participating organisations and individuals from these organisations (Diaz Andrade, 2009).

The next step was the actual data analysis. The study made use of the inductive thematic analysis method to find meaning and draw interpretations from the interviews' and secondary collected data. Inductive thematic analysis has been described as a method that reports on themes within a data set after a thorough identification, analysis and organisation of qualitative research collected data (Nowell et al., 2017). However, because qualitative studies are difficult to generalise (Diaz Andrade, 2009), the study adopted a customised method of within-case patterns and cross-case patterns to compare the emerging constructs and relationships among participating organisations. The end goal was to discover emerging themes on how AP can be used in EA, thereby ultimately producing a theoretical framework (Diaz Andrade, 2009). The study followed the six-phased thematic analysis approach, as described by Nowel et al. (2017). The steps are detailed from sub-sections 3.13.1 to 3.13.6 of this section 3.13. The NVivo software required for analysis of the data was provided by the University, and it is familiar to the researcher from his past experiences.

3.13.1 *Familiarisation with data*

The first step in thematic analysis is to become familiar with the data (Nowel et al., 2017). The researcher achieved this by watching and listening to the Microsoft Teams video recordings, reading and re-reading the final text and documents several times. This step aimed to understand the participants' experiences and perspectives and identify potential themes that emerged from the data. For the transcription of the video recordings of the research interviews, the researcher used the Google YouTube transcription service. The researcher's decision to use Google YouTube was justified by his experience and the numerous advantages of this service. First, the accurate automation of the transcription

process saved time and resources, allowing the researcher to spend more time on data analysis and interpretation. In addition, the search function of the synchronised transcripts facilitated the efficient retrieval of specific information during the analysis phase, where the researcher could replay a specific section of the recording to gain further understanding of the data. The final text was then loaded into NVivo as the source file for each case, along with the secondary data provided. Appendix C shows an example of the transcription service in action, and Figure 7 shows an example of the final text and examples of secondary data files loaded into NVivo from C1.

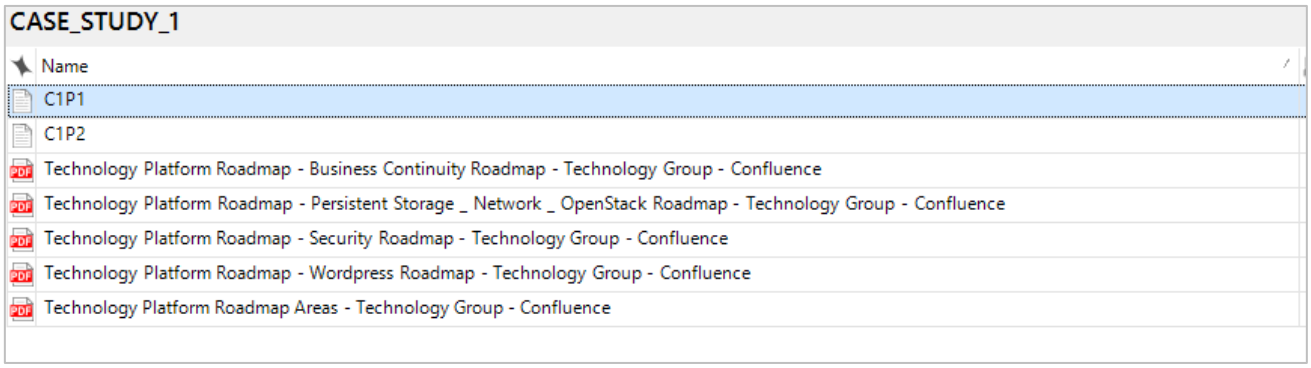


Figure 7. Case Study 1 source file examples

3.13.2 *Generating initial codes*

In this step, the researcher iteratively generates initial codes by systematically examining the data to identify and label meaningful units of information or patterns (Nowel et al., 2017). For the researcher, this process formed the basis for subsequent phases in which these initial codes were further analysed, grouped into themes and interpreted to gain insights and answer research questions. Nowel et al. (2017) suggest developing a coding scheme or using an existing scheme. A coding scheme consists of predetermined categories or concepts used to structure the analysis (Nowel et al., 2017). In this study, the researcher used the research questions as a guide for coding. Figure 8 shows the initial codes generated at this stage in NVivo.

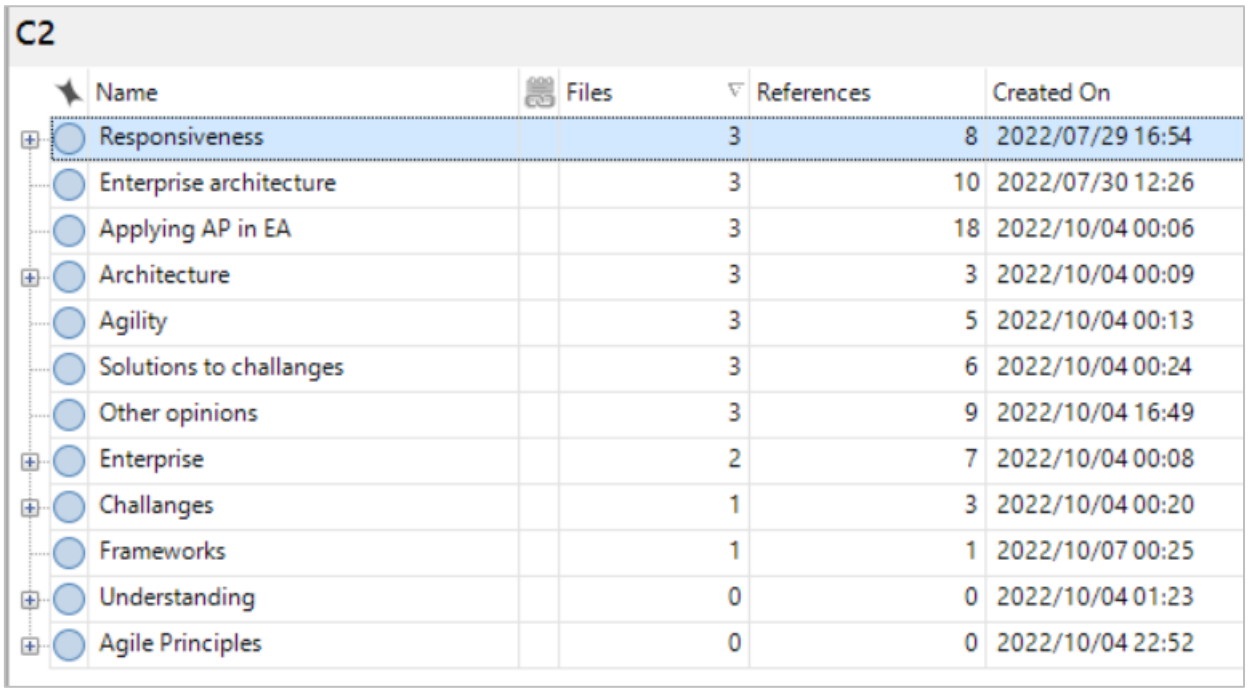


Figure 8. The generated initial code step output

3.13.3 *Searching for themes*

This step helped the researcher look for patterns, connections, and code relationships (Nowel et al., 2017). In this case, the themes represented generalised concepts that emerged from the data consistent with the research questions and reflected the essential aspects of the data (Nowel et al., 2017).

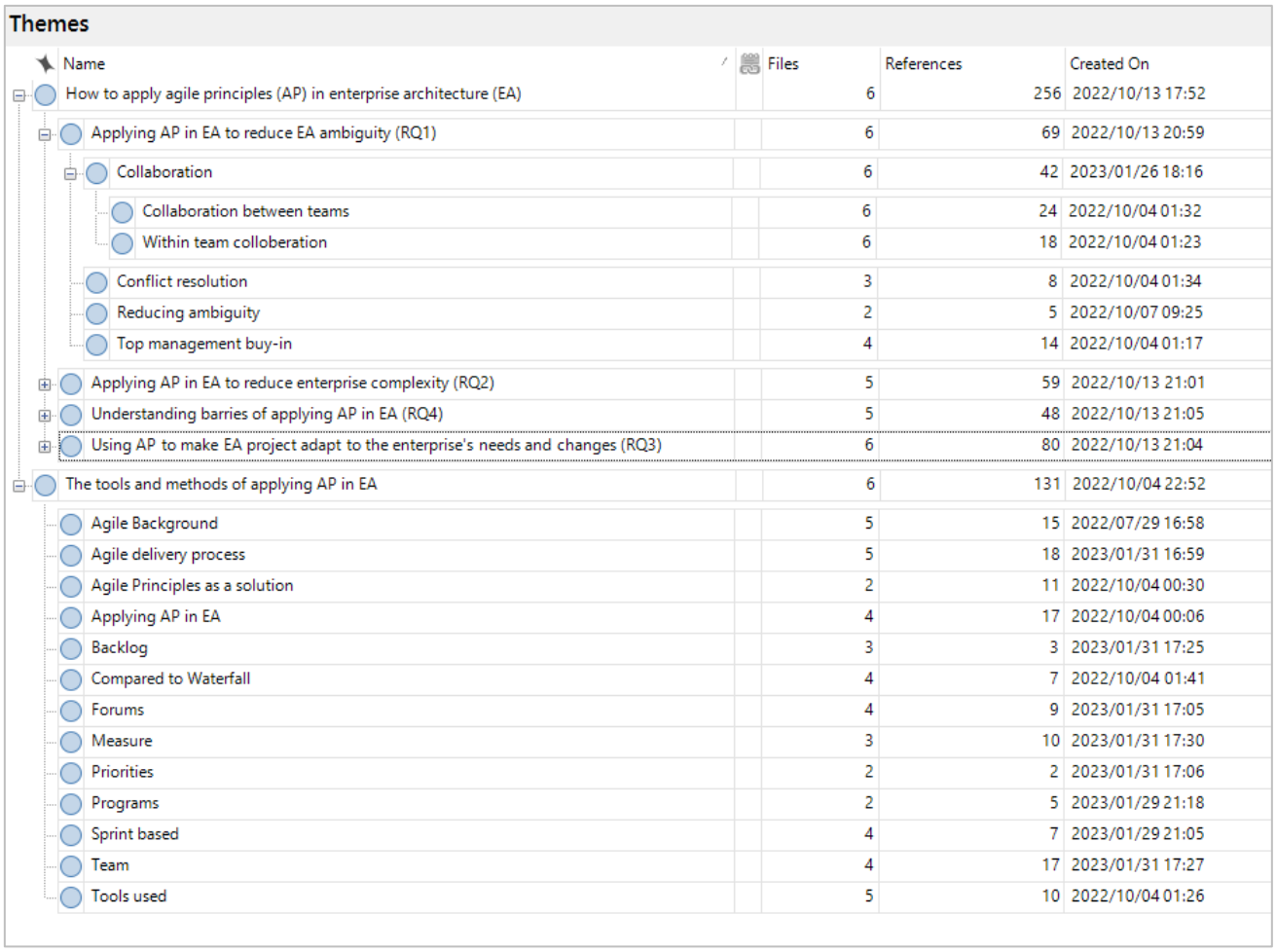
3.13.4 *Reviewing themes*

During this step, the researcher iteratively refined and revised the themes as necessary. The refinement process involved combining, splitting, or renaming the themes to establish a solid foundation for analysis (Nowel et al., 2017).

3.13.5 *Defining and naming themes*

This step aimed to ensure that the themes selected aligned with the research objectives and provided a clear definition of the underlying concepts that would contribute to formulating a sound theoretical framework (Nowel et al., 2017). Sub-themes were created to show

variations within the same concepts where necessary. Figure 9 shows an example of the themes defined for the final analysis stage of the study. These were later revised, and the final themes are listed in Appendix D.



Themes

Name	Files	References	Created On
How to apply agile principles (AP) in enterprise architecture (EA)	6	256	2022/10/13 17:52
Applying AP in EA to reduce EA ambiguity (RQ1)	6	69	2022/10/13 20:59
Collaboration	6	42	2023/01/26 18:16
Collaboration between teams	6	24	2022/10/04 01:32
Within team colloberation	6	18	2022/10/04 01:23
Conflict resolution	3	8	2022/10/04 01:34
Reducing ambiguity	2	5	2022/10/07 09:25
Top management buy-in	4	14	2022/10/04 01:17
Applying AP in EA to reduce enterprise complexity (RQ2)	5	59	2022/10/13 21:01
Understanding barries of applying AP in EA (RQ4)	5	48	2022/10/13 21:05
Using AP to make EA project adapt to the enterprise's needs and changes (RQ3)	6	80	2022/10/13 21:04
The tools and methods of applying AP in EA	6	131	2022/10/04 22:52
Agile Background	5	15	2022/07/29 16:58
Agile delivery process	5	18	2023/01/31 16:59
Agile Principles as a solution	2	11	2022/10/04 00:30
Applying AP in EA	4	17	2022/10/04 00:06
Backlog	3	3	2023/01/31 17:25
Compared to Waterfall	4	7	2022/10/04 01:41
Forums	4	9	2023/01/31 17:05
Measure	3	10	2023/01/31 17:30
Priorities	2	2	2023/01/31 17:06
Programs	2	5	2023/01/29 21:18
Sprint based	4	7	2023/01/29 21:05
Team	4	17	2023/01/31 17:27
Tools used	5	10	2022/10/04 01:26

Figure 9. Final themes.

3.13.6 *Producing the report*

Nowel et al. (2017) suggested that the final themes should be analysed sufficiently, supported by dense descriptions of the context and participants and extracts of relevant quotations supporting each theme. Each final theme named in the report should be viewed as a concept, an empirical generalisation found by grouping several instances of the extracts and researchers interpretations (Maher et al., 2018; Saldaña, 2021). In most instances, these final themes are richer sentences starting with verbs that ends with -ing using a technique called gerund coding (Maher et al., 2018; Saldaña, 2021). The use of this technique was motivated

by the context of the study, enabling the researcher to capture and categorise an array of actions and processes that emerged from the data, providing an understanding of the dynamic nature of modern enterprises. The examples of these extracts are presented in Appendix D. The researcher's aim in this step was to present and report the findings accurately and coherently, ensuring that they were linked to the literature review, the research questions and the methodological choice. The interpretations made by the researcher at this stage contribute to the generation of new knowledge (Nowell et al., 2017). Chapter 4 provides a detailed discussion of the research findings and analysis, including how the findings are presented in section 4.2.

4 RESEARCH FINDINGS, ANALYSIS AND DISCUSSION

The literature review in chapter 2 suggested the need to apply AP in EA and raised the main research question on how to apply AP in EA. Chapter 3 then defended the researcher's methodology employed to answer this main research question. This chapter presents, analyses, and discusses research findings in alignment with the reviewed literature and the chosen research methodology. This chapter is structured as follows. Section 4.1 provides specific descriptions of each case and presents a generalised discussion of all the studied cases. Section 4.2 details how the results are communicated and presented to the reader. Emerged study themes as answers to the sub-research questions one to four are then discussed from Section 4.3 to Section 4.7. Section 4.8 provides a summary of the findings. Section 4.9 then concludes the chapter by outlining the challenges and limitations of the study.

4.1 Case descriptions

Literature has noted that different organisations understand EA differently (Canat et al., 2018). In order to gather these multiple perspectives, the research participants came from different positions and from different departments within each case (Gong & Janssen, 2019). The selected organisations have business operations across the globe in different geographical regions. This section provides specific descriptions of each case studied. Table 3 represents the countries of operation, industries, and positions of the interviewed participants for each respective case organisation.

Table 3. Case country, industry and data source summary.

CASE	COUNTRY OF OPERATION	INDUSTRY	NUMBER OF DATA SOURCES	ARCHITECTURE DESCRIPTIONS PROVIDED? YES / NO
C1	United States of America, United Kingdom, Luxembourg and South Africa	Financial Services	9	Yes
C2	United Kingdom, South Africa, Australia, India, New Zealand and Poland	Financial Services	7	Yes

4.1.1 *Case 1 (C1)*

Case 1 (C1) is a financial technology company founded in 2002, providing a cloud-based platform to the world's largest and leading financial brands. C1 has more than two hundred permanent employees executing their day-to-day business activities in different countries: the United States of America, the United Kingdom, Luxembourg and South Africa.

In order to understand the complexity nature of C1 as a complex system, as highlighted in literature that an enterprise is a complex system (Nurmi et al., 2019), a participant from C2 was asked to provide how many departments are within their company, C1P2 answered, "*So the departments are product engineering, which does the engineering involved with product enhancements and product features and new products that we want to develop. We have automation which takes care of the automated deploy of software and infrastructure. We have the infrastructure department which is worried about the networking. There is QA, then for onboarding or implementation we have QA associated with that. We have a security department that is worried about our security response and our policies and procedures around security ISO 27001 falls underneath that okay and we have of course corporate IT. All those departments that I just mentioned all fall under me. Under operations, there is a design department which handles you know the design and user interface for specific client requirements. Project management which manages the product and there's the you know the*

financial you know what they call admin department so that's you know finance, talent acquisition, human resources, business operations but that's where support falls under that".

The above explanation is aligned with the view taken by this study that modern enterprises are CASs. The departments stated by C1P2 seem to refer to the heterogeneous agents that interact with each other in a dynamic, complex environment (Onik et al., 2017). These departments can also be seen as SoS within a much bigger system, the enterprise itself, as highlighted in the literature (Nurmi et al., 2019). Figure 10 summarises the structure of C1 as an enterprise as explained by C1P2.

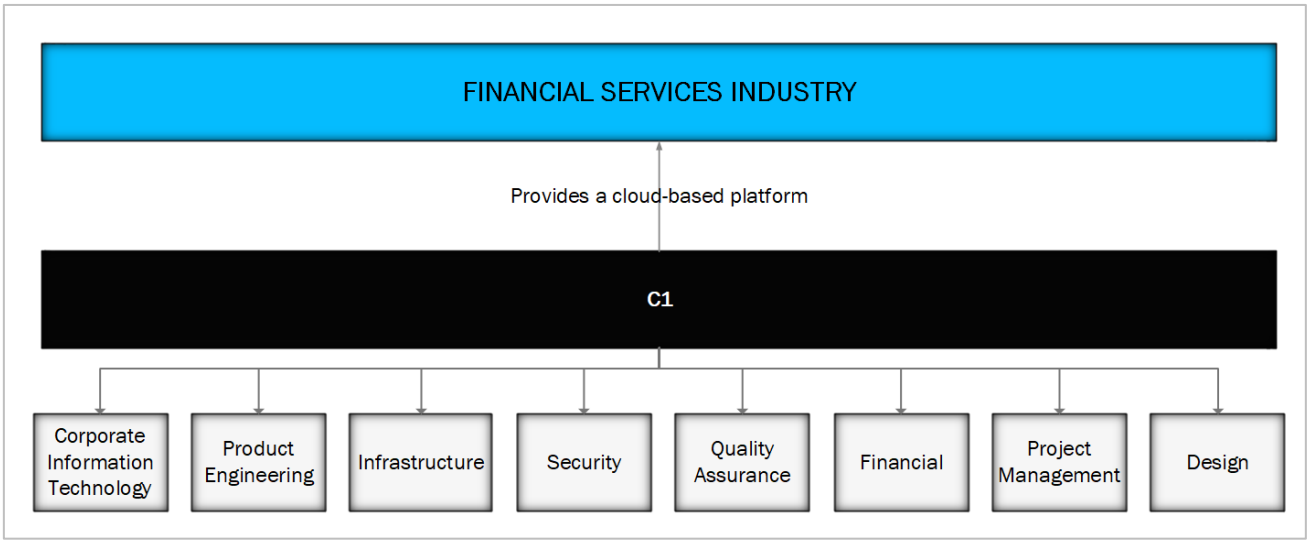


Figure 10. C1 structure.

4.1.2 *Case 2 (C2)*

Case 2 (C2) is a provider of financial technology services. The company develops and markets superannuation pensions, life insurance, transfer agency, digital solutions, investment, private wealth and portfolio administration and financial messaging software applications. C2 is a result of acquisitions of small companies. C2P2 partially explained this, "*my understanding is that C2 actually originated from an acquisition that was made of an existing company and that came with some platforms that is still in use today by some of our customers*". C2 has more than five thousand employees working in six different countries: United Kingdom, South Africa, Australia, India, New Zealand and Poland. Although the company does not have a specific organisation of EA, it contains a specific practice of solution

architecture, which can be seen as a subdivision of EA. In addition, in the hierarchy of positions in the organisation chart provided by C2, the researcher spotted the title “Head of Architecture”. However, the title does not indicate the breadth of the architecture this person is responsible for, whether enterprise, solution or software.

In terms of structure and industry, C2 resembles similarities with C1. C2P2 gave his explanation of C2, *“Industry it sort of resides or sells its services to is primarily in the wealth management and asset management sectors, and in terms of departments within C2 we’ve got the normal sort of HR, finance, risk management and information security departments. But then in terms of the ones that we interact with primarily when we do projects and implementations for our clients are the professional services team that we’re part of and then the engineering side of the company that consists of a the actual development SCRUM teams in different regionals different regions throughout the world, as well as the solution design team that forms part of the big engineering group to make sure that changes to our platforms and solutions we implement this as per our strategy and make sure that the impact is understood for any changes that we do to the platforms*”. Figure 11 summarises this explanation by C2P2. From C2P2 explanation, it is evident that the mission and strategy of the enterprise unites these departments and teams (heterogeneous agents of the CAS) mentioned. C2P3 used the words “*product vision*” when sharing a similar perspective,

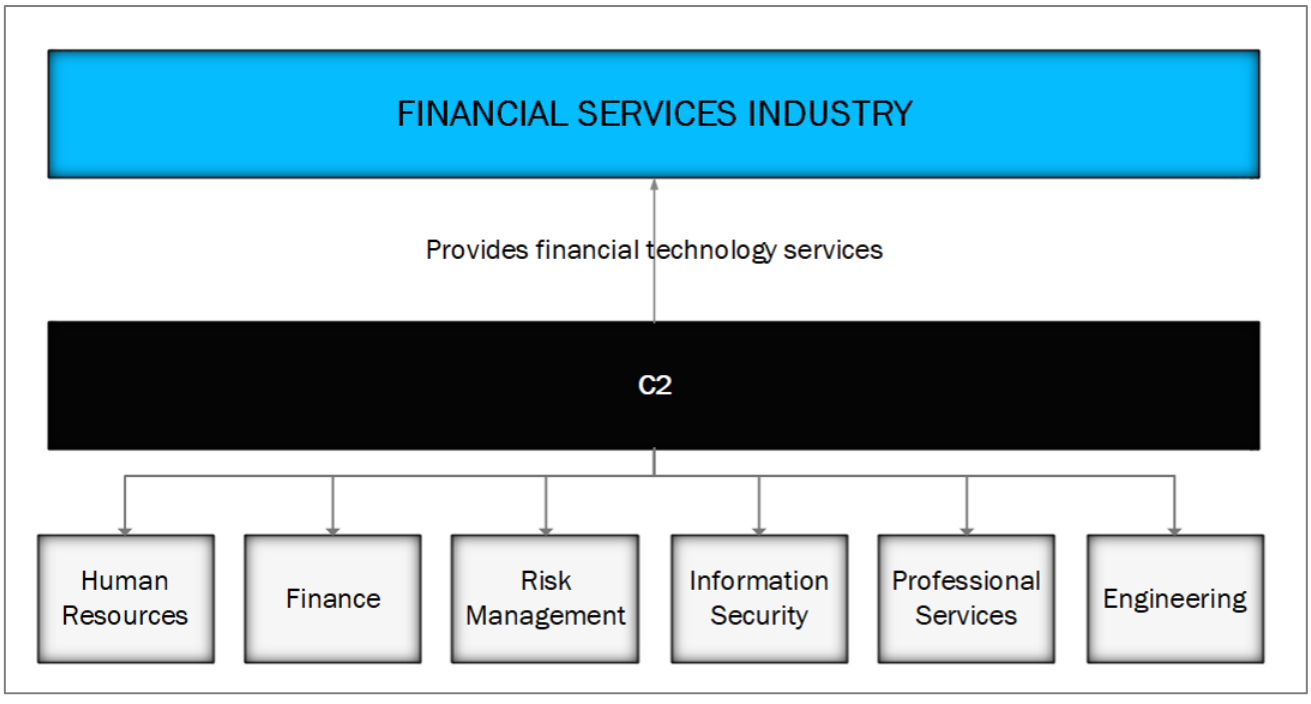


Figure 11. C2 structure.

"*the guardrails come down from the architects but the guardrails also come down from the product vision so the people know the boundaries in which they're operating in*". This has been the theme in literature that there is a connection between enterprise strategy and portfolio IT projects (Gellweiler, 2020). From this perspective, EA is seen as an enablement process facilitating this linkage and AP as the mechanism that transforms this into reality (Gill, 2015). Following in section 4.1.3 is the general discussion of both C1 and C2 on the view of AP and EA.

4.1.3 *Understanding of Agile Enterprise Architecture in cases*

The literature review pointed out that many organisations are reporting they are practising a form of agile, and agile is a new way of working (Duijs et al., 2016). This is the same view all participants shared at C1 and C2. All the participants had more than 20 years of business experience, possessed some form of postgraduate qualifications, and interacted with different stakeholders within and outside the enterprises in their current or previous roles. The respondents' views tend to be shaped by either training received or their past experiences. For example, C2P2 said, "*C2 is trying to get people to get familiar and trained up on SAFe for example, understanding agile project management on an agile methodology and the principles that guides that*" and C2P4 mentioned that "*both companies that I have worked for both XYZ and C2 have at times tried to run projects using agile with varying success*." While at C1, C1P1 confirmed the same, "*I know a lot (about AP), my entire career has been based around agile project delivery rather than waterfall … and I am both a certified project manager in Prince2 and I am a certified SCRUM master*". However, literature cautioned and questioned the applicability of AP in EA (Santos & Blosch, 2018; Thummadi et al., 2017). C1P2 at C1 tend to side with this view and cautioned the researcher, "*well your particular topic is using agile methodology in EA right so I think you need to be a little bit more specific right because there's the design and engineering process and then there's the actual implementation of the software right*".

The view of EA is different in both cases, even within the same case, to the extent of even getting multiple explanations from a single participant, confirming what was stated in the literature that there is no EA shared meaning (Gong & Janssen, 2019). For example, a single participant from C2, when asked his understanding of EA, C2P4, provided two perspectives and said, "*for me I guess EA does differ and it differs in terms of the companies, that you're*

working for. So, I think there is a very different view of enterprise architecture if I was talking about being a provider of stuff to clients like , like C2. So, we're providing software and everything else compared to a consumer that is actually selling stuff to more consumers like a YYY bank or like CCC or TTT so from a perspective of C2 I think EA is very much about aligning our products to what our clients want from an enterprise tool. *So that it's a slightly different take on it so it's less about defining the architecture of an organisation but actually more understanding how we fit with inside an enterprise architecture and so for somebody like YYY or TTT it's about how to define and set up the systems to provide operational teams and sales teams and anybody that's interacting with customers primarily a mechanism to provide that functionality considering technology making sure it's all up and consistent etc etc"*. At C1, C1P1 pointed exactly what the literature indicated, and said, "*my fundamental belief is that very few people agree on what EA is therefore what I describe EA to you as right now and what I believe it to be, someone else is going to describe it as something else that's just our responsiveness that's just our ... they'll have a totally different word for it*".

4.2 Presentation of findings

This section details how study findings are presented based on the themes arising from the collected data analysis. Each question that emerged from the literature contains a corresponding section explaining the findings. In total, there are five sections, beginning with methods and tools of AP in EA in section 4.3, which presents the essence of and generalisations regarding the application of AP in the context of EA. The method and tools section is followed up by applying AP in EA to reduce enterprise ambiguity in section 4.4, which answered sub-research question RQ1. The findings and discussions to sub-research question RQ2 are presented in section 4.5, applying AP in EA to reduce enterprise complexity. Section 4.6 presents findings to research sub-question RQ3, which seeks to explain how AP can make an EA project adapt to the enterprise's needs and changes. The last research sub-question, RQ4, is discussed and presented in section 4.7, barriers of AP in EA. A generalised discussion of the study is then presented in section 4.8, a summary of findings. Challenges and limitations of the study, then conclude the research findings, analysis and discussion chapter in section 4.9. Figure 12 shows the NVivo categories discussed in this chapter.

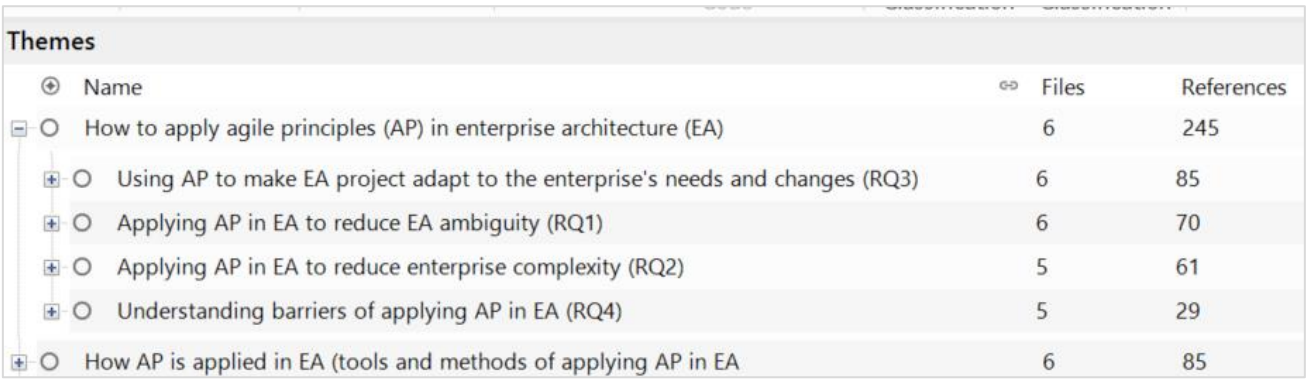


Figure 12. Research Questions Answers in NVivo.

Each section of the findings is divided into sub-sections representing the main themes (as gerunds) of the study. A summary of the findings is provided in each section as a table and a diagram. The table contains six columns. The theme column states the theme that emerged from the study, and the files column specifies the number of interviews containing the theme. The references column refers to the number of times a theme was coded in the interviews. The counts in the 'Files' and 'References' columns do not include secondary data, as the majority of the secondary data provided was in the form of diagrams. In cases where secondary data was presented in textual form, it often contained sensitive information and was, therefore, was not quoted. However, when necessary, reference is made to the relevant secondary data in the analysis. The related literature column lists the referenced literature supporting the themes that emerged from the data. Columns C1 and C2 indicate whether the theme was mentioned in the respective case. The use of diagrams was motivated by the researcher's epistemological and ontological assumptions that are important in understanding the relationship between reality and these diagrams and valuable in providing a set of concepts and inter-relations necessary when describing concepts (Wegmann, 2003). By using visual representations, such as diagrams, the researcher aims to ensure that these epistemological and ontological aspects are conveyed clearly and easily, bridging the gap between the complexity of these assumptions and the reader's understanding and facilitating a straightforward, easy understanding of the research results.

4.3 How AP is applied in EA

The literature highlighted that AP are the new way of working for modern enterprises (Duijs et al., 2016). Further, the literature considered EA to be a complex project that cannot be

done all at once but requires continuous updating at different periods based on the enterprise's needs and changes (Banaeianjahromi & Smolander, 2019). This section seeks to explain how AP is applied in EA continuously. The list of themes analysed in this sub-section 4.3 is presented in Table 4. Figure 13 visually depicts the relationships between the themes of this section.

Table 4. How AP is applied in EA findings summary.

Themes	Files	References	C1	C2	Related Literature
How AP is applied in EA (tools and methods of applying AP in EA)	***6***	***85***			
Implementing agile delivery processes	6	37	X	X	Beaumont et al., 2017; Ciric et al., 2018; Hobbs & Petit, 2017
Building high-performing teams	4	17	X	X	Lankhorst, 2017; The Open Group, 2018; Werewka & Spiechowicz, 2017
Measuring agile delivery performance	3	11		X	Ciric et al., 2018; Lapalme et al., 2016; Schilling, 2018
Engaging in forums discussions	4	10	X	X	Lankhorst, 2017
Leveraging tools in agile delivery processes	5	10	X	X	Hummel et al., 2016; Lankhorst, 2017; Syynimaa, 2017

4.3.1 *Implementing agile delivery processes*

The literature has associated the term agile with concepts of project management methodologies and practices (Beaumont et al., 2017). Other scholars have even compared agile with waterfall (Hobbs & Petit, 2017). In both cases, the view from the literature is that there is a process being executed to produce an outcome that enables the enterprise to embrace and respond to an experienced inevitable change. To understand this process, enterprise C1 provided an example in the form of secondary data. Figure 14 shows this process extracted from C1D7. The idea of viewing agile as a process has been echoed by the majority of the participants, although not explicitly using the word 'process' in some cases. For example, C2P2 mentioned that it "*needs to be something that we practice continuously*". C2P3 expanded on this, "*in terms of processes, we are trying to be process light, and so we*

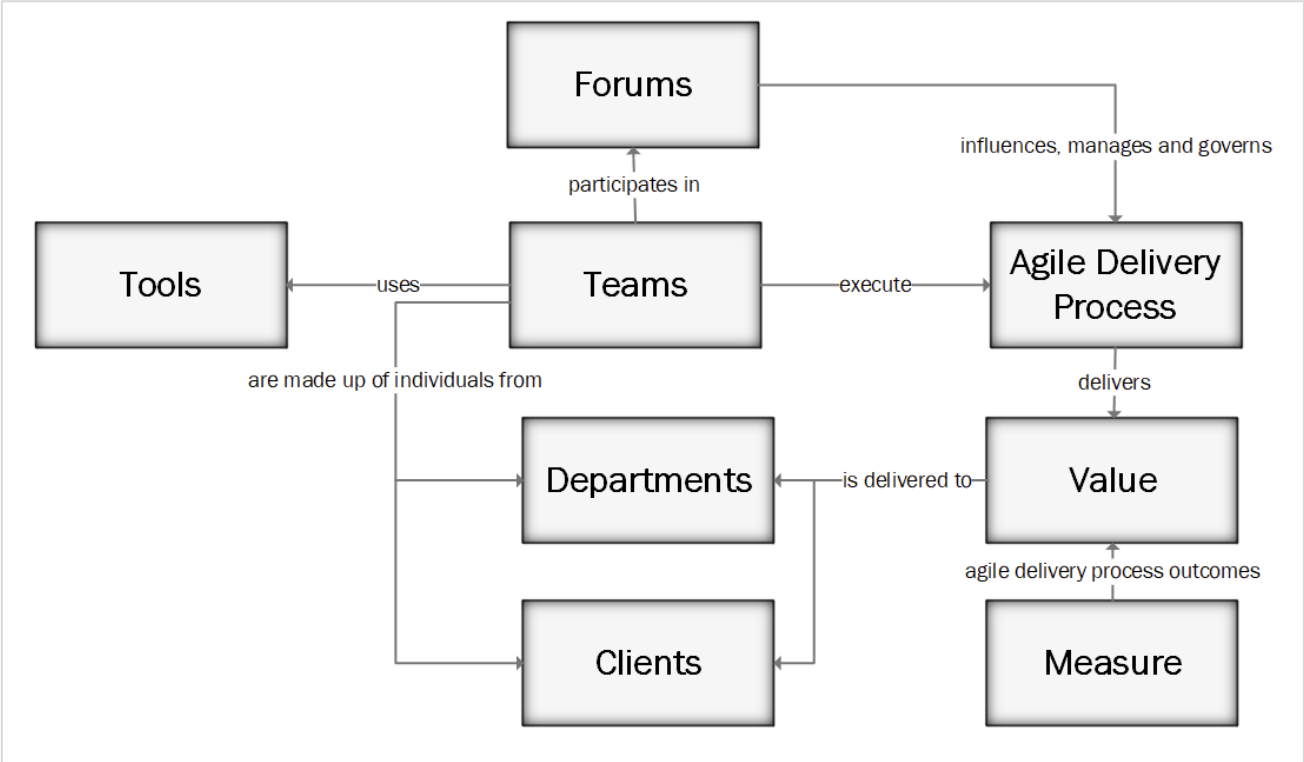


Figure 13. How is AP applied in EA?

have adopted aspects of the SAFe…so you are effectively aggregating up the output of your sprints so that you can deliver working software and business value at the end of that program". This view of delivering working software and business value stated by C2P3 is aligned with the delivery process used at C1, as shown in Figure 14 retrieved from C1D7, where there is a release after every iteration and the final go-live of the project.

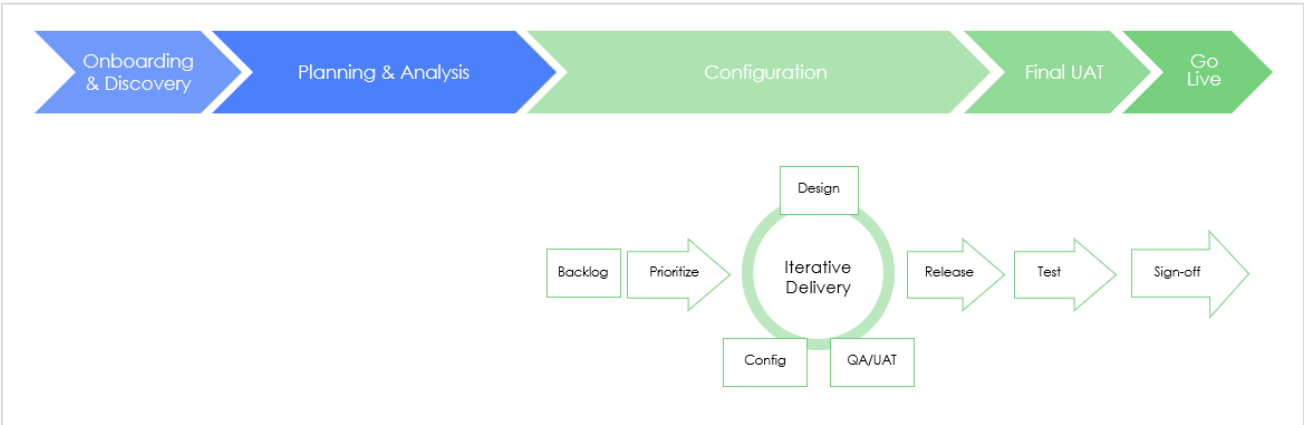


Figure 14. Example of the agile delivery process from C1 extracted from secondary data C1D7.

This is in agreement with the literature, which has stated that AP promises to deliver rapid and reliable business value desired by business leaders by engaging customers and continuously learning and adapting to their changing needs and environments iteratively (Ciric et al., 2018).

Comparison between agile and waterfall has also been a highlight among participants. C2P2 aligned with literature in comparing this agile process with the waterfall traditional method and said, "*Even if we build software and services for our customers, have a bit more regular checkpoint and see okay are we actually on the right track which is contradictory to traditional approaches like waterfall where it is we spend months and months documenting requirements doing architecture and doing designs and then go back to the customer and they say, but this is completely wrong this is not what we wanted.*" From within the same case, at C2, C2P4 echoed the same sentiment to C2P2 and said, "*I say that having worked on waterfall projects where a team has gone away, locked themselves in a dark room for three months or six months and come out and what they have then delivered is completely missed the mark and not appropriate*". At C1 said, "*my entire career has been based around agile project delivery rather than waterfall*". This comparison, even though not asked about it specifically by the researcher, it seems to be motivated by many AP advantages stated in the literature. C1P1 summarised this motivation, "*being able to be adaptive to changing needs accepting a level of change into the process because we know that no matter what we deliver it is never going to perfectly service the need when people actually start to click on it, or they see it for the first time in its final form so all of those principles are baked into everything we do really we have got a very strong agile focus*".

The literature has attributed AP successes to software engineering (Sweetman & Conboy, 2018). Participants tend to side with this view, although mainly attempting to distinguish what appear to be types of agile delivery processes. For example, at C1, C1P2 said, "*There is the design and engineering process, and then there is the actual implementation of the software right, so typically agile methodology applies to the implementation of software*". At C2, C2P1 refers to this implementation of software as a mechanical process, "*what I mean by that there is a difference between doing agile which could be called agile project management so in other words what people mean by that typically is iterative short cycles, feedback cycles and releases and development right which is a mechanical process okay*". From the researcher's point of view, the participants are thinking in terms of systems and breaking down the EA

project into stages or steps, as visualised in Figure 14. For example, as expressed by C2P1, "*I can point you to it, okay, so there were lots of workshops to unpack the business requirements and the solution as in so far as [hidden company product name].* From the secondary data provided by C1, this process of unpacking the business requirements and solution is the instance of a type of stage in the whole agile delivery process. The other sub-themes that emerged from the data related to this concept of the agile delivery process include sprint-based, programs, backlog and priorities. The relationships between these sub-themes are illustrated in Figure 15, with a summary provided in Table 5. These are discussed in the following sub-sections:

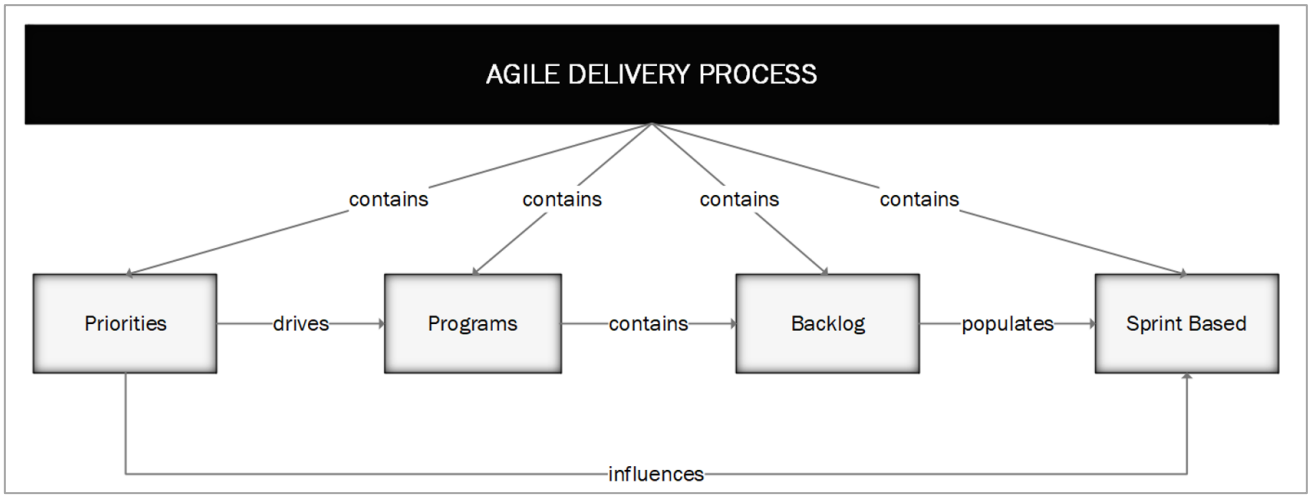


Figure 15. Agile delivery process components.

Table 5. Agile delivery process findings summary.

Themes	Files	References	C1	C2	Related Literature
Implementing agile delivery processes					
• Using sprint-based planning and execution	4	7	X	X	Ciric et al., 2018; Kaddoumi & Watfa, 2016; Onag, 2017
• Managing programs	5	5	X	X	Banaeianjahromi & Smolander, 2019
• Managing backlog	2	5	X	X	Gellweiler, 2020; Lapalme et al., 2016; Schilling, 2018
• Setting priorities	2	2	X	X	Gill, 2015; Hazen et al., 2017; Zafar, 2016

a. Using sprint-based planning and execution

The term “sprint” was commonly mentioned among the research participants, highlighting its significance within their experiences. It was referred to specifically in explaining the agile delivery process and its iterative nature. For example, at C1, C1P1 stated, “*Everything is very much on sprint bases, being able to be adaptive to changing needs accepting a level of change into the process*”. At C2, C2P2 aligned with this view and mentioned, “*So with the agile approach, I think the whole idea is to have at least a product out within three months with some two weekly whatever sprint. So, if that is something you can use to measure your agility on it, be very clear and quickly at the end of the current sprint…*”. In both perspectives on using the term sprint, it appears to be linked to the idea of delivering a meaningful business outcome to the client in a short period, for example, after every two weeks, as highlighted by C2P2. C2P3 summed up this when using the term sprint and expressed, “*I am thinking here, three sprints within a program increment. So, you are effectively aggregating up the output of your sprints so that you can deliver working software and business value at the end of that program increment*”. This possibly suggests why business leaders are demanding the urgent need to adopt AP in all management and business-related fields, including in EA initiatives (Onag, 2017), as the benefits AP suggested in the literature align with the participants’ views. For example, the promises to deliver rapid and reliable business value and adapt to clients’ changing needs (Ciric et al., 2018; Kaddoumi & Watfa, 2016).

b. Managing change through programs and roadmaps

This literature review suggested that modern enterprises are characterised by customers with continuously changing demands and changing compliance regulations (Lapalme et al., 2016; Schilling, 2018). From the researcher’s point of view, this implies situations that require EA to intervene to stop undesirable effects, enable the design of new systems that produce desirable results, or meet new aims geared towards adapting to environmental changes. This is supported in both literature and data. For example, it has been highlighted that EA is critical when connecting enterprise strategy and portfolio IT projects (Gellweiler, 2020). In the data, participants used different terms to explain the execution methods of the changes required. Some of the terms are roadmap and program. At C1, they provided these roadmaps to the researcher as secondary data, for example, C1D6 - Platform Roadmap, C1D5 Platform Roadmap Areas - Technology Group, C1D1 Business Continuity Roadmap and C1D3

Security Roadmap. Utilising information from the secondary dataset, roadmaps can be generalised to strategically organise key programs along the vertical axis. The timeline extends horizontally, providing a month-by-month depiction of the scheduled occurrences of these programs.

C1P1 explained in detail how these roadmaps deal with change and said, "*Okay, so the main way that this is expressed is we work in roadmaps for changes that need to happen*". C1P1 expanded on the point, referring to their systems, "*What else are they connected to? Where in the pipe do these regulations now apply? So, we would use agile to both work it out. So, we would have an agile process to analyse where we would need to make changes then the work to do it would also go into an agile delivery process that feeds up into a roadmap of work with defined timelines of when we need to get things in place*". This is the same idea shared among participants at C2 for example, C2P3 expressed this way, "*from an architecture point of view, the way we do this within the programs the sort of agile programs that we are working on just now as part of a scaled agile you aggregate your sprints into program increments".*

c. Managing change through backlogs of itemised work

The literature review noted that EA is an ongoing project that cannot be done all at once (Banaeianjahromi & Smolander, 2019). The backlog theme from the data seems to signify a collection or accumulation of unfinished or pending work or tasks that are part of a program concept. Based on the participant's explanations, this backlog appears to be itemising the physical changes required to move from problem to solution, possibly in incremental stages; hence, it is said that EA is a continuous project (Banaeianjahromi & Smolander, 2019). This is the shared view from both cases. At C1, C1P2 explained this way, "*there will be requirements, those requirements are broken down into stories, and those stories are estimated effectively.*" C1P1 specifically tied the relationship between the backlog and program concepts, although questioning the linkage at the same time and said, "*I found the technology roadmap. I found the product roadmap in there. Those are both easily seen. Those are expressions of the changes that they are going to be doing. How those then relate to individual work items down below is not readily apparent all the time.*" It is unclear from the data and literature why this linkage could not be apparent. However, the researcher assumes this is tied to the view that most of these tasks are software development related in alignment

with the literature (Tripp et al., 2018), where, for example, a developer might not conceptually fully understand the big picture or contextualise the task. At C2, all the participants used the term backlog to define this work breakdown and how this gets executed. C2P3 explained, "*But for me, you want, um, you want a client who has a well-articulated backlog, and you want agile SCRUMs who are able to pick up items out of those backlogs and deliver them when they are ready.*" Both cases, C1 and C2 primary and secondary data show that the backlog concept is important for breaking down program requirements into manageable tasks and supporting the agile delivery process.

d. Dynamic prioritisation of changes

The literature has proposed AEA as a strategic enabler to achieve agility in modern complex enterprises (Gill, 2015; Hazen et al., 2017; Zafar, 2016). Based on the researcher's interpretation of this perspective, priorities in AEA play a crucial role in strategically aligning architectural business system elements in Figure 5 with business objectives using limited human, financial, and technical resources, ensuring value-driven implementation and adaptability to change. This understanding is supported by data from both cases showing the positive impact of prioritisation on programs and backlogs aligned to the enterprise's current and future environmental needs. At C1, C1P1 explained linking the roadmap concept to priorities and said, "*We are going to make a change. So, first, there is a value-based decision-making structure, then it would go into a roadmap depending on which arm of the organisation would need to make this change. So, if it is a technology-based change it would go into the technology grouping. If it is a product change, it would go into product then it goes into its roadmap, and it gets relatively prioritised. Does this go top of the pile? Is there urgency? Then we would drop other work deprioritise it and get to work on that scoping it, getting it done, responding to changes, tested as fast as possible. That is very much how the method gets executed over and over and over again*". This was echoed at C2. C2P2 expressed this way, "*If there is a change in priority in tasks, something that was a low priority that suddenly shoots upright to the top because of certain reasons, you at least have got these um stand-ups and the tools that you can use to manage that, and I think that speaks to this sort of agile approach of being able to adopt a change*". It is evident from both cases that priorities drive the whole agile delivery process, by ensuring that tasks within the backlog or initiatives on the program roadmap can be prioritised based on their significance in addressing current market conditions and meeting customer demands. This dynamic prioritisation seem to suggest that

what is most important and adds substantial business value takes precedence, allowing for effective responsiveness to the evolving needs of the enterprise environment.

e. Summary

This sub-section 4.3.1 interpreted the agile delivery process concept that emerged in the data. This concept was further broken down into sub-concepts, namely sprint-based programs, backlog management, and priority alignment, all of which are supported by existing literature. The relationships between these sub-concepts are shown in Figure 15. Both the literature and participants from C1 and C2 aligned their perspectives and emphasised the importance of this process being continuous and adaptive, allowing for accommodating enterprise needs and changes while delivering value to clients. However, there are two notable findings from this sub-section 4.3.1 that should not be ignored. First, when participants are asked about agile, they tend to describe it by comparing it to waterfall. The researcher concludes that this comparison could be motivated by the perceived benefits of agile over waterfall. Second, both the data and literature provide no clear indication of the limited visibility of the linkage between the enterprise roadmap and backlog items. The researcher attributes this to the nature of backlog items, which are typically software development tasks. The following sub-section, 4.3.2, discusses the concept of a team.

4.3.2 *Building high-performing teams*

The researcher subjectively viewed architecture as a discipline concerned with analysing and designing systems and producing architecture descriptions (The Open Group, 2018). The literature also noted different observers of an enterprise with different concerns or interests, which the architecture descriptions seek to address (Lankhorst, 2017). From the researcher's perspective, these views imply that a team is responsible for this analysis, design and production of architecture descriptions, and a team consumes or leverages the produced architecture descriptions to understand their specific concerns. The data shed some light on these teams. For example, referring to the EA project using AP, C1P2 stated, "*my thinking there would be that you break it down into smaller parts so you form multiple agile teams that are looking at the different parts of the elephant. It's called the enterprise complexity, the elephant in this instance. So, you get different teams to analyse different parts but because they're all under an umbrella of let's say an enterprise architecture project*". These multiple

agile teams seem to be similar to what C2P3 mentioned, "*ability to code early fail fast, learn from the failure and course correct. It is something that we are currently doing, moving to microservices and moving to small autonomous teams as an organisation*".

In addition to the terms "*multiple agile teams*" and "*small autonomous teams*", other similar terms that appeared under this theme are SCRUM team, project team, client team and self-emerging team, with SCRUM team being used the most. The following extracts support this observation from the data. SCRUM Team, "*product owner goes to the SCRUM team and says we need to build something that looks a bit like this, and they build it in a couple of days*", C2P3. Project Team, "*so if you talk about the project team, it is about 10, but if you talk broader people that we interact with that you know like that are available to the project because we are solving their problem you know it quickly goes up to 20. um you know there is actuaries even*", C2P1. Client team, "*in terms of the [hidden client name], project in terms of the client team it is you know they do have an enterprise business, or you know they have a what they call a business architect and a solution architect. They have their own business analyst",* C2P1. C2P1 also specifically stated one of the AP in the Agile Manifesto (Ciric et al., 2018; Fowler & Highsmith, 2001) and said, "*the best architectures requirements and designs emerge from self-emerging teams*".

Regardless of these multiple terms attached to the word "team", it appears from literature and data that the teams are necessary to have a shared understanding of phenomena. As expressed by participant C1P2, "*They are fundamentally not ever going to be experts in those individual processes or technologies. Here, you want agile teams to be composed of a variety of views to get a quality visual outcome.*" This statement from participant C1P2 seems to suggest the view shared by literature that applying AP in EA offers different company stakeholders a clear understanding of what is going on and finds reasons why sometimes goals are not being met (Werewka & Spiechowicz, 2017). For instance, the agile iterative approach discussed in sub-section 4.3.1 when viewed from a team context, it appears to enable frequent inspections of project progress, facilitating early detection of deviations from desired outcomes. By integrating these AP into EA processes, the researcher proposes that enterprises with one shared understanding can enhance their responsiveness to changing requirements and market dynamics, thus increasing the likelihood of achieving strategic objectives.

Based on the dense case descriptions of both cases, the researcher assumes that a team comprises individuals from different departments and the client receiving services, and these teams participate in an agile delivery process. At C2, C2P1 attempted to clarify the composition or structure of the team and the role of the practice of architecture to these teams, "*Then a solution architect would review and sign off the solution. Architect was in the SCRUM team but obviously note there is a difference between available and dedicated right so if you are in a SCRUM team as a developer as a business, business analyst or within a multi-disciplinary team there are people there that are dedicated, they make up that team. There is a solution architect, architects that are available to that team right and that they would come to certain points to make sure that we are and where we could bounce out the ideas of them but ultimately it is in collaboration with architecture and in collaboration with information available*". Next, in sub-section 4.3.3 is a discussion of the tools used by these teams.

4.3.3 *Leveraging tools in agile delivery processes*

The literature expressed that AP are believed to help develop a shared understanding and the level of knowledge necessary for creating shared mental models that reduce ambiguity where it exists (Hummel et al., 2016). These mental models serve as system architecture descriptions discussed in sub-section 2.2.2 that depict the current and future states of the enterprise as observed (Lankhorst, 2017; Syynimaa, 2017). The data provided insights into the tools used by agile teams executing the agile delivery process. These tools appear to allow the modelling, analysis and communication of the enterprise's needs. Participants from both cases concur that they utilise various tools. This is an extract from C2 by C2P2, explaining the use of tools, "*If I look at their ways of working and some tools that they used to understand what were the tasks and the expected outcomes you know and who needs to do what, they make you made use of cam (Collaborative Agile Modelling) and boards. So, there are a lot of white boards which is mobile that you can push around on the open plan floor and then for each team SCRUM team it was a clear distinction between who needs to look at which tasks and at what stage each task is at a certain point in time so it is on the backlog or it is in progress or it is finished, ready for testing it's been signed off and that um was quite impressive for me*". The C1P2 at C1 expressed a similar understanding, stating that "*those requirements are broken down into stories, those stories are estimated effectively.*

To manage these tasks we use JIRA to do that". Some of the names of the tools mentioned in the data are JIRA, Boards, Wiki, Confluence and Models.

The understanding and interpretation of secondary data provided and studied literature is that these tools collectively contribute to effective project management, collaboration, documentation, and visual representation, enhancing overall efficiency and communication within a team or organisation. For example, JIRA and boards are understood to be project management and task tracking tools that helps teams plan, track and manage their work, making it particularly useful for agile delivery processes by providing a clear, real-time overview of the tasks, progress, and status of a project, making it easier for teams to collaborate and stay organised. Wikis provides a collaborative websites that allows team members to create and edit content collectively, serving as a knowledge-sharing platform where information can be easily created, modified, and organised collaboratively. Confluence is an example of a Wiki. Models, in this context of tools refer to visual representations or diagrams, used to visually represent complex concepts, systems, or data structures, aiding in understanding and communication among team members. Models are documented in Wikis and can be referenced in backlogs, programs, forum discussions and priority decisions. The C1D3 Security Roadmap, C2D3 [Hidden Product Name] Architecture, and C2D1 [Hidden Product Name] Capability Matrix, which are examples of models, were extracted from Confluence, a Wiki tool. The visual representation of models is analysed in detail in sub-section 4.5.4 of 'Using frameworks: Communicating with visualisations'.

4.3.4 *Measuring agile delivery performance*

The study acknowledges the rapid changes in the environment in which modern enterprises operate, including the continuous demands of customers, as documented in the literature (Lapalme et al., 2016; Schilling, 2018). From the researcher's point of view, this would imply the need to measure the outcomes of an enterprise in its agile delivery process to ensure that the business value desired by business leaders is indeed delivered (Ciric et al., 2018; Onag, 2017). This view is supported by the data, specifically among participants at C2. For example, C2P1 indicated that working software in the client's hands is the primary measure of the agile delivery process and stated, "*So, the working software is the primary measure of process*". This was the same view shared by C2P2, who offered a detailed explanation in the measuring of the process output, "*need to be something that we practice continuously and*

sort of have checkpoints and measures in place to say you know I'll be doing things the way we want to do it so that is in the form of retrospectives and having more regular check-ins even if we build software and services for our customers have a bit more regular checkpoint and see okay are we actually on the right track which is contradictory to traditional approaches like waterfall". However, while there is a sense of measurement, it is unclear exactly how the enterprise receiving and providing services measures success. For instance, it is unclear which key performance indicators (KPIs) are used, whether they are from financial, customer or operational perspectives.

4.3.5 *Governance and communication through forums and ceremonies*

The literature noted that different enterprise stakeholders have various concerns or interests, resulting in multiple realities and conflicting priorities from the same enterprise (Lankhorst, 2017). The data provided insights into how these various realities are shared, exchanged and managed, mainly through the utilisation of forums. C1P1, "I *would say that the fundamental EA approach to that is okay; there is an input that comes in. It goes into a stack of relative priority. There are very clear forums and discussions for how are we going to service this need and are we going to service the need or are we going to make a change?*" Based on this explanation, these forums appear to determine the programs or initiatives to pursue. Building upon the previous discussion, C1P1 explained, "*The core process for this is actually management decision-making. So, at the management tier, we have representation from all relevant departments as things are shifting that grouping is very communicative with one another*". From another perspective, forums play a role in providing governance to the enterprise by ensuring that things are executed within the principles of the enterprise. The data from C2 support this perspective. C2P3 explained this concept in detail, "*from an architecture point of view, the way we do this within the programs, the sort of agile programs that we're working on just now, is that we have a weekly architecture forum with a team of architects and the team of architects own a set of architecture principles*". These forums, which are also referred in the data as ceremonies enable quick communication and collaboration between all teams involved. "*We want people to talk to each other and so we have we have a handful of ceremonies and we have a handful of forums which will allow us to govern the way we deliver these things to ensure that there's coherence and consistency*", C2P3 explained.

4.3.6 *Summary*

Five themes emerged from the data that explain how AP is applied in EA. The first theme discussed the agile delivery process, which comprises four sub-themes: sprint-based, programs, backlog and priorities. These four themes depend on each other in the end-to-end agile delivery process. The second theme discussed was that of a team responsible for executing the agile delivery process and participating in forums. Forums influence, manage and govern the agile delivery process. The teams use tools when running the agile delivery process. The agile delivery process produces outcomes iteratively and frequently. These outcomes translate to the business value business leaders desire. The data suggested that working software is the primary measure of the agile delivery process. The idea is based on the view that every modern company is a software company, as indicated in the literature (Knaster & Leffingwell, 2020). The quick delivery of the software implies that an enterprise can react and adapt to changes in its environment in a reasonable time frame. The following section, 4.4, discusses applying AP in EA to reduce EA ambiguity.

4.4 Applying AP in EA to reduce EA ambiguity

The research findings discussed in sub-section 4.3 explained how AP is applied in EA. This sub-section 4.4 discusses the outcomes of combining the concepts from section 4.3, which helps to reduce ambiguity in EA. The literature noted the absence of a shared meaning of EA in any or between enterprises and identified AP as a solution in helping to bring a common understanding of EA (Hummel et al., 2016; Nurmi et al., 2019). Three themes emerged from the data, explaining how applying AP in EA can reduce ambiguity. These themes are collaboration (discussed in sub-section 4.4.1), involvement of top management (discussed in sub-section 4.4.2), and conflict resolution (discussed in sub-section 4.4.3). The analysis of these themes is presented in Table 6. Sub-section 4.4.4 concludes and summarises this section by providing a diagram in Figure 16 illustrating the relationships among these three themes.

Table 6. Applying AP in EA to reduce EA ambiguity findings summary.

Themes	Files	References	C1	C2	Related Literature
Applying AP in EA to reduce EA ambiguity (RQ1)	***6***	***70***			
Enabling collaboration	6	42	X	X	Gong & Janssen, 2019; Halawi et al., 2019; Nurmi et al., 2019
• Collaboration between teams	6	24	X	X	Hummel et al., 2016; van de Wetering & Bos, 2016
• Within team collaboration	6	18	X	X	Beaumont et al., 2017; Nurmi et al., 2019
Involvement of top management	4	14	X	X	Aljlalel, 2016; Perez-Castillo et al., 2019
Facilitating conflict resolution	3	9	X	X	Lankhorst, 2017; Saint-Louis et al., 2019

4.4.1 *Enabling collaboration*

The literature noted that multiple views of EA make it challenging to discuss or practice EA as a discipline using a structured knowledge baseline because each different organisation has its understanding and view of EA and uses EA differently (Gong & Janssen, 2019; Nurmi et al., 2019). This understanding resonates with the two cases studied, which both operate in a complex FSI where common vocabulary is essential across the organisational structure to speed up decision-making or information flows between departments, teams and other organisations participating in delivering or receiving value. Based on the data, it is evident to the researcher that agile provides a platform to collaborate and have one understanding that would allow EA to be appropriately used in delivering desired customer outcomes. At C1, C1P1 pointed out a problem and defended how EA and AP solve this problem, "*working with people outside of the team is always a difficult thing because you are all coming at it with different value sets typically to the same problem and that means there is not always alignment but that friction is good*". C1P1 explained further, "*and that comes out to the fundamental interpretation of what EA is right? That is the question. It is an interesting one because I think that what agile does is it enables EA very well because it brings it out into a highly collaborative environment. So, there is this concept of, okay, what is our architecture?*

*How are we going to change it, how are we going to optimise it etc. You put it into agile, and the nature of an agile team is more often than not cross-functional, so you have got multiple different views working on the same problem to provide an optimised outcome so I think the critical part is for everyone to have the same basic understanding of EA as a basic definition of we are now engaging in an EA projec*t".

One of the reasons for the absence of EA shared meaning mentioned in the literature is that EA draws on several associated disciplines and domains, such as information systems, systems engineering, industrial engineering, and organisational science (Halawi et al., 2019). Both case descriptions of C1 and C2, as presented in sub-section 4.1, provide supporting evidence for this view, particularly concerning specific engineering departments within these organisations. At C1, participant C1P2 provided an illustrative example of the engineering department's involvement in EA and stated, "*The product owner is embedded, you know, with the engineering team so that decisions can be made. So, as engineering discovers gaps or additional opportunities as presented to the product owner"*. The agile delivery process, team, tools and forums concepts discussed in sub-section 4.3 invite smooth collaboration between organisations and people with different disciplines or departments. In addition to the above paragraph explanation provided by C1P1, most of the participants from both C1 and C2 constantly echoed this. This collaboration also seems to speak about collaboration between technical systems, not just among social systems. One of the views in the literature is that an enterprise is a social-technical system (Nurmi et al., 2019). Using the words collaboration and technology, C2P2 at C2 explained, "*these whole ways of working where we have continuous communication and collaboration but with the right stakeholders in these type of interactions, daily or regularly. You know, I know it is not always possible, but that will ensure that you have not got this scenario of, yes, we have got all these fancy frameworks and technology, and the taxonomy is not something that the business guys understand.*"

Based on the preceding discussions concerning collaboration, the data suggests the emergence of two noticeable types of collaboration as a direct outcome of implementing AP in EA. These types can be categorised as collaboration between and within teams, which will be further discussed next, beginning with collaboration within teams.

a. Within team collaboration

Based on the researcher's perspective of viewing an enterprise as a CAS and acknowledging that this CAS consists of heterogeneous agents' interactions or relationships that are not always linear or predictable, as each agent possesses the freedom to act in ways that satisfy its goals based on each agent's role (van de Wetering & Bos, 2016), these heterogeneous agents discussed can also encompass human and computer actors (people and technologies) playing roles in the individuals' teams they belong to. The literature suggested that AP are believed to help develop a shared understanding that reduces ambiguity among the individuals that make up an agile team discussed in 4.3.2 (Hummel et al., 2016). Referring to these heterogeneous agents as people, C1P1 at C1 explained how ambiguity is removed within the team and stated, "*What agile does is allow a diversity of people to engage with it, to understand it better, their place in it and how they can service the need. Provide the visibility. I think, first and foremost, EA is about providing visibility.*"

Another view provided at both C1 and C2 is the nature of the team's collaboration. At C2, C2P3 explained that the collaboration between team actors within a team is guided by principles and stated, "*those architectural principles will talk to things like security and hosting and monitoring and integration patterns and things like that, and the SCRUM teams will be allowed to do what they want within the boundaries of those principles*." At C1, C1P2 explained this from an enterprise vision perspective and indicated, "*if you wanted to say that once you had that vision, you had the enabler, you understand the gap then the team members necessary do develop an architecture quickly and what are the components of the architecture that we care about right and when you are developing an architecture you are faced with constraints all right the constraints are you know money the amount of time you can develop the system.*"

b. Collaboration between teams

The alignment between C1 and C2 concerning providing technological solutions to the FSI highlights the similarities in their organisational structures. At both C1 and C2, departments and teams indicate a distributed approach to handling activities, tasks and responsibilities. This inherent structure viewed from the lenses of system approaches, for example, SoS, living systems and CAS alluded to in literature, necessitates collaboration and coordination among teams and departments to achieve shared objectives, which in turn translate to the

results of value produced to the external environment including customers, suppliers, competitors, regulators and other stakeholders (Nurmi et al., 2019; Onik et al., 2017). The literature further suggested that AP enables cross-team or cross-organisational collaboration (Beaumont et al., 2017). In this context, the data from both cases prove helpful in understanding this enablement.

This is an example of how the collaboration between teams is carried out, as explained by C2P2 at C2, "*in terms of the ones that we interact with primarily when we do projects and implementations for our clients are the professional services team that we're part of and then the engineering side of the company that consists of the actual development SCRUM teams in different regions throughout the world as well as the solution design team that forms part of the big engineering group to make sure that changes to our platforms and solutions we implement this as per our strategy and make sure that the impact is understood for any changes that we do to the platforms*". C2P2 further expanded on this point and highlighted the substantial benefits derived from collaboration between teams or departments, stating, "*there was a lot of engagement, then obviously tapping into the knowledge and the understanding of the other solution architects and professional service consultants in APAC (Asia Pacific region). So, they were very helpful and forthcoming and some of them even had a big part to play in the project*". This cross-team collaboration also suggests a cooperative interaction between teams from two enterprises, one enterprise supplying a service and the other consuming the supplied service. C2P1 provided further support for this interpretation and stated, "*In terms of the [company name] project, in terms of the client team, it is, you know, they do have an enterprise business or you know, they have what they call a business architect and a solution architect; they have their own business analyst…*".

Sub-section 4.4.1 showed how AP in EA encourages collaboration within and between teams, reducing silos and promoting a unified effort to achieve the overall business objectives. This enables effective teamwork and shared understanding between enterprises and eliminates ambiguities in EA efforts. The culture of collaboration facilitated by AP contributes significantly to the successful architectural outcomes desired by business leaders, demanding early investment returns and value realisation from EA projects (Kaddoumi & Watfa, 2016). Next, in sub-section 4.4.2, is how AP in EA involves top management to set the right strategy.

4.4.2 *Involvement of top management*

The literature highlighted that EA is widely used today as a continuous-change process in the alignment of different parts of the enterprise (a dynamic system), like strategy, mission, vision, structure, business processes and IT systems (Aljlayel, 2016; Perez-Castillo et al., 2019). From the researcher's perspective, this would not be possible without the support of the top management. The empirical data from both cases support this perspective. At C1, C1P1 explained the involvement of top management in the context of using AP in EA, "*The core process for this is actually management decision-making, so at the management tier, we have representation from all relevant departments as things are shifting that grouping is very communicative with one another... so our core process is actually our management structure that makes us highly adaptive.*" At C2, C2P1 supported this explanation, providing the nature of decisions influenced by top management. C2P1 stated, "*their role is to make the hard decisions and to provide the vision of the organisation is a very loaded word as well. So, they the clarify around what is of, who to go to, of what is wanted and make and taking the hard decisions to them.*" The data also highlights AP capacity to involve top management in critical aspects such as defining needs, formulating strategies, setting project boundaries and establishing success criteria. The following quotes demonstrate these key points:

"*Top management sets the need. Their direct reports would then articulate that need into deliverables. Then those get assigned to specialised units, database, infrastructure, products of various project teams that might own certain implementations actively in flight that would have to move yeah, all those sort of things."* C1P1 at C1.

"*I guess the response to that is the strategy of what we are calling microservices or what really or honestly should be called componentisation, which would allow us to make changes to more discrete parts without impacting all the others."* C2P1 at C2. The researcher included this quote because it contains the word 'strategy', and the researcher believes that the term 'strategy' and 'management' are interconnected in the business world. This belief is rooted in the literature perspective that EA plays a pivotal role in bridging the gap between enterprise strategy and portfolio IT projects (Gellweiler, 2020).

"*The role of top management has to be, in my view, to set the boundaries and the success criteria of the project.*" C2P4 at C2.

In light of the involvement of top management in EA when utilising AP, it becomes evident that this engagement plays a pivotal role by enabling transparent, alignment and collaboration across different facets of the enterprise, such as strategy, mission, vision, structure, business processes, and IT systems (Aljlayel, 2016; Perez-Castillo et al., 2019). As a result, these outcomes reduce ambiguity within EA, providing a top-down, holistic and multidimensional shared understanding of the organisation's strategy and objectives, helping align efforts across various departments and promoting a cohesive and coordinated approach to change initiatives, whether complying with new regulation, adopting new technology or reacting to a competitor in a shorter time frame. The following sub-section, 4.4.3, discusses the conflict resolution theme.

4.4.3 *Facilitating conflict resolution*

The literature and discussions thus far in this study reveal that AP, initially developed for software development, offers valuable insights into promoting adaptability, collaboration, and iterative delivery in the broader context of EA. However, the literature also acknowledged the existence of multiple realities regarding the diverse concerns and interests of various enterprise stakeholders (Lankhorst, 2017). Given that these stakeholders are human beings, their perspectives are always incomplete, complicated, incoherent and implicit, leading to potential social conflicts (Saint-Louis et al., 2019). This is the view shared at both C1 and C2. C1P1 at C1 expressed this way, "*Working with people outside of the team is always a difficult thing because you are all coming at it with different value sets typically to the same problem, and that means there is not always alignment… okay, so let me use my relationship with technology as a very good example of this. I have a strained relationship with technology fundamentally. I am on the client servicing part of the company, so I am very client first; technology is very technology first. There is a natural then friction and tension line between their road map and my protectionism of value delivery.*" Sharing similar views at C2, C2P1 said, "*So the reality is people are people, hey, and one of the challenges with projects is people are thrown together normally have never worked with one another before.*" Providing another explanation, C2P1 offered another insight and suggested that conflict resolution manifests itself not only from competing priorities among departments but also through competing technological implementations and stated, "*so where you have multiple product houses everyone has the or even just with, within everyone doing their own thing separately,*

independently. You can get mad if you don't try providing those kind of guardrails of what to so that everyone doesn't adopt competing technology because you'll end up duplicating costs and a common approach to in terms of the vision and strategies that you want to adopt so that organisation pulls in a coherent direction as opposed to operating entirely differently in silo. So, It's meant to be that bridge, that coordination is like a common approach so the awareness of same business problems or capabilities that need to be built so that they those synergies can be effective across teams or projects or business units depending on the size of the problem."

Further explanations from the participants show that the nature of the agile delivery process discussed in sub-section 4.3.1 encourages continuous communication and feedback loops, enabling stakeholders to address conflicts promptly and transparently. C1P1 from C1 provided valuable insights that further support the researcher's explanation, "*That friction is good, that friction is questioning, that means that you can truly interrogate whether you are on the right track or not, and we are all aligned, and we are all just skipping along to this wonderful, you know, end of the rainbow kind of situation. I do not think you are going to get a quality outcome. I think there needs to be friction and tension in a system for it to truly function well, not toxic or destructive, but fundamental questioning of basics and basic assumptions and interrogating them constantly bit of argument is good for the soul."* Aligned with the transparent perspective, C2P4 from C2 stated, "the *biggest thing to reduce friction is openness, and I think that is the key thing to make sure that you are always being honest and open with the clients about what is going on because the moment that you are not that changes in its entirety the type of relationship you have…being comfortable to disagree with the client I think is also.*" Based on these explanations, the researcher suggests that these aspects can effectively mitigate conflicts arising and reduce EA ambiguity. Next, sub-section 4.4.4 summarises how applying AP in EA can reduce ambiguity.

4.4.4 *Summary*

In this sub-section 4.4, through the agile delivery process, teams, tools and forums, applying AP in EA stands out as a catalyst that empowers external and cross-team collaborations. This collaboration engages top management to set strategy that is understood by everyone and demonstrates its effectiveness in conflict resolution. These AP outcomes collectively create a shared meaning, understanding and the level of knowledge necessary for reducing

EA ambiguity in any or between enterprises (Hummel et al., 2016; Nurmi et al., 2019). The collaborative environments free from EA ambiguity contribute to dynamic enterprises capable of adapting and co-evolving in an ever-changing environment, as discussed in the literature (Chan, 2001; Sweetman & Conboy, 2018). Figure 16 illustrates the context of methods, processes and tools of applying AP in EA, depicting collaboration, involvement of top management in setting the enterprise strategy, and conflict resolution as key outcomes that emerged from the data.

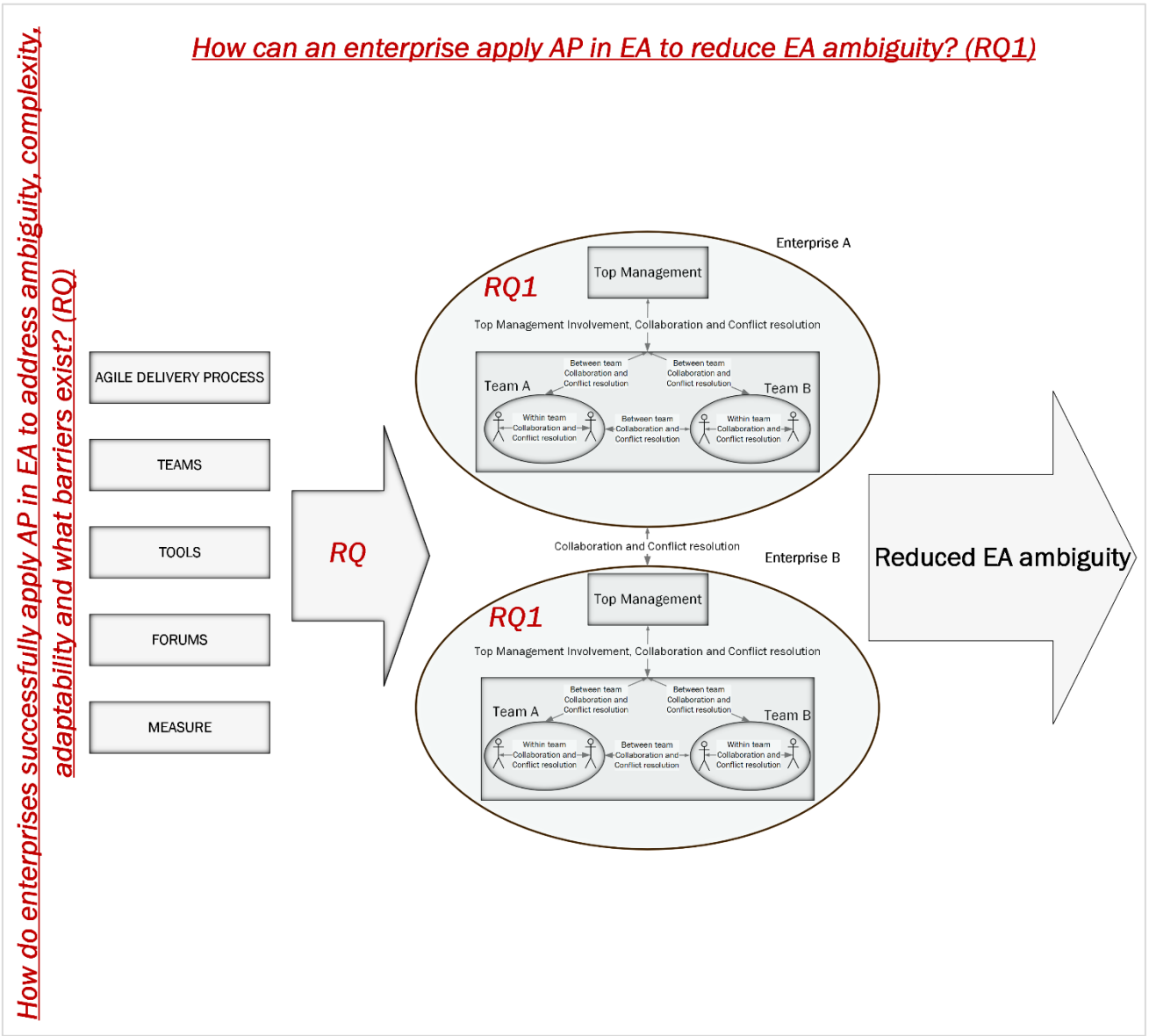


Figure 16. Applying AP in EA to reduce EA ambiguity.

4.5 Applying AP in EA to reduce enterprise complexity

The research findings discussed in sub-section 4.4 analysed applying AP in EA that reduces EA ambiguity. Academics and practitioners have advocated for the application of AP in EA as an avenue to manage and adapt to the complexities inherent in contemporary enterprises (Banaeianjahromi & Smolander, 2019; Foorthuis et al., 2016; Lumor et al., 2019). This sub-section 4.5 discusses the outcomes as themes of applying AP in EA that reduce enterprise complexity. These themes encompass the following: utilising EA, enabling understanding of an enterprise, employing frameworks for documentation, facilitating communication through visualisations, and fostering learning. Table 7 provides a summary overview of these themes.

The idea of complexity is evident in various aspects of today's business dynamic environments, such as complex enterprise that seek to connect demanding customers, partners, and related external and internal stakeholders, outsourced business capabilities and complex AEA projects undertakings to describe and implement this complex business

Table 7. Applying AP in EA to reduce enterprise complexity findings summary.

Themes	Files	References	C1	C2	Related Literature
Applying AP in EA to reduce enterprise complexity (RQ2)	***5***	***61***			
Utilising the EA elements in AP	5	15	X	X	Lankhorst 2017; Nurmi et al., 2019; Saint-Louis et al., 2019
Using frameworks through documentation, visualisation and learning	4	15	X	X	Aljlayel, 2016; Iyamu, 2019; Werewka & Spiechowicz, 2017
• Documenting the structure and behaviour of an enterprise	3	7		X	Nurmi et al., 2019; Saint-Louis et al., 2019; Syynimaa, 2017
• Learning	3	4		X	Aljlayel, 2016; Iyamu, 2019
• Communicating with visualisations	3	3	X	X	Keating, 2015
Understanding an enterprise	4	12	X	X	Bosch-Rekveldt & Blom, 2016; Kasemsap, 2016

ecosystem (Gill, 2015; Hazen et al., 2017; Zafar, 2016). Based on the case descriptions in section 4.1, both cases are examples of complex systems discussed in literature operating in a complex FSI environment. The data further confirms the inherent complexity of modern enterprises and suggests how applying AP in EA helps manage factors such as uncertainty, interdependence, complexity, ambiguity, and emergence more effectively. The following quotes affirms the presence of complexity within the context of C2 and C1:

"*Most of us find ourselves in a situation where we are working with the systems and applications that were developed before our time, and we have got to take those forward or replace them with other things right, and if you have got a like system talking to hundreds of other citizens or you do not even know what those systems are you cannot even find out what they are you certainly cannot respond to any change quickly because you cannot, you do not know what the hell it is going to cost you to or what work is involved to replace it or change it if things are really tightly coupled and do like there is no clear definition of what they do and do not do…when someone uses the word enterprise, they are trying to convey that it is big and complex, okay rightly or wrongly.*" C2P1 at C2.

"*They have built these really complex APIs (Application Programming Interfaces), which in some cases might have 50 or 60 links linked API Exchanges and if you want to change one, you have to assess the impact on the other 50 or 60, linked APIs calls so that that to me is not an agile architecture but what we want to do is we want to create a distributed architecture for our future clients something that is decoupled and does not have point to point so we are pivoting away from point to point direct API call*s." C2P3 at C2.

C2P3 went further and utilised an alternative numerical representation to illustrate complexity while drawing upon a client case and argued, *"To introduce whatever is required to accommodate that change, which is regulatory market changes, but the [hidden client name] in South Africa is a different story if there is a regulatory change that they need to incorporate these changes into their thousand systems*."

4.5.1 *Utilising the EA elements in AP*

The EA discipline conceptual framework proposed in the literature to aid in understanding the complexities of modern enterprises and the EA nature included enterprise, stakeholders,

architecture descriptions and architecture concepts (Lankhorst, 2017; Nurmi et al., 2019; Saint-Louis et al., 2019). AP is seen as a possible solution that can link the these concepts together (Sohi et al., 2016). Both cases, C1 and C2 demonstrate that this occurs because various AP concepts collaborate to establish a more transparent and easy-to-understand environment that aligns different parts of the enterprise like strategy, mission, vision, structure, business processes and IT systems (Aljlayel, 2016; Perez-Castillo et al., 2019). By analysing the relationships and alignment of these concepts, the data reveals how enterprise complexity is reduced. This is achieved through two key insights: firstly, by clarifying the nature of EA and secondly, by demonstrating how AP is applied in EA to manage this complexity.

At C1, C1P1 used the words “system theory” to emphasise how EA works and stated, “*It is effectively an expression of systems theory that there is a connective tissue that will sit throughout the organisation that all of its value delivery processes are tied very much back to a bunch of technologies, systems, other processes etc etc*”. Sharing a similar view at C2, C2P1 explained, *“a discipline really for putting in place in an organisation the necessary guidance and practices for where you understand the current state of your business and you have a shared vision of where you are wanting to go, the technologies that you want to use and some sort of ideally way of getting there right. It brings together you know, like your application architecture, your data architecture and your technology architecture as well as business right all you know bringing all those three elements together*”. By understanding EA as a unifying system and implementing guiding practices, it is proposed that enterprises can effectively navigate complexity and achieve their desired future state. This is further evident in the C2D4 [Hidden Client Name] Enterprise Architecture secondary data, where a comprehensive diagram depicts all clients, channels, business processes, enterprise systems, core business applications, integration systems, reporting and analytics, IT applications, and technological infrastructure in a unified representation. To highlight the scope and extent of utilising EA, this extract from C2D4 [Hidden Client Name] Enterprise Architecture specifically focuses on clients description, noting various types of stakeholders interacting with [hidden client name], “*The different types of customers and clients that interact with [hidden client name]. Regulatory bodies include the Financial Services Board, South African Revenue Services, Association for Savings and Investment South Africa, South*

African Reserve Bank. Third parties refers external fund managers, valuators, home affairs, banks, auditors."

C1P1 provided an explanation that facilitated the shared vision and transparency resulting from applying AP in EA and stated, "*Let us say from an EA perspective we needed to have a new security standard in place on all our servers because that is an input into it, EA would tell us okay where are these systems, what value are they providing because at any time do you know where every server is, do you know what every one of those servers is doing, what value is each of it producing what else are they connected to where in the pipe do these regulations now apply so we would use agile to both work it out. So, we would have an agile process to analyse where we would need to make changes, then the work to do it would also go into an agile delivery process that feeds up into a road map of work with defined timelines of when we need to get things in place, but there is always an issue of relative priority of tasks and dealing with problems as they come along in an agile fashion*". This seem to suggest that AP ensures not only the analysis and implementation of necessary changes but also effective management of task priorities and problem-solving, contributing to the overall agility and efficiency of the EA, ultimately leading to reduced complexity within the enterprise. This can also be attributed to the visibility offered by applying AP in EA as explained by C1P2 who stated that, "*I think first and foremost, EA is about providing visibility and an agile environment should help to provide it, I mean that is a required outcome of an agile process, that visibility of the process and the outputs is a need from each work cycle, that weight visibility. I think that is the reality right, without visibility then there is nothing happening*". Next is sub-section 4.5.2, discussing how applying EA in EA reduces complexity by enabling understanding of an enterprise.

4.5.2 *Understanding an enterprise*

An emphasised point in the literature is the interconnectedness between Complexity Theory, which underscores the adaptive nature of CASs in response to their environments (Kasemsap, 2016), and the proposition of AP as a means for complex systems (enterprises) to adaptively cope with the complex realities they face (Bosch-Rekveldt & Blom, 2016). This was echoed in the data, with one participant providing a context within a banking scenario, highlighting a business problem for a consistent onboarding experience and a unified customer view despite separate divisions. C2P1 explained in detail, "*You have got to consider*

this in the context of a bank where you are talking about these different business divisions…these are historically different completely separately run organisations, very siloed … but the big challenge was around a consistent onboarding experience and a single view of the customer, like we already know about you because of your insurance policy with WM (wealth management) now you are having to recapture all the same again that we really know about because of siloed data etc.". According to this explanation, it seems that complexity emerges from the size of organisations and ongoing growth, possibly through acquisitions, as indicated by C2P1 who stated, "*I am telling you everything is honestly what I remember, disjointed company because of the acquisitions that have happened*".

The data seem to suggest that applying AP in EA helps enterprises to better address these types of business challenges, for example, of acquisitions and mergers and gain a clearer understanding of how to streamline processes and unify customer experiences across different parts of the company. C1P2 at C2, aligned with this view and explained the importance of breaking down the enterprise complexity into smaller, manageable parts, likening it to examining different aspects of an elephant with multiple agile teams. C1P2 stated, "*you break it down into smaller parts so you form multiple agile teams that are looking at the different parts of the elephant. It's called the enterprise complexity, the elephant in this instance. So, you get different teams to analyse different parts but because they're all under an umbrella of let's say an enterprise architecture project*". By organising these teams under the umbrella of an EA project, it appears organisations can promote collaboration and alignment based on one shared understanding of the enterprise landscape. The concept of breaking down something into parts to manage complexity was also mentioned at C2 by C2P3 who stated that, "*a case of focus on the pressing business problem and iterate just do take your enterprise scale road map and break it down into a set of smaller road maps or a set of OKRs (Objectives and Key Results) even better objectives and key results and instead of trying to solve the big problem which is difficult try and solve… try iteratively, try and solve a series of smaller problems*". This view of breaking down business problems into smaller components and working collaboratively as teams to understand the broader picture as evident in both cases, suggests that this approach facilitates a shared understanding of how various elements interconnect within the enterprise. This way, stakeholders, each with their unique concerns can identify interdependencies, mitigate risks, make strategic decisions,

collaborate effectively and in transparent way and understand what is going on in the enterprise, resulting in reduced enterprise complexity.

While using AP in EA can potentially reduce complexity, other participants think that AP alone may not necessarily lead to reduced enterprise complexity. C2P3 at C2 expressed this view and stated, *"I think if you are doing anything enterprise scale, there is always going to be complexity, and I do not think you can get away from that, and I think if I had my time again at C2, I would be much stronger in encouraging our clients to think less about enterprise and think more about business problems and business value".* Document C2D2 [Hidden Client Name] Application Portfolio Architecture further supports this complexity by illustrating a web of connections between different elements within the business system. The data, aligned with the literature, also suggest a natural relationship between the terms "complex" and "enterprise", with participants naturally associating these terms in their explanations. The following quotes demonstrate this observation:

"I think when someone uses the word enterprise, they are trying to convey that it is big and complex okay rightly or wrongly", C2P1 at C2.

"To me, the enterprise bit on top of that is bringing it up from at a departmental level. We could all say we want a process management system, and we could all go out and buy a different tool and use it, but to me, the enterprise bit is bringing that up to the whole of the organisation level and saying, okay, is this a tool that we want to use across all of the company… if EA is done correctly, it is not complex. I think the challenge is that enterprises are complex and as a result of that your EA can appear very complex in certain circumstances" C2P3 at C2.

4.5.3 *Using frameworks through documentation, visualisation and learning*

Building upon the foundation of existing literature and drawing insights from emergent patterns within the collected data, this sub-section 4.5.4 discusses the framework theme. The frameworks suggested in the literature seem to suggest that they reduce enterprise complexity by guiding the development, implementation and management of EA (Aljlayel, 2016; Iyamu, 2019). The literature further suggests that when these frameworks are combined with AP, they can offer enterprise stakeholders a clear understanding of ongoing

activities and aid in identifying reasons behind unmet goals, thereby minimising complexity (Werewka & Spiechowicz, 2017). Both cases, C1 and C2, explained how a framework operates. One participant C2P2 at C2 specifically cited TOGAF and stated, "*TOGAF tries to give you a tool set and a framework that you can apply different problems and initiatives and industries. I would not say that a particular framework dictates what approach and methodologies you should use during your SDLC (Software Development Life Cycle) and project management phases. I think they try and give you the necessary knowledge tool sets and building blocks to understand which problem would be tackled you know with the best framework. Agile might not always be the correct approach for a particular problem that you are trying to solve*". This participant's perspective seems to highlight TOGAF's role as a helpful toolkit and framework for addressing diverse challenges and complexities across industries, including the FSI, as it equips practitioners with foundational components and knowledge tools, enabling them to discern the contextually best-fit approach for complex problems. This way, the framework aims to provide an overview of the business, connecting various concepts, principles and best practices into a unified discipline as pointed out by C2P3, "*so for me it is about not being prescriptive, it is about having empowered individuals, it is about having a set of guidelines or parameters within which you can work with*". From the researcher's point of view, these empowered individuals are the teams discussed in sub-section 4.3.2.

The data seems to suggest that there are three primary ways in which a framework accomplishes this, namely, through documentation, visualisation and learning. The relationship among these sub-concepts is illustrated in Figure 17. However, it is not clear from the literature and the data whether all enterprises use a specific framework and how much they follow its guidelines. For instance, this uncertainty arises when considering things like documentation. This concern and doubt about frameworks' effectiveness as a best practice have been raised in the literature about whether these frameworks are necessary, valuable, helpful, and practical for enterprises practising EA (Kotusev, 2018). The framework sub-themes of documentation, visualisation and learning are discussed next.

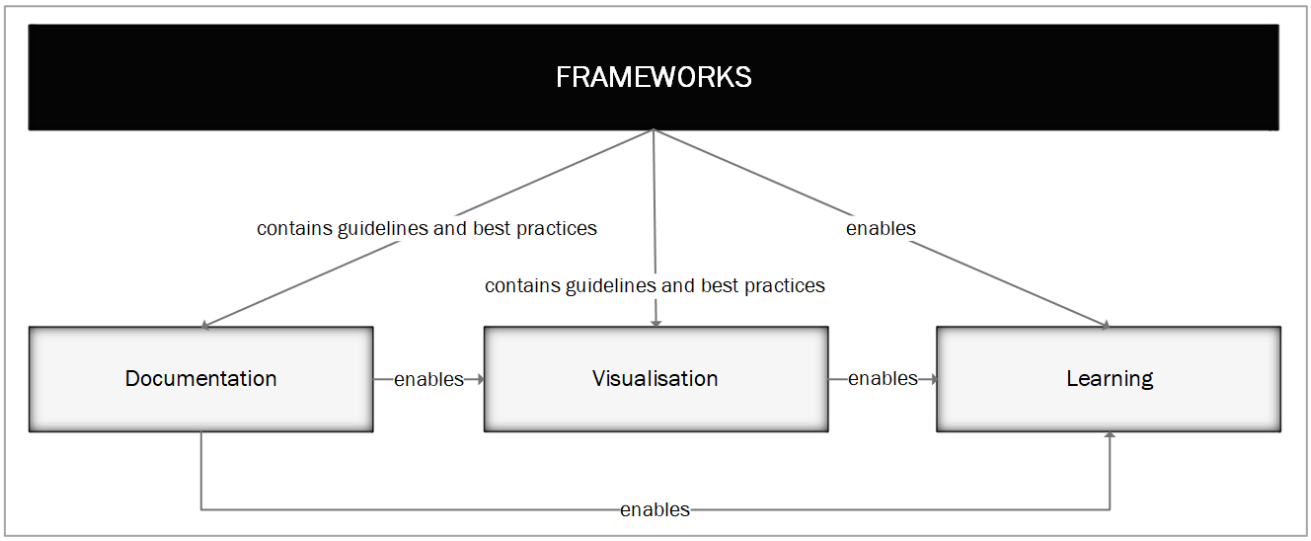


Figure 17. Framework sub-concepts.

a. Documenting the structure and behaviour of an enterprise

The literature highlights that every system, such as an enterprise, possesses a description (Syynimaa, 2017), which should be directly related to the involved stakeholders, enterprises and architecture (Nurmi et al., 2019; Saint-Louis et al., 2019). Mainly at C2, the participants share this theme perspective, showing the significance of documentation in their work in attempting to reduce complexity. C2P1 stated, "*All the complexities of having offshore site, they have DEV (software developments) centres where we have got to write everything down in detail because we are not, we cannot and different time zones it is very difficult to collaborate and respond in real-time to any questions that may arise which is why we have got to do a fair amount of documentation when we do any kind of change*". Apart from its importance in the context of internal understanding, this documentation also holds significance from an external perspective, creating a shared understanding between the enterprises providing services and receiving services, as highlighted by C2P1's further explanation, "*We have to put things down in writing because if things go wrong trust goes out the window and your clients and even internal stakeholders will pretend that conversation did not happen*". Although documentation is essential, two participants cautioned that it should not be too much, citing that too much documentation is a traditional and historical way of doing things. From this view, the main idea should be to give the client value quickly rather than spending much time on documentation. This aligns with one of the AP values, which says that having a working piece of software is more important than having lots of

documentation. The following two quotes demonstrate the observation against too much documentation.

"*Traditionally, we do all these page specs and send it to the stakeholders to sign off, and they will come back and say … Gone are the days of doing 100000 pages of artefacts just to play back to your client. What benefit do they get out of that? They want to see something tangible okay, my logon screen is working great; that was actually the deliverable for this week's sprint. Okay, next, I want to be able to capture my products and maintain it, you know, simple examples like that. You do not need 100000 pages to explain that, yes you need acceptance criteria*", C2P2 at C2.

"*So historically, we have been a design documentation shop. We have not been a software shop. We spend an inordinate amount of time producing documentation, producing design documentation. Our design, our SDLC, has so much stuff up front around a design that we should not need to do, and the proof of that has come out of our microservices work. Instead of doing a huge piece of design work, you articulate a feature, you have a conversation with somebody*", C2P3 at C2.

b. Communicating with visualisations

The data appears to indicate that certain features commonly discussed in the literature regarding modern complex systems, such as the difficulty in clearly understanding or interpreting both the system itself and the environment it operates in, as well as the interconnectedness of systems where changes in one system affect and are affected by others (Keating, 2015), can be reduced through visualisations derived from the documentations that descriptively represent the enterprise. This understanding is shared by both C1 and C2 participants, who employed words that imply visualisation and illustration purposes in their explanations. C1 participants mentioned visualisations for identifying inefficiencies and optimising processes, for example, as explained by C1P1, "*Well, it is to visualise how things actually happen, which technology systems are feeding into other systems, processes and otherwise to produce the end products that a company actually pushes out the other side, and it is to find the processes that just are dead ends waste in the system and constantly keep that updated so that you know what actually produces, what you should be producing on an ongoing basis and see hot spots, bottlenecks all those kind of issues*" At C2, participants discussed visualisations as blueprints for understanding enterprise

components and connections, C2P2 stated, "*if I can visualise it almost like a blueprint, so a blueprint of what the plans and the plumbing and the building blocks and the components looks like of the enterprise*". C2P3 added, *"I am the person who goes in and draws the end-to-end picture that says these are the applications and services that we are going to deploy and this is a sort of an infrastructure level. This is a sort of application sort of logical level, so these are the services, these are the interfaces, this is the nature of the interfaces, and this is the nature of the capabilities that each service is providing, and this is how it fits in with the client's wider technology stack*". The visualisations appear to play a role in the agile delivery process and team forums, facilitating conflict resolution, collaboration and gaining buy-in from top management. The perceived result is that they contribute to a reduction in enterprise complexity.

c. Learning

Another emerging perspective in the data is learning facilitated by EA frameworks. Through AP iterative processes and collaborative forums, teams learn to quickly identify bottlenecks, inefficiencies, and opportunities for optimisation because of two main perspectives. First, leveraging documentation and visualisations when applying AP in EA promotes a more adaptable and streamlined EA. Participant C2P3 from C2 phrased it as follows, "*ability to code early, fail fast, learn from the failure and course correct… Something that we are doing, moving to microservices and moving to small autonomous teams as an organisation*". C2P1 offered insight into this learning process and articulated that, "*in the context of skilled multi-disciplinary teams where information is available, where you can find it out without having to about what you know. You can know whatever they've signed off on and why for example, Hibernate Spring Framework, but that's on the software level…so provided it's transparent with good availability and also the ability people to understand and work with it*". Second, since most of the frameworks utilised in EA consist of guidelines and best practices from various industries and experts worldwide, the guidance offers a swift learning curve for adopting a discipline or an approach to resolving emerging situations, for example, the several EAFs discussed in the literature (Aljlayel, 2016; Iyamu, 2019; Kaddoumi & Watfa, 2016; Masuda et al., 2018). The researcher believes that the prescriptions perspective mentioned in the data aligns with this viewpoint and appears to reveal that these prescriptive implementations are grounded in guidelines and best practices provided by the framework. C2P1 explained this view, "*you need basically then more prescriptive ways of working and*

prescriptive implementations with documents that say you must do this and that which is kind of how we work at C2 where we document in detail what the developers have got to do and they literally just execute on that".

4.5.4 *Summary*

Section 4.5 analysed and discussed the complexity of modern enterprises and how applying AP in EA can reduce this complexity. The key themes that emerged included EA's role in aligning various enterprise elements, the view of an enterprise as a complex system, and the significance of frameworks and its sub-concepts of documentation, visualisation and learning in providing a blueprint of the enterprise and ways of doing things based on global best practices. The researcher formulate in Figure 18 that these concepts discussed in sections 4.3 and 4.4 collectively work together to reduce enterprise complexity and enable adaptability in today's dynamic business environments. The following section, 4.6, discusses how EA projects use AP to adapt to changing enterprise needs.

4.6 EA project adaptability to the enterprise's needs and changes using AP

Throughout this chapter, various aspects of an enterprise have been discussed. In Section 4.1, Case Descriptions, two enterprises under study were examined to provide context for analysis and discussion. A comparison was made with the modern enterprise's characteristics noted in the literature, considering factors such as their business ecosystem. In section 4.3, Application of AP in EA, participants' views on the current application of AP in EA were explored. In Section 4.4, Applying AP to reduce EA ambiguity, participants' perspectives on how AP is currently used in EA to reduce the ambiguity highlighted in the literature were discussed. In Section 4.5, Applying AP in EA to reduce enterprise complexity, participants' views on how AP is currently applied in EA to address the inherent complexity of modern enterprises were examined. Building on these discussions, this section focuses on understanding EA project adaptability to the enterprise's evolving needs and changes through the application of AP. The goal here is to explore the business outcomes themes that demonstrate an enterprise's ability to adapt to its evolving business environment due to applying AP in EA. The emerging themes are ensuring responsiveness, facilitating change,

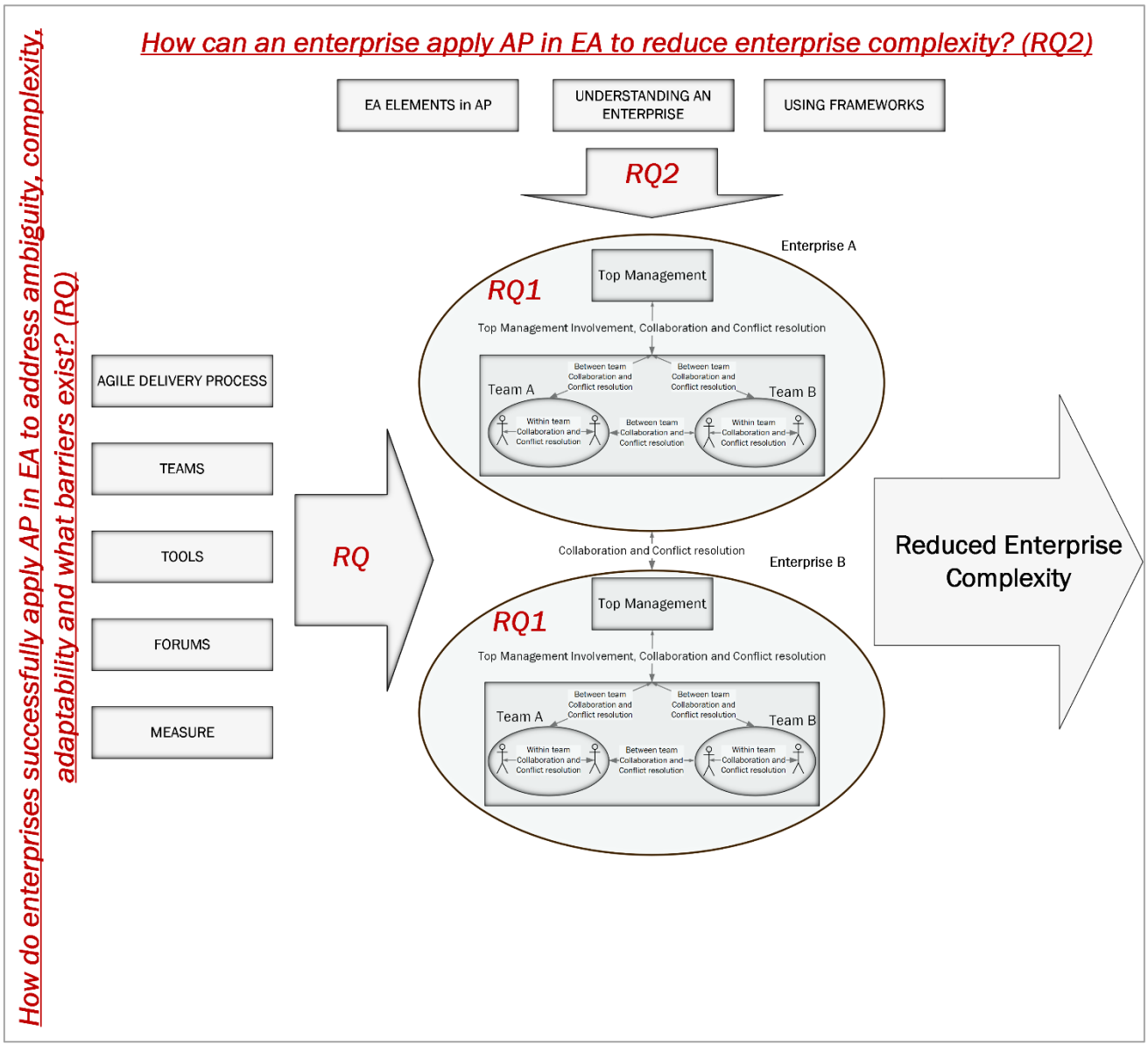


Figure 18. Applying AP in EA to reduce enterprise complexity.

achieving agility, maintaining up to date architecture, enabling sales, aligning technology and business. The list of themes analysed in this sub-section 4.6 is presented in Table 8. Figure 19 visually depicts the relationships between the themes of this section.

4.6.1 *Ensuring responsiveness*

There is an urgent need of modern enterprises to stay relevant and maintain viability by evolving as necessary in response to changing operating environment conditions (Carter et al., 2016; Hinkelmann et al., 2016; Onik et al., 2017). This perspective finds support in the

recurring theme of responsiveness that emerged from the collected data. At C1, the organisation appears more responsive than at C2. C1P1 mentioned how using AP in EA helps C1 comply with regulations, citing the European Union General Data Protection Regulation and the BREXIT (the withdrawal of the United Kingdom from the European Union) as examples and stated, "*to show you that, we changed our data centre providers with a certain regularity. So, it was private cloud we are now moving over to AWS (Amazon Web Services). We do this with a focus quite regularly because for us, our ability to execute fast*

Table 8. EA project adaptability to the enterprise's needs and changes using AP findings summary.

Themes	Files	References	C1	C2	Related Literature
Using AP to make EA project adapt to the enterprise's needs and changes (RQ3)	***6***	***8***			
Ensuring responsiveness • Top management's ability to interpret industry trends, market conditions and product positioning • Team ability to execute work based on situations	6	21	X	X	Carter et al., 2016; Hinkelmann et al., 2016; Onik et al., 2017
Aligning technology and business	4	17	X	X	Foorthuis et al., 2016; Nurmi et al., 2019; Saint-Louis et al., 2019
Maintaining up to date architecture	5	15	X	X	Gong & Janssen, 2019; Kaddoumi & Watfa, 2016; Sousa et al., 2017
Facilitating change	6	14	X	X	Kasemsap, 2016
Achieving agility • Role of technology architecture in achieving enterprise agility	5	8	X	X	Hinkelmann et al., 2016; Onik et al., 2017
Enabling sales	4	8	X	X	Ciric et al., 2018

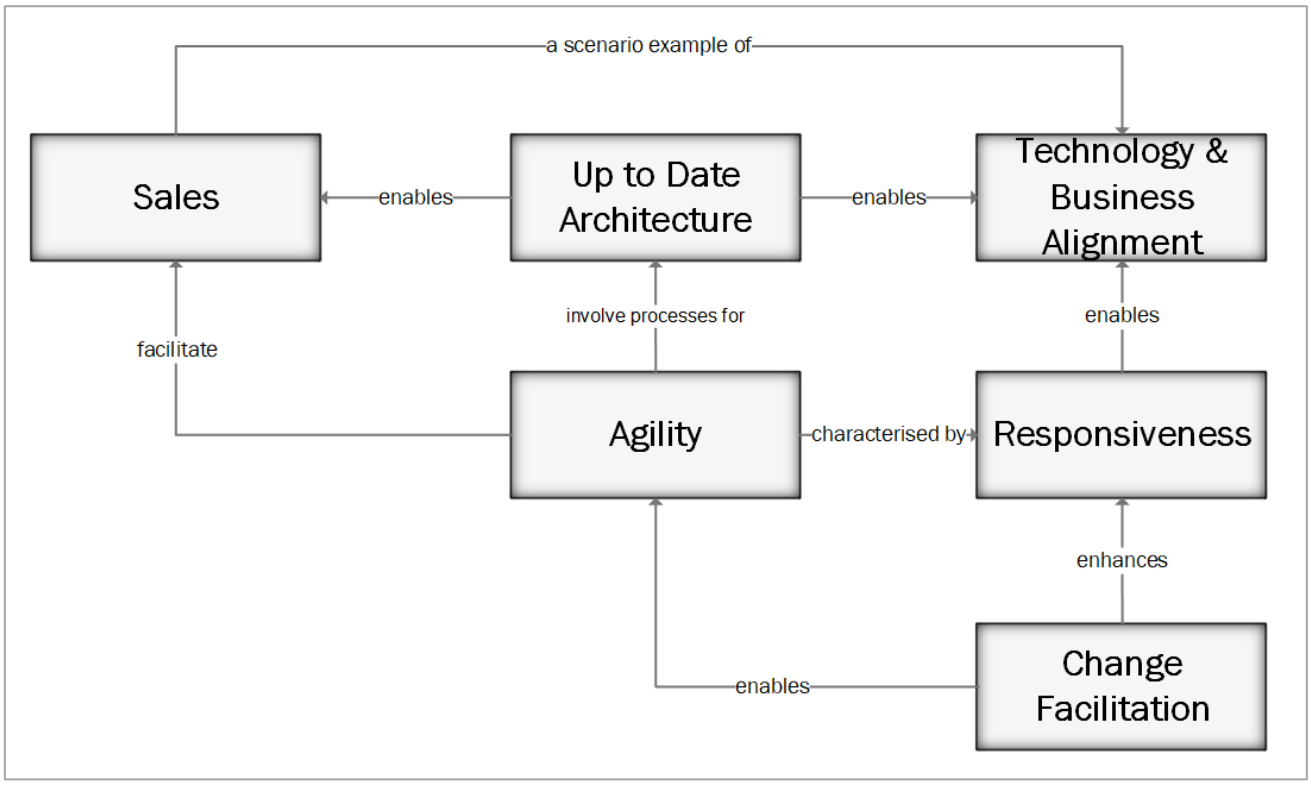


Figure 19. Business outcomes themes that demonstrate an enterprise's ability to adapt to its evolving business environment due to applying AP in EA.

and dependably is critically important to our survival". C1P1 explained further, "*we just spun up a European data centre because of BREXIT right and we have taken our whole stack over there to run things and we have done it in very reasonable time to get it up and running. That is the kind of responsiveness that we need because market conditions are always shifting, changing regulation, political, you know, so many different things affect the finance industry and we are a vendor in the finance industry, that means we must jump with it all the time*". However at C2, all the four participants agree that although they recognise the importance of being responsive, they believe the organisation has not reached that point yet. This sentiment is primarily influenced by the type of information systems offered by C1 in the market. Participants believe that C1's systems, which were designed many years ago using old design styles, lack the responsiveness required today due to their large-scale. The following quotes demonstrate the C2 participant's large-scale information systems view.

"*I would say traditionally not a lot of responsiveness or the ability to adapt because traditionally we were selling large platforms to our clients. So, it is quite a large implementation, it takes quite a long time, it comes with significant costs and it requires a lot*

of resources from C2 in itself in terms of the size of the teams that works on the implementation… we are getting there but definitely not there where we want to be", C2P2 at C2.

"I do not think we are certainly adaptive. What I would call our heritage products are not so. Think things like [hidden_platform_name_1], [hidden_platform_name_2], [hidden_platform_name_3]. So, there is this really cool theory or law that I will tell anybody about called Conway's Law, which is the solutions you build reflect the communication structures of your organisation. So, we build monolithic applications because we are a monolithic organisation", C2P3 at C2.

Another unique perspectives brought forward at both C2 and C1, still related to the broader theme of responsiveness, is a sense that what results in an organisation's ability to respond to its environment is not just applying AP in EA. However, instead, other more important factors play a significant role. The data highlighted two key factors: top management's ability to interpret industry trends, market conditions, and product positioning, and the team's ability to execute work based on situational demands. These factors are discussed further in sub-sections 4.6.1a and 4.6.1b, respectively.

a. Top management's ability to interpret industry trends, market conditions and product positioning

At C1, C1P2 emphasised that responsiveness depends on the top management's ability to interpret industry trends, market conditions and product positioning and stressed that effective decision-making for change relies on the talent and effectiveness of these senior managers. C1P2 explained it as follows, "*when we say adaptive, we have got to understand that, the interpretation of the industry, the interpretation of the market, the interpretation of what our opportunity is in there, how we feel our products address that market. This is done by senior management right and that senior management has or executive management has the necessary relationships with each other has the necessary communication and clarity of interpretation that they can see changes in that to be able to affect the change the company itself certainly you know they have departments they have the ability to give directions to the departments you know the business mechanisms are in place right but what drives the decisions that we need to make a change right? That is going to be interpretation of everything I just said right. So that very much depends on the talent and effectiveness of*

senior and executive manager". This highlights the importance of talent and effectiveness in senior and executive managers for navigating market complexities and steering the company towards strategic adaptation.

b. Team ability to execute work based on situations

At C2, C2P1 expressed a similar perspective, highlighting that a team can demonstrate high responsiveness during a crisis and provided an example from a project, stating that, "*we can at the same time when pushed to be very responsive. I have seen us be very responsive. So, on the this project when we were in trouble, we were doing massive branch development, on their branch regular releases. When I say regular that is as much as changes that can be absorbed right because you cannot do two regulars in other words it was at least we were doing a release every month to the client right and therefore that was an example of being responsive okay, but that is not the model which we as C2 typically like to work because it is expensive for us to do it that way*".

In the following sub-section, 4.6.2, the discussion centres on the theme of change facilitation resulting from applying AP in EA to enhance organisational responsiveness.

4.6.2 *Facilitating change*

A recurring theme in the data appears to be the relationship between responsiveness and change facilitation. According to participants' explanations, applying AP in EA enables enterprises to deliberately plan, implement and manage changes with the specific goal of aligning with market responses, which is in line with the idea in the literature about the urgent need to apply contemporary complexity theories when dealing with modern enterprises realities. These theories inspire concepts of adaptive structures and neural network-like self-organising enterprises, allowing enterprises to sense quickly, respond and act accordingly without delay (Kasemsap, 2016). Participants in both case studies, C1 and C2, share this same view and agree that modern enterprises need to operate like neural networks. C1P1 provided an example of how applying AP in EA enabled the planning, implementation and management of new security standard change and addressing changing priorities and issues as they arise. C1P1 provided a lengthy explanation and stated, "*let us say from an EA perspective we needed to have a new security standard in place on all our servers because*

that's an input into it, EA would tell us okay where are these systems, what value are they providing because at any time do you know where every server is, do you know what every one of those servers is doing, what value is each of it producing, what else are they connected to, where in the pipe do these regulations now apply. So, we would use agile to both work it out. So we would have an agile process to analyse where we would need to make changes then the work to do it would also go into an agile delivery process that feeds up into a road map of work with defined timelines of when we need to get things in place but there's always an issue of relative priority of tasks and dealing with problems as they come along in an agile fashion". At C2, participants indicated that applying AP in EA makes it easy to manage ongoing requirements, changes or issues in some cases, enabling them to re-evaluate project plans and find alternative solution approaches. C2P2 expressed it as follows, "*there is continuously other requirements the changes or issues we discover during the project which sort of forces you to go but back to the drawing board sometimes and in some instances there is some way we can do it differently in [C2_platform] or unfortunately some of the times it ends up in a new development or a change that we need to do*". The following sub-section, 4.6.3, will discuss the theme of agility.

4.6.3 *Achieving agility*

The central motivation for applying AP in EA is to enable modern enterprises to respond promptly and strategically execute initiatives that address continuous and unexpected changes in a globally competitive market (Hinkelmann et al., 2016). The analysis conducted thus far has demonstrated that applying AP in EA can indeed enhance the adaptability and responsiveness of enterprises and their information systems in dynamic environments, as suggested in the literature (Onik et al., 2017). When participants from both C1 and C2 were asked about their ability to identify agility and explain it, their responses varied, maybe because of their different backgrounds and contexts. However, all of their explanations pivoted around viewing agility as the ability to respond promptly to change, adapt to evolving circumstances and efficiently address problems or inefficiencies. While the participants emphasised elements like standardised interfaces, speed of deployment, and the role of cloud computing in achieving agility, they all share a common theme of adaptability and responsiveness as key characteristics of an enterprise with agility capability. The following quotes demonstrate this analysis:

"*My identification of agility would be that if I come with a particular problem and I come with a very clear brief of how that is diminishing value within a system that I control, if the organisation can respond to that very clear business case which is quantified in its monetary impact or its process or efficiency impact. Does the organisation respond, are we able to organise to change to improve or is that constantly shifted out and pushed under a rug somewhere because it's too awkward to try and make it better? So, I define that event if I have an inefficiency, if I have a problem, is there an approach to resolving it or is this something that just does not happen and I associate C1 very much with very clear responsiveness to that kind of business case, whereas other environments I have been in you come with your problem no one cares you are just it just doesn't matter just live with it is the answer. More often than not we cannot do this because we would not even know where to start*" C1P1 at C1.

"*Agility in my head speaks to the ability to respond to changing circumstances whether it be to scale up, whether it be to extend, extensibility, you know how to integrate, how easy you know which are often within how easy is it to integrate with other systems…*", C2P1 at C2.

"*I think it is how efficiently and how quickly you can adapt to change but also focus on you need to continuously learn and collaborate because it is one thing yes we can adopt a change and quicker or in a better way but if there is nothing that comes out of that process in terms of stuff that we have learnt new ways of working. Continuous collaboration because I think it is very important to have that collaboration and communication between the teams and the customers",* C2P2 at C2.

"It is being able to respond to the needs, to change quickly", C2P3 at C2.

a. Role of technology architecture in achieving enterprise agility

A sub-theme emerging from data linked to this agility theme is the role of technology in achieving enterprise agility. This is underscored by the adoption of design strategies that leverage patterns and capabilities that enhance architectural agility and reduce complexity in applications and team interactions. Based on the explanations from the participants and secondary data, the focus appears to revolve around a modular approach to software development. Four key concepts emerge to explain the participants' perspectives, namely, microservices, standard interfaces, pub-sub pattern and cloud computing.

For instance, data sheds light on the microservices concept, particularly in the context of acquisitions, where the practical application of AP in EA can facilitate agility in integration of acquired companies into the existing infrastructure. This may involve aligning IT systems, data migration and ensuring business processes remain efficient during the transition. This view is based on C2P3 explanation at C2, who explained, "*we have only really now arrived at a point where we can do truly agile work which is what we are doing with some of the microservices work on the back of the acquisition of [hidden_company_name]… working for firms who were doing consolidation work, acquiring advisor firms, migrating advisor firms from one back office system onto another, migrating them from one platform to another*". Other participants also echoed the concept of microservices mentioned by C2P3. Within the context of AP, the data seems to suggest that this microservices concept enables an organisation to develop and deploy modular solutions, facilitating the quick delivery of new functionalities, enhancements and innovative ideas into the market, as explained by C2P4, "*I think what you have got to realise is that to me the microservice is agile. So, agile is an approach. How do you do the development, how do you work as an organisation and then the microservices is how do we deliver things, how do we deliver these products, these pieces of functionality and the two are mutually beneficial of each other. So actually with inside the microservices as we deliver them out we use agile to actually deliver additional functionality*".

C2P3 further explained how the immediate functionality is realised from within the deployed new application through the utilisation of the publish-subscribe paradigm and stated, "*you should be able to deploy the new application and it should be able to subscribe to a topic in the data broker and immediately start working and immediately start publishing to that data broker. So, you abstract away the complexity of the API and you end up with much less complexity and dependency in your API build and that is kind of a real world example of how we are trying to build more agile architectures. We are moving more and more to pub-sub patterns doing more stuff with big data and relying less on coupled applications through direct API calls".* Based on the explanation provided by C2P3 and secondary data on C2D3 – [Hidden Product Name] Architecture, it seem to suggest that Pub-Sub, is short for Publish-Subscribe, a messaging pattern used in software architecture to enable communication between different components, services, or internal and external systems.

Other participants discussed APIs from the context of large organisations and cloud computing, emphasising that agility stems from two primary factors: firstly, the capacity to

recognise and implement standardised interfaces within systems, and secondly, the rapid deployment of tools, with cloud computing representing a significant enabler of agility within architectural frameworks. C2P4 at C2, explained, "*When I am talking about big organisations, for me agility comes from two key. The first is the ability to identify and deliver standardised interfaces into systems. The second bit is probably speed of deployment of a tool and I guess to me that the idea of cloud computing is one of those things that gives us agility in an architecture*". Data suggests that cloud computing also contributes to scalability which can lead to agility, a point raised by C1P2 at C1, "*we made the decision to really move to the cloud and utilise a SaaS (Software as a Service) concept which meant that the database needed to be multi-tenant, we needed to have scalable enterprise architectures*".

This sub-section 4.6.3 discussed how applying AP in EA helps modern enterprises to navigate the challenges of an ever-evolving and competitive global market. Through an analysis of participants' perspectives on agility, it becomes evident that leveraging AP in EA helps enterprises achieves adaptability and responsiveness. While responses varied among participants, they collectively viewed agility as the capacity to promptly address change, adapt to shifting conditions and efficiently tackle challenges or inefficiencies. Key sub-theme of the role of technology architecture in achieving agility emerged underpinned by elements such as standardised interfaces, rapid deployment of modular software enabled by microservices and the integration of cloud computing. The following section, 4.6.4, discusses the theme of maintaining up to date architecture.

4.6.4 *Maintaining up to date architecture*

The literature has noted a concern that modern enterprises struggle to keep up with the rapid changes around them (Sousa et al., 2017). One of the struggles is that it is hard to accurately represent their current, transition, and target state as described in their architectural descriptions (Gong & Janssen, 2019). The problem is that when the business environment changes, these documents become outdated and are no longer helpful in planning and improving the enterprise (Kaddoumi & Watfa, 2016). The data provide insights into potential solutions for this problem. Both participants at C1 and C2 noted that agility characteristics, as discussed in sub-section 4.6.3, should inherently involve processes for maintaining and updating EA documentation. In this view, AP and the whole agile delivery process are valuable for ongoing documentation updates and ensuring documentation remains up to

date. At C1, C1P1 described it in this manner, "*well, agile is one of those wonderful things where you can define the expectations to come out of the process on an ongoing basis. So, what is great about agile is… so when you have got a heavy load of documentation to do, potentially at the end, once you have done a whole bunch of work. Agile is parts. So, in a two week cycle or a one week cycle update the parts that you have worked on you. You are taking that complexity and you are reducing it to a simple more manageable outcome and then you can build, update of documentation in to each and every work cycle and then it just becomes easier to keep everything up to date*". At C2, majority of the participants simply stated it that this need to be part of the process, for example, C2P2 stated simply, "*EA documentation it needs to be part of the process right.. when your house is clean it is easy to keep it clean but if your house is filthy it can be hard to actually get it to a clean state so there is a lot of catch up… keeping the documentation as a deliverable as part of whatever you are doing is a key part of it*". The following sub-section, 4.6.5, will discuss the theme of sales.

4.6.5 *Enabling sales*

One of the AP promises stated in the literature is the ability to deliver rapid and reliable business value by engaging customers and continuously learning and adapting to customers changing needs and environments in an iterative fashion (Ciric et al., 2018). Sales emerged as a recurring theme, providing context for EA's adaptability to the enterprise's needs and changes when using AP. From the data, both at C1 and C2, it appears that sales serve as a scenario demonstrating how AP enables interactions with both existing customers and potential customers, ultimately translating these interactions into successful deals. The following quotes support this analysis:

"*All of those sorts of things where I think EA becomes an increasing focus area for us and how we think of our company in a consolidated fashion but very much servicing the same need into the asset management industry, a variety of tools to largely focused on sales and marketing enablement*", C1P1 at C1.

"In our context of our organisation right that happens at the sales phase because they buy… there is an RFP (Request for Proposal) where we then demonstrate and show what capabilities we deliver and then it is about executing on that but there is the customer solution design certainly where we have got to unpack more detail around that around where our

solution fits in with the ecosystem the client's ecosystem to align on their EA, the client's EA not our enterprise", C2P2 at C2.

"*We quickly won the [hidden_client_name] as a client. I was kind of involved in the pre-sales activities, had some involvement in mobilising some of those projects. The client wants certainty of certainty of scope, they want certainty of delivery. So, they want to know when they are getting it and they want certainty of cost*", C2P3 at C2.

"*I think probably the only other thing I would say is having worked in scenarios and for firms which are obviously suppliers to other people, I think agile is a funny enough a really good sales tool as well. I know that might sound a bit silly but it is surprising how it resonates with people when you talk about the idea of smaller iterations seeing things close quicker all of that sort of thing*", C2P4 at C2.

4.6.6 *Aligning technology and business*

The literature highlighted a growing interest among researchers and practitioners in EA driven by recognising the importance of business and IT alignment (Foorthuis et al., 2016; Nurmi et al., 2019; Saint-Louis et al., 2019). In the context of EA projects, participants from both C1 and C2 hold differing perspectives on how EA and agile AP approaches help an enterprise adapt to changing needs. However, from an EA perspective, most participants align with the literature, stating that EA facilitates technology alignment with business goals. C1P2 at C1 illustrated this way, "*my specific view is looking at EA as a discipline that aligns technology with business goals or with business objectives. So, I am going to say the first thing you got to do is to understand what are the differences you know between agile methodology as applied to engineering versus architecture okay so in the case of engineering the business goals and the technology that we think we are going to apply".* Sharing the same view of aligning technology with business at C2, C2P3, stated "*Our job really is to go to a client site and understand what they do, understand their existing technology stack, understand how that is going to change and understand the role that our applications will play in that future state and actually come up with a coherent vision of what that collection of applications and services looks like*". Based on these explanations, it appears that the perceived business-IT alignment results from the capabilities enabled by EA, including aspects such as market understanding, opportunity identification and the appropriate use of technology to address

specific business challenges. C1P2 at C1 summarised this observation and stated, "*So it is an interesting topic right. So, if you think about it this is a multi-vector problem, right. Why am I developing something? Yes right, I am trying to take advantage of an opportunity, business-wise okay. So, business-wise is the thought of taking advantage of an opportunity you know, understanding a market, seeing a gap in that market either from efficiency or supply of functionality and then trying to address it*". This seems to imply that EA and AP are employed throughout the entire change process, phase or step, from planning to execution. The following sub-section, 4.6.7, concludes this section 4.6 EA project adaptability to the enterprise's needs and changes using AP.

4.6.7 *Summary*

In this section, the focus has been on the adaptability of EA projects using AP and their potential impact on business outcomes, adding value for both the business and its client base. Figure 20 depicts how the concepts from sections 4.3 and 4.4 collaborate to achieve the desired business outcomes of modern complex enterprises.

The analysis has suggested that responsiveness involves quickly adjusting to changing needs. When changes are facilitated effectively through applying AP in EA, enterprises become more agile, resembling the characteristics predicated by CAS theory, allowing them to respond promptly to shifting market circumstances. This agility, as demonstrated, has tangible advantages, particularly in enabling sales and marketing activities. Agile delivery processes and methods support continuous collaboration and learning, simplifying essential processes that ensure EA remains up to date. An up to date architecture can enhance efficiency and customer focus, thereby improving sales outcomes. Participants from both cases emphasised the significance of maintaining up to date architecture, as it plays a vital role in aligning technology with broader business objectives. Participants cited microservices as an example of technology and acquisitions and sales as examples of business, illustrating how the application of AP in EA supports integrated and efficient functioning within modern enterprises, enabling them to stay relevant and adaptable in the face of changing conditions. This section has explained the outcomes of responsiveness, change facilitation, agility, up to date architecture, sales and alignment between technology and business, empowering enterprises to thrive in today's complex environments. The following section, 4.7, discusses and analyses the barriers to applying AP in EA.

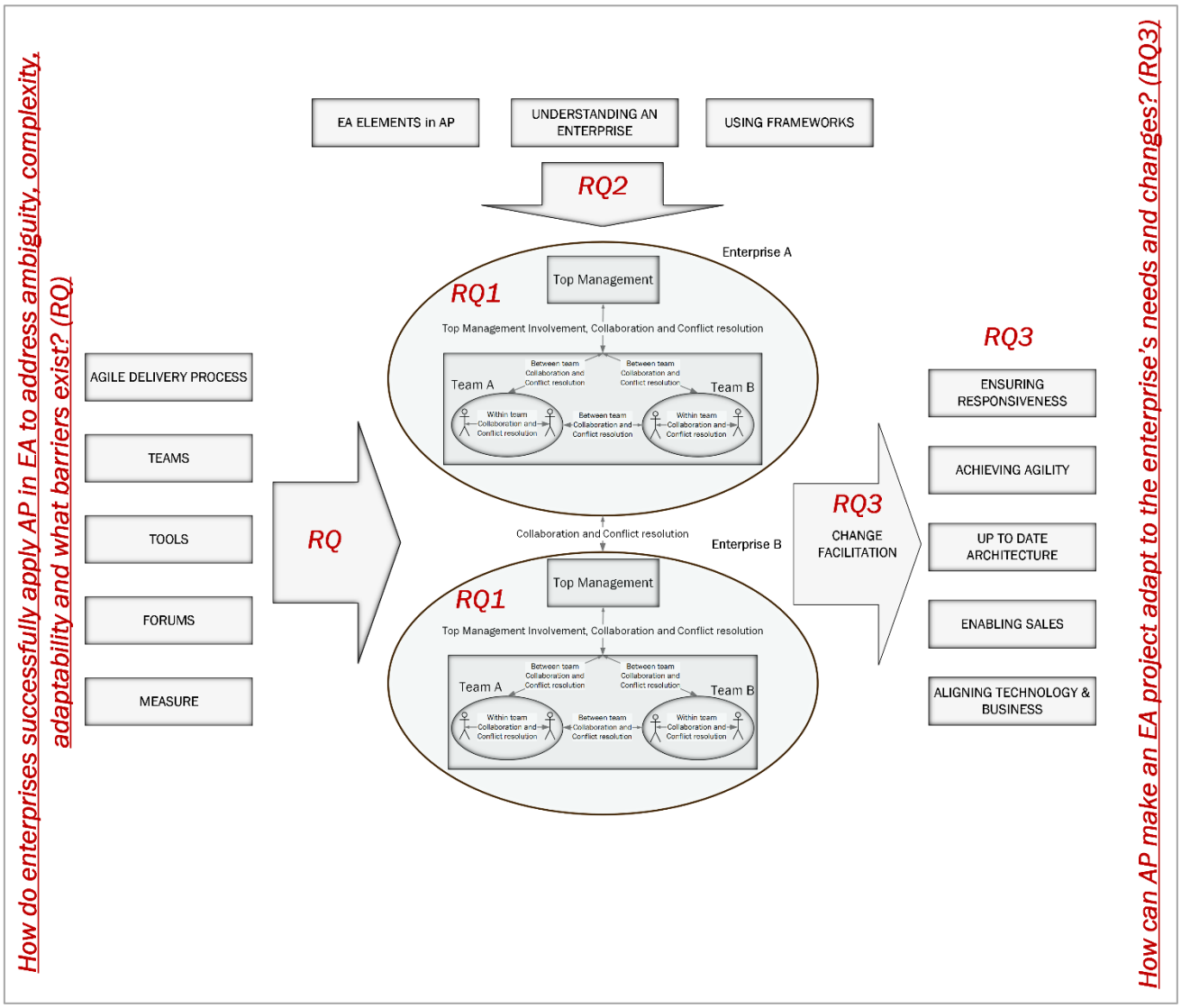


Figure 20. EA project adaptability to the enterprise's needs and changes using AP.

4.7 Barriers of AP in EA

Up to this point, the analysis has examined the application of AP in EA. It has explored its general application, its role in reducing EA ambiguity, its contribution to simplifying enterprise complexity and how it enhances adaptability to meet the ever-changing needs of the enterprise. The literature noted that despite the potential benefits of EA reported by academics and practitioners, costly and ineffective EA initiatives, influenced by factors such as technology, social context, organisational structure and communication challenges, often result in unmet expectations and project failures (Foorthuis et al., 2016; Gerber et al., 2020; Hazen et al., 2017; Uludağ et al., 2019). This section 4.7 delves into and examines the challenges or problems that have become apparent from the data in applying AP in EA. Table

9 summaries these challenges. The challenges or problems themes to be discussed include the following: challenges in organisational culture (discussed in sub-section 4.7.1), lacking skills in AEA (discussed in sub-section 4.7.2), resistance to change (discussed in sub-section 4.7.3), lack of centralised control (discussed in sub-section 4.7.4), agile processes precedence over business value (discussed in sub-section 4.7.5) and EA as a bottleneck (discussed in sub-section 4.7.6). Sub-section 4.7.7 concludes and summarises this section.

4.7.1 *Challenges in organisational culture*

The collaborative culture supported by AP plays a vital role in achieving the architectural outcomes that business leaders aim for, which include expecting early returns on investment and realising value from EA projects (Kaddoumi & Watfa, 2016). At the same time, this culture can also potentially hinder the realisation of these desired outcomes. In the data analysis, several elements of organisational culture have been identified as obstacles to applying AP

Table 9. Barriers of AP in EA findings summary.

Themes	Files	References	C1	C2	Related Literature
Understanding barriers of applying AP in EA (RQ4)	***5***	***29***			
Challenges in organisational culture	3	8	X	X	Kaddoumi & Watfa, 2016
Lacking skills in AEA	5	8	X	X	Lankhorst, 2017; The Open Group, 2018
Lacking centralised control	4	7	X	X	Aljlayel, 2016; Banaeianjahromi & Smolander, 2019; Perez-Castillo et al., 2019
Resistance to change	3	5		X	
Agile processes precedence over business value	1	1	X		
EA as a bottleneck	1	2		X	

in EA, including reputation within the organisation, communication challenges and the types of organisational structures. At both cases, participants agreed on the reputation of agile. At C1, C1P1 shared this perspective "*I would say agile is a… it comes with a certain level of sin as in agile has a terrible reputation for also being too fanatically process driven like uh oh no*

we must uh subscribe to this defined method of doing agile. Whereas I believe that agile actually sits behind that in the agile manifesto principles which is I do not care if it is going to be SCRUM or Kanban or whatever it is going to be it, must service basic value needs and I think that is actually the basis of agile versus SCRUM as an expression of it." At C2, the reputation of AP is influenced by people's hesitation due to a lack of successful past experiences with agile. The perception is that achieving success with AP requires a cultural change. C2P1 elaborated on this view, "*I think people generally have an awareness of what agile could be, but I do not think there is anyone that has really seen successful agile and therefore there is a general apprehension towards it. Although I would be an agile advocate but just it is a difficult thing to get right unless you change the culture and the values of people as we*ll".

Another view brought forward at C2 around culture is bureaucratic organisation. C2P1 explained further, "*but also the challenges that you can be faced with if you have a very bureaucratic organisation where you cannot get anything done as well… it is hard to do that if people do not have like the right belief systems in terms of non-hierarchical transparency and trust so that you can have the interactions that are honest*". Other characterises of a bureaucratic organisation were mentioned by C2P2, who stated, "*One that comes to mind is keeping your team motivated because without a motivated team, I think it is going to be hard to reach the deliverables… if you have got a team that is skilled enough but you try and micromanage them and you do not give them the freedom to make decisions as we go along with the project… at the end of the day you know if you think about it if that team is not happy, motivated, skilled enough, given the right opportunities and tools and techniques and support to do their job, what are we going to achieve in any project, in the world nobody's getting the work done, nobody's going to get paid, nobody's going to get the product or service they asked for so that's going to be a big problem".* At C1, C1P1 attributed all the cultural problems leading to the failure of AP in EA to communication issues, stating that, "*well, I think it comes down to communication and common understanding*".

4.7.2 *Lacking skills in AEA*

In sub-section 4.3.2, it was discussed that agile teams can be viewed from two perspectives: either as teams analysing and designing systems and producing architecture descriptions (The Open Group, 2018), or as various observers of an enterprise with different concerns or

interests, which the architecture descriptions aims to address (Lankhorst, 2017). The data suggests that teams may struggle to achieve their goals without the right skills. Participants at both C1 and C2 shared this view. At C1, participant C1P1 expressed it as follows, "*I am familiar with corporate structures and the pace of technology change and the pace of systems change in those environments where things are very measured slow sometimes decades long to get rid of systems that are effectively redundant and there are no skills to service them you know there is this one guy in there. So, in contrast C1 is highly adaptive to using newer technologies to solve problems because of access to skills*".

C2P4 at C2 provided examples of these types of skills and explained that, "*If you do not get that right as well and it is amazing how often I have seen RFPs (Request for Proposals) RFIs (Request for Information) and people fail those because they have not been able to articulate their architecture well enough and I think again being able to articulate those architectures and what your plans are and how you want to move forward are really key*". This failure may be attributed to a lack of experience, as pointed out by C2P2, *"I think without having experience in embedding these principles and methodologies in projects you work in, I think it comes with experience. So, if you have not had a lot of exposure or working in an agile manner it is going to be very difficult to number one in the beginning, to adjust to that and from wearing the other hat where you may be a SCRUM master or project program manager where you need to make sure that you try and embed these principles if you have not got that experience ...I think it just comes with practice and how you can help and guide your team to adopt these principles that is the challenge*". The views shared by participants at both C1 and C2 highlight the critical importance of skills acquired from experience in applying AP in EA.

4.7.3 *Resistance to change*

Aligned with the researcher's philosophical position that reality is subjective and the reality of each person is different (Scotland, 2012; Van Zyl, 2015), the majority of participants at C2 suggested that people within organisations, whether on the supplying or receiving end of services, will always have varying perspectives on change, regardless of whether AP is applied or not. C2P4 stated that, "*I think there are people in at all organisations who are happy with the way that they have done stuff for the last 20 years and will want to continue doing stuff for 20 years and I have seen people that have not dealt with change in my career*".

While applying AP in EA can facilitate change, it appears, based on C2P4's view, that individuals within agile teams can also significantly support or resist change by clarifying or confusing requirements. However, the reviewed literature does not explicitly address the reasons behind not supporting change, for example, including fear of the unknown, uncertainty about the impact of change, a lack of trust in the change process or the possibility of withholding necessary knowledge for altering elements of the enterprise, which also remains unclear in the data. Some indirect reasons for this situation may include a dependency on other parties for information and a lack of forward thinking. The two following quotes support this observation:

"I think for me you are reliant on your suppliers to a big extent when it comes to some of that, particularly around compliance changes. I mean you have to be reliant on the people that are supplying you the software", C2P4 at C2.

"*We are not especially reactive in that way and the reason for that is that we are not outward looking. So and this is again something I want to change our people have their heads down… which means we do not innovate and we do not see what is coming next and we do not anticipate the market movements. We are always reacting, we are never proactive and we want to change. If we change a product culture and a product mindset part of our people's job will be to look outward to the market*", C2P3 at C2.

4.7.4 *Lacking centralised control*

While the literature and data suggest that EA is widely employed as a continuous-change process to align various aspects of the enterprise, such as strategy, mission, vision, structure, business processes, and IT systems (Aljlayel, 2016; Perez-Castillo et al., 2019), this alignment may appear lacking in practice from another perspective when implemented in AP context. Participants from both C1 and C2 shared different perspectives, all highlighting the same issue: a lack of centralised control as a challenge of applying AP in EA. At C1, C1P1 stated that, *"I would say EA here at C1 is not entirely centralised. So, technology has a very solid grip of all the technologies and processes in play on their side, product has a very solid grip on all the things that they are doing, but to some extent there is a tension of a lack of centralised control around those aspects*". At C2, the perception tends to be towards lack of governance, guidelines and principles. C2P2 expressed as follows, "*how do you practically*

make it work, how do you practically look at some of these guidelines and principles and embed them in your team and your day-to-day processes?". C2P4 explaining the lack of governance, explained, *"I think are important particularly when applying agile one is the governance or the architecture governance that needs to in some ways actually sit outside of the agile processes and I have seen scenarios where an agile team have gone off and done work that has had to be completely redone because they have used a tool that the enterprise as the architecture team were not comfortable delivering or was not allowed or went down a path that used the wrong technology*".

The data seems to suggest that this lack of centralised control is a result of the general view of EA complexity (Banaeianjahromi & Smolander, 2019), as stated by C2P3, who said, "*The problem with EA is that it is kind of too large to do*". However, this directly affects the desired outcomes. For example, maintaining up to date architecture, especially in large organisations, as acknowledged in the data, with a need for dedicated and consistent efforts to keep documentation aligned with evolving enterprise needs as highlighted by C2P4 at C2 who stated that, "*It is very difficult to manage. I think to keep EA documentation up to date as well. I do not know the answer to how that one works or how to deal with that because I just do not think I have seen it ever done particularly well anyway in fact well with a slight exception if there was a dedicated documentation team but even that I think it is still a bit of a challenge*". In this view, this dedicated documentation team mentioned by C2P4 can also be related to or form part of the desired centralised control team. Another view is of solution ownership also related to lack of centralised control as explained by C2P3, "*I think what so many of our clients miss is that really strong solution ownership. So you kind of the architect, the architect sets the direction of travel they draw, the sort of blueprint for the whole program and then they kind of walk away and it does not mature, it does not iterate, it does not evolve and the reason that that does not happen is that there is not that sort of solution ownership".*

4.7.5 *Agile processes precedence over business value*

While only one instance was cited in case C1, it is suggested to acknowledge the risk of becoming overly process focused to the extent that the primary focus shifts away from delivering business value. C1P1 explained, "*But people can become extremely process focused where they sacrifice value because the process becomes sacred*". It remains unclear, both in the literature and from the gathered data, whether teams adhere rigidly to

agile processes, prioritising them over the ultimate goal of delivering valuable outcomes to the business and its stakeholders because of agile popularity (Duijs et al., 2016). However, the researcher perceives this behaviour as potentially stemming from various factors, including misinterpreting AP. Therefore, this study suggests that teams must balance adhering to AP and ensuring they remain aligned with delivering tangible business value.

4.7.6 *EA as a bottleneck*

There is also a perception among participants that sometimes solution or EA can bottleneck agile teams. An example of this perception is the explanation provided by C2P1, who stated that, "*But they also do not have the transparency of what they cannot do. It means that solution architecture is a bottleneck right. I have seen solution or EA as a massive bottleneck because you cannot get answers out of them okay in terms of the architecture board right*". This can be a result of other barriers already discussed, such as lack of AEA skills, lack of centralised control or lack of solution ownership. The perceived opposing result is that when stakeholders are unaware of constraints, decision-making processes can be delayed, and projects may suffer. This can strain relationships between business departments and architectural and agile teams, hindering collaboration and innovation. The study suggests that it is necessary to mitigate the perception of architecture as a bottleneck and align architectural decisions with business objectives in an open environment.

4.7.7 *Summary*

In sub-section 4.7, barriers hindering the practical application of AP within EA were discussed and analysed. Six themes emerged as obstacles to this desired approach: challenges in organisational culture, lack of AEA skills, resistance to change, lack of centralised control, agile processes precedence over business value and EA as a bottleneck. These themes are illustrated in Figure 21. Culture, mainly bureaucratic organisational structures, is perceived to hinder agility, creating slow decision-making processes and sharing of information and ideas across teams and departments, causing delays and misalignment. This impacts EA's reputation within enterprises. The shortage of skills and experience in implementing EA and AP is a common roadblock brought forward by participants from both C1 and C2. Resistance to change, stemming from people's unwillingness to adapt to new methodologies, further

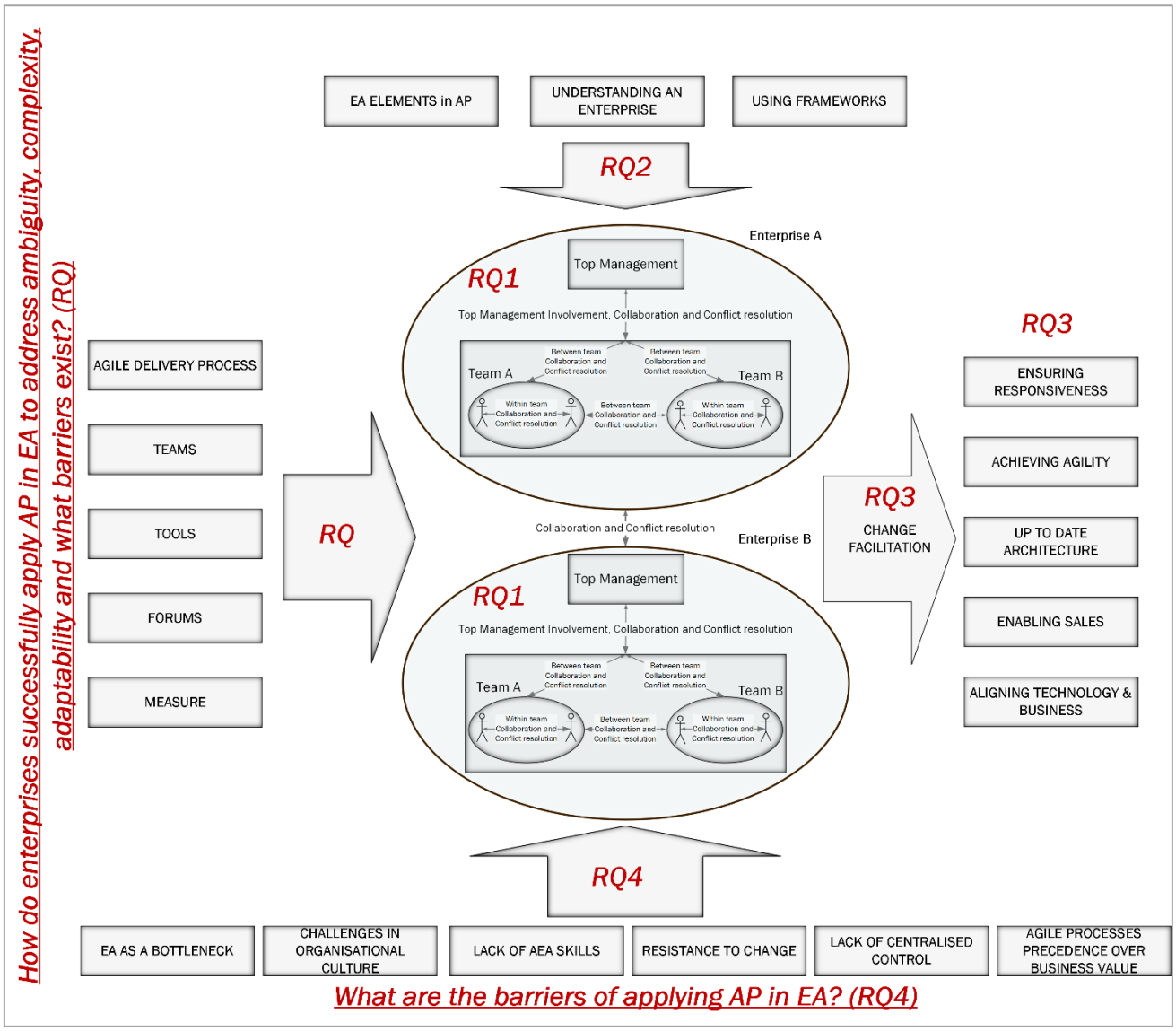


Figure 21. Barriers of AP in EA.

makes it difficult to apply AP in EA. The absence of centralised control and governance structures makes it challenging to consistently guide and enforce AP and EA guidelines throughout the organisations, resulting in inconsistency and non-compliance with AP, out of date architecture and no ownership and accountability. The following sub-section, 4.8, presents a summary of the findings.

4.8 Summary of findings

This study aimed to explain how to apply AP in EA. At the beginning of chapter 4, the two enterprises under study were described to set the context for the interpretation and

discussion. In each sub-section, results were presented, interpreted, discussed and summarised. In sub-section 4.3, the researcher explained how AP is applied in EA continuously. Five themes emerged from the data that help provide this explanation: implementing agile delivery processes, building high-performing teams, leveraging tools in agile delivery processes, measuring agile delivery performance and governance and communication through forums and ceremonies. A summary of these themes is presented in Table 4, and a diagram showing the relationships between the themes is given in Figure 13. A practical example of an agile delivery process in case C1 is presented in Figure 14. The agile delivery process theme further yielded four sub-themes: using sprint-based planning and execution, managing change through programs and roadmaps, managing change through backlogs of itemised work and dynamic prioritisation of changes. The relationship between these agile delivery processes sub-themes is visualised in Figure 15.

In sub-section 4.4, the researcher explained how AP reduces EA ambiguity by discussing three themes from the data: enabling collaboration which can be both within team and between team collaboration, involvement of top management in setting strategy and facilitating conflict resolution. A summary of these themes is presented in Table 6. A diagram was then provided in Figure 16 to show how, through the agile delivery processes, teams, tools, measures and forums empower internal and cross-team collaboration and secure top management’s support and conflict resolution.

In sub-section 4.5, the researcher explained the complexity of modern enterprises and how applying AP in EA can reduce it, emphasising the role of alignment, complex system views, and frameworks by discussing three themes: utilising the EA elements in AP, understanding an enterprise and using frameworks through documentation, visualisation and learning. A summary of these themes is presented in Table 7. The framework concept is divided into three sub-themes: documenting the structure and behaviour of an enterprise, communicating with visualisations and learning. These sub-themes and their relationships to each other are depicted in Figure 17. Figure 18 then illustrates how these themes, utilising EA in EA, understanding an enterprise and the use frameworks and themes discussed in sections 4.3 and 4.4 collectively reduce enterprise complexity and enhance adaptability in dynamic business environments.

In sub-section 4.6, the researcher focused on explaining how applying AP in EA enables EA project adaptability to the enterprise's needs and changes by discussing six themes: ensuring responsiveness, facilitating change, achieving agility, maintaining up to date architecture, enabling sales and aligning business and technology. Two sub-themes under responsiveness were discussed: top management's ability to interpret industry trends, market conditions and product positioning and team ability to execute work based on pressing situations. A summary of these themes is presented in Table 8 and Figure 19. These themes are seen as desired business outcomes. Figure 20 shows how these themes are achieved as desired business outcomes in modern complex enterprises from the collaboration of sub-sections 4.3 and 4.4 themes.

In sub-section 4.7, the researcher explained the six themes that emerged as obstacles to applying EA in AP: challenges in organisational culture, lack of AEA skills, resistance to change, lack of centralised control, agile processes precedence over business value and EA as a bottleneck to agile value delivery. A findings summary of these themes is presented in Table 9. Figure 22 summarises all the sub-sections discussed in one diagram, showing three allows as input mechanisms for applying EA in EA enterprise and one output as the outcomes of the inputs.

4.9 Challenges and limitations of the study

As indicated in the data and literature, EA is a complex field and very sensitive because it captures the essence of the business operations and the technology used. The FSI targeted by the research is also a very sensitive industry and highly regulated, making it even more challenging to access participants. The secondary data retrieved by the researcher from the participating organisations is subject to strict restrictions. Because of this combination of EA and the FSI nature, finding FSI organisations willing to participate in the study was challenging. This constrained the number of cases to only two, although the researcher had initially planned for four when designing the research. The researcher tried all necessary means to get more than two cases. However, this was not possible. Also, given the nature of the degree of this Masters of Commerce in Information Systems program, the researcher was bound by the duration of the course.

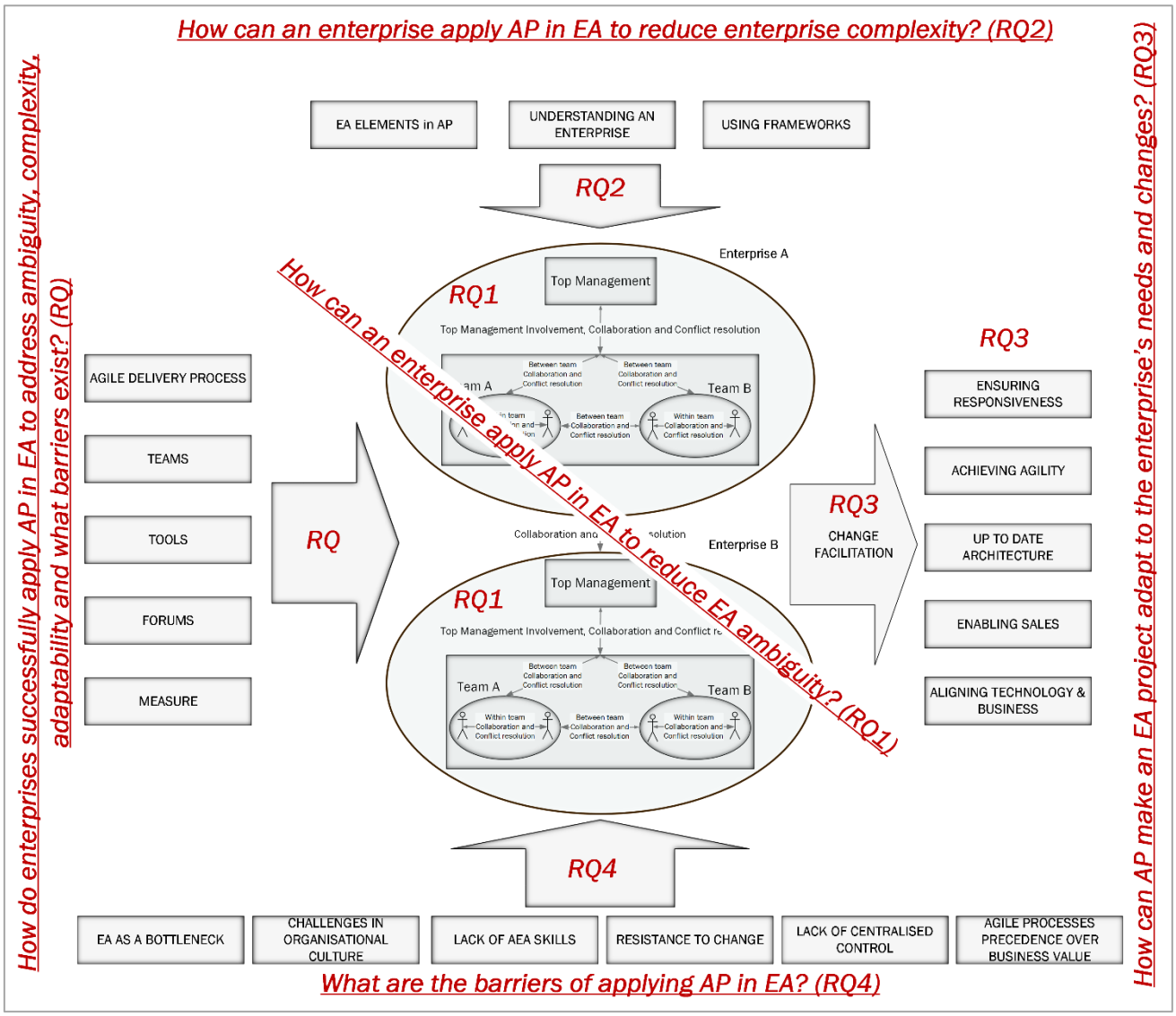


Figure 22. Summary of findings.

Although the researcher, an interpretivist with over a decade of experience in the IT industry, has never practiced the discipline of EA. This lack of experience doing actual EA work might have influenced the substance of the questions and interpretation provided in the analysis of the study. From another point of view, the researcher's experience in the IT industry and working in agile enterprises might have subjectively influenced both the questions and the explanations provided in the study. The following chapter 5 concludes this study by providing a summary, discussion and future recommendations from this study.

5 CONCLUSION

Chapter 1 of the study introduced the study. Chapter 2 provided a literature review of the study, showing how the research questions were derived. Chapter 3 defended the research methodological choices based on the researcher's epistemological and ontological assumptions stemming from the researcher's interpretivism philosophical position. Chapter 4 discussed, interpreted, analysed and summarised the research findings. The goal of this chapter 5 is to present the conclusions drawn from the study. The research questions are restated, and each question's key findings are presented. This is followed by a discussion of the implications of the findings, both from theoretical and practical perspectives. The suggestions for future research then conclude this section.

5.1 Summary

The purpose of the study was to explain how to apply AP in EA. This was achieved by answering the main RQ: How do enterprises successfully apply AP in EA to address ambiguity, complexity, adaptability and what barriers exist? This main RQ was answered by conducting two case studies at C1 and C2. C1 and C2 are companies operating in the FSI across the Asia Pacific, Europe, the Middle East and Africa and North American regions. The main RQ was sub-divided into four sub-research questions:

1. How can an enterprise apply AP in EA to reduce EA ambiguity? (RQ1)
2. How can an enterprise apply AP in EA to reduce enterprise complexity? (RQ2)
3. How can AP make an EA project adapt to the enterprise's needs and changes? (RQ3)
4. What are the barriers of applying AP in EA? (RQ4)

Figure 23 shows a summary of the themes that were provided as answers to the main RQ and sub-research questions.

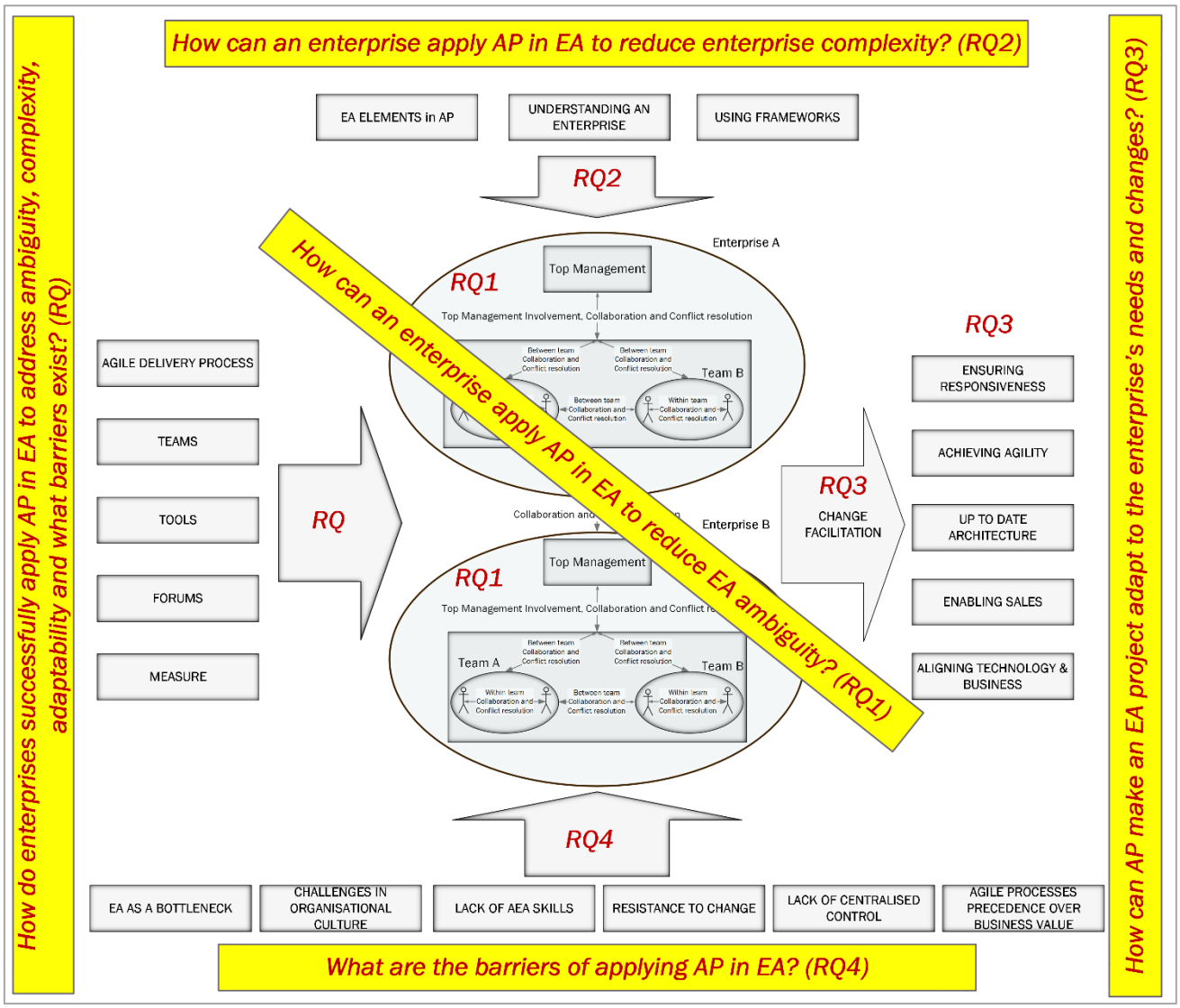


Figure 23. How do enterprises successfully apply AP in EA to address ambiguity, complexity, adaptability and what barriers exist?

5.2 Discussion

The generalised understanding from the data and literature confirmed that AP are the new ways of working for modern enterprises (Duijs et al., 2016). C1 and C2 confirmed their use of AP. The data revealed five concepts that explained this way of working: agile delivery process, teams, tools, forums and measures. The new way of working emerged as an agile delivery process executed to produce an outcome that enables the enterprise to embrace and respond to its operating environment. The research findings suggest the concepts of an agile delivery process, which is sprint-based, made up of programs of projects, a backlog of tasks to be executed and priorities, a team that executes the process, tools that are used in

the process by the team, forums where the teams discuss the process, priorities and the tasks.

EA is characterised by the absence of a shared meaning in any or between enterprises (Hummel et al., 2016). AP is seen as a solution in helping to bring a common EA understanding (Nurmi et al., 2019). According to the data, answering “RQ1: How can an enterprise apply AP in EA to reduce EA ambiguity?”, the explanations provided showed how the agile delivery process reduces EA ambiguity by promoting collaboration, involves top management in setting right strategies and enables smooth conflict resolution within and between enterprises.

Modern businesses face complex and ever-changing environments with global competition, shifting customer demands, evolving regulations and rapid technological advancements (Lapalme et al., 2016; Schilling, 2018). This makes modern enterprises, that is, complex systems challenging to manage and understand (Banaeianjahromi & Smolander, 2019; Foorthuis et al., 2016; Lumor et al., 2019). AP applied in EA is seen as a solution to cope with this complexity (Sohi et al., 2016). Answering “RQ2: How can an enterprise apply AP in EA to reduce enterprise complexity?”, the data reveal that while reducing EA ambiguity, the enterprise complexity is also reduced because of the effective use of EA. The effective use of EA is assumed to be facilitated by three other related concepts: understanding of an enterprise, utilising EA elements in AP and frameworks.

The realities of EA ambiguity and enterprise and environment complexities are making it vital and essential for today’s businesses to respond quickly and adapt effectively to ongoing and unforeseen changes in a competitive global market by changing how capabilities are carried out and the information systems used to automate them (Hinkelmann et al., 2016; Onik et al., 2017). The outcomes of a combination of reduced EA ambiguity (RQ1 explanations) and enterprise complexity (RQ2 explanations) is an agile and responsive enterprise, answering the “RQ3: How can AP make an EA project adapt to the enterprise’s needs and changes?”. According to the data, the characteristics of such an enterprise using AP in EA are that it can facilitate change promptly, incorporates processes in their changes to ensure that architecture is always up to date and reflects reality as observed, is in sync with the market conditions supporting sales and marketing activities effectively and strong ability in aligning business goals and technology. However, the study acknowledges the difficulties of this

reality by stating barriers of applying AP in EA. The identified barriers are culture, skills, resistance to change, prioritisation of agile processes over business value, lack of centralised control and perceived view that EA can sometimes act as bottleneck in enterprises required changes. The following section, 5.3, discusses research contributions to theory and practice.

5.3 Findings implications to theory and practice

The study formulated a theoretical framework that explains how to apply AP in EA, which can help from two perspectives. First, this formulated theory provides empirical evidence to guide how AP can be applied in the EA discipline. This empirical evidence fills the limited knowledge acknowledged in the literature (Duijs et al., 2018; Tripp et al., 2018) and contributes to the EA body of knowledge. Second, the researcher hopes that the formulated theoretical framework will assist in showing and guiding how AP can be practically applied to EA and minimise industry confusion on whether AP can be applied in EA (Santos & Blosch, 2018; Thummadi et al., 2017).

Compared to the literature, this study's findings align with prior research on the role of AP when applied in EA to address common enterprise challenges of today and tomorrow. However, this study demonstrates how AP in EA promotes adaptability, addresses ambiguity and manages complexity in globally distributed financial services enterprises.

Integrating CAS theory into practical EA methodologies further strengthens this study's contributions to the EA discipline. This research highlights how real-world, globally distributed financial services enterprises, characterised by inherent complexity, wide-ranging regulatory obligations and operations in dynamic and competitive global markets, are embracing complexity rather than avoiding it. Teams are experimenting with solutions, learning from outcomes and scaling successful strategies across enterprises. This study demonstrates how AP in EA manages complexity by breaking down large systems (enterprises) into smaller, manageable components. Modular designs and iterative approaches enable teams to address specific parts of an enterprise (a system) while maintaining a holistic view.

Previous literature has emphasised the theoretical underpinnings of EA as a complex system (Lankhorst, 2017). This study offers empirical validation by showing how diverse teams within and across enterprises put these EA concepts into practice. Practical mechanisms such as

daily stand-ups, cross-functional team workshops, and visual tools like Kanban boards emerged as key enablers. These practices help teams define and align objectives, reduce uncertainty and create a common language for decision-making. This study reinforces the importance of such practices, supporting findings of past research (Thummadi et al., 2017).

As with any effort, applying AP in EA comes with challenges, such as resistance to change. Previous studies have noted similar concerns (Thummadi et al., 2017; Uludağ et al., 2019). This study builds on this previous work by identifying specific mechanisms, such as iterative design and continuous feedback loops, that can help overcome these barriers. The following section, 5.4, discusses future research areas.

5.4 Future research

The study findings do provide the following five insights:

1. It was noted in the data that it is not always apparent all the times how roadmaps relate to individual work. More study is required to understand the exact mechanisms that link business drivers, mission statements and vision to the directives, goals, objectives, requirements and actual course of action or plan when applying AP in EA.

2. The concept of measure as applied to the agile delivery process requires further studies to understand how the enterprise receiving or providing services measures the process, for instance, the ability to identify the KPIs necessary for the EA context.

3. The shortage of skills and experience in implementing EA and AP necessitates training and development efforts from both the private and public sectors, which requires collaborative efforts. Future studies should also investigate the relationship between the talent and effectiveness of senior and executive managers and the organisation’s ability to interpret industry trends, respond to market conditions and strategically adapt to changes in the context of EA, exploring how the capabilities of senior management influence decision-making processes, organisational agility and overall performance.

4. The perception among participants that EA can sometimes bottleneck agile teams, leading to delays in decision-making processes and potentially hindering collaboration and innovation within the organisation, requires further investigation to understand the underlying

factors contributing to this perception, for example, investigating how EA is implemented within organisations and its interaction with agile teams, including the role of solution and enterprise architecture and the effectiveness of architectural decision-making processes, as well as identifying strategies to mitigate this perception.

5. It is crucial to understand why individuals might not support change to effectively manage change in the context of applying AP in EA. By addressing these concerns, organisations can increase the likelihood that individuals will support change and that change will be successful.

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7 APPENDICES

7.1 Appendix A: Research instrument

The interview questions have been adopted from Bui and Sjölenius (2018), Canat (2018), Velumani (2017) and Waterman (2014).

Section 1: Participant and enterprise background

Question No.	**Question**
1	Would it be alright if we record this interview?

2	Please begin by giving me a short history of your own career and how you came to be working in your current role?
3	Please give me a brief overview of the company and its history (*Industry, how many departments etc.?*)
4	Do you feel that your enterprise and information systems are more adaptive and responsive to the environment you operate in and why do you feel this way?
5	Do you have any processes in place to make your enterprise and information systems adaptive and responsive to the environment you operate in?

Section 2: Adapting to enterprise's needs and changes

Objective: To explain how AP make an EA project adapt to the enterprise's needs and changes

Question No.	**Question**
1	What do you know about agile project management/AP?
2	What is your understanding of EA?
3	What agile experience do the members of the team have?
3	How do you work with Agile in EA?

4	What comes into your mind when agility of the architecture is mentioned?
5	Do you have a clear way of identifying agility? Could you explain it to me?
6	How your EA working methods changes depending on market changes/ changing compliance regulations/advances in technology?

Section 3: Reducing EA ambiguity

Objective: To explain how the application of AP in EA reduces EA ambiguity.

Question No.	**Question**
1	Please describe a “typical” agile enterprise architecture project that your organisation is\has been involved in terms of size, duration, the number of participants (and their locations), stakeholders, and deliverables.
2	What was/is the role of top management in this design project/technology change situation? (*Are business goals clear for the EA team?*)
3	Do you feel top management understand EA the same you do and why do you think that way?
4	Do you feel the rest of the team you worked or working with understand EA? (*Were their tasks described, what tools did they use and where was their work done, stakeholders clear on what is expected from the EA team?*)

5	What were or are the deliverables in each task? (*Are these deliverables something you may show me?*)
6	Were people you worked with open to new ideas?
7	How was the experience working with people outside your team?
8	How do you manage friction between different groups or inside the group?
9	How do you manage architectural tasks?(e.g., architectural task backlog)
10	How can agile reduce EA ambiguity?

Section 4: Reducing enterprise complexity

Objective: To explain how to apply AP in EA to reduce enterprise complexity.

Question No.	**Question**
1	How would you describe the relationship between the word's enterprise and complexity?
2	How do you apply agile in EA to reduce complexity in an enterprise?
3	How do you apply agile to ensure EA documentation are up to date?

Section 5: Barriers of AP in EA

Objective: To explain the barriers of AP in EA.

Question No.	Question
1	What are the major failures/obstacles you face in applying AP in EA?
2	Describe what you believe causes these problems?
3	Is there anything you or the team could do to prevent or mitigate the problem(s)?

Section 6: Concluding Questions

Question No.	Question
1	Are there any other issues you'd like to raise or comments you'd like to make?
2	Is there anyone else I can talk to?

7.2 Appendix B: Organisational letter example

Department of Information Systems

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16 March 2022

Interview participation consent form

Dear Sir/Madam,

In terms of the requirements for completing a Master's degree in Information Systems at the University of Cape Town a research study is required.

Hakunavanhu Gilbert Ndoro, the researcher, has chosen to conduct a case study entitled '*Applying agile principles in enterprise architecture*'.

The objective of the research is to explain how to apply agile principles (AP) in enterprise architecture (EA) by answering four sub-research questions below:

a. How can AP make an EA project adapt to the enterprise's needs and changes?
b. How can an enterprise apply AP in EA to reduce the EA ambiguity?
c. How can an enterprise apply AP in EA to reduce enterprise complexity?
d. What are the barriers of applying AP in EA?

This research has been approved by the Commerce Faculty Ethics in Research Committee. All information will be treated in a confidential manner and used exclusively for the purpose of this study. No individual names will be recorded or published. You will not be requested to supply any identifiable information, ensuring anonymity of your organisation and employees. Your participation in this research is voluntary. You can choose to withdraw from the research at any time for whatever reason, in accordance with ethical research requirements.

The interviews will be conducted at your preferred venue and will last a maximum of 60 minutes. If you are willing to participate in this study, kindly sign the consent form below:

HGN

Hakunavanhu Gilbert Ndoro
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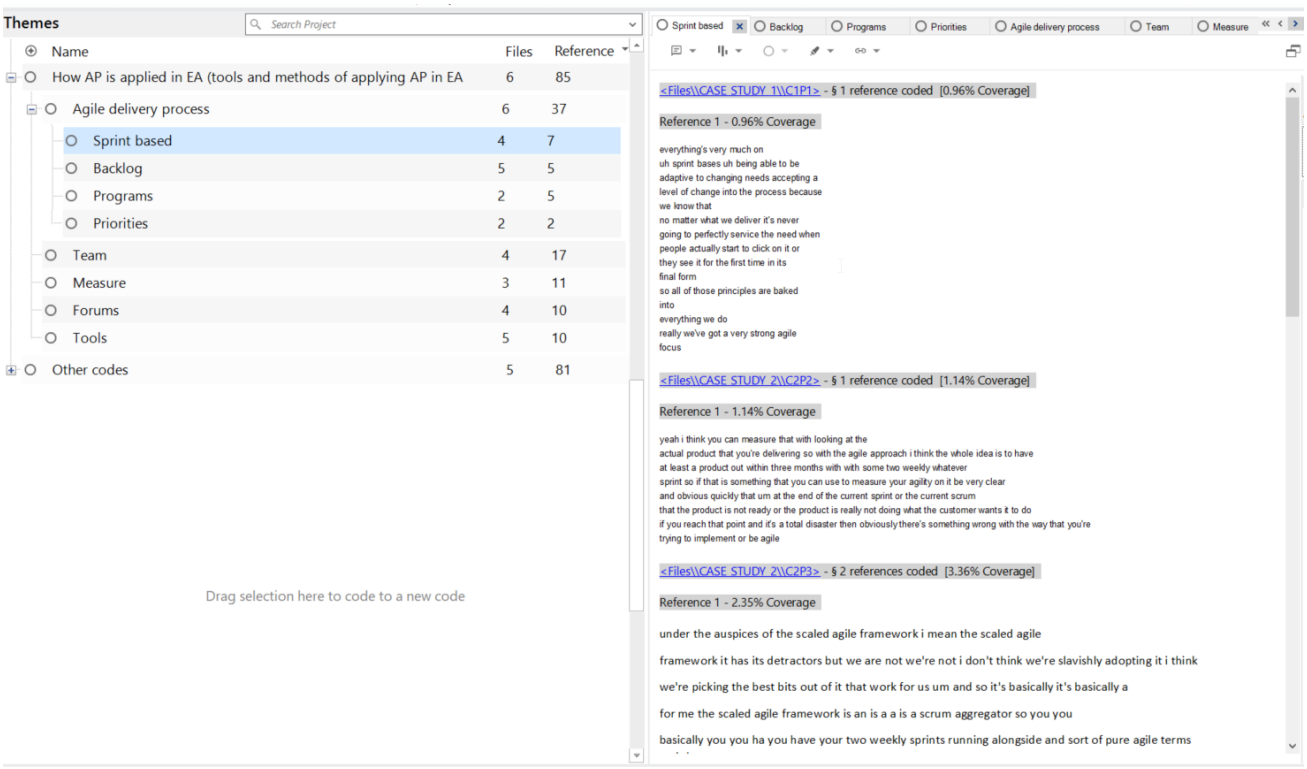
Research Participant Consent Form

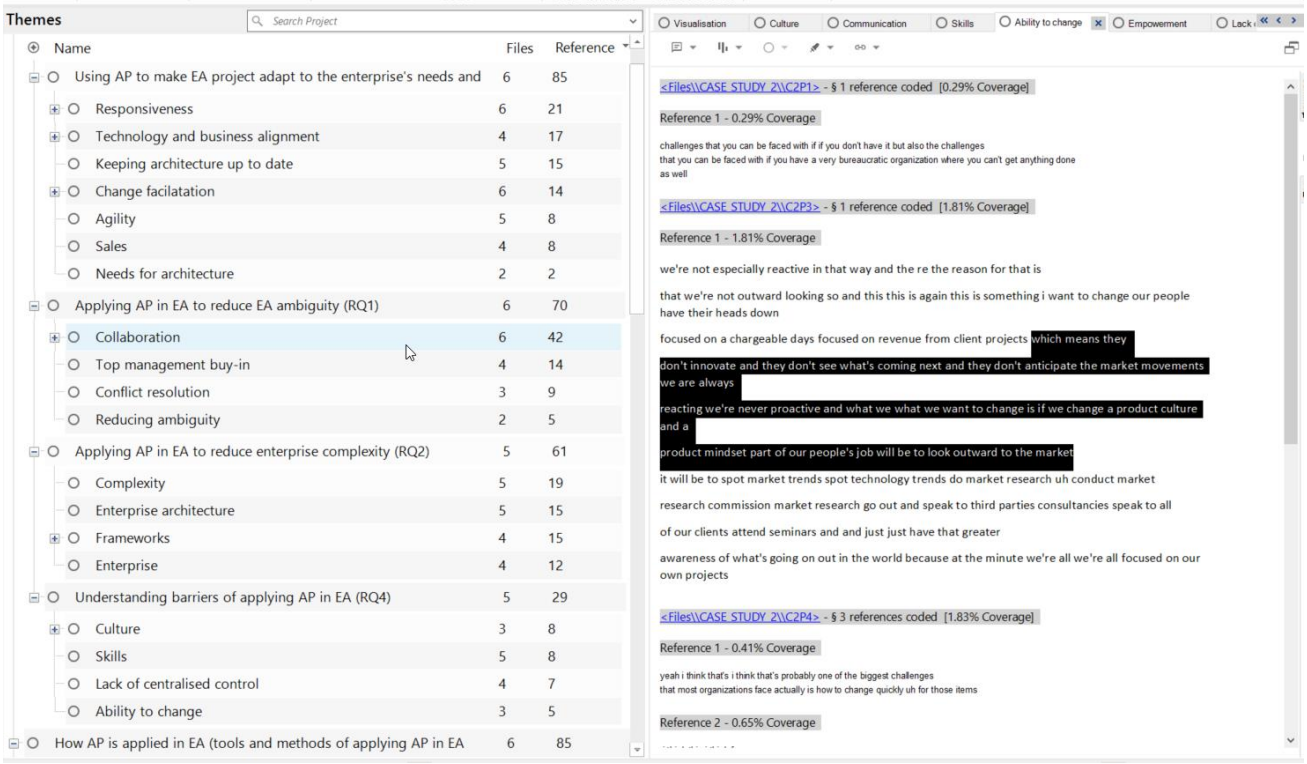
I,_____ consent to participate in the research on *Applying agile principles in enterprise architecture*. I am aware that participation is voluntary and that I may choose to withdraw from this study at any time, should I choose to do so.

Signature Date

7.3 Appendix C: Automated transcription example

7.4 Appendix D: Final NVivo analysis





7.5 Appendix E: List of acronyms

2EA	Efficacious Adaptive EA AP: Agile Principles
AEA	Agile Enterprise Architecture
AP	Agile Principles
CAS	Complex Adaptive System
EA	Enterprise Architecture
EAFs	Enterprise Architecture Frameworks
EACOE	The Enterprise Architecture Centre Of Excellence
EI	Enterprise Integrating
EEA	Enterprise Ecological Adaptation
EITA	Enterprise IT Architecting
IT	Information Technology
SoS	System of Systems