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Developing a Decision Model for Project Management Methodology Selection: Evidence from the South African IT Sector

by

Motlalepula James

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Submitted in (partial) fulfilment of the requirements for the degree of

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by

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DEGREE: **MASTER OF COMMERCE**

ABSTRACT

Background: Implementation of successful information technology (IT) projects that meet user requirements has increased the visibility of project management (PM) approaches. With IT projects being robust and dynamic due to the evolving nature of user requirements, choosing the most suitable project management methodology presents a challenge. The challenge lies in the absence of an integrated framework that incorporates available methodologies and best practices to create a unified view of the most suitable approach for an IT project. Decision models are essential tools that enable organizations to assist project managers and practitioners in choosing the most appropriate methodology for implementing IT projects. When implemented correctly, decision models are powerful tools that lead to increased competitive advantage. Moreover, project managers and practitioners in South Africa face major challenges when it comes to choosing the appropriate project management methodology. The known issues are unclear project scope, communication breakdowns, inadequate risk management, and difficulties in managing stakeholder expectations. As such, assessing the development of an IT Project Management Decision Model is essential to assist project manager and practitioner when implementing projects.

Objective: Using project management theory as an underpinning lens, the purpose of this study is to investigate the distinguishing characteristics, advantages, and disadvantages of an agile approach (such as Scrum) versus plan-driven /stage-gate methods based on a Traditional Waterfall process from the perspective of IT project managers and practitioners. This study focuses on generating a decision model that guides IT project managers in selecting the appropriate project management methodology for implementing IT projects in South Africa.

Methods: A qualitative multi-method research approach was utilised in this study by making use of an interpretive paradigm, abductive reasoning, qualitative description research strategy, and semi-structured interviews as data collection methods to elicit feedback on the study's IT Project Management Decision Model. Document analysis was conducted to rank the project management characteristics in order of relevance, and thematic analysis was conducted to categorise and code the interview data.

Findings: It was found that the relevant IT decision model elements to consider are project management phases, project management methodology process, and project management methodology process recommendations. Four project management phases are identified:

concept, development, implementation, and closeout. Each phase has Traditional and Agile processes that can be combined to create Hybrid processes that appropriately suit each IT project implementation.

KEYWORDS: IT Project Management, Decision Model, Scrum, Traditional, Agile

DECLARATION

I, Motlalepula James, hereby declare that the thesis entitled, Towards a Decision Model for Selecting the Appropriate Approach to Projects in the South African IT Sector, which I submitted for the degree Master of Commerce at Rhodes University, is my own work. I also declare that this dissertation has not previously been submitted by me for a degree at this or any other tertiary institution and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references. I am fully aware of Rhodes University's policy on plagiarism, and I have taken every precaution to comply with the regulation.

Motlalepula James

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20 February 2025

Date

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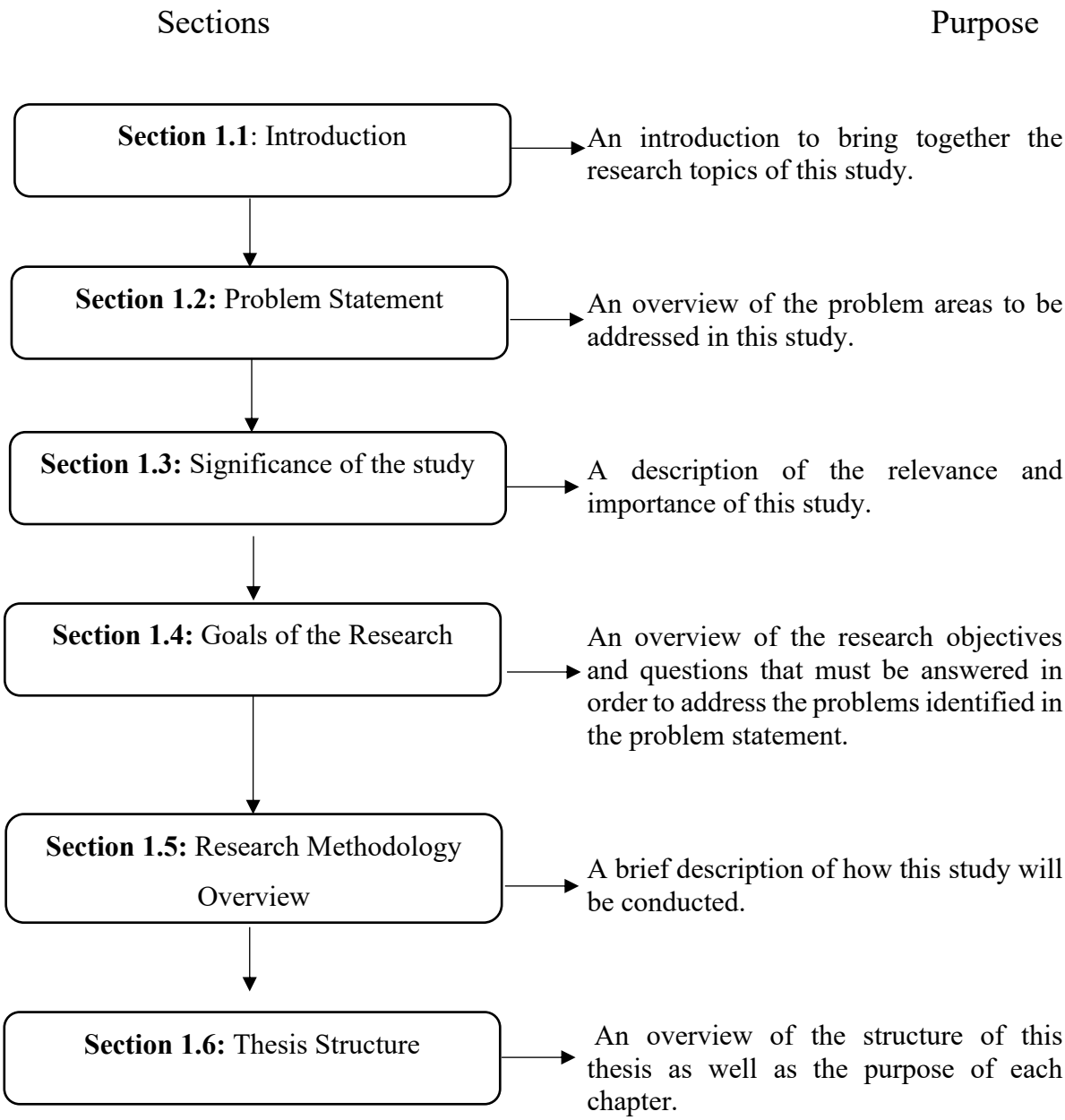
ACRONYMS

ACRONYM	DESCRIPTION
AI	Artificial Intelligence
AHP	Analytic Hierarchy Process
ANSI	American National Standards Institute
APM	Agile Project Management
ASD	Adaptive Software Development
BDT	Boolean Decision Tree
DevOps	Development and IT Operations
DMN	Decision Model and Notation
DSDM	Dynamic System Development
ELECTRE	Elimination Et Choice Translating Reality
FDD	Feature Driven Development
FMCDM	Fuzzy Multi-Criteria Decision-Making
ICT	Information and Communication Technologies
IT	Information Technology
IPMA	International Project Management Association
ITPMDM	IT Project Methodology Decision Model
MADM	Multiple Attribute Decision-Making
MCDA	Multi-Criteria Decision Analysis
MCDM	Multi-Criteria Decision-Making
ML	Machine Learning
MVP	Minimum Viable Product
PM	Project Management
PMI	Project Management Institute
PMDM	Project Methodology Decision Model
PMBOK	Project Management Body of Knowledge
PMM	Project Management Method
PRINCE2	Projects in Controlled Environments
TPM	Traditional Project Management
TOPSIS	Technique for Order Preference by Similarity to Ideal Solution
VIKOR	VlseKriterijumska Optimizacija I Kompromisno Resenje in Serbian
WBS	Work Breakdown Structure
WPM	Weighted Product Method
WSM	Weighted Sum Method
XP	Extreme Programming

1 RESEARCH OVERVIEW



1.1 Introduction and background

Project management (PM) is a discipline that spans across many industries, is generic, and deals with cross-functional teams and skills to bring about a unique solution (Silvius, 2021; Faraji et al., 2022; Varajão, Fernandes & Amaral, 2023). Project management is used in the information technology (IT) sector, and IT projects are arguably not too different from most other projects, except that the deliverables or outputs focus on IT-related artifacts or products (Koi-Akrofi, Afful & Matey, 2019; Pires & Varajão, 2024). IT projects are regarded as fixed-term interrelated sets of activities and tasks aimed at creating unique and secure IT-related systems (Terlizzi et al., 2016; Alami, Madsen & Krancher, 2021; Varajão, Fernandes & Amaral, 2023). IT projects deliver IT-related services or products that are not limited to system development or computer software, as is often suggested. They carry a broader definition under the Information and Communication Technologies (ICT) banner, that is, information technology equipment, hardware, and communications equipment and applications and software services (Koi-Akrofi, Afful & Matey, 2019; Pires & Varajão, 2024). The success of an IT project is dependent on well-managed project activities and processes (Koi-Akrofi, Afful & Matey, 2019; Picciotto, 2020). Project activities work well with good coordination and clearly defined procedures. For IT projects, good project management practices create project success. Project management is viewed as planning, organizing, monitoring, and controlling all aspects of a project within a set scope, agreed schedule, and with measurable deliverables and performance criteria (Radujković & Sjekavica, 2017).

The Project Management Body of Knowledge (PMBOK) and Projects in Controlled Environments (PRINCE2) are frequently used methodologies by businesses and organizations for software development projects (Matos & Lopes, 2013). According to Matos & Lopes (2013, pp.788-789), “PMBOK is a development of the Project Management Institute (PMI) to ensure that any collection of knowledge ideologies or principles and standards result in a successful project when followed accordingly.” Furthermore, PMBOK is a fully comprehensive standard consisting of ten knowledge groupings divided by activities spanning five phases/stages or process groups (Matos & Lopes, 2013, pp. 788-789). In addition to these knowledge areas, tools, and techniques, PMBOK argues that effective project management (PM) necessitates well-entrusted knowledge and an understanding of the given application area, the current project environment, and general management practices to drive a successful project (Matos &

Lopes, 2013,p.789). The latest PMBOK guideline, PMBOK version 7, suggests that project managers deliver projects through 12 prescribed principles.

According to Matos & Lopes (2013,p.789), Projects in Controlled Environments (PRINCE2) is considered a process-based framework of project management. PRINCE2 is based on experience gathered in hundreds of qualifying projects, and product delivery is based on project stages and phases (Matos & Lopes, 2013,p.789). A PRINCE2 project uses a business case to outline the organization's explanation, assurance, and rationale for delivering a successful product (Matos & Lopes, 2013,p.789).

Radujković & Sjekavica (2017) suggest that project managers should focus on conducting a well-executed process flow to deliver a project successfully. Project management guides processes, methods, and practices that must be followed for a project to be completed successfully (Silvius, 2021). Traditional and Agile Project Management methodologies currently guide organizations and practitioners in running all forms of projects (Thesing, Feldmann & Burchardt, 2021; Faraji et al., 2022). According to Ciric et al. (2020,p.1408), Traditional Project Management (TPM) plans and anticipates all possible details and needs before realizing each project phase. Traditional IT projects use the Waterfall process with work packages, responsibilities, and deadlines that are well stated at the project's inception (Thesing, Feldmann & Burchardt, 2021). Similarly, the Waterfall process uses logical sequence deliverables set in advance, and project development and performance are evaluated at stage-gate reviews (Terlizzi et al., 2016; Thesing, Feldmann & Burchardt, 2021). TPM has fixed rigid processes with clearly defined roles and responsibilities, and consistent, efficient planning from the beginning of the project. (Thesing, Feldmann & Burchardt, 2021). Furthermore, TPM's sequence-driven methods are seen as predictable and mechanized, with upfront planning and linear phased-gate-driven principles (Conforto et al., 2014; Faraji et al., 2022). For many years TPM has been the cornerstone for plan-driven project delivery (Thesing, Feldmann & Burchardt, 2021). TPM does have drawbacks; however, given the perceived rigid planning processes with stage-gate characteristics, project managers and practitioners do not see TPM as a fit for all IT project delivery approach (Ciric et al., 2020).

TPM's success is measured by the golden triangle of quality, cost, and time, which is considered less effective in today's dynamic business environment (Totten, 2017; Ciric et al., 2021). In particular, TPM methods are said to face many challenges when the goals and

requirements rapidly change during the project life cycle (Ciric et al., 2020). When these changes occur, the rigid project plan needs to be revised without understanding what has changed in the business environment (Totten, 2017). The consequence is that many stakeholders are left with questions about the change management of requirements. Many organizations and practitioners have tried to find answers, which has led to an increase in the popularity of Agile Project Management approaches (Rasnacis & Berzisa, 2017; Ciric et al., 2021).

Agile Project Management Methodology emerged from the principles and guidelines of the Agile Manifesto that focus on an iterative process (Ciric et al., 2020; Federico, Andrea & Pellizzoni, 2021). Iterations are used to construct Agile projects that offer clients value by utilizing short-term deliverables and rapid feedback (Conforto & Amaral, 2010; Ribeiro & Domingues, 2018). When project requirements are uncertain and likely to change as the project evolves, an Agile methodology such as Scrum is considered most appropriate to improve operational efficiency and alignment (Bendig et al., 2022)). Agile methodologies are based on collaboration, flexibility, and dynamism when implementing a project (Chaouch, Mejri & Ghannouchi, 2019; Ciric et al., 2021). Because of regular feedback loops from clients and short feedback and development cycles, Agile Project Management can recognize changing requirements in a very short period (Grebic, 2019; Thesing, Feldmann & Burchardt, 2021). The Agile Project Management approach uses minor detail and has a shorter time to develop the project plan (Ciric et al., 2021). Requirements are usually not clear in the initial phases of the project; however, they become more detailed as more iterations are completed (Thesing, Feldmann & Burchardt, 2021; Mayo-Alvarez et al., 2024). The frequent changes in requirements necessitate a resource planning approach that aligns with agile methodologies. In Agile projects, the project team is tasked with developing a step-by-step solution and delivering results to the customer in short cycles called Sprints (Ciric et al., 2020; Thesing, Feldmann & Burchardt, 2021). However, there are some concerns related to Agile methodologies. Agile Project Management removes the elements that provide formal feedback to a hierarchical structure (Špundak, 2014; Ciric et al., 2020; Thesing, Feldmann & Burchardt, 2021). A further challenge for Agile Project Management is the lack of comprehensive documentation and a formal reporting structure required to assess work quality, which poses difficulties for hierarchical organizations aiming to fully implement the Agile approach (Rasnacis & Berzisa, 2017).

Notably, the thought of combining Agile and Traditional approaches becomes the next point of discussion. The benefits that Agile development brings can be combined with the Traditional approach without removing the stability of both methodologies (Ciric et al., 2021; Marder et al., 2021). As discussed, TPM is highly process-oriented, while Agile offers flexibility to cater to requirements that change on an ongoing basis (Ciric et al., 2021). According to Rasnacis & Berzisa (2017, p.44), the principle of agility is to strike a balance between flexibility and stability. All things considered, when there is a high level of requirements certainty and a fixed timeline, a Traditional Project Management methodology approach works well, especially when the requirements are clear (Špundak, 2014). There is a need to find the best fit in both processes and techniques that complement each other to implement a well-balanced IT project, achieving flexibility and stability while simultaneously enhancing quality, adhering to timelines, and optimizing cost efficiency. A combination of the plan-driven Traditional approach and the Agile principle approach is proposed(Conforto et al., 2014; Thesing, Feldmann & Burchardt, 2021). The merging of Traditional and Agile methodology could result in what may be referred to as a Hybrid methodology (Thesing, Feldmann & Burchardt, 2021). Such integration should ensure a harmonious balance that fosters rigidity and flexibility.

Furthermore, a Hybrid approach could be used to improve the project plan-driven Traditional process model with the Agile/Scrum principles of iterative planning. This would also impact the participation of dedicated project teams in communicating, planning, and controlling project activities (Conforto et al., 2014; Thesing, Feldmann & Burchardt, 2021). The value of self-organizing, fast feedback loops, transparency, and adaptability while still following the structure of the Traditional project plan suggests that a Hybrid project approach may be appropriate (Thesing, Feldmann & Burchardt, 2021). Such a Hybrid methodology would need to be created under the guidance of a process model framework.

Process modelling is a powerful instrument for creating knowledge and innovation that guides and solves complex processes and system events (Henneberger et al., 2008; Rabiser, 2019). Process modelling is also a technique for arranging the logical sequence of activities and functions for dynamic interaction between systems and people (González Moyano et al., 2022; Winter et al., 2023). It can support the growth of an organization's internal and external capabilities and identify the decision-making processes required to achieve a goal by describing business process pressures (Burek & Herre, 2020; Nailer & Buttriss, 2020). The trial-and-error

learning process allows the process model to adapt through experience by articulating the real-world process (Recker, 2010). The Plunung & Entscheidung Model by Adam (1997 cited by Thesing, Feldmann, and Burcnardt, 2021, p.748) identifies models, objectives, and methods as the elements needed to produce a practical process model. It guides the use of the defined overall process elements to capture, formulate, analyse, reproduce, and verify (Thesing, Feldmann & Burchardt, 2021). This establishes a baseline understanding of the decision model creation process.

The introduction of a Project Methodology Decision Model (PMDM) would allow practitioners to evaluate project characteristics. A PMDM could assist project managers and practitioners in incorporating professional practice when choosing the appropriate methodology for delivering project phases. This could mitigate the risk associated with a one-size-fits-all approach, which lacks the flexibility to adapt to the diverse needs of change of scope, shifting timelines, and budgetary constraints, potentially resulting in compromised project processes. A Hybrid methodology could arguably be used across all types of IT projects. A PMDM could provide both an adaptable and flexible best practice approach for IT project managers and practitioners contemplating a new project.

1.2 Problem statement

Practitioners and project managers are experiencing challenges in choosing the appropriate project management methodology when implementing modern-day IT projects, such as launching a mobile app or developing a digital platform (Papadakis & Tsironis, 2020). While global literature provides abundant insights into Agile and Traditional project management, limited research focuses on how practitioners can systematically determine which methodology is most suitable for a given IT project context (Terlizzi et al., 2016; Ciric et al., 2021; Varajão, Fernandes & Amaral, 2023). South African organisations often adopt methodologies based on institutional precedent or client preference rather than structured assessment (Conforto et al., 2014; Varajão, Fernandes & Amaral, 2023). This misalignment between project characteristics and methodology selection contributes to inefficiencies and project failure such as activity delays, budget overruns, and stakeholder dissatisfaction. Consequently, there is a need to develop a decision model that guides IT project managers in selecting an appropriate methodology, Traditional, Agile, or Hybrid, based on contextual project factors, which this study aims to address.

1.3 Significance of the study

Project management has evolved to be more than an approach that uses one specific methodology for project implementation, but now plays a major role in driving concurrent methodologies within a project (Papadakis & Tsironis, 2020). Project managers need toolsets and processes that will help them identify key project phases that will need specific project management methodologies. According to Imani, Nakano & Anantatmula, (2017, pp. 39-46) and Papadakis and Tsironis (2018,p.739), project managers use off-the-shelf project management methodologies that are not appropriate for all IT projects. This results in increased project costs, schedule delays for tasks, poor quality of deliverables, and ultimately, project failure for stakeholders. Furthermore, failure to select and implement an appropriate project management methodology can lead to wasted resources, missed deadlines, and duplicated efforts, ultimately undermining the effectiveness and intended impact of the project (Wysocki, 2019; Ciric et al., 2021). The need for a Project Methodology Decision Model to bridge the gap becomes apparent. To put it more simply, the study will significantly add to the toolset that project managers and practitioners have in determining the appropriate blend of Traditional and Agile Project Management processes, thus reducing IT project failure associated with cost due to budget overruns, time due to missed deadlines, and scope due to changing requirements.

1.4 Goals of the research

1.4.1 Research objective

The research objective is to develop and evaluate an IT Project Management Decision Model that guides project managers in selecting appropriate project management methodologies per project phase based on project characteristics, drawing on established literature and validated through practitioner interviews, constructed on the characteristics of the Planung and Entscheidung process model.

1.4.2 Research question

RQ: How can an IT Project Management Decision Model be systematically developed and evaluated to guide the selection of appropriate project management methodologies per project phase in the South African IT sector?

1.4.3 Research sub-questions

RQ1: Which project and organisational characteristics should inform the design requirements of the model?

RQ2: Which principles, components, and decision rules from Traditional (e.g., PMBOK) and Agile (e.g., Scrum) methodologies should be combined to construct the model?

RQ3: How do experienced IT project managers evaluate the model (usefulness, clarity, coverage, applicability), and what refinements are indicated?

1.5 Methods, procedures and techniques

Research Methodology Overview

This study adopts a qualitative multi-method approach underpinned by an interpretivist paradigm. The research proceeds through two phases: (1) model development, using document analysis and synthesis of existing frameworks; and (2) model evaluation, using semi-structured interviews with experienced IT project managers. The abductive reasoning approach allows iterative movement between theory and practice, ensuring both rigour and relevance.

Scope and Delimitations

The study focuses on IT projects conducted in the South African context, primarily within medium to large organisations. It does not seek to compare the effectiveness of methodologies, but rather to provide a structured framework for selecting among them.

1.5.1 Research strategy

The research will adopt a qualitative-driven multi-methods approach, utilizing an abductive approach in which the researcher aims to gather multiple forms of data, such as document analysis and semi-structured interviews, rather than relying on a single data source. The details are discussed in Section 7.4.

1.5.1.1 Data collection and analysis

This study will utilize a two-step data collection process comprising the following:

Step 1:

- *Purpose* – To review the literature related to project management methodologies to understand the development and implementation of various IT project-related methodologies.
- *Method* – A literature review will be conducted to gain a comprehensive understanding of the various IT project management methodologies.
- *Data* – The data comprises secondary data from scholarly articles and journals.
- *Analysis* – A summary of attributes from previous decision models will be generated.
- *Output* – A proposed practitioner Project Management Methodology Decision Model.

Step 2:

- Purpose – To communicate and validate the proposed Project Management Methodology Decision Model by conducting semi-structured interviews with ten (10) South African IT project management professionals.
- *Method* – In-depth semi-structured interviews will be conducted with ten (10) project management practitioners from South African IT Systems Development companies.
- *Data* – The data collected during Step 2 will consist of voice recordings and notes captured during the individual interview sessions. Transcripts of the interviews will be drafted from the voice recordings of the interviews.
- *Analysis* – Thematic analysis will be undertaken as follows, using Atlas.ti.:
    - Prepare the data for analysis through data familiarisation.
    - Transcribe and reduce the data into themes through a process of coding.
    - Represent the themes through theme development and revision.
- *Output* – A revised IT Project Management Methodology Decision Model that is based on views and perspectives from interviews.

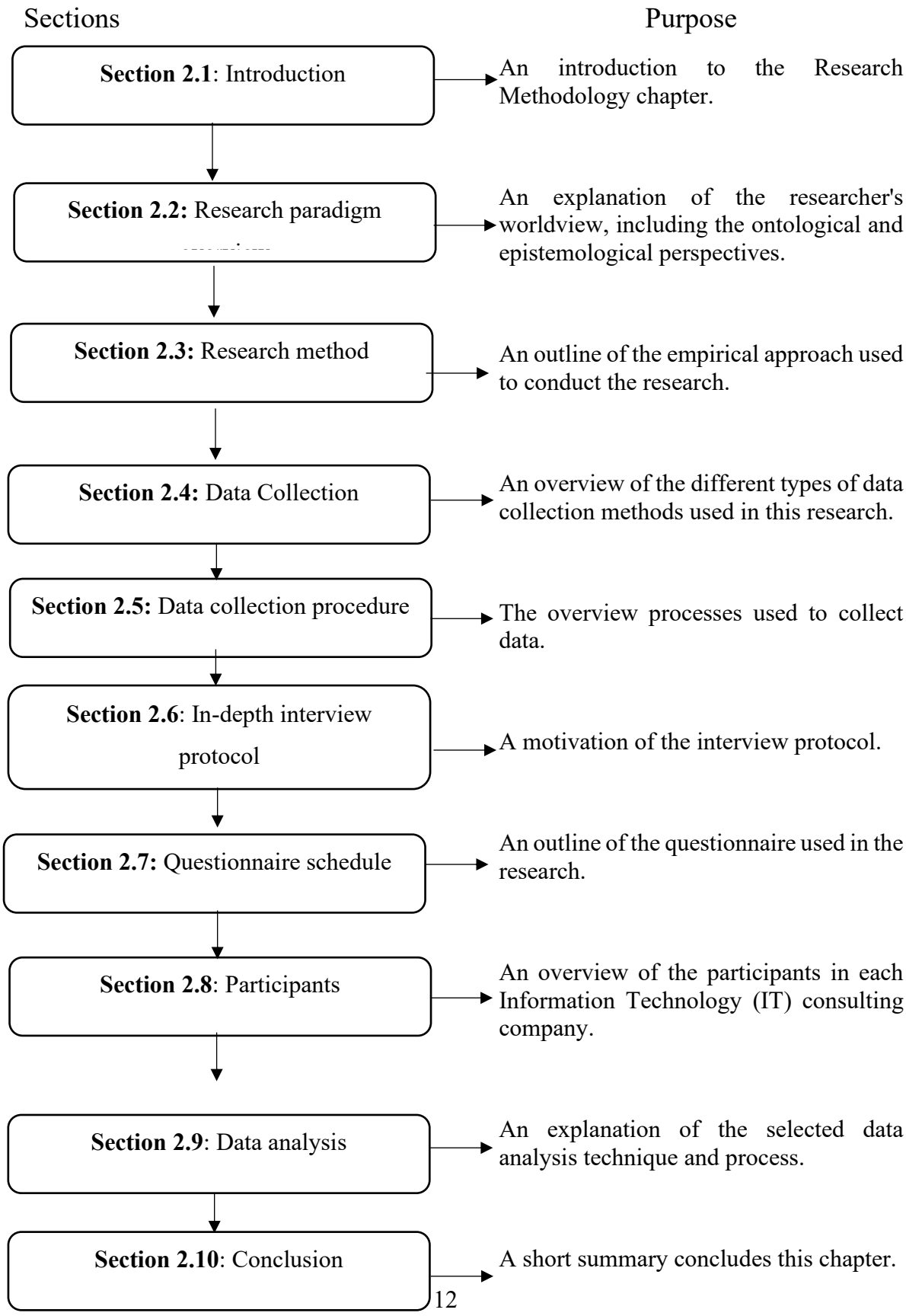
1.6 Thesis structure

This first chapter outlines the research background, problem statement, research objectives, research questions, and the significance and methodology of the study. Chapter 2 addresses this study's research methodology (i.e., the rationale behind the research approach, data collection method, and data analysis method) that was adopted to answer the main research question. Chapters 3, 4, and 5 detail the relevant literature on IT project management and TPM as implemented by PMBOK and Scrum: Agile methodology. Chapter 6 discusses the hybridising of the IT project management approach, while Chapter 7 discusses the literature relevant to decision models and decision model types. Chapter 8 details the data collection analysis methods and presents the primary research findings of the study. These are discussed in Chapter 9, which also concludes the study with a summary of the highlights of the previous chapters and provides recommendations, limitations, and suggestions for future studies. Table 1 summarises the structure of the thesis.

Table 1: Thesis Structure

	Chapter 1: Research Background	
	Chapter 2: Research Methodology	
Research Methodology Step 1	**Chapter 3**: IT Project Management	**Literature Review**
	Chapter 4: TPM as implemented by PMBOK	
	Chapter 5: Scrum: Agile Methodology	
	Chapter 6: Hybridising of the IT Project Management Approach	
	Chapter 7: Decision Models and Decision Model types	
Research Methodology Step 2	**Chapter 8**: Data Results and Analysis	
	Chapter 9: Discussion, Recommendations, and Conclusion	

2 RESEARCH METHODOLOGY



2.1 Introduction

This chapter describes the methodological framework guiding this study. It outlines the research paradigm, approach, design, data collection, and analysis methods used to develop and evaluate the decision model. The chapter ensures transparency and alignment between research objectives, questions, and procedures to guide Information Technology (IT) project managers in selecting an appropriate project management (PM) approach. This study employs two sequential phases aligned to the research questions: (1) Model Development via document analysis and a desktop literature review (addresses RQ1–RQ2), and (2) Model Evaluation via semi-structured practitioner interviews (addresses RQ3). According to Wohlin and Runeson (2021), the term research methodology refers to the research technique used to handle the research problem through numerous activities systematically. It assists researchers in formulating and interpreting their research question and/or problem before presenting conclusions based on the information gathered during a study. Therefore, this chapter discusses the rationale behind the research methodology used in investigating the research question: *How can an IT Project Management Decision Model be systematically developed and evaluated—using literature and practitioner input—to guide the selection of appropriate project management methodologies per project phase in the South African IT sector?* RQ1–RQ3: See Chapter 1 Section 1.4 for the sub-questions that respectively address design requirements, model construction, and evaluation/refinement. This chapter begins with a description of the research paradigm and design, then details the data collection and analysis methods for both phases. It concludes with a discussion of ethical considerations and trustworthiness strategies.

2.2 Research paradigm and philosophies

Research Paradigm

The study adopts an interpretivist paradigm, recognising that knowledge about project management practices is socially constructed and context dependent. The interpretivist stance allows exploration of subjective meanings attached by project managers to methodology selection, aligning with the study's qualitative and exploratory nature.

Research Approach

An abductive reasoning approach was followed, combining inductive insights from literature with deductive validation through practitioner feedback.

A research paradigm or philosophy is regarded as a worldview or a way by means of which scientists understand the complexity of the real world and how problems should be understood and addressed (Wohlin & Runeson, 2021). As there are various research paradigms, Thomas Kuhn was recognized for promoting the idea that is viewed as how a research study will be conducted, as determined by the type of knowledge being investigated in a study (Berrell, 2023). According to Saunders, Lewis & Thornhill (2016), one should consider the variations in the assumptions that each research philosophy makes in order to distinguish between philosophies. These assumptions have an impact on how a researcher views their research question, the research methodologies they plan to employ, and how they interpret their results during analysis. These assumptions relate to ontology and epistemology, as discussed in Sections 7.22 and 7.3, respectively. The ontological and epistemological perspectives inform the appropriate research paradigm used in the study (Saunders, Lewis & Thornhill, 2016),, as discussed in the sections that follow.

Figure 1 shows the Research Onion, which was described by Saunders, Lewis & Thornhill (2016) as a comprehensive description of the elements of a research paradigm. In the following sections, the Research Onion layers will be addressed (working from outside the onion inwards) in relation to this study.

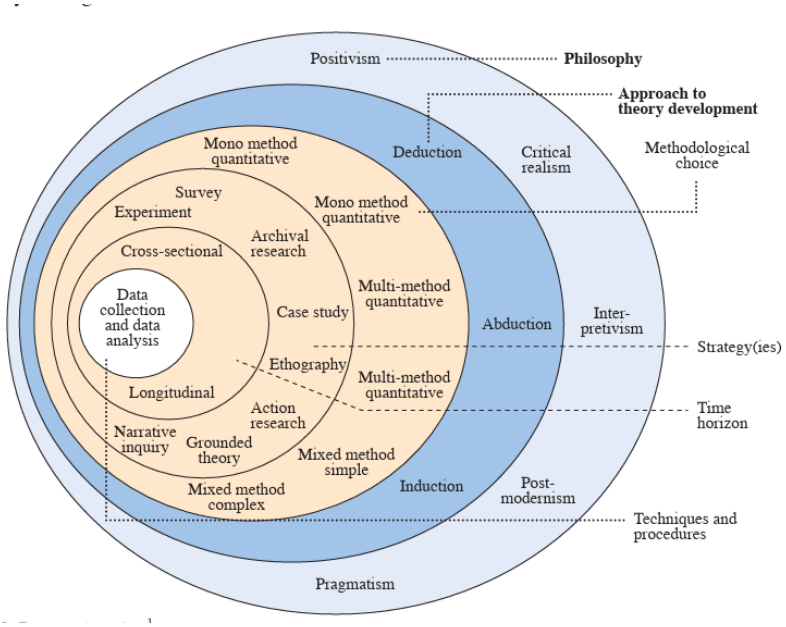


Figure 1: The Research Onion (Saunders, Lewis & Thornhill, 2016)

2.2.1 Ontology

Highlighting ontological distinctions is an essential part of the research process, because it allows the researcher to understand human nature, perceptions, and their impact on the approach used to discover the social reality and generate new knowledge (Cancino et al., 2018; Hellman, 2021). Ontology is a study that analyses what actually exists in the natural world, and the basic types and relationships of existence in which humans can acquire knowledge (Middleton, Shadbolt & De Roure, 2004; Park & Storey, 2023). Researchers may use various approaches to interpret social reality, such as different ontological perspectives. Hellman (2021) argues that the researcher's task is not to describe and explain social forces, but to explore how they come about and what they produce. According to Weber (2004), reality can be perceived from an ontological perspective as separate from the observation of the individual, meaning that the subject (i.e., the researcher) and the object (i.e., the particular phenomena) are separate independent entities of each other. This view is a positivist ontological perspective.

Costa (2016) supports a different ontological perspective, which suggests that reality and the researcher are not separate. According to this ontological perspective, our perception of the world is shaped by our experiences throughout our lives. This study is based on the latter, by which the researcher adopts an interpretivist ontological perspective.

2.2.2 Epistemology

Epistemology is part of the branch of philosophy that investigates the nature, limits, methods of knowledge, and what constitutes a knowledge claim (Ozkal et al., 2009; Tanriverdi, 2012). Vallverdú (2014) describes the equivalency of ontology and epistemology as capturing and codifying reality in a human-shared context, as such influencing the choice of which paradigm to use. In other words, epistemology can be referred to as how individuals come to know their theories and beliefs, which influence knowledge development (Nussbaum & Bendixen, 2003; Tanriverdi, 2012). Several paradigms within epistemology offer different perspectives on how knowledge is acquired, justified, and evaluated.

2.2.3 Axiology

Axiology is one of the foundational pillars of the philosophy of science, serving as a basis for a more holistic understanding of interpretation by emphasizing the value dimension and the social implications of interpretive outcomes development (Lucarelli, 2022; Barret, Newman & Bagasrawala, 2026). It constitutes a branch of moral discourse that examines what is considered good or bad and investigates the criteria that determine why certain things are regarded as good or bad (Spangenberg, & Settele, 2016). Axiology focuses on the interpretation of moral values and goals to be achieved through the process of value definition (Lucarelli, 2022; Barret, Newman & Bagasrawala, 2026), as well as through an understanding of how, why, and to what extent objects, actions, or outcomes possess value.

2.2.4 Research Philosophies and Design

This section discusses the understanding of research philosophy as a system of beliefs and assumptions about knowledge development. According to Saunders, Lewis & Thornhill (2016) there are three main research philosophies that are based on different ontological and epistemological assumptions discussed in Sections 7.2.1 and 7.2.2, namely:

- *Positivism* – A philosophical approach often adopted by natural scientists, based on empiricism, that attempt to construct knowledge of a reality that is thought to exist beyond the human mind, and can be quantifiable and objectified (Weber, 2004; Class et al., 2021). This paradigm uses empirical observation, measurement, and experimentation to generate knowledge. Positivists believe that scientific knowledge is objective, universal, and can be verified through empirical observation and experimentation (Spash, 2012; Bryman & Bell, 2015).

- *Interpretivism* – Interpretivists adopt the view that the knowledge that is developed reflects their specific goals, experiences, history, culture, and more knowledge in the form of experience as shared by individuals' lived experience; it is formed by the social construction of the world and by making sense of the world and is a critic of positivism (Weber, 2004; Bryman & Bell, 2015; Sanchez et al., 2023). This is done by creating new, richer understandings and interpretations of social worlds and contexts (Saunders, Lewis & Thornhill, 2016).

- *Pragmatism* – Adheres to the idea that concepts are only meaningful when they facilitate action and change; humans acting in a world which is in a constant state of becoming (Goldkhul, 2012; Saunders, Lewis & Thornhill, 2016) Pragmatists recognise that there are many alternative ways to view the world and carry out meaningful research, and are concerned with action and change and the interplay between knowledge and action (Goldkhul, 2012; Saunders, Lewis & Thornhill, 2016). This makes it appropriate as a basis for research approaches that are intervening in the world and not merely observing the world (Goldkhul, 2012). Pragmatism is mostly concerned with applying whatever works best within whichever situation, and this clearly falls short of the basic beliefs of multi-method research (Kankam, 2019)

- *Design Science Research* – Focuses upon solution-oriented research to develop, implement, evaluate, and adapt valid knowledge that supports practitioners in solving business problems (Schnall et al., 2014; Saunders, Lewis & Thornhill, 2016). It seeks to enhance human knowledge by creating innovative artifacts that solve problems and improve the environment in which they are implemented (Spash, 2012)

From an ontological perspective, this study is grounded in relativism, which posits that truth and knowledge are relative to the observer, vary from individual to individual, and that reality is regarded as subjective (Spash, 2012). It implies that, based on their particular experiences and social interactions, individuals may have different understandings and interpretations of reality (Spash, 2012). Consistent with relativism, subjectivism is the epistemological assumption underlying this study. Subjectivism acknowledges that an individual's perception of reality completely relies on their subjective nature (Saunders, Lewis & Thornhill, 2016).

This study is grounded in the interpretivist paradigm, which recognises that knowledge is socially constructed and context-dependent (Bryman & Bell, 2015). The interpretivist stance is appropriate because the study seeks to understand how IT project managers make decisions in context, and how a model can support such decisions. Furthermore, the study aims to gain a holistic understanding of a topic that aligns with an interpretivist researcher's perspective as they make sense of the world (Bryman & Bell, 2015).

2.3 Research approaches – Reasoning processes for theory development.

A research study can be either inductive, deductive, or abductive when it comes to the reasoning processes used in research methodology (Saunders, Lewis & Thornhill, 2016). Inductive reasoning involves formulating theories when a gap exists between a researcher's logical argument and the premises and conclusion the researcher observes (Woo, O'Boyle & Spector, 2017). Deductive reasoning looks at what is known about a domain and theoretical consideration within it, deduces a hypothesis that must be subjected to empirical scrutiny, whereby you wish to adopt a clear theoretical position that you will test through the collection of data (Ibrahim, 2012). Abduction goes one step further from induction and deduction, in drawing an inference based on observation and deriving a feasible and best explanation for a phenomenon from one used to generate testable conclusions (Saunders, Lewis & Thornhill, 2016).

The reasoning approach considered most suitable for this study is abduction. This is because the study initially uses an inductive approach to analyse previous scholarly literature to construct the proposed IT Project Management Decision Model. Subsequently, a deductive approach is taken as data is collected and analysed based on the proposed IT Project Management Decision Model.

2.4 Research approaches

Research can use quantitative or qualitative methods to analyse the phenomenon based on its philosophical origins (Barghi & Shadrokh sikari, 2020). Qualitative research is used in various research paradigms or nested collections of related methods, methodologies, epistemologies, and ontologies (Hagman, 2023). The types of data and methods of collection and analysis are informed by the project methodology, which is, in turn, shaped by an understanding of epistemology, an understanding of how knowledge is or should be created, and ontological beliefs about whether research can be used to access an actual reality of the world (LaMarre & Chamberlain, 2022; Hagman, 2023). Quantitative research uses hypothesis-based measures for generalizations, whereas qualitative research uses a naturalistic approach to gather an in-depth understanding of a phenomenon using questions such as how many or how much (Johnston & Dowling, 2023). The research aims to gain a rich data source regarding the research problems and capture the related complexity. Therefore, a qualitative research paradigm, which is in line

with the ontological and epistemological views of the interpretivist paradigm of this research, as indicated in Section 7.22, is used in the study.

Although there are many approaches to qualitative research, all lean towards being flexible and focusing on retaining rich meaning when interpreting data (LaMarre & Chamberlain, 2022). Furthermore, Johnston & Dowling (2023) consider that each methodology has different philosophical origins when reading and undertaking qualitative research. There is no overarching qualitative research; each methodology has different backgrounds, origins, and often diverse data collection and analysis methods (LaMarre & Chamberlain, 2022). The researcher perceives research philosophy as truth, reality, knowledge, and subjectivity, which may entail some degree of biasness. According to Kreuzen et al. (2023), those who are not close to the phenomenon have an advantage over those who work within it.

It is an abductive process: inductive reasoning is applied in Phase 1, followed by deductive reasoning in Phase 2.

2.5 Research strategy

A research strategy is "a plan of how a researcher will go about answering her or his research question" (Saunders, Lewis & Thornhill, 2016, p.177). It outlines the methodological path that the study will take, including how data will be collected, analysed, and interpreted. The research aim shapes the strategy (qualitative, quantitative, or mixed), and the nature of the phenomenon being investigated. Numerous research strategies exist, such as survey, case studies, experiments, action research, and grounded theory (Bryman & Bell, 2015). The research strategy utilised in this study is a qualitative multi-method. The aim is to acquire knowledge and understanding of a phenomenon, a process, or the perspectives and worldviews of the participants pertaining to a particular subject in a more holistic and comprehensive understanding of the research topic than either method (qualitative or quantitative) could achieve in isolation (Bryman & Bell, 2015; Kankam, 2019).

This study aims to understand how IT project managers make decisions in context and how a decision model can support such decisions. Additionally, it relies heavily on the opinions of the research participants regarding project management

The study employs a qualitative multi-method strategy comprising two sequential phases:
Phase 1: Document Analysis – synthesising existing frameworks and models to identify factors influencing methodology selection.
Phase 2: Semi-Structured Interviews – collecting expert insights from IT project managers to evaluate the model's relevance and applicability.

2.5.1 Model development and evaluation method

The study followed a two-phase method:

Phase 1: Model Development (Addresses RQ1–RQ2)

- Conducted a desktop literature review and document analysis of established project management frameworks (e.g., PMBOK, Agile Manifesto, PRINCE2);
- Extracted decision criteria and contextual factors that influence methodology selection; and
- Developed a hybrid decision model, combining a question-based assessment with a quadrant-based visualization system to guide methodology selection (Agile, Waterfall, Hybrid, or Traditional).

Phase 2: Model Evaluation (Addresses RQ3)

- Semi-structured interviews were conducted with 10 experienced IT project managers from the project management industry; participants were asked to evaluate the draft model for four attributes; and
- The feedback was used to refine the proposed decision model and ensure that it is grounded in practice.

2.6 Time horizons

According to Bryman and Bell (2016), time horizons relate to the duration of time necessary to conduct a research study. Saunders, Lewis & Thornhill (2016) state that there are two types of time horizons: cross-sectional and longitudinal.

- Cross-sectional – applies when the research is a snapshot time collection, as data is collected and analysed at a specific moment in time.
- Longitudinal – applies when examining change over time is an important aspect of the research, that is, data collection occurs over a considerable period (possibly years, depending on the nature of the research).

This research is cross-sectional at the study level (single evaluation window), although it contains two sequential process phases (development → evaluation).

2.7 Data collection

Various data collection methods can be used to retrieve information regarding the phenomenon of interest. The data collection method should agree with the purpose of the research. A document analysis and in-depth interview were used in this study. Three key principles of data collection on the sources of evidence, as recommended by Rowley (2002), were observed in this research, as illustrated in Table 2:

Table 2: Data collection - sources of evidence

Key principles	Description	How it was used in the research
Triangulation	Use of evidence from different sources to validate the findings.	Literature review (Chapters 1 to 6), in-depth interviews, and data analysis techniques.
In-depth interview database	Strengthens repeatability and transparency of the findings.	Documents and interview transcripts.
Chain of evidence	A link between data collection, research questions, and suggestions should be transparent.	Alignment is made between all the chapters.

2.7.1 Document analysis (Phase 1)

Documents are defined as a range of written material sources that are available on a particular topic (Kayesa & Shung-King, 2021). An individual produces them for private purposes, or an organization or team for public use, including media reports, research reports, personal letters, emails, diaries, and policy documents (Kayesa & Shung-King, 2021). Document analysis is a systematic procedure for reviewing, collecting, documenting, analysing, interpreting, and organising data, printed or electronic, and evaluating documents, including manuscripts and illustrations, that have been published without a researcher's intervention (Kayesa & Shung-King, 2021; Baninemeh, Farshidi & Jansen, 2023). Document analysis is one of the analytical methods in qualitative research that requires data investigation and interpretation to elicit meaning, gain understanding, and develop empirical knowledge to answer a research question. Document review and document analysis are often used interchangeably; some may regard document review as a descriptive and non-analytical process, versus the more empirical and analytical method of document analysis. In this dissertation, we will use the term document analysis. According to Kayesa & Shung-King (2021), similar to questionnaires, document analysis has several shortfalls that were acknowledged and overcome by the researcher/interviewer. For this study, document analysis was conducted to construct the draft decision model based on the literature review. This was performed through a review of documentation that helped to understand the theory-building of the research question. Over 80 documents were reviewed from different fields or disciplines, and 42 documents from various scholarly sources were selected based on the following criteria: authenticity, representativeness, meaning, and validity toward the research question. The data were used to construct the IT Project Management Decision Model.

2.7.2 The researcher in the interview

Zainal & Barlas (2022) refer to qualitative research that utilizes in-depth interviews to enable researchers to understand participants' worldviews through listening attentively to, and respecting their voices and interpretations of, life events. The researcher's impact on the interview may create debate, with some researchers advocating for firsthand knowledge of a phenomenon, while others believe there should be a greater distance between the researcher and the subject (Fulton, 2022). According to Kreuzen et al. (2023), those who are not closely associated with the phenomenon have an advantage over those who work within it. The

disadvantage is that a human face during interviews can reduce the information that the interviewee discloses. The researcher perceives research philosophy as truth, reality, knowledge, and subjectivity, which may entail some degree of bias.

2.8 Data collection procedure

2.8.1 Sampling and participants

Purposive sampling was used to select participants with relevant experience.

The inclusion criteria are as follows:

- Minimum 5 years of experience in IT project management.
- Exposure to both Agile and Traditional project approaches; and
- A total of 10 participants were interviewed, representing sectors including government, finance, and software development.

Data saturation theory was used, since there is no numeric guideline for the number of participants to be used (Hennink & Kaiser, 2020). It is believed that a point of data saturation can be reached within the proposed sample. Hughes, Williamson & Young (2022) argue that since qualitative research strategies typically focus on gaining an extensive and rich understanding of a topic (especially with interviews as the data collection method), smaller sample sizes ranging from five to fifty participants are most suitable.

2.8.2 Participants

In the questionnaire-based interview, participants in the organization's consulting services unit voluntarily participated in the research. Ethical clearance procedures were followed to ensure that there was confidentiality and privacy. A total of ten participants from various IT consulting companies, including those in government and finance, took part in the questionnaires. Data saturation theory was employed, as there is no numerical guideline for the number of participants to be included (Hennink & Kaiser, 2020). The subsequent section explains how data analysis was conducted.

2.8.3 In-depth interview protocol(Phase 2)

The in-depth interview procedure, is an integral part of the in-depth interview design that guides data collection, contributes to more rigorous research, and ensures external validity (Shah et al., 2023). The evaluation questionnaire-based interviews followed the following protocol (Fulton, 2022):

1. IT consulting companies and individuals should be identified and approached via a gatekeeper to participate in this research study.
2. Contact should be established with the IT consulting company and individuals at the highest level possible to obtain permission to conduct the research and use the employees' responses. Therefore, an invitation gatekeeper letter and individual letter to conduct the research at the particular IT consulting company should be provided to the IT Consulting company manager and the individual.
3. Once written consent from the IT consulting company and individual has been received, the researcher should invite participants from the IT consulting company or individual and arrange a convenient time and location to conduct the questionnaire.
4. The researcher should explain the goals of the research, justify its necessity, outline the types of questions that will be asked, and indicate the expected duration of the session before administering the questionnaire.
5. The research participants' information and letters of consent should be provided to comply with the university's ethical standards requirements. These documents include rules and research information that should be clarified by the researcher and abided with by both the researcher and the participants.
6. A transcript should be completed and provided to the participants as soon as possible after the questionnaire interview to ensure that their views are adequately represented. The participants are invited to identify any omissions or misinterpretations by the researcher, and these should be noted. A letter of thanks for participating in the questionnaire should be sent promptly.
7. After completing each questionnaire, the researcher should record the impressions of the participants and the setting in field notes.

8. Data analysis procedures will be implemented to ensure that the collected data adhere to confidentiality provisions, thereby protecting the identities of the organizations and participants involved in the research.

The interview questions were elicited from literature focusing on Traditional and Agile methodology processes.

2.9 Model evaluation

Participant Evaluation Guide (Interview Questions)

The following semi-structured interview questions are designed to evaluate the decision model based on four key dimensions: usefulness, clarity, coverage, and applicability. According to Bahaw et al. (2025), past scholars have noted that the four dimensions support model evaluation, provide assistance with structural and logical coherence, and facilitate decision-making regarding adaptability of the model.

Table 3 Participant Evaluation Guide

Evaluation Dimension	Interview Questions
Usefulness	• Does the model assist you in selecting a suitable project management methodology? • Would this model help you make better decisions in your current or past projects?
Clarity	• Is the structure and flow of the model easy to understand? • Are the model's terms and decision points clear and logical?
Coverage	• Are there any important factors missing in the model? • Does the model address the typical challenges you face when selecting a methodology?

Applicability	• Can you envision using this model in real project planning situations? • Is the model adaptable to different types of IT projects?

2.10 Data analysis

Data collection and analysis, as discussed previously, need to be mindful of the researchers' influence and biases. Research data analysis refers to inspecting, cleaning, transforming, and modelling data to discover useful information, draw conclusions, make informed decisions based on optimized results, and enhance data flow (Ogiela, 2020). In research, data analysis is a critical step that involves a wide range of statistical and computational techniques to extract meaningful insights from the data, and has an important part in the qualitative research process (de Casterle et al., 2012). According to Dierckx de Casterle et al. (2012) and Renfro et al. (2022), qualitative data analysis is a complex and challenging part of the research process, receiving limited attention in the literature due to a lag in adoption, largely driven by scepticism regarding the rigor of the process. The adoption of qualitative research methods has increased, as many researchers have recognized the value of understanding participants' viewpoints on actions; cultural, social, and political events; and individuals or groups and their relationships (Renfro et al., 2022). This qualitative multi-method study will use document analysis and interview analysis.

2.10.1 Document analysis

Possible analytical approaches that can be used in this study include thematic analysis, content analysis, and narrative analysis (Braun & Clarke, 2006; Saunders, Lewis & Thornhill, 2016). According to Saunders, Lewis & Thornhill (2016), these analytical approaches are relatively similar, but have distinct features. Inductive thematic analysis was selected to analyse the data in the study of key documents and frameworks. It is a widely used approach for analysing qualitative data in research (Braun & Clarke, 2006; Saunders, Lewis & Thornhill, 2016; Johnston & Dowling, 2023). According to Johnston & Dowling (2023), it involves identifying and interpreting patterns, themes, and meanings within textual or qualitative data. It provides a systematic approach to uncovering and understanding the underlying meanings, experiences, or concepts present in the data and can be used across various epistemologies and research

questions (Purssell & Gould, 2021; Johnston & Dowling, 2023). Inductive thematic analysis allows researchers to create codes grouped into categories (e.g., governance, risk, flexibility) to construct decision model components.

Thematic analysis allows researchers to explore and understand the underlying concepts, experiences, or perspectives present in the data, and differs from other analytic methods as it seeks to describe patterns across qualitative data (Braun & Clarke, 2006; Purssell & Gould, 2021). Moreover, thematic analysis can be applied to multiple types of qualitative data, including interviews, focus groups, surveys, or written documents (Braun & Clarke, 2006; Saunders, Lewis & Thornhill, 2016; Purssell & Gould, 2021). Purssell & Gould (2021) suggest that thematic analysis requires an iterative and reflexive approach to allow for flexibility and adaptation as new insights emerge from the data. Furthermore, it is essential to maintain transparency in the analytical process by documenting decisions, justifying interpretations, and keeping an audit trail of the analytical process (Saunders, Lewis & Thornhill, 2016; Purssell & Gould, 2021). It enables researchers to explore the rich and nuanced meanings within qualitative data and provides a rigorous framework for organizing and reporting findings (Braun and Clarke, 2006; Saunders, Lewis & Thornhill, 2016; Johnston & Dowling, 2023),.

The research involved descriptive data that aimed to examine the use of a decision model to help IT Managers or practitioners to choose processes in the interest of delivering a successful IT project. Therefore, thematic analysis could be used to analyse and interpret the data from the questionnaires and in-depth interviews to acquire relevant information to achieve the research's objectives. The following decisions were made, as presented by Braun and Clarke (2006):

- The researcher used a more detailed and nuanced account of a group of themes from the data related to a specific question or area of interest, as illustrated in Chapter 8.
- The researcher decided to use a theoretical, bottom-up approach instead of a deductive thematic analysis. This approach is not driven by the researcher's theoretical or analytic interest in the area. This thematic analysis procedure provides a rich description of the data and a more detailed analysis of some aspects of the data. Hence, the data being coded is quite specific to the research question. This approach is also in line with the in-depth interview design of the research. The researcher used a sematic approach

instead of a latent one in which themes would be identified. Therefore, the themes are identified from the meaning of the data as taken at face value.

The researcher used a constructive approach to thematic analysis.

2.10.2 Interview analysis

These analytical approaches were adopted to ensure the most suitable way of analysing data. Semi-structured interviews often include open-ended questions that allow for flexibility, enabling the researcher to conduct cursory-level analysis (Saunders, Lewis & Thornhill, 2016; Johnston & Dowling, 2023). Several processes were used in analysing the data, as illustrated in the following paragraphs (Braun and Clarke, 2006):

1. Familiarizing yourself with your data: This phase involves transcribing the interview-based questionnaire responses from verbal to written form and the electronic storage thereof. This allows the researcher to be immersed in the data, using repeated and active readings, constantly searching for meanings and patterns.
2. Generating initial codes: This phase involves formulating codes by identifying interesting features of the data. The qualitative data analysis software, ATLAS. ti, was used in this research to help code the data to discover and analyse complex phenomena. Coding depends on whether the themes are more theory-driven or more data-driven. The research applied a theory-driven approach by reading the data with specific questions in mind when coding. The coding for this study was structured around four evaluation dimensions:
    i. Usefulness (e.g., "This would help in ambiguous projects.")
    ii. Clarity (e.g., "Scoring logic needs simplification.")
    iii. Coverage (e.g., "Consider cultural fit of team.")
    iv. Applicability (e.g., "This works well for hybrid projects.")
3. Searching for themes involves sorting the different codes into potential themes and organizing all the relevant coded data extracts within these identified themes. Hence, the researcher considered how the various codes could be merged to form an overarching theme.
4. Reviewing themes: This phase involves reviewing the set of possible themes and refining them. This includes assessing whether the themes should be combined or broken down into separate themes. The researcher then checked the data for validity of the individual themes

by ensuring that the data extracts matched the themes and by coding additional data that might have been omitted.

5. Defining and naming themes: This phase involves further refining the specifics of each theme by naming and defining the meaning of each theme.
6. Producing the report: The write-up in the thematic analysis should represent the data in a manner that indicates both merit and validity to the reader. Sufficient evidence and examples from the data extracts to demonstrate the themes should be provided. In this study the modifications to the decision model were tracked against participant feedback.

2.11 Trustworthiness and rigour

Trustworthiness and rigour ensure that the research accurately reflects the phenomenon under study and that the findings are meaningful and can be trusted to reduce the possibility of researcher bias (Saunders, Lewis & Thornhill, 2016).

To ensure quality and credibility of findings, the following techniques were applied:

Table 4: Trustworthiness and Rigour Techniques

Criterion	Technique Used
Credibility	Member checking: Some participants reviewed their transcripts. Saunders, Lewis & Thornhill (2016) state that it is important to separate description from sense-making in order to provide clarity and to help establish the rigour and credibility of your research.
Dependability	Audit trail of model development and coding process. Saunders, Lewis & Thornhill (2016) state that your research has to consider dependability issues as a criterion for assessment. In this context, it means recording all of the changes to produce a reliable/ dependable account of the emerging research focus that may be understood and evaluated.
Confirmability	Independent supervisor reviewed coding framework. Confirmability ensures that the findings result from the participants' experiences and perspectives, rather than the researcher's interpretations or assumptions (Weber, 2004; Bryman and Bell,2015).

Transferability	Thick description of model and participant context provided. Transferability refers to the extent to which a research study's findings apply to other settings (Saunders, Lewis & Thornhill, 2016).

Table 5 illustrates the 15-point checklist recommended by Braun and Clarke (2006). This checklist was used in this study to ensure that all the concepts were fulfilled.

Table 5: Data collection sources of evidence

Process	Criteria	Checklist
Transcription	1. 1. The data have been transcribed to an appropriate level of detail and the transcripts have been checked against the tapes for 'accuracy'.	√
Coding	2. 2. Each data item has been given equal attention in the coding process. 3. Themes have not been generated from a few vivid examples (an anecdotal approach); the coding process has been thorough, inclusive and comprehensive instead. 4. All relevant extracts for each theme have been collated. 5. Themes have been checked against each other and back to the original data set. 6. Themes are internally coherent, consistent, and distinctive.	√
Analysis	3. 7. Data have been analysed / interpreted, made sense of / rather than just paraphrased or described. 8. Analysis and data match each other / the extracts illustrate the analytic claims. 9. Analysis tells a convincing and well-organized story regarding the data and topic.	√

	10. A good balance between analytic narrative and illustrative extracts is provided.	
Overall	4. 11. Enough time has been allocated to complete all phases of the analysis adequately, without rushing a phase or giving it a once-over lightly	√
Written report	5. 12. The assumptions about, and specific approach to, thematic analysis are clearly explicated. 13. There is a good fit between what you claim you do and what you show you have done; that is, the described method and reported analysis are consistent. 14. The language and concepts used in the report are consistent with the epistemological position of the analysis. 15. The researcher is positioned as active in the research process; themes do not just 'emerge'.	√

2.12 Ethical clearance procedure

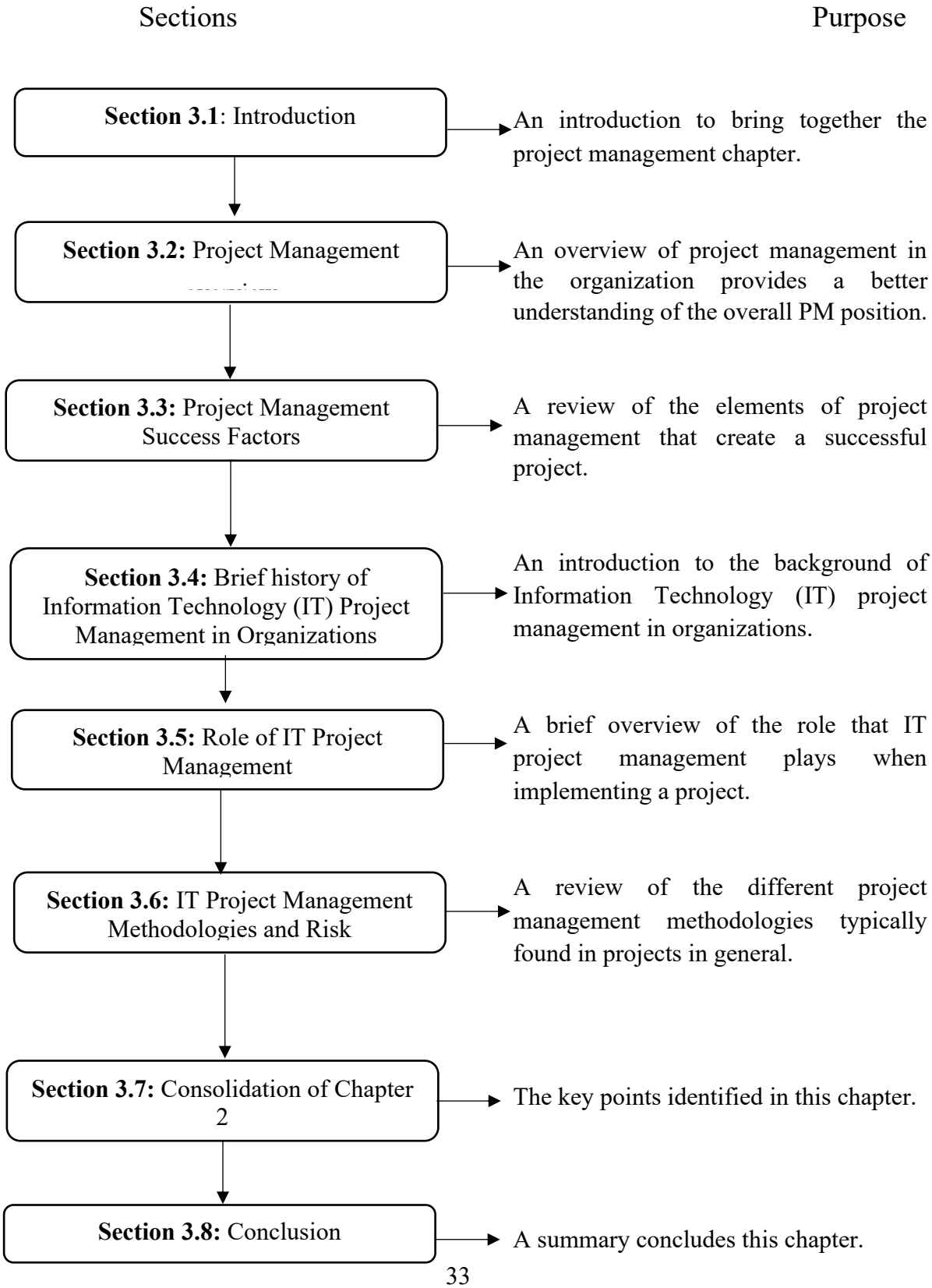
The research abided by the policies, protocols, and guidelines in the latest version of the Rhodes University Ethical Standards Handbook. Ethical clearance was obtained from Rhodes University (Ref No: 2024-7640-8702). The Rhodes University Ethical Standards subcommittee in the Computer Science and Information Systems Departments approved this research. This subcommittee ensures that the research activities are accomplished responsibly and that they meet the highest ethical standards. Sensitive information, such as financial information regarding the IT consulting companies, will not be disclosed. The research involves human participants, and although the researcher is aware of the participants' identities, this information will remain confidential; no identifiable information was reported to ensure that all participants' responses remain anonymous. Participants provided informed consent and could

withdraw at any time. The collected data were kept secure and deleted upon completion of the research. Data was anonymised and securely stored. All participants were informed of the purpose of the research, the anticipated benefits of the study, how their privacy would be ensured, and that their participation was voluntary. Interview data will be retained for 5 years in accordance with university policy.

2.13 Conclusion

The researcher considered an interpretivist ontological perspective as most suitable for this investigation. The research uses a qualitative multi method to address the objectives. The research methodology involves a series of steps or procedures that researchers follow to ensure their findings' accuracy, reliability, and validity, according to Setiawan & Sembiring (2023). Research can use quantitative or qualitative methods to analyse the phenomenon based on its philosophical origins (Barghi Shadrokh sikari, 2020). This chapter outlined the interpretive, qualitative methodology used to develop and evaluate a decision model for selecting appropriate project methodologies in IT projects. The decision model was developed from literature and practitioner frameworks, and validated using expert feedback from experienced project managers. Thematic analysis was selected to analyse the data in the study. The collected data was analysed using thematic analysis facilitated by ATLAS.ti. Ethical clearance procedures were followed to ensure that the participant's responses were kept anonymous and confidential. The following chapter presents the results of the evaluation process and describes how feedback was used to refine the model.

3 PROJECT MANAGEMENT OVERVIEW



3.1 Introduction

As project management (PM) has gained momentum over recent years, organizations have not matured sufficiently to cope with the demands of change, complexity, and uncertainty when managing projects (Totten, 2017). The rise in complexity and uncertainty of organizational requirements often leads to the unsuccessful completion of many projects (Picciotto, 2020; Pires & Varajão, 2024). Unmonitored costs, unplanned activities, and not having the right person for the right task have contributed to the failures of many projects (Lalmi, Fernandes, & Souad, 2021; Varajão, Fernandes & Amaral, 2023). Therefore, having a project management approach is crucial in keeping track of all critical activities that influence a project's success.

Previous research has explored the type of project management methodology that is currently used (Conforto & Amaral, 2016; Imani, Nakano & Anantatmula, 2017; Wiśniewski, Kluza & Ligęza, 2018; Ciric et al., 2020). However, no clear decision model exists to guide project managers and practitioners in choosing the appropriate project management methodology for an Information Technology (IT) project (Terlizzi et al., 2016; Varajão, Fernandes & Amaral, 2023). Therefore, the unguided project management selection process shows a highly unpredictable practice that will continuously fail to support projects if not handled accordingly (Terlizzi et al., 2016).

3.2 Project management overview

Historically, institutions have used project management in a process of learning by experience or trial and error, a common feature that shows a lack of practical project management knowledge (Varajão, Colomo-Palacios & Silva, 2017). Garel (2013, p. 663) argues that there is no unified theory of project management, but rather a combination of many management theories used by institutions. Therefore, organizations use project management to decide on the most effective tools and techniques to integrate well with project delivery.

According to Radujković & Sjekavica (2017, p. 608), "a project is a short-term attempt seeking to create a unique experience in product, service, or outcome for an organization. Thus, the short-term nature of projects shows a fixed beginning and end". Project management applies to project activities with a pre-determined start- and endpoint. The Project Management Institute (PMI) views project management as applying knowledge, skills, tools, and techniques to create a product or service using project activities with a beginning and an end (Garel, 2013).

Furthermore, effective project management involves anticipating and rationalizing processes that allow an organization to address identified problem areas with solutions through a systematic approach (PMI, 2008).

Project management is a collection of best practices that improve an organization's competitive advantage in teaching and learning (Garel, 2013; Pires & Varajão, 2024). Moreover, these practices must be pragmatic and useful to add to project management knowledge. In other words, project management exists as a general practice of its own accumulated knowledge, concepts, organizations, methodologies, and lines of thinking in a well-planned systemic approach that is process-driven to guarantee project success (Abdulnasser & Alawi, 2020; Lalmi, Fernandes & Souad, 2021).

3.3 Project management success factors

Project management performance has fallen short of stakeholders' expectations in the past due to excessive spending, failure to fulfil deadlines, and poor product quality (Radujković & Sjekavica, 2017). As a result, organizations established their unique mixture of project management methodology for implementing projects, including processes and strategies; these include defined activities and best practices, respectively (Mchugh and Hogan, 2011; Varajo et al., 2017). Because project management provides both tangible and intangible benefits to organizations through short and long-term goals, combining project management methodologies has also changed the criteria of successful and unsuccessful project management. Project management delivers the work packages within the triple constraints of a project which is, on time, within the budget, and within the scope (Sanchez, Terlizzi & de Moraes, 2017). Referring to the views of Radujković & Sjekavica (2017, p. 608), the triple constraints or iron triangle modelling is merely one characteristic that contributes to project management success and performance. The coordination of integration, scope monitoring, human resource management, communication management, risk management, and procurement management are other factors that should be incorporated when managing any project. The inclusion of the extended project management elements drives project processes to standardization during implementation (Garel, 2013; Varajão, Fernandes & Amaral, 2023). It creates an increased level of formality in project execution, planning, and progress monitoring, as well as improving product delivery that contributes to the understanding of the organization's project environment (Sanchez et al., 2017; Paula et al., 2021).

3.4 Brief history of project management in organisations

Historically, as organizations moved to a project-oriented delivery process, complexity increased, and the need for developing various project management approaches also peaked (McHugh & Hogan, 2011; Garel, 2013). The introduction of complex projects allowed the organization to rethink how they manage projects from initiation to closing (Pinto & Winch, 2016; Varajão, Colomo-Palacios & Silva, 2017). As a result, organizations had to revisit the project management approaches and the tools and techniques available for project delivery, with consideration of all aspects of managing projects. Complexity and uncertainty came with the introduction of information technology into organizations. Organizational operations became significantly dependent on information technology to achieve strategic goals (Terlizzi et al., 2016; Rosenberger & József, 2021; Pires & Varajão, 2024). Moreover, the need to include IT project management knowledge as a project delivery methodology in an organization's strategic thinking became important (Varajão, Colomo-Palacios & Silva, 2017). Consequently, exploring the IT project management methodology became the focal point.

Previously, for an organization to acknowledge that a methodology was followed, IT project delivery required a combination of individual skill sets, such as proper formal training and facilitation programs, performance assessments, key management coaching, and post-project reviews (Matos & Lopes, 2013; Varajão, Fernandes & Amaral, 2023). Moreover, the use of a recognizable methodology was needed. IT projects are defined as projects using methodology as the formalization of grouped tasks into something logical and formal based on recognizable aspects (Matos & Lopes, 2013; Rosenberger & József, 2021). IT processes demanded significant attention to governance and control for project delivery (Bicevskis & Bicevska, 2015; Terlizzi et al., 2016). Therefore, project management in IT projects needs clearly defined activities to manage procedures and decision-making rights, so as to enable business value through IT. A framework or guideline was needed to create a project structure for IT deliverables (Varajão, Fernandes & Amaral, 2023). The goal of the framework, guideline, or standard was to prevent inefficiencies from affecting project deliverables. Moreover, IT needed to operate within a methodology that is suitable for IT software projects. Therefore, a standard was described as a formal document that describes established norms, methods, processes, and practices (Varajão, Colomo-Palacios & Silva, 2017).

Table 6: Institutions and Frameworks for Project Management

Institution	Framework
PMI – Project Management Institute	PMBoK – Project Management Body of Knowledge
IPMA – International Project Management Association	ICB – IPMA Competence Baseline
OCG – Office of Government Commerce	Prince2
JPMF – Japan Project Management Forum	ENAA Model Form
AIPM – Australian International Project Management	RegPM Standards
APM – Association for Project Management	APM Body of Knowledge

Several international and national organizations have emerged as authoritative bodies in project management, playing a vital role in developing, standardizing, and professionalizing project management practices. These institutions advance the body of knowledge and provide certification frameworks that serve as benchmarks for professional competency. Table 6 outlines key organizations and their respective frameworks that significantly influence global project management standards.

The Project Management Institute (PMI), based in the United States, is one of the most widely recognized organizations in the field. It publishes the Project Management Body of Knowledge (PMBOK®) Guide and offers globally recognized certifications, such as Project Management Professional (PMP). The International Project Management Association (IPMA) is a global network of national project management associations. It provides a four-level certification system (Levels A through D) based on a competency-based model.

The Office of Government Commerce (OGC), formerly a department of the UK government and now part of the Cabinet Office, has contributed significantly to best practices in project and service management. It developed the widely used Project Management in Controlled Environments (PRINCE2) methodology (Projects IN Controlled Environments).

Similarly, the Japan Project Management Forum (JPMF) is Japan's leading authority on project management, offering certifications recognized across Asia and aligning with international standards through collaboration with global bodies.

In Australia, the Australian Institute of Project Management (AIPM) is the primary organization responsible for promoting project management excellence. It offers the RegPM certification program based on a national competency standard.

Finally, the Association for Project Management (APM) is the chartered body for the project profession in the United Kingdom. It offers a structured certification pathway, including the Project Fundamentals Qualification (PFQ) and the Project Management Qualification (PMQ). It publishes the APM Body of Knowledge, which is widely used in academic and professional contexts. Collectively, these organizations play a critical role in advancing project management knowledge, establishing professional standards, and promoting best practices across various sectors and regions. These bodies are also used as a source of literature guidance in the study, as they are authoritative sources that are considered to be benchmarks in the profession; their evolving standards reflect broader professional development trends that will bring a shift towards developing suitable project management methodologies.

3.5 Roles of IT project management

- IT Project Management (ITPM) delivers organizational growth through innovation, process improvement, and business development for improving competition from almost all angles (Silvius, 2021, p. 124). It is done by following an appropriate IT project management methodology. It requires both technical skills and the ability to lead teams, projects, and processes (Niazi, Mahmood, Alshayeb, Riaz, et al., 2016; Li et al., 2021). This enables technical expertise to focus on core business processes (Varajão, Fernandes & Amaral, 2023). The technical expertise can use software applications that are easy to navigate. There are different types of project management software available on the market. ITPM utilizes resource competencies for delivering the project (Niazi, Mahmood, Alshayeb, Riaz, et al., 2016). Resource competencies certifications can lend credibility to the ability to implement IT projects. Furthermore, ITPM addresses the lack of client involvement, facilitates knowledge transfer, and monitors the lack of coordination and communication that impact the organizational culture (Niazi, Mahmood, Alshayeb, Qureshi, et al., 2016). Silvius (2021, p. 126) states that ITPM identifies critical success factors tailored to the project methodology, focusing on project processes and characteristics that cultivate shared beliefs. This

enables smarter, better, and informed decision-making that is driven by systems thinking.

3.6 IT project management and methodologies risk

Research has shown that various IT project management methodologies are available. According to Garel (2013, pp. 666-668), Traditional Project Management (TPM) has been the standard project management model in selecting IT projects in the past. However, a growing trend supports Agile Project Management as the PM methodology of choice for IT projects (Salah, Hefny & Darwish, 2017; Faisal et al., 2022; Varajão, Fernandes & Amaral, 2023). This implies that the two apparent project management methodologies being considered are Agile and Traditional Methodology, which represent Scrum and Project Management Body of Knowledge, respectively. At some point, it may be beneficial to employ both techniques to undertake different projects to widen existing project management skills and experience. This study seeks to investigate the affordances of both TPM as implemented via PMBOK and Agile as offered via Scrum, to highlight the approaches of each and the extent to which a hybridized blend of both may be the most appropriate method, given the characteristics of a specific IT project. It may also be useful to use both methodologies to implement different types of projects (Špundak, 2014; Salah, Hefny & Darwish, 2017; Grebic, 2019; Ciric et al., 2020). Combining project management processes to create a Hybrid methodology can offer a more flexible alternative to predictable project management knowledge (Totten, 2017; Papadakis & Tsironis, 2020).

3.6.1 Risk on IT projects

Risk and challenges in organizational projects are viewed as inevitable paths to reaching project success (Niazi, Mahmood, Alshayeb, Riaz, et al., 2016; Varajão, Colomo-Palacios & Silva, 2017, p. 216; Sithambaram, Nasir & Ahmad, 2021, p.1). Despite IT organizations being aware of project risks, the failure rate of IT projects is on the rise (Durmic, 2020). Filho, Bouzon & Fettermann (2022) suggest the uncertainty of the environment and a lack of technical knowledge as contributors to the increased failures of IT projects, whereas Suroso et al. (2018) and Salah, Hefny & Darwish (2017) identify risk management process as one of the methods needed to avoid IT project failure. The risk management process can be balanced by understanding the advantages and disadvantages of the methodology that is being

implemented. It is argued, planning the project management methodology by which to implement a project contributes to the level of risk that a project will be exposed to (Vujovic et al., 2020). Therefore, the understanding of a risk management process in an IT organization is a key component of effective governance and enables the organization to avoid or minimize the negative effects of unforeseen events associated with IT project failure (Filho, Bouzon & Fettermann, 2022; Kramarz & Korpysa, 2023). Furthermore, to reduce the risk of project failure, risk planning and project risk management processes are of great importance, whether using agile or Traditional project methodologies.

Notably, risk management is avoiding, transferring, mitigating and accepting some loss or unfavourable outcome. Therefore, known risks can be detected and analysed proactively using the risk management process. These risks can be identified as poorly defined requirements, rapid technological changes, incorrect cost estimates, lack of skilled personnel, and external market fluctuations. According to the Project Management Institute (2017), risk management processes have the following processes:

- Planning of risk management;
- Risk identification;
- Qualitative risk analysis;
- Quantitative risk analysis;
- Planning a risk response; and
- Monitoring and risk control.

In project management, risk arises in the context of a situation that exists or is likely to occur in the future, which has negative consequences or positive opportunities including scope creep, technology issues, budget overruns, resource limitations, and performance problems (Patel, 2024). Project risks cannot be eliminated; however, they can be reduced to an acceptable level depending on the methodology implemented (Filho, Bouzon & Fettermann, 2022). Project managers must have complete information on the project to make sound decisions when implementing projects in Agile or Traditional environments, due to the risk strategy under risk management that will be implemented, that is, avoidance, mitigation, transfer, and acceptance.

Risk identification and analysis process are crucial to informed decision-making for IT projects (Kramarz & Korpysa, 2023). They provide guidelines for applying the best practice of identification and analysis during project implementation to reduce the failure rate (Durmic, 2020). These are done through planned project meetings were all project stakeholders are represented.

Traditional or agile project risks are categorised into residual and inherent risks based on internationally accepted standards and approaches (Durmic, 2020; Patel, 2024). Residual risks are those that persist in the project even after implementing risk response actions (Patel, 2024). Inherent risk refers to the potential for a problem to occur within a process due to the absence of actions to change or control the underlying conditions (Patel, 2024). A project manager should proactively identify and evaluate these risks based on the risk management process in each project phase regardless of the project management methodology. However, Traditional methods are better suited for minimizing inherent risk in a stable, well-defined project, while Agile methods are better for continuously managing and adapting to risk in a complex or uncertain environment.

According to Kramarz & Korpysa (2023), Traditional methodology employs structured and documented processes to mitigate the inherent risks related to cost, time, and scope in IT projects, including the following:

- Developing a work breakdown structure.
- Defining a schedule for tasks identified in the Work Breakdown Structure; and
- Developing a project budget as a cost objective.

The risk management process of reducing inherent risks helps improve project performance by providing a necessary understanding of concepts such as uncertainty, decision-making, probability, and risk modelling within an IT project at any early stage of implementation (Filho, Bouzon & Fettermann, 2022). However, this approach poses the challenge of assuming that risks are fully known and documented upfront; consequently, heavy documentation slows down decision-making and leaves no room for iterative learning.

According to Kramarz Korpysa (2023) and Patel (2024), agile risk factors that can impact their success and must be identified and analysed. These factors include:

- Setting of achievable objectives by embracing continuous change and uncertainty;
- The type of activities to be addressed iteratively; and
- The resources and organisational setting identified through collaboration and transparency.

Decision making in IT project risk management can have probability and uncertainty elements based on the factors influencing an agile project. These need to be dealt with, with the understanding that the probability element is an event that will occur and has consequences or impact that need to be considered. Uncertainty involves unknown or unpredictable events and cannot be ignored, as it affects objectives and can be expressed and modelled utilizing probability. However, the agile risk factors pose a challenge in under-documenting risk when setting objectives. Furthermore, emergent risks can be missed based on the type of activities being addressed, as they do not have an immediate impact. According to Patel (2024), organizations must adopt new tools and techniques for risk management and mitigation, and develop a proactive and agile approach to managing IT project risks to prevent project failure. Risk management is discussed in the Project Management Body of Knowledge principles as a key knowledge area. Traditional approaches have limitations in managing risks related to IT projects with sector-specific challenges. Their sequential, phase-driven structure treat risk management as a distinct, formal process that is heavily focused on upfront planning (Patel, 2024). As a result, a combination of Agile and Traditional approaches would need to be implemented, since Agile brings an ongoing, iterative activity – not a separate phase, but one that is continuously embedded within core project practices. This combination approach would address project risks, such as vague or incomplete project scope, poor scheduling, and inaccurate cost estimates, which in turn contribute to project failures.

According to Kramarz & Korpysa (2023), managing risks becomes increasingly challenging as organizations adopt more sophisticated technologies and expand their digital footprints on project implementations. The percentage rate of successful and failed IT projects is displayed below in The Standish Group Reports, which provide an overview of the progress made by an organization to avoid project failure.

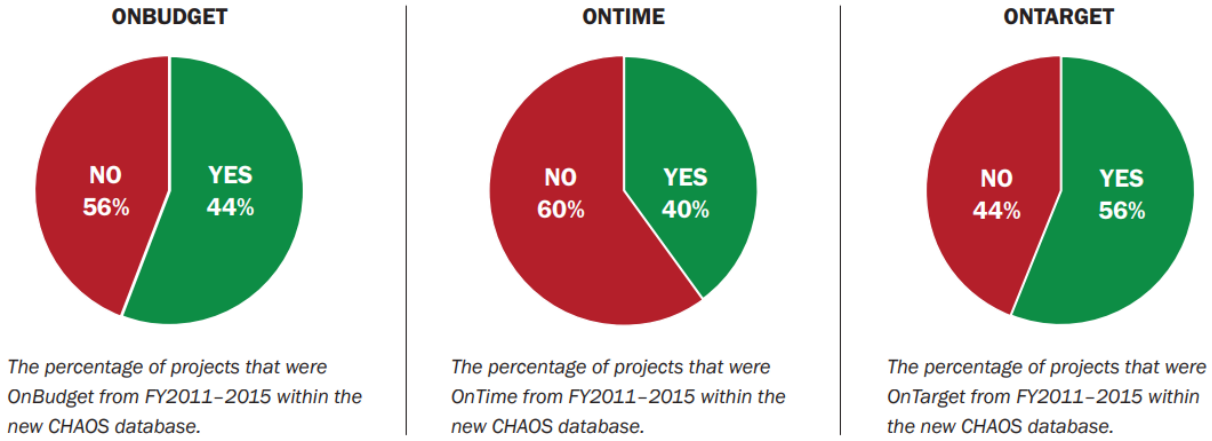


Figure 2: The percentage of IT projects that were OnBudget, OnTime, and OnTarget from FY2011–2015 (The Standish Group International, 2015)

CHAOS RESOLUTION BY AGILE VERSUS WATERFALL

SIZE	METHOD	SUCCESSFUL	CHALLENGED	FAILED
All Size Projects	Agile	39%	52%	9%
	Waterfall	11%	60%	29%

Figure 3: The resolution of all software projects from FY2011–2015, segmented by the Agile process and Waterfall method (The Standish Group International, 2015)

The Standish Group Reports in

Figure **2** displays project performance during the period 2011– 2015 based on Budget, Time, and Target (The Standish Group International, 2015). The report indicates that 44% of all projects finished within budget, and 56% of all projects with a budget overrun. It also identified that only 40% of the projects were on time, while 60% experienced time delays. The report identified that 56% of all projects were on target with the required scope, and only 44% were not on target on completion.

Figure **2** displays projects that have been successful, experienced challenges, and failed from 2011–2015, based on Agile and Waterfall methodologies (Traditional). The report showed that Agile had a success rate of 39%. It identified 52% as being challenged, late, or over budget, and 9% as failed, which were cancelled before completion. The report also identified that

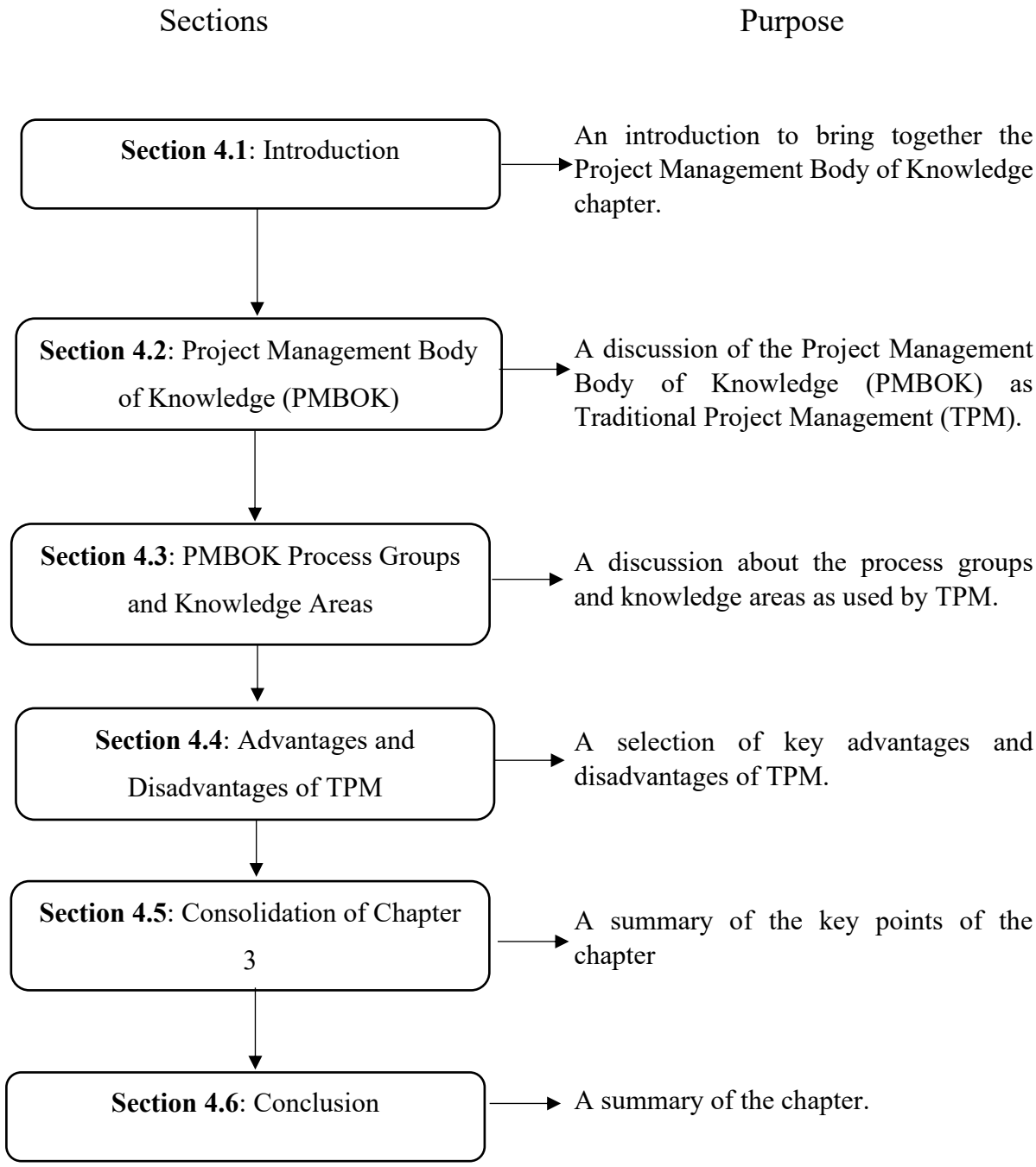
Waterfall had a success rate of 11%. It identified 60% as challenged, late, or over budget, and 29% as failed, which were cancelled before completion.

The IT risk management process is robust in dealing with uncertainty and complex requirements; however, IT projects still show a high failure rate, both in Agile and Traditional projects, based on the Standish Group reports. Uncertainty and probability in the form of scope creep, unrealistic timelines, and budgeting without enough detail are still elements that impact a project manager's success. As organisational projects become more sophisticated and digitally advanced, the risk of failure grows, posing a greater challenge for project managers. Having a hybrid approach to risk management, in turn, complements the overall project management approach, providing a balanced, flexible, and scalable way to manage risks in an IT project. As a result, this will favourably impact the IT project success rate and have an inverse impact on the failure rate.

3.7 Conclusion

Project management is valuable to an organization that wants to implement projects successfully. It helps manage complexity and uncertainty by following a prescribed methodology. The chosen project management methodology uses the available techniques and tools for implementing a project. However, IT Projects also follow a similar approach to the implementation of successful projects. They use IT project management methodology for project delivery, that is, TPM and APM. When implementing an IT project, success and failure extend beyond the triple constraints or iron triangle modelling. TPM or APM limits the project's scope to only the prescribed project management methods. Some projects might need to use more than one PM methodology.

4 PROJECT MANAGEMENT BODY OF KNOWLEDGE



4.1 Introduction

In recent years, the Project Management Body of Knowledge (PMBOK) has become the most common Traditional Project Management (TPM) approach among organizations for the development of software and many other business areas (Matos & Lopes, 2013; Faisal et al., 2022). PMBOK is a product of the Project Management Institute (PMI), and is based on a set of project management (PM) knowledge principles (Matos & Lopes, 2013). Furthermore, it guides project managers who are seeking to implement projects that follow a detailed structure. TPM, as discussed in Chapter 3, includes methodologies such as PMBOK from the Project Management Institute, Projects in Controlled Environments (PRINCE2), and the International Project Management Association (IPMA). This chapter discusses PMBOK as the most popular methodology of TPM (Matos & Lopes, 2013; Salah, Hefny & Darwish, 2017; Grebic, 2019).

4.2 Project Management Body of Knowledge

The Project Management Institute founders standardized procedures and approaches in 1980 (Faraji et al., 2022). The PMI was established in Philadelphia, Pennsylvania, USA in 1969 and in its publication, A Guide to Project Management Body of Knowledge, or simply the PMBOK Guide, the PMI listed all of the knowledge, skills, and techniques required for successful project management (Grebic, 2019; Faisal et al., 2022; Faraji et al., 2022). In 1996, the first edition of the PMBOK Guide was published. The second, third, and fourth editions were released in 2000, 2004, and 2008, respectively, and the fifth, sixth, and seventh editions in 2013, 2017, and 2021 (Project Management Institute, 2017; Salah, Hefny & Darwish, 2017). Thousands of recommendations for improvement are sent by PMI volunteers to the PMI as input, and PMBOK is updated to reflect growth and relevance (Project Management Institute, 2008). Moreover, the need for continuous improvement leads the PMI to tailor the development approach and processes of PMBOK towards more Agile methodology in support of emerging technology, new frameworks, and rapid market changes (Abdulnasser & Alawi, 2020). This is reflected in the last two editions, the sixth and seventh, which have changed from a conventional process-based system to a performance-based approach.

PMBOK includes proven Traditional practices that are widely applied, as well as innovative practices emerging in the PM profession (Varajão, Colomo-Palacios & Silva, 2017). The PMI recognizes the value of Agile approaches and attempts to dispel the myth that PMBOK is the

only methodology for managing successful projects that have evolved for PMBOK to remain relevant (Project Management Institute, 2008). Furthermore, the PMI (2008) stated that PMBOK is intended for extremely complex projects. The goal is for organizations to choose from a subset of processes that are more appropriate for the size and nature of a specific project. PMBOK is a detailed framework of ten knowledge areas, broken down into activities spanning five stages or process groups of the project life cycle (Matos and Lopes, 2013; Varajão et al., 2017; Faisal et al., 2022). Moreover, there are five PMBOK process groups: initiating, planning, executing, monitoring and controlling, and closing. Thus, the ten knowledge areas are integrated: stakeholder, scope, human resources, time, cost, risk, quality, procurement, and communication (Matos and Lopes, 2013; Varajão et al., 2017).

The ten knowledge areas and five process groups describe the use of the PMBOK tools and techniques. These knowledge areas and process groups challenge a novice project manager, and applying this knowledge requires experience and training (Abdulnasser & Alawi, 2020; Marcelino & Domingues, 2022). By understanding each of the ten knowledge areas, project managers learn to integrate the process groups needed to implement a successful project phase. Moreover, the knowledge area processes fall into one of the five process groups to allow for a thorough execution of project activity (Abdulnasser & Alawi, 2020; Rosenberger & József, 2021). This creates a matrix structure such that every process can be mapped to one knowledge area and one process group (Rdiouat et al., 2012; Rosenberger & József, 2021). According to Rdiouat et al. (2012,p. 163) & Schwalbe (2019), a PMBOK process is a set of inputs, techniques and tools, and outputs, as shown in Figure 4, which illustrates how the ten project management knowledge areas (Schwalbe, 2019), represented as boxes arranged horizontally, align with the needs and expectations of stakeholders, thereby supporting successful project planning and execution. These knowledge area boxes (Scope, Time, Cost, Quality, Human Resources, Communications, Risk, Procurement, and Stakeholder Management) have arrows that connect to a central arrow labelled as Project Integration Management (Schwalbe, 2019). Through the use of project integration management tools and techniques, these knowledge areas come together in project planning and execution to deliver project success and complete the scope within the planned time and resources.

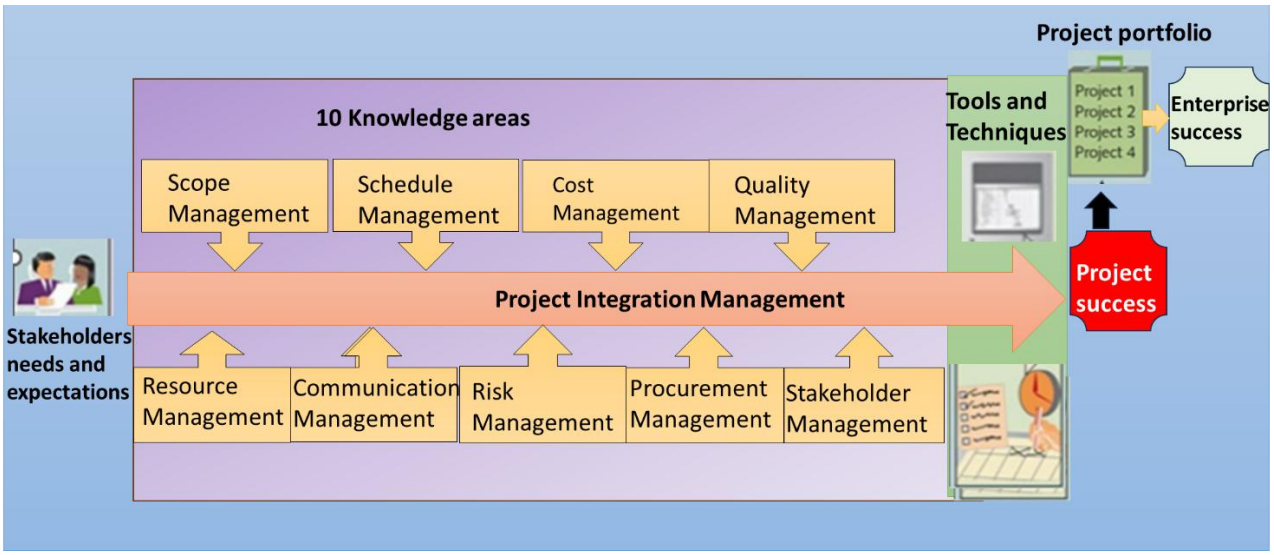


Figure 4 Project Management Framework (Schwalbe, 2019)

4.2.1 Stakeholder needs and expectations

Stakeholders include individuals or organizations with an interest or involvement in the project. Project outcomes and deliverables should align with business requirements, defined as the tasks and resources necessary to support the organization's mission and objectives (Schwalbe, 2019; Abdulnasser & Alawi, 2020).

4.2.2 Tools and techniques

Various tools and techniques are used to enhance understanding and effectiveness across all knowledge areas, although they are especially critical in the core areas (Schwalbe, 2019).

4.2.3 Project portfolios

A project portfolio is a collection of projects grouped for more efficient and strategic management (Schwalbe, 2019). Project Portfolio Management enables the coordination and alignment of individual projects with broader organizational goals by integrating their planning and execution under a unified framework.

4.2.4 PMBOK certification and local chapter

For many years, project management has been moving towards standardisation and professionalisation through voluntary certification of practitioners for effective project delivery

(Dehghanpour, Thomas & Blomquist, 2019; Soroka-potrzebna, 2021). Practitioners develop PMBOK certification for practitioners. The certification is based on rigorous standards and ongoing research to meet the real-world project needs of organizations, and for practitioners to meet a specified minimum standard of practice (Blomquist, Farashah & Thomas, 2018). For PMBOK, the certification path can broadly be summarized in the following PMI steps:

1. **Confirm your eligibility**
   Before embarking on the journey, the prerequisites specific to the chosen certification are met.
2. **Track and log your experience**
   The candidate keeps track of project experience and training records. To apply for certification, they will need to complete an online profile and log their experience.
3. **Prepare for and write the exam**
   Once the application is approved, exam preparation can begin. The candidate has 12 months to write and pass the exam.
4. **Maintain your certification.**
   Obtaining the certification is just the beginning - now it needs to be maintained. The PMI South Africa Chapter offers countless opportunities to earn PDUs.

Individuals who join PMI become part of a global community of changemakers. After joining PMI, members are encouraged to join their local chapter. These volunteer-run communities allow professionals to connect to other project management professionals, develop their skills, and give back to their local area. The PMI South Africa Chapter is a wholly volunteer-managed, non-profit organization to serve the local membership base and support the promotion and advancement of the art, science, and benefit of project management. It is based on three pillars: connect, develop, and give back.

4.3 PMBOK process groups and knowledge areas

This section discusses the PMBOK Process Group of the project management life cycle. The PMBOK knowledge areas regarding skills, tools, and procedures for project success will follow. Finally, the advantages and disadvantages of PMBOK are outlined.

4.3.1 PMBOK process groups

The PMBOK process groups and knowledge areas drive project process improvement through the project management life cycle (Niazi, Mahmood, Alshayeb, Qureshi, et al., 2016; Varajão, Colomo-Palacios & Silva, 2017). Following the project management life cycle, the PMBOK process groups can systematically prioritize and create quality processes in various projects. This may help select good practices that are replicable throughout all project types. The established good practices from the PMBOK processes can help implement projects of any nature by tailoring the processes to the project phase.

The interaction of the five steps or process groups is seen in Figure 5.

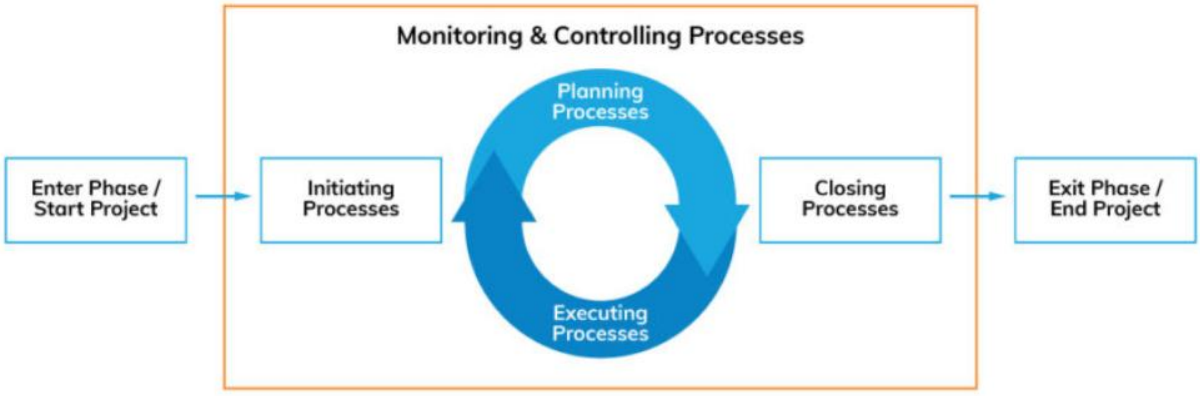


Figure 5 PMBOK Process Groups (Project Management Institute, 2017)

Rdiouat et al. (2012,p.163) state that project management processes can be divided into five groups, each containing one or more processes, as follows:

1. **Initiating Process**

The initiating process deals with the project start (sometimes referred to as the project kick-off), structure definition, and initial scope definition, which is used at the start of a project or phase and unpacked in the project charter (Rdiouat et al., 2012; Cuoto et al., 2022). The upcoming work's objectives are also determined and analysed, which includes knowing the project's estimated cost and economic feasibility (Abdulnasser & Alawi, 2020; Cuoto et al., 2022).

2. **Planning Process**

The planning process focuses on the planning and final scope definition by describing project activities (Rdiouat et al., 2012; Cuoto et al., 2022). It creates a series of actions, namely, a

Work Breakdown Structure (WBS), predicts the duration of activities, and creates the work schedule and cost estimations (Jamali & Oveisi, 2016). Furthermore, it identifies all resources needed for the plan (Abdulnasser & Alawi, 2020; Cuoto et al., 2022).

3. **Executing process**

The executing process deals with executing the project work to satisfy the project specification requirements (Rdiouat et al., 2012; Cuoto et al., 2022). It achieves this through the provided resources and cooperation between parties according to the pre-determined plan by leading and managing project implementation through quality assurance tools (Abdulnasser & Alawi, 2020; Cuoto et al., 2022). Furthermore, it improves the project group's handling of investor confidence by communicating progress effectively (Jamali and Oveisi, 2016; Cuoto et al., 2022).

4. **Monitoring and Controlling Process**

The monitoring and controlling process is an important process that deals with progress and performance monitoring, as well as content and quality review (Rdiouat et al., 2012; Cuoto et al., 2022). Monitoring entails comparing actual achievement and project progress to the plan (Abdulnasser & Alawi, 2020). Furthermore, this process considers how to predict deviations, analyse causes, and address them before they affect the project quality, risk, and schedule; it further considers cost control and resource performance (Jamali & Oveisi, 2016).

5. **Closing Process**

This process formally closes all activities across all process groups (Rdiouat et al., 2012; Cuoto et al., 2022). It ensures that the project is delivered to the owner, who is responsible for reviewing what has been accomplished (Abdulnasser & Alawi, 2020; Cuoto et al., 2022). Furthermore, finishing work with the resources and completing the project needs a record of all lessons learned from project implementation (Jamali & Oveisi, 2016; Cuoto et al., 2022).

4.3.2 PMBOK knowledge areas

The PMBOK knowledge areas and practices apply to most projects, resulting in an understanding that the use of skills, tools, and procedures can improve the chances of project success (Varajão, Colomo-Palacios & Silva, 2017) The supporting guidelines for managing individual projects clearly describe project management-related concepts used to assist practitioners in making better decisions (Varajão, Colomo-Palacios & Silva, 2017).

Furthermore, using systems and procedures, the use of hierarchy by authority structures, and processes to allocate resources and coordinate or control activities in a project are acknowledged as good practice in PMBOK (Matos & Lopes, 2013; Terlizzi et al., 2016). All things considered, effective project management, according to PMBOK, necessitates knowledge of the application field, the project environment, general management knowledge and abilities, and interpersonal skills (Matos & Lopes, 2013, p.788). According to Salah, Hefny & Darwish (2017, pp. 13-14), Project Management Institute (2017), and Colleoni et al. (2022), the following PMBOK knowledge areas and processes must be considered to acquire a more detailed understanding of adequate PM knowledge:

1. Project Integration Management refers to the processes that integrate and coordinate project management's many processes and activities. It comprises the following processes:

- Creation of a project charter;
- Creation of a project management plan;
- Leading and organizing project work;
- Observing and controlling project work;
- Completing integrated change control; and
- Signing off the project or phase.

2. Project Scope Management explains the processes needed to govern the scope of the project. It consists of:

- Discussing the scope management;
- Gathering the requirements;
- Describing the scope;
- Developing the Work Breakdown Structure;
- Confirming the scope; and
- Managing the scope.

3. Project Schedule Management explains the processes needed to organize the completion of the project in time. It consists of:

- Discussing schedule management;
- Defining the activities;
- Arranging the activities;

- Discussing the activity resources;
- Calculating the activity durations;
- Developing the schedule; and
- Organizing the schedule.

4. Project Cost Management explains processes dealing with the estimate, budget, funds, and cost control. It consists of:

- Discussing cost management;
- Planning the costs;
- Controlling the budget; and
- Governing the costs.

5. Project Quality Management defines the processes that determine quality procedures, policies, objectives, and responsibilities. It consists of:

- Discussing quality management;
- Creating quality assurance; and
- Organizing quality control.

6. Project Human Resource Management defines all the necessary processes that organize, manage, and lead the project team. It consists of:

- Discussing human resource management;
- Organizing the project team;
- Establishing the project team; and
- Leading the project team.

7. Project Communications Management supports the processes concerned about the time plan, distribution, and dispositioning of project information. It consists of:

- Discussing communications management;
- Leading communications; and
- Governing communications.

8. Project Risk Management supports the processes concerned to identify, analyse, and control project risk. It consists of:

- Discussing risk management;
- Recognizing risks;
- Leading qualitative risk analysis;
- Leading quantitative risk analysis;
- Discussing risk responses; and
- Observing and governing risks.

9. Project Procurement Management supports processes that acquire the products and services required for project completion. It consists of:

- Discussing procurement;
- Planning procurement;
- Governing procurement; and
- Signing off procurement.

10. Stakeholder Management supports a process that monitors stakeholder activities and relationships. It consists of the following:

- Identifying stakeholders;
- Planning stakeholder engagement;
- Managing stakeholder engagement; and
- Monitoring stakeholder engagement.

4.3.3 PMBOK project challenges

The PMBOK, as a standardised framework, has challenges and limitations observed during a project implementation, as advised by the literature (Ciric et al., 2020; Project Management Institute, 2021a). The literature about the PMBOK has identified some observable challenges, as follows:

4.3.3.1 Project Objective

Unclear or poorly defined objectives lead to scope creep, misaligned stakeholder expectations, and difficulty measuring success (Ciric et al., 2020; Project Management Institute, 2021a; Sithambaram, Nasir & Ahmad, 2021).

4.3.3.2 Project Size

Larger projects tend to be more complex, harder to coordinate, and require more resources and management effort (Ciric et al., 2020; Project Management Institute, 2021a; Sithambaram, Nasir & Ahmad, 2021).

4.3.3.3 Scope

Scope creep, resulting from changing requirements or stakeholder demands, can derail timelines and budgets (Ciric et al., 2020; Project Management Institute, 2021a; Sithambaram, Nasir & Ahmad, 2021).

4.3.3.4 Cost

Underestimating costs or unexpected expenses leads to budget overruns (Ciric et al., 2020; Project Management Institute, 2021a; Sithambaram, Nasir & Ahmad, 2021).

4.3.3.5 Schedule

Poorly planned or unrealistic schedules result in missed deadlines and rushed deliverables (Ciric et al., 2020; Project Management Institute, 2021a; Sithambaram, Nasir & Ahmad, 2021).

4.3.3.6 Quality

Quality issues can arise from ambiguous requirements, a lack of standards, or insufficient testing (Ciric et al., 2020; Project Management Institute, 2021a; Sithambaram, Nasir & Ahmad, 2021).

4.3.3.7 Integration management

Coordinating all project elements to work together smoothly can be complex, especially when multiple teams or vendors are involved (Ciric et al., 2020; Project Management Institute, 2021a; Sithambaram, Nasir & Ahmad, 2021).

4.3.3.8 Communications management

Poor communication can cause misunderstandings, conflicts, and the loss of important information (Ciric et al., 2020; Project Management Institute, 2021a; Sithambaram, Nasir & Ahmad, 2021)

4.3.3.9 Risk management

Failure to identify or mitigate residual and inherent risks can cause unexpected delays, costs, or failures (Ciric et al., 2020; Sithambaram, Nasir & Ahmad, 2021).

4.3.3.10 Procurement management

Delays or issues with vendors/suppliers impact project timelines and quality (Ciric et al., 2020; Sithambaram, Nasir & Ahmad, 2021).

4.3.3.11 Resources management

Inadequate or poorly allocated resources can cause bottlenecks and reduce productivity (Ciric et al., 2020; Project Management Institute, 2021a; Sithambaram, Nasir & Ahmad, 2021).

The above shows that PMBOK has challenges when implementing a project and should be able to adapt to control-heavy processes.

4.4 Advantages and disadvantages of PMBOK

As seen from the previous section, the PMI PMBOK is structured around many processes, and describes which activities should take place in each process. The following section outlines the perceived advantages and disadvantages as described in the literature.

Table 7: Advantages of PMBOK according to Thesing, Feldmann & Burchardt (2021, p.750)

Advantage	Description
Planning for achieving great efficiency	Traditional Project Management is distinguished by comprehensive planning, stability, and a long-term view.
Reliable estimation of time and budget	It is crucial to find a way to modularize the work; time and budget are fixed, and allow change very rarely (Ciric et al., 2020)
Fixed roles and processes with clearly defined responsibilities	Traditional Project Management is a fixed process with clearly defined roles and responsibilities.
Planning that is stable, systematic, and documented	The planning process is methodical and well-documented, providing a stable foundation for project execution.
Predictive capacities of team members	The ability to foresee team members' capacities (based on planning) and the measurability of project progress.
Project progress can be measured using milestones	Every process is detailed and defined at the start of the project.
Content dependencies can be considered right from the start	The entire project is planned ahead of time, with no room for changing requirements or preparing all dependencies.

To have a comprehensive understanding of the PMBOK, examining of its advantages is important for potential benefits:

Planning for achieving great efficiency

Traditional Project Management places a strong emphasis on upfront planning, that is, a step-by-step roadmap for leading a project from initiation to closure. By clearly defining objectives, tasks, timelines, and resources at the outset, teams can work more efficiently and avoid unnecessary delays or rework (Varajão, Colomo-Palacios & Silva, 2017; Thesing, Feldmann & Burchardt, 2021).

Reliable estimation of time and budget

The structured nature of Traditional Project Management enables more accurate forecasting of timeframes and budgets. It is crucial to find a way to modularize the work, as time and budget are fixed, and changes are very rarely made (Ciric et al., 2020). This reliability helps organizations to allocate resources effectively and manage stakeholder expectations (Varajão, Colomo-Palacios & Silva, 2017; Thesing, Feldmann & Burchardt, 2021).

Fixed roles and processes with clearly defined responsibilities

Roles and responsibilities are explicitly outlined from the beginning, ensuring clarity and accountability across the team within a fixed process (Varajão, Colomo-Palacios, & Silva, 2017; Thesing, Feldmann & Burchardt, 2021). This reduces confusion, supports smoother workflows, and enhances individual and team performance.

Stable, systematic, and documented planning

The planning process is methodical and well-documented, providing a stable foundation for project execution (Varajão, Colomo-Palacios & Silva, 2017; Thesing, Feldmann & Burchardt, 2021). This documentation is useful for reference, audits, and knowledge transfer, especially in larger or long-term projects.

Predictive capacities of team members

With clear plans and expectations, team members can make informed predictions about project outcomes and potential risks. This predictive capability supports proactive decision-making and risk mitigation (Varajão, Colomo-Palacios & Silva, 2017; Thesing, Feldmann & Burchardt, 2021).

Project progress can be measured using milestones

Traditional Project Management often utilises milestones to track progress, making it easier to assess performance, identify delays, and implement corrective actions when necessary (Varajão, Colomo-Palacios, & Silva, 2017; Thesing, Feldmann & Burchardt, 2021).

Content dependencies can be considered right from the start

The structured planning phase allows teams to identify and manage task dependencies early in the project (Varajão, Colomo-Palacios & Silva, 2017; Thesing, Feldmann & Burchardt, 2021). This helps prevent bottlenecks and ensures that interrelated tasks are properly coordinated.

Table 8: Disadvantages of PMBOK, according to Thesing, Feldmann & Burchardt (2021, p. 750)

Disadvantages	Description
Inadequate planning as a result of vague specifications	Initial needs are abstract and misconstrued, resulting in incorrect assumptions in the planning phase, as these can significantly impact subsequent project processes.
Difficulty in formulating all requirements in detail at the beginning	Customers are frequently overloaded by the need to explain all requirements explicitly and in detail at the outset of a project, making planning difficult.
Error correction is frequently costly as a result of complex plans	Because of the rigidity of the mistake, correction is not intended for large projects and offers no room for changing requirements once project development begins, as it will be costly.
At the start, there is a lot of planning and paperwork	A Traditional system focuses on early planning, prioritizing elements such as cost, scope, time, and documentation.
There is no continuous customer or user feedback	The customer is only involved in the development process at the beginning.
Less flexibility as a result of the project's tight phase sequence	Works under the assumption that it will not be examined again after a phase is completed. As a result, it cannot respond to sudden changes in the work plan.

To have a comprehensive understanding of the PMBOK, examining its disadvantages is important for critical thinking:

Inadequate planning due to vague specifications

Traditional Project Management assumes that all requirements are known upfront. However, when project specifications are unclear or incomplete, the initial planning may be flawed, leading to issues during execution(Varajão, Colomo-Palacios & Silva, 2017; Thesing, Feldmann & Burchardt, 2021).

Difficulty in formulating all requirements in detail at the beginning

Projects often evolve over time, but the Traditional model requires detailed requirements at the start, whereby customers are frequently overloaded with the need to explicitly explain all requirements (Varajão, Colomo-Palacios & Silva, 2017; Thesing, Feldmann & Burchardt, 2021). This can be challenging, especially for complex or innovative projects where not all needs are apparent early on.

Error correction is frequently costly due to complex plans

Since Traditional Project Management follows a linear approach, changes or corrections made later in the process can be difficult and expensive, as they may require revisiting earlier phases or altering detailed plans (Varajão, Colomo-Palacios & Silva, 2017; Thesing, Feldmann & Burchardt, 2021).

Extensive planning and paperwork at the start

A significant amount of time and effort is spent on planning and documentation in the early stages, with a focus on early planning and prioritising elements such as cost, scope, time, and documentation (Varajão, Colomo-Palacios, & Silva, 2017; Thesing, Feldmann and Burchardt, 2021). This front-loaded effort can delay project kick-off and reduce agility in responding to changing needs.

Lack of continuous customer or user feedback

Feedback from stakeholders is typically gathered only at specific stages (such as at the beginning or end), limiting the opportunity to incorporate ongoing input (Varajão, Colomo-Palacios & Silva, 2017; Thesing, Feldmann & Burchardt, 2021). This can lead to misalignment between project outcomes and user expectations.

Reduced flexibility due to a rigid phase sequence

The Traditional approach follows a strict sequence of phases (e.g., planning, execution, closure), leaving little room for adapting to changes once the project is underway (Varajão, Colomo-Palacios & Silva, 2017; Thesing, Feldmann & Burchardt, 2021). This rigidity can hinder responsiveness to new challenges or insights.

Previously, PMBOK required specialized expertise from a PM to use the available tools and approaches for managing an Information Technology (IT) software project (Matos & Lopes 2013, pp. 788-789). Furthermore, PMBOK has been certified as an American National Standard by the American National Standards Institute (ANSI). Thus, the PMBOK tools and strategies aid in overcoming an organization's resistance to project-driven transformation by following the five process groups. Finally, PMBOK systematizes project management knowledge with the presumption that it identifies existing patterns and generalizations by implementing the ten knowledge areas (Matos & Lopes, 2013). Faisal et al. (2022) suggest that the five process groups and ten knowledge areas have described better structure and success of IT projects, encouraging discipline in how projects are implemented.

Recent research has indicated a shift in PMI thinking. More researchers are exploring alternative PM approaches when managing projects (Salah, Hefny & Darwish, 2017; Chaouch, Mejri & Ghannouchi, 2019). This can be deduced from the advantages and disadvantages listed in Tables 7 and 8. For PMBOK to remain relevant, the PMI is investigating a refined approach to projects of a specific nature, and the latest edition with refined processes proves just that. The PMI recognizes the value of Agile methodologies and encourages practitioners to be tool-agnostic, so as to dismiss the view that PMBOK is the sole methodology for managing successful projects (PMI, 2008). Furthermore, the PMI has suggested that PMBOK, in its entirety, is intended for highly complex projects and outlines project life cycle phases that correspond to Agile releases and iterations (Project Management Institute, 2021a). The intention is for organizations to select from a subset of processes that are more in keeping with the size and nature of a specific project. Faraji et al. (2022) suggest concerns that TPM is more process-driven and process-intensive, demanding comprehensive documentation that delays the cycle from products to market. The advantages listed in Table 7 display the strength of PMBOK as stated in the literature. Further, based on the nature of the project and size, TPM is better for more risk-averse organizations and offers a more formalized approach and a fixed

reporting structure. Depending on the nature of the business model, TPM is implemented differently by an organization that has an in-house ongoing Development and IT Operations (DevOps) team compared to an outsourced software development organization that requires a more structured implementation and reporting processes (Nagarajan, Velanganni & Sujatha, 2015; Jackson & Brannon, 2018). The disadvantages listed in Table 8 show how a TPM implementation can negatively affect organizations based on the type of enterprise.

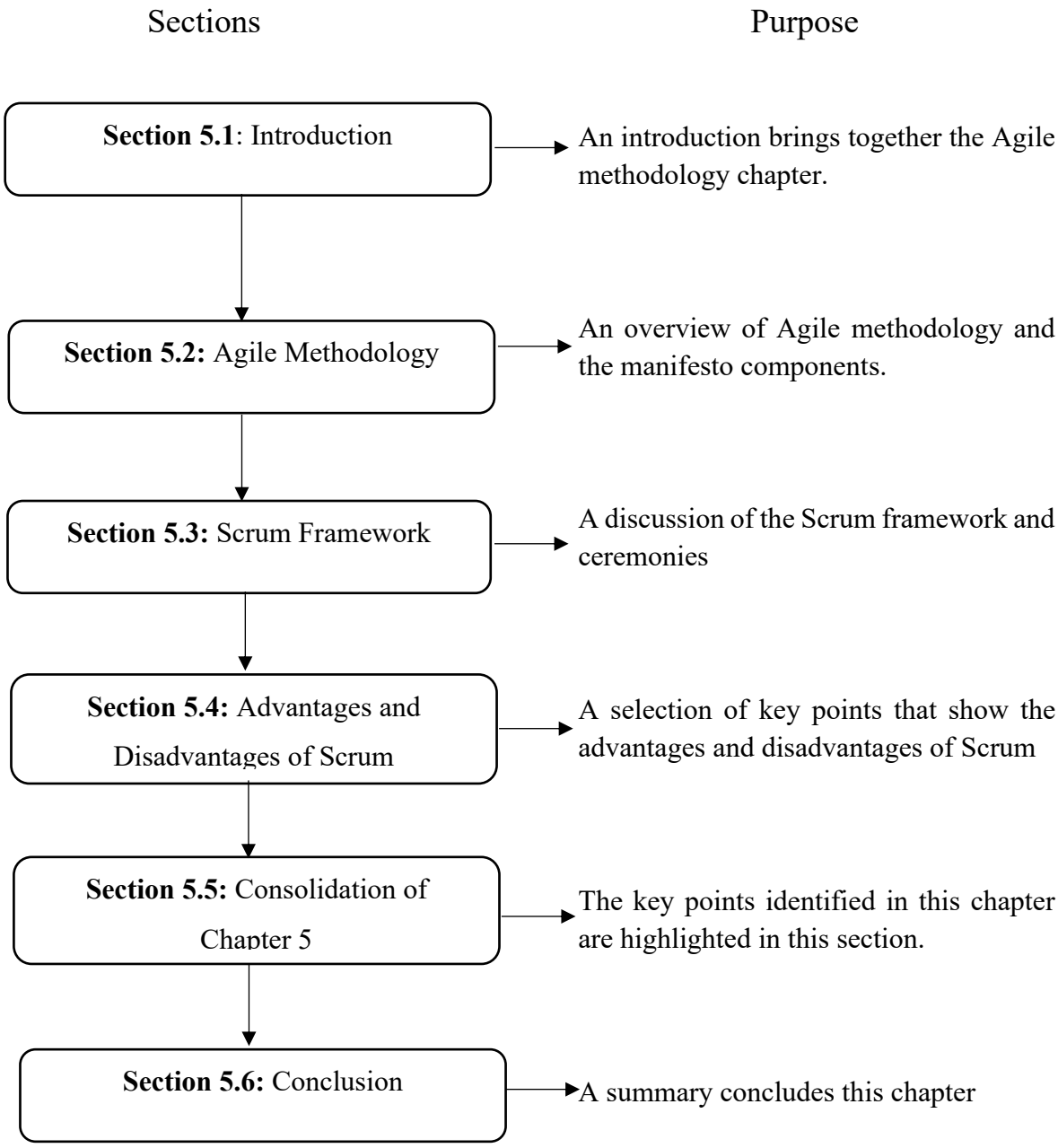
Although Agile software development techniques are thought to have potential, Agile philosophies are not fundamentally at odds with PMBOK. The hesitation in using Agile approaches over more Traditional Project Management procedures and tools appears to be due to a lack of awareness of when and how the Agile techniques match and differ from PMBOK (Sanchez et al., 2019; Federico, Andrea & Pellizzoni, 2021). Even though Agile methodologies are becoming more popular among organizations that use Traditional Project Management approaches, most of these enterprises still prefer to use both Agile and Traditional methodologies when implementing projects such as enterprise software and legacy system integration and E-commerce website development (Niazi, Mahmood, Alshayeb, Qureshi, et al., 2016; Totten, 2017). Therefore, a guide to highlight the strengths and weaknesses is needed. The Scrum framework can entirely or partially support the PMBOK processes and some of its knowledge areas, if it can balance the advantages and disadvantages listed in Tables 7 & 8. However, Agile challenges in certain knowledge areas may affect project delivery and success. Therefore, organizations should determine if the lack of support from Scrum processes affects a project's overall success when selecting projects (Niazi, Mahmood, Alshayeb, Qureshi, et al., 2016).

4.5 Conclusion

PMBOK is a detailed framework of ten knowledge areas, broken down into activities spanning five stages or process groups of the project life cycle. The ten knowledge areas and five process groups describe how the PMBOK tools and techniques are used. A PMBOK process is a set of inputs, techniques and tools, and outputs. The noted advantage in the literature of PMBOK is its fixed roles and processes with clear responsibilities. On the other hand, the notable disadvantage of PMBOK, as described in literature, is incorrect planning due to abstract specifications. PMBOK requires specialized expertise from a PM to use the available tools and approaches for managing an IT software project. TPM is better for more risk-averse

organizations and offers a more formalized approach and a fixed reporting structure. Although Agile software development techniques are thought to have potential, Agile philosophies are not fundamentally at odds with PMBOK. The hesitation in using Agile approaches over more Traditional Project Management procedures and tools appears to be due to a lack of awareness.

5 AGILE METHODOLOGY OVERVIEW



5.1 Introduction

Agile Project Management (APM) methods are frameworks that enable organizations to respond fast to changing client requirements by providing flexibility in project management (PM) (Agile Alliance, 2001; Butt, 2016; Thesing, Feldmann & Burchardt, 2021; Mayo-Alvarez et al., 2024). They emerged as a concept for software development and Information Technology (IT) projects, and have appeared to address the flexibility issues experienced by traditional models (Picciotto, 2020). APM is aided by developing a set of principles, tools, and strategies for delivering value to customers while accounting for the project's unpredictability and the customer's changing needs (Ciric et al., 2020). Therefore, APM determines the best course of action based on the organization's needs. The goal is to introduce lightweight development approaches as a viable alternative to established development methods. The Agile methodology, as discussed in Chapter 3, includes methodologies such as Extreme Programming (XP), Scrum, Dynamic System Development (DSDM), Feature Driven Development (FDD), Adaptive Software Development (ASD), Crystal methodologies, and others. This study will discuss Scrum as the most popular Agile methodology.

5.2 Agile methodology

According to Butt (2016) and Cooper & Sommer (2016, p. 2), Agile is a set of methodologies for developing new software products using a human-centred design approach. It is based on the Agile Manifesto crafted by IT industry leaders in 2001, which is based on four values and 12 principles as a set of rules and guidelines (Agile Alliance, 2001; Cooper & Sommer, 2016). The focus is on people doing the work and the interactions amongst them, as opposed to the processes and tools used to perform the task (Agile Alliance, 2001). The values of APM address both the need to construct Agile and adaptable products, and to create Agile and adaptable development teams that are self-organizing, cross-functional, and that understand how to utilize appropriate Agile methodologies to create their project deliverables when producing working software and services (Conforto & Amaral, 2010). It also values working products over lengthy documentation, as it is more critical to deliver working software than documentation without a product (Agile Alliance, 2001; Ribeiro & Domingues, 2018). The Agile methodology helps with adaptability and flexibility, reducing the residual and inherent risks mentioned in Section 3.6.1.

Table 9 provides a brief overview of the four Agile values:

Table 9: The Four Agile Values (Agile Alliance, 2001)

More value	Important, but less value
Individuals and interactions	Processes and tools
Working software	Detailed documentation
Customer collaboration	Contract negotiation
Responding to change	Following a plan

Furthermore, APM is more dependent on tailoring the project management process and methodology to the situation at hand, focusing on delivering pieces of the project or product, and making quick alterations as needed, as responding to change is more valuable than plans that do not allow for change (Ribeiro & Domingues, 2018; Picciotto, 2020). It prioritises customer collaboration over negotiation, as the voice of the customer should come first in any business commitment, focusing on individuals and interactions over processes and tools, as shown in Table 9 (Agile Alliance, 2001). APM methods work best in small-scale projects with unclear goals and changing requirements, and with a cross-functional team with the appropriate skill set. Agile promotes flexible working, continuous improvement, and team responsibility, emphasizing performance and outcomes that benefit the worker, their team, and the organization, focusing on working software rather than detailed documentation as shown in Table 9 (Marder et al., 2021; Mayo-Alvarez et al., 2024). This suggests that Agile describes how one performs and streamlines some activities without necessarily creating a new methodology, but only by changing the mindset in approaching project tasks.

The APM approach is designed for innovative product development projects, emphasizing incorporation of customer feedback and continuous releases (Conforto & Amaral, 2010; Saragih, Dachyar & Zagloel, 2021). Moreover, Agile working entails bringing people, processes, connectivity, technology, time, and place together to determine the most appropriate and effective way to achieve project success, putting visibility on customer collaboration rather than contract negotiation, as shown in Table 9 (Marder et al., 2021). Project success is achieved by completing new product iterations and adding value to customers through short-time deliverables (Conforto & Amaral, 2010; Butt, 2016).

Agile development is not a methodology in itself. It is regarded as an umbrella term for a number of Agile methodologies that are accepted in practice. According to Salah and Hefny (2017) and Ribeiro & Domingues (2018), Agile methodologies include Extreme Programming, Scrum, Dynamic System Development, Feature Driven Development, Adaptive Software Development, Crystal methodologies, and others. Most Agile methodologies encourage iterative development, working software, customer collaboration, and process adaptation (Salah, Hefny & Darwish, 2017; Chaouch, Mejri & Ghannouchi, 2019). These methods were regarded as lightweight or Agile, and their creators collaborated to create a manifesto called the Manifesto for Agile Software Development (Agile Alliance, 2001; Conforto et al., 2014).

The following text provides a brief overview of the different Agile frameworks, including Scrum, which is the focus of this study.

- **Extreme Programming (XP)**

  XP is based on values and factors such as communication, simplicity, feedback, time boxing, pair programming, unit testing, flat management structure, and expecting changes in requirements; it intends to improve software quality and responsiveness (Batra et al., 2010; Anwer et al., 2017; Papadakis & Tsironis, 2018).

- **Scrum**

  Scrum development is based on a time-boxed development period called a *Sprint,* maintaining a backlog of user requirements, self-organizing teams, verbal communication, and expecting changes in requirements (Batra et al., 2010). It is breaking work into goals that can be completed, and accepts that the user requirements cannot be clarified without actually developing software (Batra et al., 2010; Anwer et al., 2017; Papadakis & Tsironis, 2018).

- **Dynamic System Development**

  DSDM is framed into three phases: pre-project, project life cycle, and post-project, and is used to manage business process transformation projects through a rapid application development approach that emphasizes a fixed cost, quality, and time at the outset, using the MoSCoW prioritization of scope (Anwer et al., 2017; Papadakis & Tsironis, 2020; Saragih, Dachyar & Zagloel, 2021).

- **Feature Driven Development**

FDD is an Agile model that uses short iterations to develop functional software by combining the concept of feature with the software development process (Chowdhury & Huda, 2011; Anwer et al., 2017; Ribeiro & Domingues, 2018; Papadakis & Tsironis, 2020).

- **Adaptive Software Development**

  ASD is a dynamic speculative collaborative-learn software development life cycle instead of the static plan-design-build software development life cycle, which embodies the principle of continuous adaptation of the process to work (Chowdhury & Huda, 2011; Salah, Hefny & Darwish, 2017; Ribeiro & Domingues, 2018).

- **Crystal methodologies**

  Crystal clear methods are a collection of Agile software development methodologies that can be used for different software projects depending on size, complexity, criticality, and the number of people involved (Papadakis & Tsironis, 2020). Crystal methods focus on people and communication among them, rather than on a process to deliver working software to non-critical business applications frequently (Anwer et al., 2017; Ribeiro & Domingues, 2018).

According to the State of Agile Report (2022), Scrum, with 87%, continues to lead as the most popular Agile framework to use, followed by Kanban at 56%, and the least used is Extreme Programming at 7%. Agile methods such as Scrum or Kanban are not focused on comprehensive, advanced planning and the linear, precise execution of a detailed plan (Thesing, Feldmann & Burchardt, 2021). As a result, the most popular Agile methodology is Scrum due to its ease of implementation, focus on teamwork, and regular updates on tasks (Marder et al., 2021).

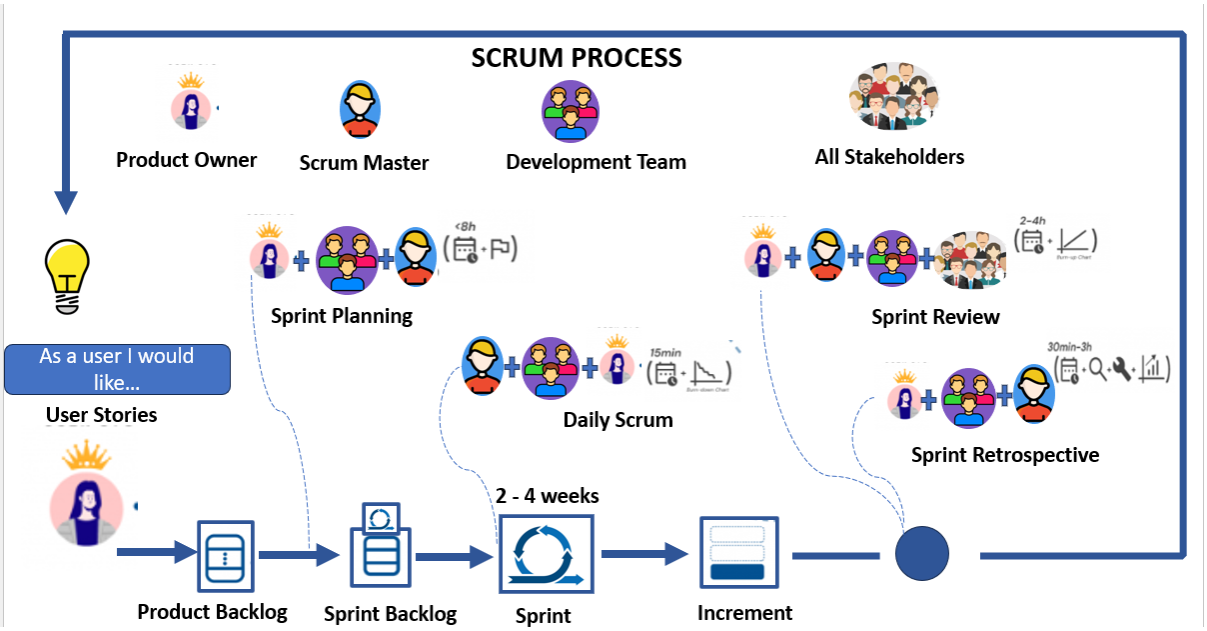


Figure 6 Scrum Process Flow ((Salah, Hefny & Darwish, 2017)

5.3 Scrum framework

Scrum is a framework based on the theory of practical rapid process control within which people can address large complex issues, while delivering services or products of the highest quality productively and creatively (Grebic, 2019; Papadakis & Tsironis, 2020). The Scrum approach enables problem solving through complex adaptive system methods that rely on transparency and inspection; eventually should drive teams towards continuous improvement in addressing the issue or opportunity; and should improve the confidence within the team itself (Chaouch, Mejri & Ghannouchi, 2019; Marder et al., 2021; Mayo-Alvarez et al., 2024). It is both iterative and incremental in techniques and methodologies for customer requirements that are not defined upfront (Ribeiro & Domingues, 2018; Grebic, 2019).

Referring to the views of Grebic (2019, p. 57) and Marder et al. (2021, p. 3), Scrum presents three entirely new roles in Agile IT projects that did not previously exist in that form. The Product Owner is responsible for maximizing value in a project and protecting stakeholders' interests, often external customers, while also contributing to sprint planning, daily scrum, sprint review, and sprint retrospective. This is done by maintaining a prioritized and up-to-date list of project needs and product attributes based on what is happening in the project (Mayo-Alvarez et al., 2024). The Scrum Master, the individual who is responsible for all the members in an Agile project, and who is the administrator and facilitator of the Scrum framework, takes

on the role of Scrum process facilitator; this person is not necessarily a member of the technical team, and contributes to sprint planning, daily scrum, sprint review, and sprint retrospective (Marder et al., 2021). Scrum Masters are responsible for mentoring, coaching, teaching, directing, and assisting a Scrum Team and its environments to properly understand and use of Scrum methods (Marder et al., 2021). The Development Team is a collection of specialists working together to develop products that possess the necessary knowledge and directly generate value in a project, contributing to sprint planning, daily scrum, sprint review, and sprint retrospective (Grebic, 2019). The Scrum team is a self-organizing group that delivers product or service increments at the end of each defined Sprint (Grebic, 2019).

According to Marder et al. (2021), the Product Backlog is a selected list of the work to be completed in continuously creating, maintaining, building, and sustaining a product or service, which represents one of the phases in the Scrum framework. It lists clearly prioritized user stories for delivering product or service increments and reaching what is defined as planned Sprint goals (Salah, Hefny & Darwish, 2017). Sprint planning is a time-limited event where the dedicated Scrum Team inspects and allocates weights to the highest prioritized work from the defined Product Backlog to be completed next, and designs and allocates the work into a workable Sprint Backlog. Sprint planning describes the determined tasks and weighted priorities, and gives guidance for their execution (Salah, Hefny & Darwish, 2017). The Sprint Backlog is the Development Team’s agreed plan or overview of the work required by the team to achieve Sprint's goals. Sprints are described as high-productivity short work cycles for development teams that may vary in length from two to four weeks based on what was agreed in sprint planning.

Furthermore, a Sprint is known to last several weeks, sometimes a month, and results in a complete, functioning, usable, and potentially shippable product or service artifact (Salah, Hefny & Darwish, 2017). The daily scrum is known as a short check-in meeting held by the Development Scrum Team to review previous work challenges and success, plan and give advice, and maximize the team's ongoing planned performance (Salah, Hefny & Darwish, 2017). They are regarded as fifteen-minute meetings of the team members at the start or beginning of every defined workday, focused on assisting with current planning and advising on resolving problems (Salah, Hefny & Darwish, 2017). The Sprint Review ceremony with the development team considers the incremental benefits of the allocated Sprint/s so far, looping

back to create dynamic processes that enable continuous product or service improvement, while building strong team engagement (Salah, Hefny & Darwish, 2017). Sprint Reviews are team meetings during which time all the tasks completed and incomplete throughout the Sprint are reviewed, evaluated, weighted, and stakeholders see the project's progress. Lastly, the Sprint Retrospective is an internal meeting of team members geared to improve allocated tasks after Sprint (Salah, Hefny & Darwish, 2017). The Retrospective serves the Scrum Team to inspect and engage the past Sprint and plan for recognized improvements to be enacted during the next planned Sprint. The Scrum framework is a project management methodology used to efficiently manage complex work, especially when requirements change frequently. It supports the goal of delivering value to the market more quickly as supported by the importance of using a project management methodology in a project is discussed in Section 2.5.

5.4 Agile project challenges

The Agile methodology presents challenges and limitations during project implementation, as noted in the literature (Ciric et al., 2020; Project Management Institute, 2021a). The literature about the Agile methodology has recognised some observable challenges, as follows:

5.4.1 Project objective

Project objectives can evolve as the project progresses. This fluidity can create confusion if the overall vision is not clear or communicated well. Teams might struggle with balancing short-term sprint goals and long-term product vision (Ciric et al., 2020; Sithambaram, Nasir & Ahmad, 2021).

5.4.2 Changes in top management

Agile requires buy-in and support from leadership. Changes in top management can disrupt Agile adoption if new leaders do not understand or support Agile principles, leading to shifting priorities or reverting to traditional methods (Ciric et al., 2020; Sithambaram, Nasir & Ahmad, 2021).

5.4.3 Cost

Agile's iterative approach makes upfront cost estimation difficult (Ciric et al., 2020; Sithambaram, Nasir & Ahmad, 2021). Budgeting can be a challenge because the scope is flexible and evolves with each sprint.

5.4.4 Coordination and integration management

Agile projects often involve multiple teams working on different parts of the product, which can lead to integration issues and coordination overhead, especially in large or distributed teams (Ciric et al., 2020; Sithambaram, Nasir & Ahmad, 2021).

5.4.5 Risk management

Agile does not always explicitly highlight risk management as a separate process, which can lead to overlooked risks, especially in fast-paced environments (Ciric et al., 2020; Sithambaram, Nasir & Ahmad, 2021).

The above illustrates that the agile methodology has its challenges, and its project management success depends on thoughtful implementation. This thought process needs to establish strengths and weaknesses of the methodology based on project characteristics and even consider blending these within available project methodologies to manage project risks and responses.

5.5 Advantages and disadvantages of Agile

These are summarised in Table 10 and Table 11:

Table 10: Advantages of the Agile Methodology, according to Thesing, Feldmann & Burchardt (2021,p.750)

Advantage	Description
Fast recognition of changed requirements	The most significant advantage of Agile Project Management is the ability to quickly recognize changed requirements due to regular customer feedback or iterations.
Fast identification of errors due to short development cycles	The benefit of rapidly identifying errors and bugs based on the short, regular feedback-and-development cycles is seen as a major advantage.
Flexibility and quick response to changing requirements	Flexibility pays off when change is frequent.

Lower risk of false developments	The focus on continuous, iterative delivery creates a low risk of false developments.
Continuous optimization of the project processes	Constant self-reflection and striving for continuous development and improvement is one of the core principles.
High motivation of the team through personal responsibility	Keeping the importance of the team's motivation and some foundational principles such as the right people, commitment and dedication, and adequate authority for responsibility.
Unlimited ways to find process solutions	Solutions evolve throughout the life cycle of the project.

To have a comprehensive understanding of the agile methodology, examining of its advantages is important for problem-solving:

Fast recognition of changed requirements

Agile enables teams to quickly identify and adapt to changing requirements. Frequent iterations and ongoing communication with stakeholders ensure that new needs are recognized early and incorporated effectively (Conforto et al., 2014; Thesing, Feldmann & Burchardt, 2021). This means promptly incorporating changes into the project workflow to reduced waste with less time and money spent building features and higher customer satisfaction.

Fast identification of errors due to short development cycles

Agile's short development cycles (e.g., sprints) allow for early testing and review. This leads to quicker detection of errors, reducing the cost and effort required for corrections (Conforto et al., 2014; Thesing, Feldmann & Burchardt, 2021). Hence defects and bugs are identified quickly and early in the development process, rather than accumulating over time. This is to avoid delayed feedback and large changes during the development.

Flexibility and quick response to changing requirements

Agile is built for adaptability and pays off when change is frequent. Agile's iterative nature enables teams to rapidly modify priorities, features, and deliverables in response to evolving business goals or user feedback (Conforto et al., 2014; Thesing, Feldmann & Burchardt, 2021). Instead of seeing a change in project scope or requirements as a disruption to be avoided, the team embraces it as an opportunity to deliver a better, more valuable product.

Lower risk of false developments

Frequent customer feedback and regular product reviews reduce the likelihood of developing features that do not meet user needs or business objectives, thereby minimizing wasted effort (Conforto et al., 2014; Thesing, Feldmann & Burchardt, 2021). This means teams are less likely to spend time and resources building features or products that ultimately miss the mark or fail to deliver value.

Continuous optimization of project processes

Agile promotes regular reflection and improvement through retrospectives. Teams continually assess what is working and make adjustments to improve efficiency and outcomes (Conforto et al., 2014; Thesing, Feldmann & Burchardt, 2021). This means constantly seeking and implementing small, incremental improvements to a team's workflow, methods, and practices.

High motivation of the team through personal responsibility

Agile empowers teams by giving them ownership of their work. Self-organization and autonomy enhance motivation, accountability, and innovation among team members (Conforto et al., 2014; Thesing, Feldmann & Burchardt, 2021). This means empowering team members to own their work and the project's outcomes, rather than being managed with a top-down, command-and-control approach, which fosters accountability and meaningful work.

Unlimited ways to find process solutions

Agile is not tied to rigid methods. Teams can experiment with different practices, tools, and workflows to find what works best for their specific context, encouraging creativity and continuous improvement (Conforto et al., 2014; Thesing, Feldmann & Burchardt, 2021). This means that teams are not locked into a single, pre-defined set of rules; instead, they are continuously encouraged and empowered to experiment, innovate, and find the specific process that works best for them to deliver value.

Table 11: Disadvantages of the Agile Methodology according to Thesing (2021, p. 750)

Disadvantage	Description
An iterative approach does not fit the corporate culture	The iterative approach may not be the best fit for the corporate culture in areas of planning and development, reporting, hierarchical structures and bureaucracy, and leadership management.
The ability of teams to self-organize is critical to their success.	The ability to succeed depends strongly on the team's skills and abilities and its members' discipline to organize.
Dedication and work to the project should be full-time for the team members.	An Agile team is composed of part-time workers due to the nature of organizations, resulting in obligations other than the project work.
Limited and unclear communication for large and scattered teams	Limited and unclear communication for large and scattered teams emerge since teams work on each component in different cycles, resulting in the completed output becoming very fragmented rather than one cohesive unit.
The use of iterative development may require more time spent on tasks and more budget	The incremental delivery method may help bring products or services to the market faster, but may require more time spent and more budget as requirements change rapidly.
Great presence of users for testing requirements	Users need to allocate a large percentage of their capacity to testing.

To have a comprehensive understanding of the Agile methodology, the examination of its disadvantages is important for decision-making:

An iterative approach may not fit the corporate culture

Agile requires flexibility, openness to change, and a collaborative mindset. In organizations with a rigid, hierarchical structure or a traditional Waterfall mindset, Agile's iterative and adaptive approach may clash with the existing culture, making adoption difficult (Conforto et al., 2014; Thesing, Feldmann & Burchardt, 2021). This suggests that the organizational culture is so ingrained in command-and-control, top-down decision-making, and rigid processes.

Team self-organization is critical to success

Agile relies heavily on teams being self-managed and proactive. If team members lack experience, discipline, or initiative, the project may suffer from poor coordination, lack of direction, or inconsistent delivery (Conforto et al., 2014; Thesing, Feldmann & Burchardt, 2021). This means that self-organizing teams lack the autonomy to make decisions related to their tasks, roles, and processes, resulting in chaos and a lack of leadership.

Full-time dedication is often required

Agile works best when team members are fully dedicated to the project. If individuals are assigned to multiple projects or part-time roles, it can reduce focus, slow down progress, and hinder collaboration (Conforto et al., 2014; Thesing, Feldmann & Burchardt, 2021).This means that to be effective, members should focus exclusively on a single project to reduce wasted time, minimize mistakes, and expedite delivery.

Limited and unclear communication in large or distributed teams

Agile emphasizes close and continuous communication, which can be challenging in large or geographically dispersed teams(Conforto et al., 2014; Thesing, Feldmann & Burchardt, 2021). Time zone differences, lack of face-to-face interaction, or inconsistent communication tools may lead to misunderstandings or misalignment.

Iterative development can increase time and budget requirements

Frequent iterations, continuous testing, and regular feedback loops may consume more time and resources than originally expected (Conforto et al., 2014; Thesing, Feldmann & Burchardt, 2021). Without careful management, this can lead to scope creep, delays, or budget overruns.

High user involvement is required

Agile development depends on regular feedback from users or customers throughout the development process (Conforto et al., 2014; Thesing, Feldmann & Burchardt, 2021). This requires a significant time commitment from stakeholders, which may not always be feasible, especially in busy or resource-limited environments.

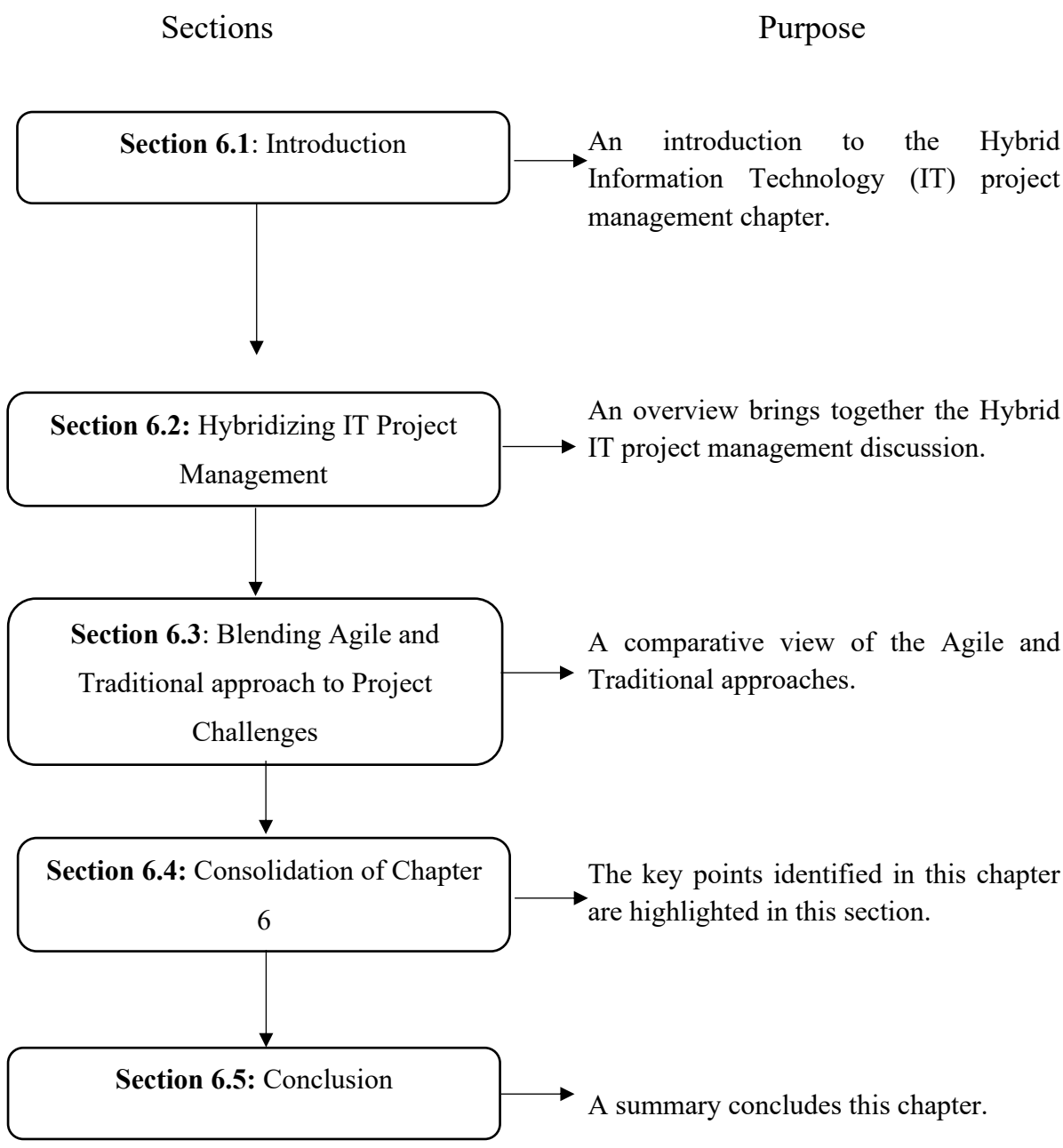
Agile methodologies comprise many different methodologies that address rapidly changing user requirements. Each Agile methodology has its strength and weakness when addressing innovative user requirements. Chaouch (2019) suggests that Scrum professionals are aware of the risk of working with incremental deliverables by considering the advantages and disadvantages of Agile, as mentioned in Tables 10 and 11. According to Papadakis and Tsironis (2018), collaborative efforts make Scrum powerful in addressing complex user needs faster, and in tailoring the best adaptive solution in a short cycle. A Scrum methodology is best used when addressing IT project requirements, as they require flexibility in responding to change, encompassing both collaborative and rapid response to user needs which not all project

require during implementation (Federico, Andrea & Pellizzoni, 2021; Mayo-Alvarez et al., 2024). The above views solidify the point that Agile methodology supports productivity and creativity in delivering products of the highest possible value. However, not all projects demand speed, flexibility, and collaboration in all phases; some phases require a detailed structure and rigid procedures for standardization. Therefore, a Hybrid approach would assist in solving this challenge.

5.6 Conclusions

APM is aided by developing a set of principles, tools, and strategies for delivering value to customers, while accounting for the project's unpredictability and the customer's changing needs. It is based on the Agile Manifesto, crafted by IT industry leaders in 2001, which comprises four values and 12 principles as a set of rules and guidelines. Scrum is the most popular Agile methodology and presents three new roles that did not previously exist in traditional IT project implementation. The Product Owner is the individual responsible for maximizing the value of a project. The Scrum Master is responsible for all the members of an Agile project. The Development Team is a group of specialists collaborating to develop products. Furthermore, ceremonies are facilitated by the Scrum roles, that is, Sprint planning, Daily stand-up, Sprint review, and Retrospective. The advantages and disadvantages highlight the strengths and weaknesses of the Agile methodology, with consideration of its values and principles.

6 HYBRIDISING THE IT PROJECT MANAGEMENT APPROACH



6.1 Introduction

As seen from Chapters 3, 4, and 5 and illustrated by literature, the Project Management Institute (PMI) Project Management Body of Knowledge (PMBOK) and Agile methodology Scrum face similar project challenges. This chapter describes how each methodology, that is, Traditional and Agile, addresses the identified project challenges outlined by knowledge areas, with consideration of the distinguishing characteristics, advantages, and disadvantages. The literature review has successfully highlighted the project challenges and revealed the advantages and disadvantages of Agile and PMBoK in running Information Technology (IT) projects, that is, Scrum and Traditional approaches. However, it has not clearly shown us how each approach deals with challenges or how each approach can create opportunities of success for project managers at a project level.

6.2 Hybridising IT project management (Chapters 3,4, and 5)

As stated previously, Chapters 3, 4, and 5 support the main goal of this research, namely the first research sub-question, as stated in Section 1.4.3 of Chapter 1. Looking at the distinguishing characteristics, project challenges, and advantages and disadvantages of the Traditional and Agile methodologies, the IT project manager and practitioner should be able to understand why the Hybrid approach is needed and beneficial.

6.2.1 Drivers for hybridising IT project management

Recent research suggests an increasing trend to use a Hybrid approach for highly complex IT projects (Salah, Hefny & Darwish, 2017; Papadakis & Tsironis, 2020). The goal is to balance Agile and Traditional methodologies' strengths while suppressing their drawbacks (Imani, Nakano & Anantatmula, 2017; Salah, Hefny & Darwish, 2017). This may be possible within a planned project implementation when we apply each methodology where it is appropriate (Totten, 2017; Papadakis & Tsironis, 2020). The increasing complexity and changing requirements of implementing an IT project lead project managers to seek tools and processes to manage volatility, reduce disturbance, and create continuous progress tracking (Imani, Nakano and Anantatmula, 2017). Furthermore, IT Projects often span multiple domains such as hardware, software, and business processes that cannot be fully addressed using a single methodology to cater for market dynamics and pressures due to evolving customer feedback (Salah, Hefny & Darwish, 2017; Papadakis & Tsironis, 2020). In many organizations, legacy

systems coexist with modern applications, as such driving the integration of project management (PM) methodology to accommodate these mixed environments and to allow innovation and creativity in dynamic environments (Salah, Hefny & Darwish, 2017; Papadakis & Tsironis, 2020; Lalmi, Fernandes & Souad, 2021). As a result, project managers (PMs) and practitioners will be faced with three project management options: Traditional methodology, Agile methodology, and Hybrid methodology (Imani, Nakano and Anantatmula, 2017). Furthermore, to identify the most helpful project management methodology, strategic intent and practical implications would have to be considered for leveraging the best of both worlds; it is important to understand the project context and the organizational level to be able to adjust the project management methodology along with the project challenges stated in Chapters 4 and 5 (Jackson & Brannon, 2018). Therefore, IT project managers need to understand the advantages and disadvantages of each methodology, as outlined in Chapters 4 and 5, for continuous improvement.

6.2.2 Hybrid IT project management models

The known IT project management methodologies can become more complex when a practitioner works within dynamic environments, such as software development, engineering, or product design, while managing an in-house or external development team (Jackson & Brannon, 2018).

According to Imani, Nakano & Anantatmula (2017), research revealed two Hybrid approach model types. The first is to use both Traditional plan-driven and Agile methodology in one project implementation, alternating methodology depending on the project phase. This is regarded as hybrid-by-phases and is best suited to in-house software development, due to its continuous improvement characteristics (Jackson & Brannon, 2018; Papadakis & Tsironis, 2020). These can, for example, be banking apps, developed by any organization that has a Development and IT Operations (DevOps) team. The second alternative involves utilizing mixed methods via Scrum, such as having a Traditional plan-driven estimation tool in an Agile development (Conforto & Amaral, 2016; Totten, 2017; Papadakis & Tsironis, 2020). This is regarded as hybrid-by-method, and appropriate to be undertaken by an external consulting IT software development organization (Jackson & Brannon, 2018; Papadakis & Tsironis, 2020). This Hybrid approach would be most effective in large complex system development projects,

where organizational structure and contractual issues would hinder the iterative development process that is essential to Agile methodology.

According to Totten (2017) and Salah ,Hefny & Darwish (2017), research debates how Agile and Traditional approaches should be used in each Hybrid model type. The literature indicated that blending Agile and Traditional practices is viewed as practical and necessary. This is demonstrated by a Hybrid IT project creation and management study that combines Scrum and Traditional Waterfall in a software development project (Salah, Hefny & Darwish, 2017; Lalmi, Fernandes & Souad, 2021). This Hybrid concept was focused on three levels of approach. First, "Waterfall-upfront" is used to establish criteria. Thereafter, Agile approaches can be used during design, implementation, and unit testing. Finally, the "Waterfall-at-end" method can be used to run an integration test (Salah, Hefny & Darwish, 2017; Papadakis & Tsironis, 2020). This Hybrid model type is associated with the first Hybrid approach model type, as it is in phases, using both Traditional plan-driven and Agile methodologies in one project implementation.

Another study discovered a new adaptable Hybrid methodology for managing IT projects that blend Traditional and Agile methodology in activities (Conforto & Amaral, 2016). This proposed methodology was divided into four distinct sections. The first and last are always done in the Traditional manner, while the second and third are in a more adaptable style (Conforto & Amaral, 2016). This Hybrid model type is associated with the second Hybrid approach model type, which utilises different methodologies in each activity section of the project implementation. The two Hybrid model types demonstrate that a project management implementation can employ either an agile or Traditional dominant methodology.

6.2.3 Case study example from the literature

According to Conforto and Amaral (2016), a Hybrid model using the first Hybrid approach model type outlined in Section 6.2.2 (i.e., a phase-gate model with iterations for each phase) was used as a case study. The fundamental purpose of using stage-gate or phase-oriented modelling is to utilise strong iterative development to allow for different planning and execution stages in a Hybrid management approach, just like the first Hybrid model type outlined in Section 6.2.2. For fast-changing and inventive project environments, this provides for a mix of discipline and flexibility (Conforto & Amaral, 2016; Papadakis & Tsironis, 2020;

Lalmi, Fernandes & Souad, 2021). Technology firms are respectable examples of establishments that are constantly confronted with uncertainty when developing innovative goods and new technologies with limited structures and resources (Conforto & Amaral, 2016; Papadakis & Tsironis, 2020). This Hybrid model type would best suit their business model. One of the core principles of Agile Project Management is adding value through iterative development cycles by employing a plan-driven phase-gate model, which brings more detailed structure per phase. Therefore, the type of technology enterprise drives a project's level of hybridisation based on the end-user's product, that is, whether as an in-house development project or with outsourced development project services (Conforto & Amaral, 2016; Salah, Hefny & Darwish, 2017; Papadakis & Tsironis, 2020).

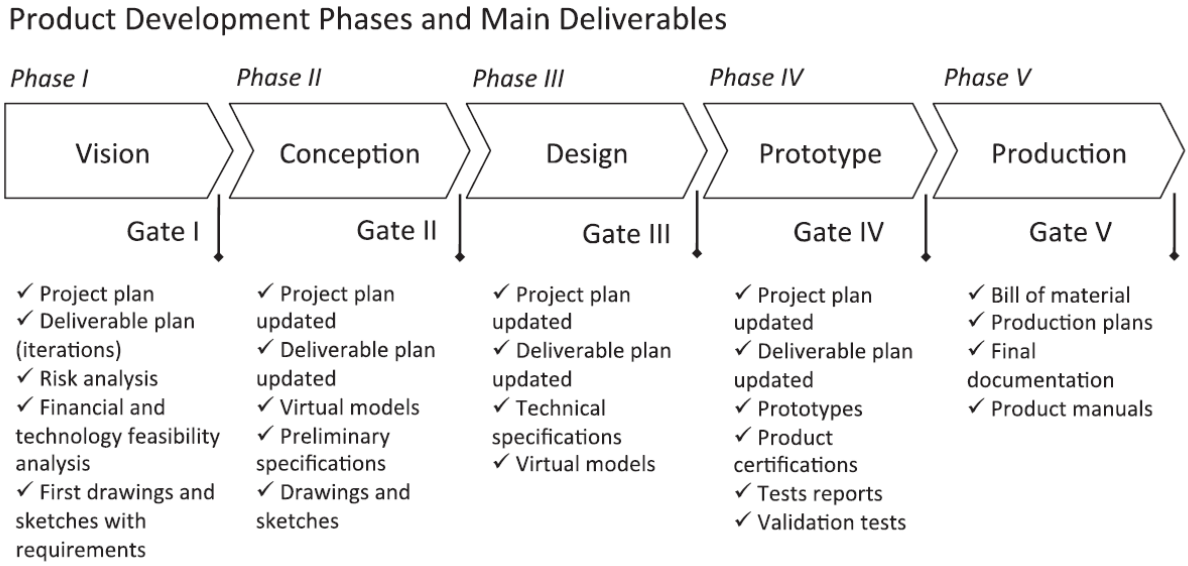


Figure 7: Product Development Phases and Main Deliverables for Hybrid projects (Conforto and Amaral, 2016)

The model in Figure 7 demonstrates that Agile and Traditional approaches can work together. Phase and criterion definitions define milestones with iterative development, and short development cycles with regular informal meetings and feedback result in a more Hybrid approach that is better adapted to the project's goals and problems (Conforto & Amaral, 2016). This Hybrid approach combines stage-gate and APM practices, similar to the first Hybrid model type (Conforto & Amaral, 2016).

All of the research supports the integration of Agile software development with stage-gate project management, and incorporating Agile approaches in phases where it makes sense to assist in maintaining the communication flow (Conforto & Amaral, 2016; Salah, Hefny & Darwish, 2017; Totten, 2017). The Hybrid framework contributes to several aspects of project and product development; it describes improvements by appropriately adapting and combining stage-gate models with Agile practices in handling project challenges (Conforto & Amaral, 2016).

6.3 Blending Agile and Traditional approaches to project challenges (Chapter 3 and 4)

This section examines how Agile and Traditional approaches address project challenges in relation to knowledge area requirements. As previously stated, Chapters 3 and 4 support one of the main goals of the research, namely, the first research sub-question (see Section 1.4.3 of Chapter 1). In examining the advantages and disadvantages of Traditional and Agile methodologies, the knowledge areas identified are the ones that are used mainly in PMBOK.

Table 12 shows the knowledge areas and the challenges column, as well as the Agile and Traditional response columns.

Table 12: The responses of Agile and Traditional approaches to project challenges presented by knowledge areas

Knowledge areas	Challenges	Agile PM Response	Traditional Project Management (PM) Response

Project Objective (Ciric et al., 2021)	How to meet business needs and systems' functional requirements; meeting the schedule is more important than meeting the budget.	The Agile approach will give the team the independence to make changes as and when needed, rather than firmly adhering to the original proposed plan (Conforto &Amaral, 2016).	The project steering committee approves any requirement changes for additional scope and budget, but only when the team can show strategic benefit via business case communication (Matos & Lopes, 2013; Varajão et al., 2017).
Project Size (Project Management Institute, 2021a)	The project involves many stakeholders from internal business sponsors, users, project managers, system analysts, and external/internal developers from around the world.	Scrum resolves the project size complexity by time-boxing the agreed development and limiting the frequency of ad hoc changes (Chaouch, Mejri & Ghannouchi, 2019).	Big contracts with the selected vendor need appropriate stakeholders with suitable Information Technology (IT), business, and methodology skills, and use a work breakdown structure (WBS) to maintain clarity and control (Conforto & Amaral, 2016).
Scope (Project Management Institute, 2021b)	Most users cannot describe and articulate understandable requirements in the initial planning stages; user requirements constantly evolve and develop over time.	Scrum allows the team to access change and manage it; Scrum cycles protect Sprint goals from ad hoc interruptions within the Sprint	In the requirements collection stage, specifications are documented and signed as an agreement between the business sponsors and the analyst and developers, to

		cycle (Conforto & Amaral, 2016).	describe the expected functionality communication (Matos and Lopes, 2013; Varajão et al., 2017).
Changes in top management (Ciric et al., 2021)	Current processes and systems requirements are needed when top management shifts priorities, changes the agreed-upon project scope and functionality requirements, redo analyses with investigations, and redesign the system.	The impact of top management changes is reduced when using Scrum, which enables frequent reassessment and adaptation (Chaouch, Mejri & Ghannouchi, 2019).	Top Management changes delay all decision-making in the project, realignment and reviews at check-in points are used (Totten, 2017).
Cost (Project Management Institute, 2021a)	The estimated costs are adjusted (increased) over time; initial estimated costs are found to be unrealistic and could not be used as a measure for current project goals	Easy access to the steering committee can enable the change meeting to be convened within 24 hours to make a decision (Picciotto, 2020).	The steering committee has to evaluate changed costs based on a business case for fund requests (Conforto and Amaral, 2016).
Schedule (Project Management Institute, 2021a)	An unrealistic initial schedule leads to adjustments (increases) to the initial schedule.	Each request for changing the schedule is accompanied by a time estimate; all stakeholders are kept informed (Picciotto, 2020).	The team is expected to keep and maintain changing timelines at all costs (Totten, 2017).
Quality (Project Management Institute, 2021a)	To create quality systems and documents.	Scrum continuously provides quality working software by facilitating and	Existing processes encourage the team to comprehensively document all

		evaluating output (Conforto and Amaral, 2016).	expectations for quality assurance and to review communication (Matos and Lopes, 2013; Varajão et al., 2017).
Coordination and integration management (Project Management Institute, 2021a)	Difficulty aligning work across teams and integrating all parts to avoid duplicates and inefficiencies	Scrum uses collaboration, self-organizing teams, and incremental delivery (Chaouch, Mejri & Ghannouchi, 2019).	All required decisions are well documented and all project parts are aligned, synchronized, and contributing to the defined project objectives.(Salah, Hefny & Darwish, 2017; Chaouch, Mejri & Ghannouchi, 2019).
Communications management (Project Management Institute, 2021a)	The formal communication structure can slow down development goals.	Scrum uses a two-week cycle called Sprint as well as daily scrums to ensure that effective communication is achieved (Picciotto, 2020).	All major decisions and user requirements are documented and tracked to ensure that all requirements are communicated (Salah, Hefny & Darwish, 2017; Chaouch, Mejri & Ghannouchi, 2019).
Risk management (Project Management Institute, 2021a)	No risk analysis and planning lead to unanticipated changes in the quadruple constraints of scope, cost, schedule, and quality; change	In Scrum, decision-making and learning lead the team to reassess risks and constantly	Lack of qualified internal risk management resources with the needed technology and methodology

	management becomes a critical project factor.	introduce new activities (Marder et al., 2021).	skills leads to a high risk of project failure (Salah, Hefny & Darwish, 2017; Chaouch, Mejri & Ghannouchi, 2019).
Procurement management (Project Management Institute, 2021a)	Documentation of all formal contracts and all project acquisitions are needed for all agreed changes.	All procurement activities are done in an Agile approach. (Picciotto, 2020)	All formally documented changes are coordinated with the correct project structure (Salah, Hefny & Darwish, 2017; Chaouch, Mejri & Ghannouchi, 2019).
Resources management (Project Management Institute, 2021a)	Dealing with high work-related stress is unsustainable for the current pace of development.	Agile principles are not involved in HR Workload management (Marder et al., 2021).	Having structured methods of HR planning and controlling the workload does not apply to Traditional projects (Salah, Hefny & Darwish, 2017; Chaouch, Mejri & Ghannouchi, 2019).

Traditional Project Management (TPM) and APM are essential and useful for solving different knowledge area challenges that arise during a project. Lalmi, Fernandes & Souad (2021) suggest that, depending on the characteristics, requirements, and demands of a project, it is important to use an appropriate approach when selecting an IT project management methodology. For projects that are unique, highly complex, and risky, a more process-driven

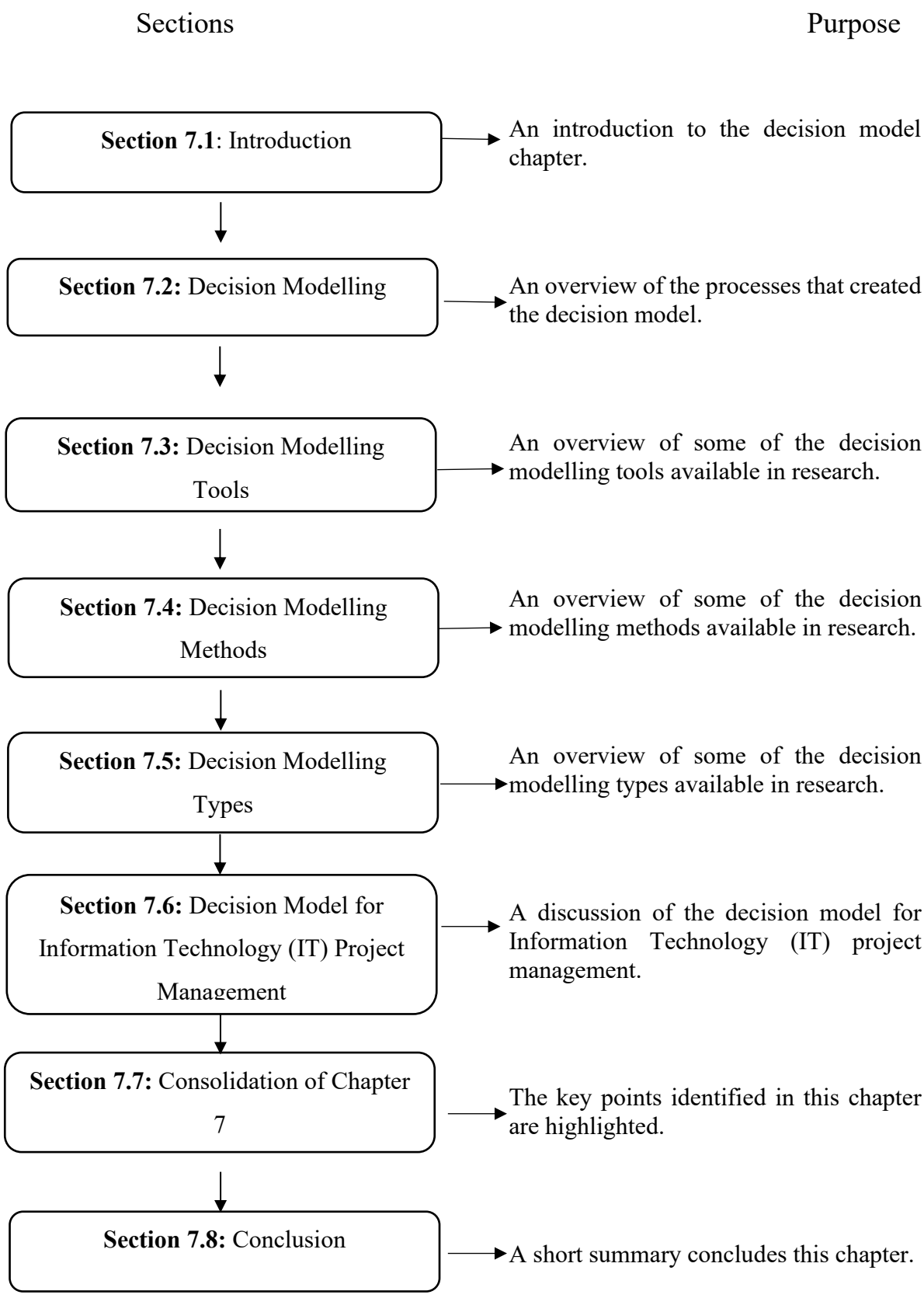
methodology such PMBOK is applicable when addressing specific knowledge area challenges, as seen in Table 12. PMBOK provides a global and general view of many aspects of project management, and is a useful reference for any environment. However, applying the same extent of project management rigor to every project is wasteful; Scrum is decisive in its flexible approach to addressing knowledge areas. The Scrum software development method cannot be applied directly to all knowledge area challenges, as it represents a dynamic approach and promotes a change of work culture.

Notably, there is a need to find the best and most complementing fit of process and technique to implement a well-balanced IT project with flexibility and stability. A combination of TPM and APM approaches is needed (Conforto et al., 2014; Thesing, Feldmann & Burchardt, 2021). This merging of some varieties of the processes of both Traditional and Agile methodology could result in what may be referred to as a Hybrid IT Project Management Methodology Decision Model (Papadakis & Tsironis, 2020; Thesing, Feldmann & Burchardt, 2021). The Hybrid approach would improve the TPM process model through the use of the Scrum principles of iterative planning, even when it is not followed purely and when only a few TPM/Scrum methodology elements are implemented (Conforto et al., 2014; Thesing, Feldmann & Burchardt, 2021).

6.4 Conclusion

The literature review has successfully shown the advantages and disadvantages of Agile in running IT projects, that is, using Scrum or Traditional approaches. Research suggests an increasing trend to use a Hybrid approach for highly complex IT projects by combining Agile and Traditional methods. It is important to adjust PM methods based on an understanding of the project context and the organizational level when identifying the most helpful PM methods for collaborative software development. The research identified that a Hybrid approach could be hybrid-by-phase or hybrid-by-method. The TPM and APM use essential and useful PM methods and processes for solving different knowledge area challenges that arise during a project. This displays the need to find the best fit in process and technique to complement each other in order to implement a well-balanced IT project with flexibility and stability. As a result, a Hybrid IT Project Management Methodology Decision Model is needed.

7 DECISION MODEL



7.1 Introduction

Making good decisions in an organization is difficult for several reasons, including time and financial pressure, an increasing number of alternatives, insufficient or too much information, and a complex and progressive business environment (Ratcliff et al., 2016; Tali, Nader & Chalal, 2017). Project managers and practitioners are faced with the difficult challenge of selecting the appropriate project management (PM) methodology as a communication tool that facilitates knowledge transfer and successful project completion(Sakka & Ben Kraiem, 2022). Researchers have proposed various methods that can be adopted in the decision process, and have argued that a decision matrix/model is appropriate in most situations (Yang & Huang, 2000; Soares, Tereso & Sousa, 2015; Islam & Arakawa, 2022). Decision modelling allows decision-makers to understand complex situations, evaluate alternatives, reach decisions, and improve decision-making effectiveness (Prabadevi et al., 2021). Figure 9 shows the typical decision-making process:

7.1.1 Identification of the problem

This is recognizing that a decision is needed due to a problem, gap, or opportunity identified by monitoring, identifying, and confirming the existence of the problem (Thakkar, 2021).

7.1.2 Problem definition

By clearly defining the problem, and to understand its scope and root cause, we identify the stakeholders affected by the problem and define the problem in measurable and specific terms (Thakkar, 2021)

7.1.3 Development of a decision matrix

The structure and evaluation of alternatives are based on multiple criteria, which identify possible solutions or alternatives and define evaluation criteria (Thakkar, 2021).

7.1.4 Application of the analytical model

By analysing the alternatives using tools, models, or simulations to understand potential outcomes and assess the implications of each alternative (Thakkar, 2021).

7.1.5 Ranking alternatives

The use of the decision matrix scores or the outputs from the analytical model to compare alternatives based on the results of the analysis (Thakkar, 2021).

7.1.6 Selection of the highly ranked alternative

The selection of the top-ranked option or a combination of options to choose the best alternative for implementation (Thakkar, 2021).

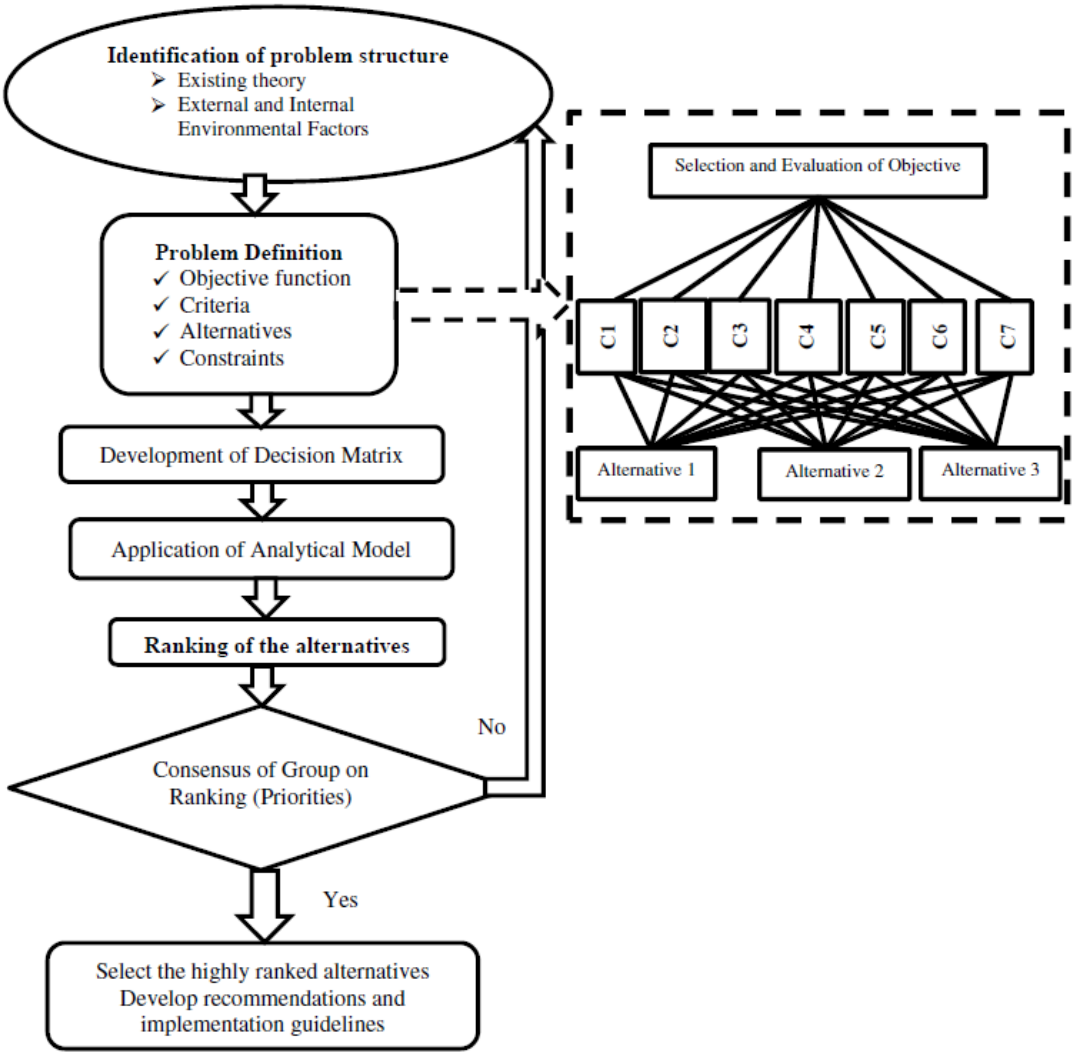


Figure 8: The typical decision-making process (Thakkar, 2021, p. 3)

7.2 Decision modelling

Decision-making includes predicting, classifying, and recognizing one or more options from a given set of choices (Prabadevi et al., 2021). El et al. (2017) suggest that the decision process should include clear, coherent analytical steps and produce results that convince those involved to accept the selected outcome over the available alternatives. An essential systematic evaluation parameter must be adopted as part of the most appropriate decision process strategy when discovering and addressing problems (Das et al., 2021). To manage these decision parameters and represent their knowledge, the decision process strategy must facilitate a selection criterion (Ratcliff et al., 2016), which is then used to generate a systematic approach that represents a decision-making model with accurate and interpretable recommendations (Etikala et al., 2021; Xu et al., 2021).

Research on the decision-making process started three centuries ago, opening up new pathways that deal with the relationship between two or more alternative execution flows (Larbani & Yu, 2017; Silva et al., 2022). Larbani & Yu (2017); Prabadevi et al. (2021) state that the decision-making process has evolved through four stages of evaluating multiple conflicting criteria in a problem domain: (1) Preoccupation with the rational: in this stage, decision-making is viewed as a logical and rational process where decisions are made based on the analysis of available information and options; (2) Critiques and extensions of the rational tradition: this stage emerged as criticisms of the rational approach highlighted its limitations, such as its inability to account for the human element in decision-making, the presence of cognitive biases, and the complexity of decision environments; (3) Creation of fully articulated alternatives to the rational: in this stage, decision-makers began to embrace alternative approaches to decision-making, such as intuition, heuristics, and creativity and, finally: (4) A multi-perspective or -dimensional view of decision-making: in this stage, decision-makers adopted a more comprehensive and integrated approach to decision-making that is influenced by multiple factors, including individual values, organizational culture, social and political contexts, and technological advancements. Furthermore, these four stages reflect the evolution of decision-making from a simple and rational process to a more complex and multi-dimensional approach that considers subjective factors. To understand the decision-making process further, Larbani & Yu (2017) introduce the rational theory of decision-making, which is used as a utility function that avoids common biases that undermine human judgment. Silva et al. (2022)

describe the decision model as a tool that encompasses decision-making problems under conditions requiring a series of decisions, where the decisions depend on each other. It is difficult to find applicable normative theories for these decision-making problems in research to improve the flow of information.

El et al. (2017) suggest that decision modelling is an ideal decision support approach to help decision-makers and analysts represent complex decision problems. Doppler & Rabiser (2019) describe the earliest documented approach to decision models as part of the Synthesis method developed by the Software Productivity Consortium for the industrial reuse process model. These decision models use a particular formalism and describe different ways of representing decision rules, constraints, and conditional statements (Baninemeh, Farshidi & Jansen, 2023). Moreover, these decision models specify the premises and outcomes of a given situation and govern the actions in applications, processes, and systems, considering all possible alternatives. They weigh different scenarios of each alternative by probabilities of available information.

Furthermore, decision models describe the consolidated knowledge representation of the requirements and the logic of operational decisions in business organizations (Etikala et al., 2021). Decision modelling involves expressing decisions in an accurate, transparent, unambiguous, and potentially executable format to support decision-makers and analysts in their activities (Ratcliff et al., 2016). In contrast, Baninemeh, Farshidi & Jansen (2023) argue that some decision models are not scalable; their evaluation process must be revised if the list of alternatives or criteria is changed, and these approaches are expensive and only apply to a limited set of criteria and alternatives.

7.3 Decision modelling tools

Decision modelling tools can be regarded as software applications designed to help individuals and organizations make informed decisions based on data, and analyse the time spent searching for the correct information to support business decisions (Dhanisetty, Verhagen & Curran, 2018). These tools use techniques, such as decision trees, statistical models, and optimization algorithms, to support decision-making processes. Sometimes, decision modelling tools are simple and can be represented simply by using pencil and paper (Tali, Nader & Chalal, 2017). However, in instances where decisions are complex or where a decision model is to be shared among many stakeholders, the manual decision model construction, manipulation, and

validation become cumbersome. These decision models cannot be handled without process, system, and computer support. Several decision modelling tools are available in the marketplace that enable the decision to be represented and investigated. Decision-makers and analysts can use standard drawing tools such as Microsoft Excel or Microsoft Visio, TreeAge Pro, IBM Watson Studio, and Analytica; however, such tools would not provide sophisticated modelling or requirements capabilities. Decision-makers and analysts can use commercially available tools that are specifically developed for decision modelling, with a proven record of effectiveness in facilitating a decision-making process (Baloyi & Meyer, 2020). The choice of tool depends on the specific needs and requirements of the user and the decision-making problem that they are trying to solve. These tools provide several collaboration functionalities, code generation, and others, and support one or more decision modelling methods, including the use of Artificial Intelligence (AI).

Decision modelling tools in AI refer to software or frameworks that assist in modelling and analysing complex decision-making processes and that can aggregate data from various areas of operation (Cao et al., 2023). Some AI decision modelling tools are used in machine learning (ML) algorithms, such as precision, accuracy, recall, f-score, and root means square error, which is based on statistics. For example, the health industry developed a practical AI decision model from reading actual patient treatment records (Cao et al., 2023). These tools leverage artificial intelligence techniques to support decision-makers by providing data-driven insights, scenario analysis, and optimization capabilities. The choice of tool depends on the specific requirements, domain, and complexity of the decision-making problem at hand, and on the evolution of these systems over time.

7.4 Decision modelling methods

Decision modelling methods refer to analytical techniques used to evaluate and make decisions about complex systems, processes, and projects (Devi, Nayak & Patnaik, 2020). These methods use mathematical and statistical models to analyse and compare options, with consideration of risk, uncertainty, and trade-offs (Baloyi & Meyer, 2020). Decision modelling is achieved through decision modelling methods that are based on research. The following are a selection of methods identified in the available literature: Decision Model and Notation (DMN), GRAI Nets, Decision trees, Decision tables, Influence diagrams, Analytic Hierarchy Process (AHP), and Multi-Criteria Decision Analysis (MCDA) (Tali, Nader & Chalal, 2017). Each method has

a particular view of the decision taken, uses different modelling components and processes, and represents the same problem graphically, that is, by means of tables, trees, nets, and diagrams. Decision modelling methods provide decision-makers with a structured and analytical approach to evaluate complex systems and make informed decisions based on quantitative data and analysis. Singh, Upadhyay & Powar (2022) argue that some decision modelling methods fail to control subjective biases and are replaced by methods that facilitate objective decisions. According to Khosravi et al. (2019), the Analytic Hierarchy Process and Multi-Criteria Decision Analysis are the most used decision modelling methods. These decision models provide the following:

(i) Consideration of multiple criteria,
(ii) Incorporation of subjective preferences,
(iii) Flexibility and adaptability,
(iv) Structured decision-making processes,
(v) Transparency and communication,
(vi) Quantitative results, and
(vii) Widely used and well-established approaches.

These methods are described briefly in Section 7.5, after which the most appropriate methods for solving this research problem are identified. The Analytic Hierarchy Process and Multi-Criteria Decision Analysis methods offer a systematic and robust approach to decision-making, which renders them valuable tools for complex decision problems (Thakkar, 2021). They support the research for their ability to handle multiple criteria, incorporate subjective preferences, provide a structured process, facilitate transparency, and deliver quantitative results.

7.5 Decision modelling types

Researchers have introduced a variety of decision models in the literature. Das et al. (2021) suggest that multiple attribute decision-making (MADM) finds its employability when selection is to be made among the available number of finite alternatives by guiding how the available information about the attributes is to be used to make a decision. According to Pesode et al. (2023), the most frequent Multi-Criteria Decision-Making (MCDM) techniques, which are available methods to answer choice problems, are presented as follows: The Weighted Sum

Method (WSM), Weighted Product Method (WPM), a Technique for Order Preference by Similarity to the Ideal Solution (TOPSIS), Analytic Hierarchy Process, Elimination Et Choice Translating Reality (ELECTRE), and VlseKriterijumska Optimizacija I Kompromisno Resenje in Serbian (VIKOR). These represent a selection of the methods that come under the purview of decision models. An example is the procedure model developed by Adam (1996), which had been previously used in an engineering project. It was a decision model that examined the selection of engineering methodology.

The Weighted Sum Model is an aggregation function that transforms multiple criteria into a single value by multiplying each criterion by a weighting factor and summing up all weighted criteria (Das et al., 2021; Baninemeh, Farshidi & Jansen, 2023). The Analytic Hierarchy Process is a structured and well-known method for organizing and analysing Multi-Criteria Decision-Making problems based on mathematics and psychology. TOPSIS is an MCDM approach that employs information entropy to assess alternatives. In other words, it takes a compensatory aggregation approach to identify the best alternative among an identified set of alternatives (Thakkar, 2021). The Boolean Decision Tree (BDT) is an MCDM method used to choose one of the available and feasible decision alternatives (Baninemeh, Farshidi & Jansen, 2023). Khosravi et al. (2019) argue that, due to decision model criteria dependencies, the listed decision models do not require much detailed information regarding model characteristics and generally achieve high prediction accuracy. The scientific community has employed them to make decisions over a wide range of areas, from agriculture and health to various engineering applications. In these MCDM techniques, two weight-assigning strategies are followed. In one approach, the decision-maker does not provide weight information; in the other, the decision-maker only provides partial preference information over attributes.

Singh, Upadhyay & Powar (2022) suggest that, when the decision environment is highly ill-defined, information is incomplete and marred by subjectivities; assigning relative importance to each criterion further poses difficulties. However, Multi-Criteria Decision-Making techniques offer possibilities to overcome these limitations. MCDM techniques can chart a range of criteria and sub-criteria that can be assessed and evaluated. These straightforward hierarchical structure techniques help to identify contesting attributes, assign and prioritize weightage to attributes, rank the alternatives, and help to arrive at the best possible solution (Wang et al., 2016). Moreover, these explicit, rational, and efficient techniques help improve

decision-making quality. In contrast, Khosravi et al. (2019) note that MCDM methods like VIKOR and TOPSIS have several disadvantages:

(i) They are incredibly data-intensive in recording a decision's preferences. The data recorded can be time-consuming and costly to gather, especially in situations involving multiple criteria;
(ii) The required amount of data may not be available for all decision-making problems, and the required data may not be available, making it difficult to apply; and
(iii) Due to the weighting of variables, strong assumptions are required from decision-makers, making them relatively subjective, which can introduce biases into the decision-making process that may not always hold in practice.

Therefore, it is essential to carefully consider the advantages and disadvantages of different decision-making methods and select the most appropriate approach based on the characteristics of the decision-making problem, available data, and decision-makers preferences when using a decision model.

7.5.1 The Weighted Sum Method (WSM)

The Weighted Sum Method is a well-known multi-criteria decision-making model for addressing multi-objective optimization problems; it is used to assess and rank alternatives based on multiple criteria in the real world for optimization of problem-solving (Pesode et al., 2023). It is a simple additive weighting and intuitive approach that allows decision-makers to consider various factors and their relative importance when making decisions. Application of the methodology in optimisation of the weighted function enables a high accuracy of estimation (Thakkar, 2021; Chinda & Rao, 2022). Furthermore, this method has the unique capability of dealing with single, multi-response, and multi-component optimization problems in various decision-making processes (Thakkar, 2021; Chagas & Wagner, 2022). The method involves simple and sound mathematics and is quite comprehensive; it can be successfully applied to any decision-related situation with interdependencies between the different components (Thakkar, 2021; Chagas & Wagner, 2022). According to Pesode et al. (2023), the WSM is based on the following steps:

(i) Identify criteria;
(ii) Assign weights;

(iii) Normalize criteria;
(iv) Assess alternatives;
(v) Do a weighted sum calculation;
(vi) Rank alternatives; and
(vii) Interpret and decide.

The Weighted Sum Method provides a systematic framework for decision-making by considering multiple criteria and their relative importance. Its core idea consists of converting the multi-objective problem at hand into several single-objective problems by using different combinations of the original objectives (Chagas & Wagner, 2022). Note that it assumes that the criteria are independent, that the weights accurately reflect the preferences of the decision-maker, and that the estimates revealed do not always reflect the actual situation; the results obtained may not be logical (Thakkar, 2021). It is essential to carefully define the criteria, gather relevant data, and ensure that the weights accurately represent the decision-makers' priorities to obtain meaningful results (Thakkar, 2021). For example, the Weighted Sum Method has been applied in the biomedical usage of titanium and alloys in the health materials and aviation industries. It was observed that the Weighted Sum Method can be used to identify the ideal best titanium alloy for biomedical applications (Pesode et al., 2023). Figure 9 summarises The Weighted Sum Method.

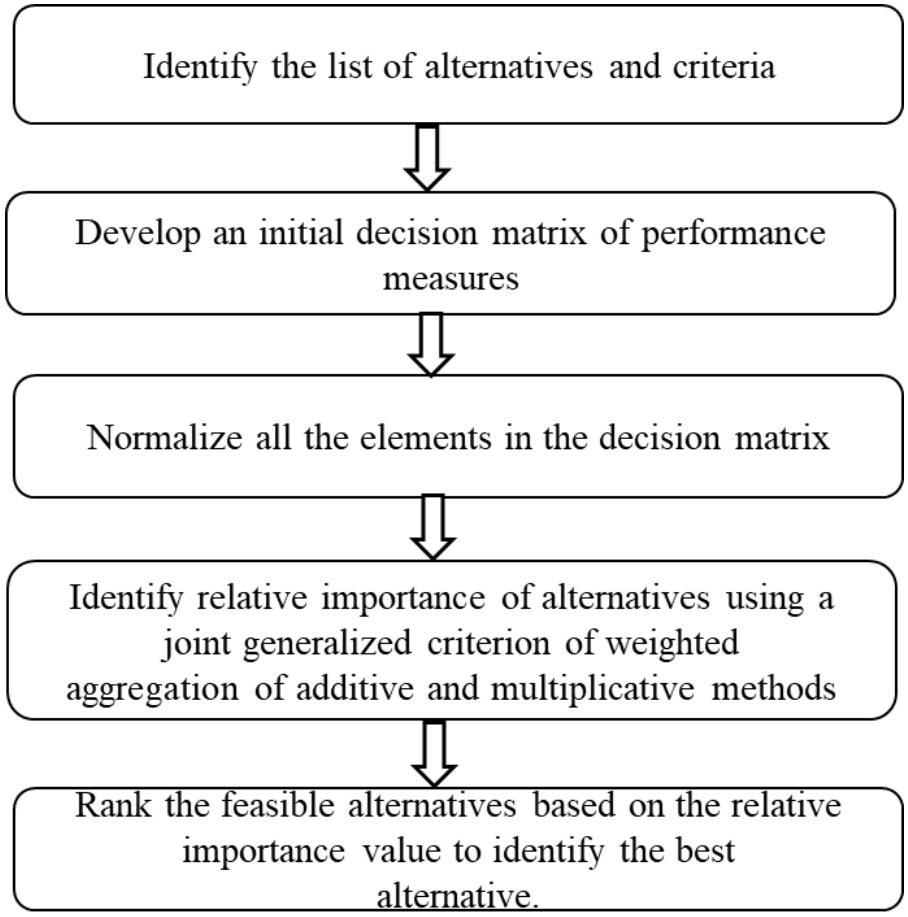


Figure 9: The Weighted Sum Method (WSM)) (Thakkar, 2021, pp. 253–279)

The Weighted Sum Method uses the score of an alternative equal to the weighted sum of its evaluation ratings, where the weights are the importance weights associated with each attribute to achieve optimal solutions based on multiple, usually conflicting, criteria (Thakkar, 2021).

7.5.2 Analytical Hierarchical Process (AHP)

According to Yang & Huang (2000), the AHP was mainly developed to address and solve decision problems under uncertainty and with multiple criteria characteristics, with the features needed for outsourcing decisions. AHP is a method that collects the expertise of decision-makers and uses a hierarchical structure to present a complex decision problem by decomposing it into several more minor sub-problems. Baninemeh, Farshidi & Jansen (2023) view AHP in two ways.

(i) AHP does not assume that the alternatives and criteria are independent. The feedback mechanism handles their potential dependencies.

(ii) AHP has a network structure that forms subnetworks and sub-models. Using pairwise comparisons, a square matrix can be derived from the hierarchy and can calculate the eigenvector with the largest eigenvalue. The eigenvector provides the priority order, and the eigenvalue measures the consistency of judgment. Furthermore, the AHP method encompasses three steps:

(i) Constructing the hierarchy;
(ii) Computing the weight of the elements in each level; and
(iii) Computing the importance of alternatives.

Baloyi & Meyer (2020) state that AHP is a method that can handle an ill-structured and complicated problem and still be effective in facilitating the decision-making process. AHP's ability to represent the elements of a problem in a hierarchical form allows the problem to be broken down into more minor constituent parts, with the objective/goal of the decision-making process on top. The advantages of AHP are that it is easy to use and flexible in that its size can be adjusted to accommodate different decision-making problems. AHP is also not data-intensive, as is the case with other MCDM methods. Its ability to handle qualitative and quantitative criteria has become popular (Meghdad et al., 2020). As an example, AHP has been used in selecting appropriate materials for the thermal management of automobile cabins in the automotive industry (Das et al., 2021). Figure 10 shows the Analytic Hierarchy Process.

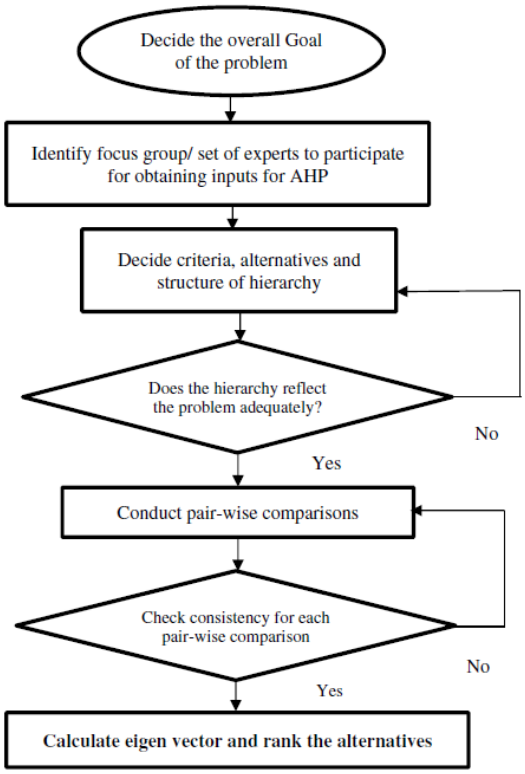


Figure 10: The Analytic Hierarchy Process (AHP) (Thakkar, 2021, pp. 48–78)

Both academia and industry have adopted the Analytic Hierarchy Process. The technique has gained significant attention in various domains, including machine selection, supplier selection, ambulance allocation, nurse and other resource prioritization in healthcare, and prioritization of academic policies. This technique, which was developed in 1970 by Thomas L. Saaty, is a well-known and widely popular MCDM technique (Thakkar, 2021).

7.5.3 VlseKriterijumska Optimizacija I Kompromisno Resenje in Serbian (VIKOR)

VIKOR is a multi-criteria decision-making method that was developed in 1894 by Duckstein and Opricovic to select an alternative as a compromised solution from a list of alternatives to make a final decision in a complex system (Khosravi et al., 2019; Baloyi & Meyer, 2020). The Serbian-derived name means multi-criteria optimization and compromise solution. Meghdad et al. (2020) suggest that, if the goal in multi-criteria decision-making is to choose the best option, the VIKOR method is appropriate, depending on the issue. The approach consists of identifying various alternatives for a problem, establishing the priority among them and ranking them, and selecting the best compromise solution based on the ranking (Thakkar, 2021).

VIKOR selects the best choice and brings it as close as possible to the ideal alternative, or instead views the closest valid solution to the perfect solution as the compromise solution. This method suits decision-making on conflicting and inappropriate criteria in different measurement units. The method ranks alternatives according to three scalar quantities ðSi, Ri, and QiÞ, independently evaluated against the criteria. VIKOR only requires the decision-maker's intervention, where the coefficient 'v' value must be chosen (Baloyi & Meyer, 2020). An advantage to the VIKOR method is that it allows the decision-maker to assess how far the second-best alternative is from the first. Assume that the method finds that the best alternative in terms of Qi is the best regarding the global criteria performance only (Si), or in terms of the performance measurement of a single criterion (Ri) only. In that case, the first best alternative cannot be considered the best in isolation, but with other alternatives in a subgroup. Therefore, VIKOR gives satisfaction to the acceptability of the final rankings. Assume that the method finds that the best alternative in terms of Qi is the best regarding the global criteria performance only (Si), or in terms of the performance measurement of a single criterion (Ri) only. In that case, the best alternative cannot be considered the best in isolation (see Figure 11).

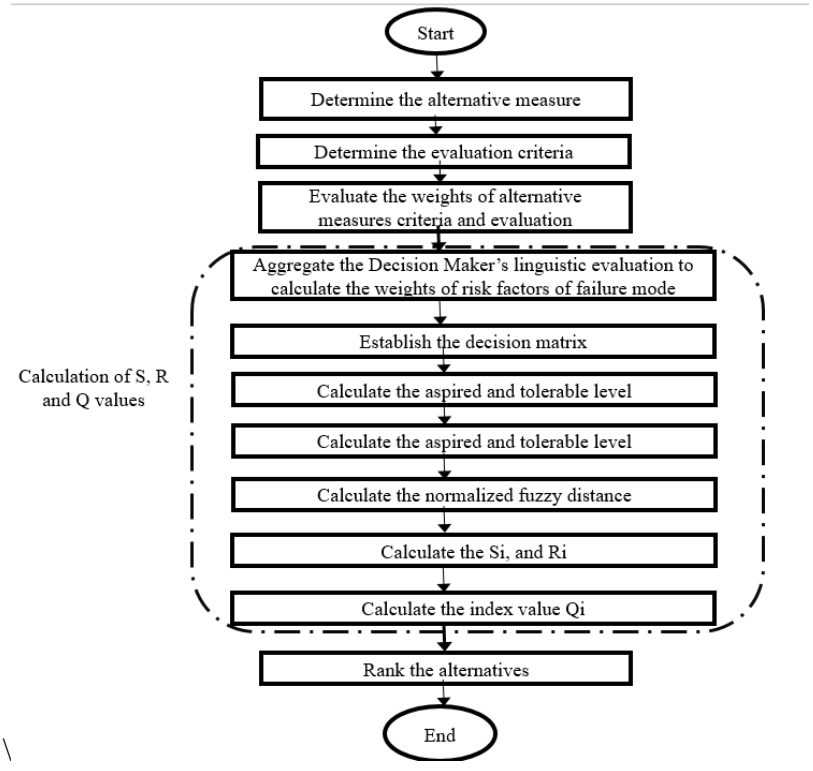


Figure 11: The VlseKriterijumska Optimizacija I Kompromisno Resenje in Serbian (VIKOR) Decision Model (Thakkar, 2021, pp. 129–138)

VIKOR is a powerful tool that can be used for various strategic decision-making problems in various social, economic, or environmental environments. The VIKOR is, for example, used in the Medical Sciences field to assess the performance of nurses based on the 360-degree model (Meghdad et al., 2020).

7.5.4 Technique for Order Preference by Similarity to Ideal Solution

TOPSIS is a multi-criteria decision-making tool developed by Yoon and Hwang, and has been appraised by various levels of decision-makers. It takes a compensatory aggregation approach to identify the best alternative among the identified alternatives (Thakkar, 2021).

The TOPSIS method is based on the concept that the best alternative should have the least geometric distance from a positive-ideal solution, and similarly farthest from any negative-ideal solution. Hwang and Yoon proposed the TOPSIS in 1981, based on the Euclidean distance between decision-making alternatives (Baloyi & Meyer, 2020). This is the most straightforward technique as it is based on the concept of selecting the alternative that should have the shortest distance to the positive ideal solution and the farthest distance from the negative ideal solution. This means that the method aims to minimize the distance between the best and positive ideal alternatives, while maximizing the distance to the negative ideal solution.

The TOPSIS method assumes that each criterion tends toward a monotonically increasing or decreasing utility. Furthermore, it is easy to define the positive and negative ideal solutions. The Euclidean distance approach was proposed to evaluate the relative closeness of the alternatives to the ideal solution (Khosravi et al., 2019). Thus, the preference order of the alternatives can be derived by a series of comparisons of these relative distances. Baloyi & Meyer (2020) argue that there is limited subjective input needed in TOPSIS, which does not have a component to check for the inconsistency of the judgment, expressed preferences, uncertainty, and imprecision in the decision matrix. TOPSIS is used in the energy industry to determine the correct placement of flexible AC transmission systems (FACTS) controllers in the power systems network (Chinda & Rao, 2022). Figure 12 summarises the technique.

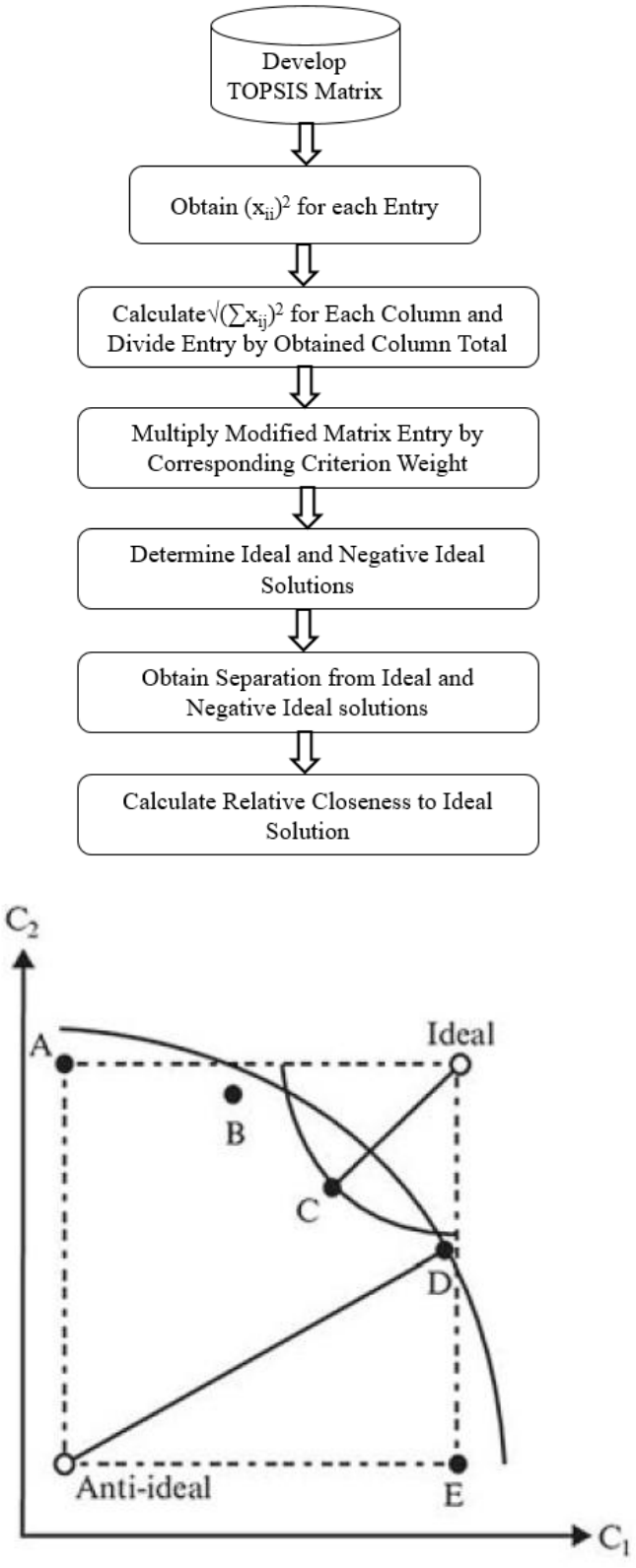


Figure 12: The Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) Decision Model (Thakkar, 2021, pp. 83–91)

7.5.5 Elimination Et Choix Traduisant la REalite

ELECTRE is one of the fuzzy multi-criteria decision-making methods for resolving the ambiguity of concepts associated with the decision-maker's judgments and solving the problem of multiple attribute decision-making (Komsiyah, Wongso & Pratiwi, 2019; Ozsahin et al., 2021). Elimination Et Choix Traduisant la REalite is translated to mean: Elimination and Choice Expressing Reality; it was developed in 1968 by Bernard Roy, allowing decision-makers to evaluate alternatives based on multiple criteria and preferences. It is based on the assumption that there are several decision criteria, and that each criterion is evaluated independently (Ozsahin et al., 2021). The model is designed to identify the strengths and weaknesses of each alternative, which helps in selecting the best option (Baloyi & Meyer, 2020). Since then, different ELECTRE methods have been developed. ELECTRE I & ELECTRE IS were developed for selection problems. ELECTRE TRI was developed for analysing sorting problems, and ELECTRE II, III, and IV are for ranking problems. The method is used for analysing data in a decision matrix to rank alternatives. In ELECTRE I, one common advantage for many decision-making methods is the ability to handle qualitative and quantitative criteria. ELECTRE possesses such an ability.

In some instances, ELECTRE fails to sort the alternatives in different ranks; it is developed due to concordance and no discordance tests, including certain input preference information. This strategy is considered to be generally complex. The ELECTRE model is a complex decision-making approach that requires a significant amount of data and analysis. However, it can provide decision-makers with a comprehensive and objective evaluation of the alternatives and tolerate incomparable circumstances with subjective and immense criteria. The ELECTRE is, for example, used in the construction industry to select vendors in the supply of raw materials (Komsiyah, Wongso & Pratiwi, 2019). Figure 13 summarises the Elimination Et Choix Traduisant la REalite.

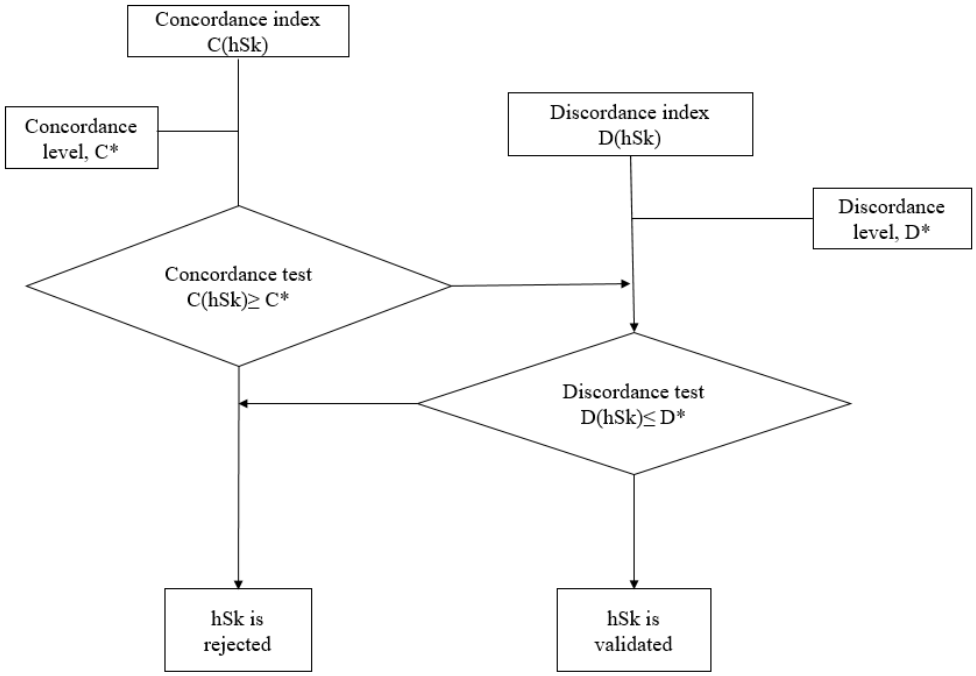


Figure 13: The Elimination Et Choix Traduisant la REalite (ELECTRE) Decision Model (Thakkar, 2021.pp. 93–117)

The Elimination Et Choix Traduisant He Realite is a decision-making method that was proposed by Bernard Roy and his team (Thakkar, 2021).

7.6 Case study example: Decision model process for selecting an appropriate procedural model

A decision model was provisionally established based on desktop research, founded on the planung und entscheidung model processes and further developed. The quality of a model is ensured by following the six principles of proper modelling found in the planung und entscheidung model (Thesing, Feldmann & Burchardt, 2021). These principles are guidelines for modelling information systems, which can be transferred to modelling the decision model as a methodological framework. The principles aim at clarity, consistency, assurance, and quality (Thesing, Feldmann & Burchardt, 2021). These highlighted principles help create themes related to process modelling when evaluating a decision model's relevance. The principle of correctness requires that the model depicts the real world in its essential features. According to the principle of relevance, a model should not represent all facts, but only those relevant to the purpose of the model (Thesing, Feldmann & Burchardt, 2021).

The decision model to be presented meets the requirements of practitioners about comprehensibility, simple applicability, and practical relevance. This model case study guides the process of representation when building a decision model, which needs to be covered when evaluating the relevance of questions within the model.

To ensure efficiency, the decision-making process of the model is divided into two steps. In the first step, exclusion criteria are used for a first assessment; in the second step, a detailed catalogue of criteria is used to analyse the project thoroughly. Thereby, it follows the idea to customize the procedural model for a specific project situation, ensuring that the methodology is aligned with the company's existing processes, which is considered a key success factor (Thesing, Feldmann & Burchardt, 2021). Exclusion criteria are characteristics of projects that serve as knockout criteria (Thesing, Feldmann & Burchardt, 2021). These exclusion criteria can be structured according to the nature of the project and the nature of the organization or project sponsor, and follow established findings (Thesing, Feldmann & Burchardt, 2021). This decision-making model process is suited for predictable, rule-driven decisions and requires a consistent, step-by-step approach to ensure accuracy and compliance (Thesing, Feldmann & Burchardt, 2021; Baninemeh, Farshidi & Jansen, 2023).It also encourages criteria-driven evaluation when examining project characteristics.

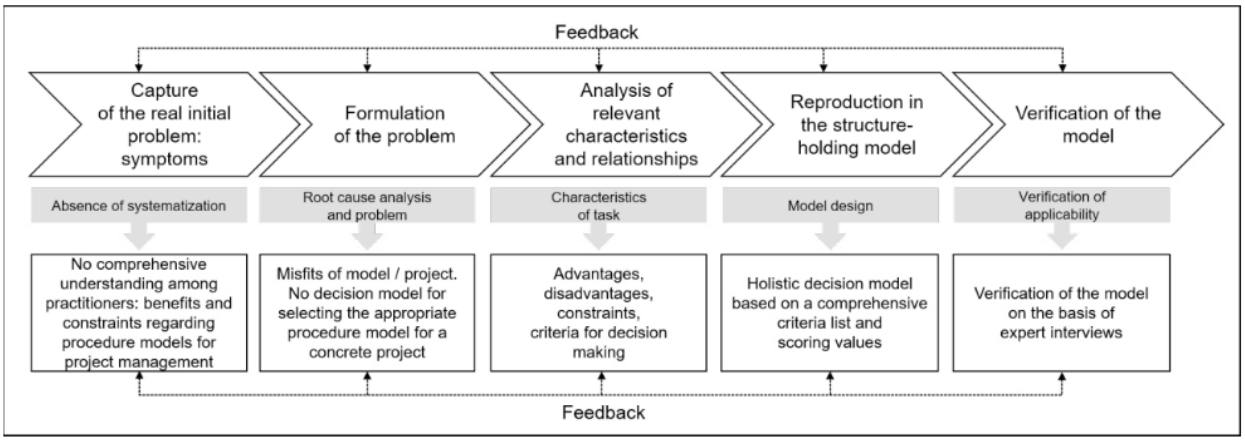


Figure 14: Decision Modelling process developed by Adam (1996) (Thesing, Feldmann & Burchardt (2021)

7.6.1 Decision models for Information Technology (IT) project management

A decision model in project management is a tool that helps project managers make informed decisions about project planning, execution, and control to reduce risk of project failure. Project management decision models are designed to provide a framework for analysing complex project issues, identifying potential risks, and evaluating alternative solutions (Ratcliff et al., 2016; Tali, Nader & Chalal, 2017). In Information Technology (IT) project management, a decision model can be a logical or mathematical representation used to guide the decision-making process when selecting a project management approach. IT Project Management Decision models are considered critical for project success, and no methodology can be suitable for all types of projects as they differ tremendously (Chiang & Lin, 2020; Sakka & Ben Kraiem, 2022). IT project management decision modelling enables project managers to clearly identify decision requirements and to shortlist feasible solutions (Soares, Tereso & Sousa, 2015).The following section of the study will examine three decision model examples provided in the literature of IT project management.

Firstly, a decision model used in the research of Chiang & Linc (2020) proposes a framework for assisting a software company to allocate human resources for software development projects. The project manager evaluates existing human resources for a decision on whether the estimation of a project tender is feasible and effective in acquiring more human resources for the team's formation in a fixed duration project with existing labour, skill, and budget constraints. The decision process applied in an integer programming model and simulation study was undertaken to demonstrate the applicability of their proposed model to assist the decision-making process for software companies that are assembling project teams. The results suggested four variants for maximum skills efficiency or minimum hiring cost. Different considerations of both key factors are included in this research, and they demonstrate that these factors could bring out different sources to help companies make further evaluations for allocating staff in a software development company.

Secondly, Sakka & Ben Kraiem (2022) developed a decision model for a standardized execution process for the upstream decision-making conceptual model for Project Management Method (PMM) selection. The decision model used detailed execution processes that allow for better utilization of the upstream decision-making for PMM selection. This was achieved, firstly, by defining the execution processes proposed for the standardized execution approach.

Secondly, it suggested the definition for each step, a distinction of the expected activities based on the nature of the participants' roles. Thirdly, it defined a reliable implementation environment and configuration that would allow for the stable reproducibility of the approach and the adoption of an accessible set of tools and collaborative techniques. The result was that a group of well-known decision-making tools led to a semi-automatic decision process. The body of work considered not only the characteristics of the project, but also the organizational factors and the previously discussed influencing factors of PMM selection.

Lastly, the Sakka (2022) model uses the weighted sum model characteristics to calculate the human resource allocation in the project management of software development. The model also represents the elements of a problem in a hierarchy such as the AHP. It then has the ability to identify and select the positive and negative ideal solution of the PM process using the TOPSIS model.

The decision models for IT project management above display the toolset that can address the project challenges discussed in Chapters 4 and 5. Furthermore, the discussion on blending agile and Traditional approaches in Section 6.3 can be adapted to solve different knowledge area challenges that arise during a project.

7.6.2 The selection rationale

The previous section discussed the five well-known decision model types and elaborated on practical use. This section presents the rationale behind selecting the decision model attributes (Van Der Burg et al., 2019). The commonality between them is that their attributes resolve problems in the following elements (Rabiser, 2019; Van Der Burg et al., 2019):

(i) Flexibility and adaptability;
(ii) Structured decision-making process;
(iii) Transparency and communication; and
(iv) Quantitative results.

This is done for the following reasons:

(i) They can be applied to a wide range of decision contexts and domains;
(ii) They guide decision-makers through a step-by-step approach;

(iii) They provide a clear framework for decision-making, resulting in a more transparent process; and
(iv) The results are in the form of priority weights, scores, or rankings.

The planung und entscheidung model is built on flexibility and adaptability while keeping structure in decision-making by identifying models, objectives, and methods as the elements needed to produce a practical process model (Thesing, Feldmann & Burchardt, 2021). These are the elements needed for a decision model when planning for a successful project implementation with limited risk.

Table 13 below tabulates the strengths related to decision models that were discovered in the literature review. These strengths are used to inform the proposed IT project management decision model (Table 13).

Table 13: Decision Model Strengths Comparison

Decision Models	Strengths	Reference
1. Weighted Sum Method (WSM)	Easy to use, intuitive, and works well for straight forward problems.	(Thakkar, 2021; Chinda & Rao, 2022)
2. TOPSIS (Technique for Order Preference by Similarity to Ideal Solution)	Balances pros and cons; useful in engineering, supply chain, and project selection.	(Thakkar, 2021; Singh, Upadhyay & Powar, 2022)
3. Analytic Hierarchy Process (AHP)	Handles qualitative and quantitative factors; supports group decision-making.	(Thakkar, 2021; Faisal et al., 2022)
4. ELECTRE (Elimination and Choice Expressing Reality)	Useful for screening and ranking with qualitative and conflicting data.	(Komsiyah, Wongso & Pratiwi, 2019; Thakkar, 2021)
5.VIKOR (VlseKriterijumska Optimizacija I Kompromisno Resenje)	Ideal for negotiations, public policy, and decisions involving trade-offs.	(Baloyi & Meyer, 2020; Thakkar, 2021)

From the commonalities of decision models, selection criteria are considered in terms of the strengths required for a decision model to be used (Khosravi et al., 2019; Sakka & Ben Kraiem, 2022). For this study the selection criteria will consider four decision attributes according to Khosravi et al. (2019) and Sakka & Ben Kraiem (2022), as follows:

- Fit to decision type

This decision attribute helps in determining whether the model is suitable for the project's complexity and scope (Khosravi et al., 2019; Sakka & Ben Kraiem, 2022).

- Feasibility

The feasibility decision attribute evaluates whether this model, given available time, resources, skills, and technology, can realistically deliver (Khosravi et al., 2019; Sakka & Ben Kraiem, 2022).

- Expected Outcomes

When planning for expected outcomes such as risk and cost, the evaluation of this model attribute is most likely to lead to a high-quality, defensible, and efficient decision (Khosravi et al., 2019; Sakka & Ben Kraiem, 2022).

- Stakeholder Acceptability

The last decision attribute to consider is whether stakeholders will understand, trust, and support the model, as well as whether it is effective in multi-party environments (Khosravi et al., 2019; Sakka & Ben Kraiem, 2022).

The distinction in decision models is that some of them are more mathematically organized and others are more process-oriented. The context for this particular research study is the selection of a particular set of processes guided by the selection criteria that are deemed to be the most appropriate for conducting a successful IT project, while guiding and supporting decisions required to:

(ii) Identify the project scope and requirements;
(iii) Evaluate project complexity;

(iv) Evaluate project size;
(v) Evaluate project team experience;
(vi) Determine project budget;
(vii) Evaluate project timeline;
(viii) Evaluate organizational culture; and
(ix) Monitor and evaluate.

The above types of decisions need a step by step rule-based process that has the flexibility and the adaptability to assess and evaluate project characteristics (Papadakis & Tsironis, 2020; Thakkar, 2021; Sakka & Ben Kraiem, 2022) to be supported by a decision model to select the appropriate method, and a process to enable a good fit for selecting the most appropriate IT project management methodology. The rationale behind the proposed IT project management decision model is to understand the strengths of the available decision models presented in Table 13 and adapt them to the advantages and disadvantages of project management methodologies discussed in Chapters 3 and 4.

7.6.3 Theoretical framework

This section outlines an inductive theoretical framework used for the study's IT Project Management Decision Model. The decision model emphasizes the integration of project management theory and decision model theory to enhance the selection and execution of an appropriate IT project management methodology, thereby creating clarity and focus when implementing IT projects. The existing theories used to solve the research problem are:

Project Management theories

The Project Management Body of Knowledge (PMBOK) has become the most common Traditional Project Management (TPM) approach among organizations for software development and various other business areas (Matos & Lopes, 2013; Faisal et al., 2022). According to (2016) and Cooper & Sommer (2016, p. 2), Agile is a set of methodologies for developing new software products that employ a human-centred design approach in project management. These project management theories use advantages and disadvantages during a project management implementation to resolve project challenges. The blending of Agile and Traditional methodology is used to create a suitable project management methodology

depending on the characteristics of a project (Salah, Hefny & Darwish, 2017; Totten, 2017; Papadakis & Tsironis, 2020).

Decision model theories

Researchers have introduced a variety of decision models in the literature. According to Pesode et al. (2023), the most frequent Multi-Criteria Decision-Making techniques, which are available methods to answer choice problems, are presented as follows: The Weighted Sum Method, the Weighted Product Method, the Technique for Order Preference by Similarity to the Ideal Solution, the Analytic Hierarchy Process, Elimination Et Choice Translating Reality, and VlseKriterijumska Optimizacija I Kompromisno Resenje in Serbian. The strengths of each decision model have been evaluated, and the most relevant have been selected to create the decision-making section of the proposed IT Project Management Decision Model.

The research study will use a Hybrid approach from project management methodologies. This will be assisted by the assessment and ranking alternatives process, as outlined in the Weighted Sum Method decision model. The combination of these theories will produce the proposed framework on which the IT project management methodology will be based.

7.6.4 Proposed IT project methodology decision model

As stated previously, the discussion in Chapter 6 supports one of the goals of this research, namely addressing the second research sub-question, as stated in Section 1.4.3 of Chapter 1, sub-question 2, by investigating "*Which principles, components, and decision rules from Traditional (e.g., PMBOK) and Agile (e.g., Scrum) methodologies should be combined to construct the model?"* Furthermore, the literature review in Chapter 5 addresses the first research sub-question presented in Section 1.4.3 of Chapter 1, sub-question 1, "*What project and organisational characteristics should inform the design requirements of the model ?*" A deductive theoretical framework is formed by the combination of the project management theory and decision model theory to build the Proposed IT Project Methodology Decision Model (ITPMDM).

The proposed model is based on the procedure model developed by Adam (1996). The procedure model was previously used for methodology selection in an engineering project, including scope, time, cost, organisational context, and project team characteristics. While the

ITPMDM is based on Adam's model, the variance on the ITPMDM is based on IT projects, not on engineering projects, considering that competing methodologies exist. There is confusion around the benefits, advantages, and disadvantages of both iterative and predictive methodologies. However, the ITPMDM model acknowledges and references the Adam (1996) model in its context, and differs especially given some of the confusion related to the affordances and disadvantages between iterative and predictive, specifically in project management.

Introducing an IT Project Methodology Decision Model would allow practitioners to evaluate project characteristics. An ITPMDM could assist project managers and practitioners in incorporating professional practice when choosing the appropriate methodology for delivering project phases. This could mitigate the risk of a one-size-fits-all approach. A Hybrid method could arguably be used across all types of IT projects. An ITPMDM could provide an adaptable and flexible best practice approach for IT project managers and practitioners who are contemplating a new project.

The following section is a combination of Chapters 3, 4, and 5; it integrates the methodology characteristics used to discuss the four (4) generic phases of a project, used in Step 1 of Table 14, and to identify those processes that relate to both predictive, Traditional projects and iterative Agile projects:

Concept

- Identify the project scope and stakeholder requirements.
- Assess project feasibility by understanding the business problem.
- Obtain authorization to proceed with the project (approve, modify, or reject).
- Create project success criteria from a selection of doable items.
- Evaluate project task complexity.
- Establish change and release management.
- Evaluate project size and roles required.
- Estimate project budget and time constraints.

Development

- Develop project plans and milestones with short description features;

- Evaluate the project timeline, with tasks being broken down to the granularity level;
- Evaluate the project budget constraints;
- Determine communication strategy with continuous refinement and adaptation;
- Evaluate project risk, procurement, and quality; and
- Evaluate project team skill set and experience.

Implementation

- Carry out project execution with continuous updates on the product progress;
- Evaluate organizational culture and its impact on conducting the project;
- Facilitate team and issue management with continuous integration; and
- Determine issues, status reporting, and delivery management for regular feedback.

Closeout

- Obtain formal project acceptance;
- Evaluate project performance and transition;
- Document lessons learnt on how the team can improve; and
- Prepare project closure report for completion of the project vision.

While the four (4) generic phases may appear to follow more of a Traditional (predictive) sequence, all projects (including Agile) go through these stages. By using the decision model attributes discussed in Section 6.7, we can ensure that we select a project management approach that is well-suited to any IT project, and that aligns with the organization's needs found in step 2 in Table 14.

The proposed IT Project Methodology Decision Model in this study, as discussed in detail in the following section, uses the Weighted Sum Method decision model, as described in Section 7.5.1. The WSM's simple additive weighting and intuitive approach allow decision-makers to consider various factors and their relative importance when making decisions to reach the highest accuracy displayed in Table 14. The WSM identifies the knowledge areas needed to select the appropriate project management methodology, categorized by the project phases. The decision model in Table 14 below is constructed by following the five steps, as follows:

Step 1- Determine the project phase processes according to the project characteristics. This step is based on the four generic project management phases. Each phase has a set of questions

and statements to guide a project manager or practitioner through a thought process for using both agile and Traditional methodologies during project implementation.

Step 2- Determine the project approach weighting for the four generic project phases. This step involves weighing the response given in step 1 in terms of its likelihood of using a project characteristic, on a scale of 0 to 5.

Step 3- Map out the Cartesian plane for each generic project phase. This step involves mapping the resolution from the table in Step 2. The weighting (0–5) assigned to each project characteristic in response to the scenario questionnaire in Step 1 is summed at the bottom of the table to provide a total weighting for each approach (A or B).

Step 4- Plot the aggregated. In this step, the total column of the table in Step 2 will give a summed value from each Project Characteristic out of a possible total per project phase (XX/20). These values are used as points on a Cartesian plane, with each value A and B representing X and Y coordinates.

Step 5- Review quadrant outcomes. In this step, the quadrant outcomes result from the plotted points from the summary table (A and B). The point of interception lies on 1 of 4 quadrants, and each quadrant will provide a set of recommended project management processes and methodology.

The following steps illustrate the proposed IT Project Methodology Decision Model:

Table 14: Proposed Information Technology (IT) Project Methodology Decision Model

Step 1	Determine the project phase processes according to the importance of the project characteristics. The project phase processes can vary depending on the project structure and management methodology adopted. The four generic project management phases, namely, concept, development, implementation, and closeout, each have characteristics that guide the project manager to the deliverables that are expected at the end of each phase. Data are collected using a survey format and weighted rating scale in an A and B scenario questionnaire-based form. The survey instrument uses a 5-point Likert scale response. The points scale is from 0 to 5. The lowest number, which is 0, suggests not suitable, and the highest number 5 suggests strongly agree, with 2 and 4 suggesting disagree and agree, respectively. The last score is 3, which suggests undecided. The points of each question are weighed as:

Table 15: Rating scale and score

Score	Scale
0	**Not suitable**
1	**Strongly disagree**
2	**Disagree**
3	**Undecided**
4	**Agree**
5	**Strongly agree**

The A and B scenario questionnaire statement form is used to determine which project management approach is suited for the given project characteristic in each project phase.

The A and B scenario questionnaire statement instructions are as follows:

- Carefully read each numbered item and its statements marked "A" and "B".
- Assign a point value to the A and B statements as follows:
  - The total point value for A and B added together is five (5).
  - If statement A is most similar to what you would do, mark 5 for A and 0 for B.
  - If A is not wholly satisfactory but, in your judgment, better than B, mark 4 or 3 for A and 1 or 2 for B.
  - The converse is true: if B is best mark 5 for B and 0 for A and so on.
- Each scenario question per phase represents project characteristics or a knowledge area that needs to be answered by A or B statement.
- The A or B statements in each phase assist with considering if a Traditional approach (A) or an Agile approach (B) is required.

The answer to the scenario questions is then represented (A and B) in a table that shows the numeric value selected for each scenario statement (1.1 A and 1.1 B) per phase.

The values are summed to a total for each statement A and B.

The summed values A and B are used to find an interception point (A= X axis and B= Y axis) on a plain.

The interception points, once plotted, will lay in 1 of 4 quadrants, each of which will provide the recommended project management process and methodology per phase.

These project characteristics are elicited by evaluating the following scenarios per generic project phase:

1. Concept Phase:

	1.1. In identifying the project scope and purpose, the response should be: • _____A, The project idea is conceived and defined with a comprehensive plan upfront. • _____B, The project idea is initially explored, and a high-level vision is established, identifying a Minimum Viable Product (MVP) with incremental and early product releases. **1.2. In identifying the need to assess the project's viability, the response should be:** • _____A, The project objectives, scope, and requirements are determined through documentation and assessing the skills and experience of the potential team. • _____B, The detailed requirements are not available and will be determined as the project progresses. **1.3. In identifying the need to understand the pace of delivery of requirements, the response should be:** • _____A, Initial planning is established, including a project charter and high-level project plan with fixed timelines and milestones due to understanding the size of the project. • _____B, Partial requirements are established in a less formal and more collaborative approach to cater to flexible timelines and evolving or uncertain requirements. **1.4.In identifying the stakeholder interest in the project, the response should be:** • _____A, Stakeholder involvement will mostly feature at the beginning and end of the project. • _____B, The decisions on the project are made on whether to approve, modify, or reject a requirement by ongoing stakeholder collaboration and feedback. **2. Development Phase:** **2.1. In identifying how the project will be delivered, the response should be:** • _____A, The development and construction activities of the project will take place sequentially, developing a work breakdown structure (WBS). • _____B, The project delivery is divided into a series of time-boxed iterations (Sprints in Scrum) based on the team's size and expertise. **2.2. In identifying the need to manage the timeline of the project, the response should be:**

- _____A, The project is typically divided into sequential phases with strict dependencies (requirements, design, development, testing, and deployment).
- _____B, Development, testing, and quality assurance activities occur concurrently within each iteration.

2.3. In identifying the need to plan for change requests of the project requirements, the response should be:

- _____A, The changes to project scope are generally discouraged or follow formal change request processes in conjunction with a project steering committee.
- _____B, The requirements evolve and are refined with each iteration based on feedback from stakeholders by adding new items, clarifying existing ones, and adjusting priorities.

2.4. In identifying the need to manage the cost estimation and budgeting of the project, the response should be:

- _____A, The project involves creating a detailed budget, including cost estimates for all project activities and resources once planning is complete.
- _____B, The project involves flexible budgeting and costing with continuous customer input.

2.5. In identifying the need for documentation and reporting of the project, the response should be:

- _____A, Creating comprehensive documentation of project issues, delays, or scope changes to keep track of project outcomes.
- _____B Documentation is captured by a description of features or functionality in short one to two-sentence form.

3. Implementation Phase:

3.1. In identifying the need to monitor and evaluate the actual implementation processes of the project, the response should be:

- _____A, Having a formalized, structured, and controlled process to identify and resolve issues better.
- _____B, Having an ongoing process throughout the project, with increments of the product being delivered at the end of each iteration.

3.2. In identifying changes in the requirements as the project progresses, the response should be:

- _____A, Any change requires formal communication and hierarchical approval.

	• _____B, Changes are allowed with more flexibility and adjusting requirements to facilitate ongoing delivery better. **3.3. In identifying the need to support how the team gives feedback on the project's progress, the response should be:** • _____A, The team meets at fixed formal periods and reports on the entire project process. • _____B, The team gathers for daily short meetings (Standups) and collaborates to complete the work according to the Definition of Done (DoD). **3.4. In identifying the need to know the way the team delivers the work package, the response should be:** • _____A, The final unit testing, user acceptance testing (UAT), and user documentation process will be followed and completed. • _____B, The user training and system rollout will occur incrementally as features are completed. 4. **Closeout Phase:** **4.1. In identifying the need for the way in which the project is defined as complete, the response should be:** • _____A, Obtaining formal acceptance of project deliverables, documentation, and finalizing all project-related activities from the stakeholders. • _____B, A final retrospective and review will occur, and documentation of lessons learned and feedback is updated.
Step 2	Determine the project approach weighting for the four generic project phases. The scenario questionnaire responses from Step 1 are collected using a table with column A for Traditional and B for Agile. The first column has the ID number (#), followed by Project Characteristics, and then the columns with the approaches: Traditional (A) and Agile (B). The approach columns A and B are populated with weightings from 0 to 5 for each project characteristic noted. These weightings are collected from the response statements in the scenario questionnaire in Step 1. Once the questionnaire for each phase is completed, the answers are grouped between Traditional (T) or Agile (A), and are summed at the bottom of the table to give a total weighting per approach A or B.

	#	**Project Characteristics**	**A (Traditional)**	**B (Agile)**
	1.1	Project scope and purpose		
	1.2	Project viability		
	1.3	Pace of delivery		
	1.4	Stakeholder interest		
		Total:	**_ /20**	**_ /20**
Step 3	Map out the Cartesian plane for each generic project phase, namely, concept, development, implementation, and closeout. From the table in Step two, the weighting (0 – 5) given for each project characteristic in response to the scenario questionnaire in Step 1 is summed at the bottom of the table to give a total weighting per approach A or B. Once these two categories (A and B) are placed in the last two columns of the questionnaire, the categories are weighted and interpreted on a four-quadrant graph.			
Step 4	Plot the aggregated (concept, development, implementation, and closeout) decision-makers' summed-up matrix evaluation on a Cartesian plane with X coordinates representing Traditional and Y coordinates representing Agile. The total column of the table in Step 2 will give a summed value from each Project Characteristic out of a possible total per project phase (XX/20). These values are used as points on a Cartesian plane, with each value A and B representing X and Y coordinates. Once the A and B coordinates are plotted, an intercept point can be read.			
Step 5	Review quadrant outcomes: The quadrant outcomes are a result of the plotted points from the summary table (A and B). The point of interception lies on 1 of 4 quadrants, and each quadrant will provide a set of recommended project management processes and methodology.			

The matrix in Table 16 illustrates the Concept Phase table used in Step 2 of the IT Project Methodology Decision Model, with columns A for Traditional and B for Agile. The table columns start with column ID number # showing for sequencing, followed by the Project

Characteristics grouped from the step 1 scenario statements then the approach columns Traditional (A) and Agile (B).

Table 16: The Proposed IT Project Methodology Decision Model (ITPMDM) Phase attribute matrix

Concept phase

#	Project Characteristics	A (Traditional)	B (Agile)
1.1	Project scope and purpose	5	0
1.2	Project viability	1	4
1.3	Pace of delivery	0	5
1.4	Stakeholder interest	0	5
	Total	**6/20**	**14/20**

Figure 15 illustrates the Concept Phase Cartesian plane, with the four quadrants referring to the project management methodology processes that are most likely to be used. These project management methodology processes give guidance through referring to the recommendation methodology process table (XYZ). The four quadrants each represent a set of project management processes suited to the identified Project characteristics in Step 1 of the IT Project Methodology Decision Model. Quadrant one represents Agile processes with a blend of Traditional processes. Quadrant two represents strong Traditional processes, and quadrant three strong Agile processes. Finally, quadrant four represents Traditional processes with a blend of Agile processes. The Recommended Methodology Process table guides each quadrant process.

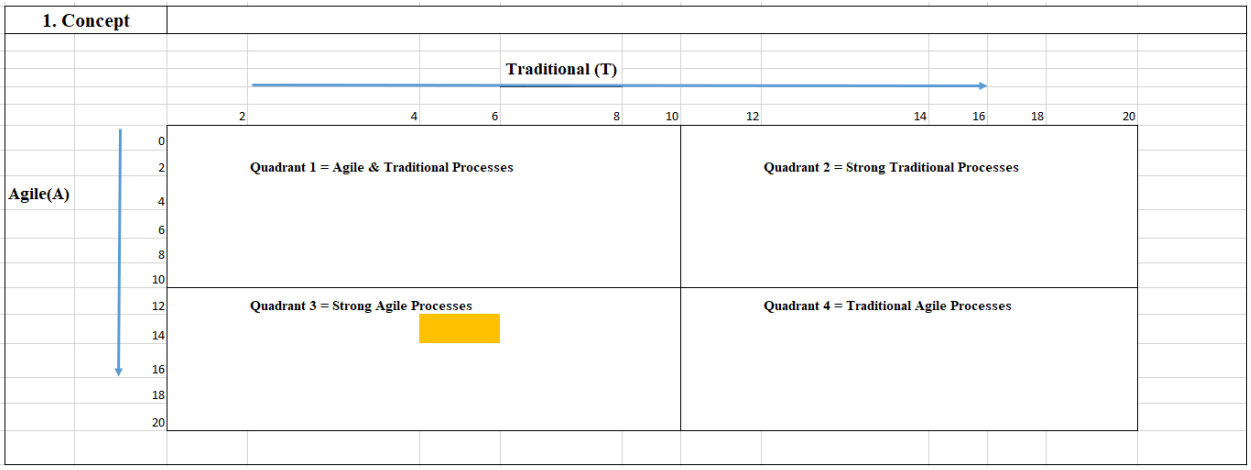


Figure 15: The Proposed IT Project Methodology Decision Model (ITPMDM) Phase Cartesian Plane

Recommended methodology processes table

The recommended methodology process table highlights the generic phase of the project and its processes. Table 17 has quadrant and process columns. The quadrant column represents the quadrant number and shows the project characteristic per quadrant. Each quadrant has a set of processes that are linked to the project characteristic that refers to a project management methodology framework.

Table 17: Concept Phase Recommended Methodology Processes Table

Concept

Quadrant	**Process**	**Quadrant**	**Process**
Quadrant 1	**Balanced Agile & Traditional Processes**	**Quadrant 2**	**Strong Traditional Processes**
1.1 Project scope and purpose	1.1.1 High-level requirements gathering process *(refer to Agile Practice Guide (2017), Project Factors That Influence Tailoring section)* (*Refer to PMBOK seventh edition Planning Performance Domain section*) 1.1.2 High-level cost estimation process (*refer to Agile Practice Guide (2017) Project Factors That Influence Tailoring section)*	**2.1 Project scope and purpose**	2.1.1 Project initiation process (*refer to PMBOK sixth edition Part 2: Initiating Process Group section*) 2.1.2 Project planning process (*refer to PMBOK sixth edition Part 2 Planning Process Group section*) (*Refer to PMBOK seventh edition Planning Performance Domain section*)

1.2 Project Viability	1.2.1 High-level feasibility assessment process *(refer to Agile Practice Guide (2017) Project Characteristics Of Project Life Cycle section)* 1.2.2 High-level risk assessment process *(refer to Agile Practice Guide (2017) Project Characteristics Of Project Life Cycle section)*	**2.2 Project Viability**	2.2.1 Technical viability analysis process (*refer to PMBOK sixth edition Part 2 Initiating Process Group section)* 2.2.2 Operational viability analysis process (*refer to PMBOK sixth edition Part 2 Initiating Process Group section*) 2.2.3 Financial viability process (*refer to PMBOK sixth edition Part 2 Initiating Process Group section*) 2.2.4 Legal compliance process (*refer to PMBOK sixth edition Part 2 Initiating Process Group section)*
1.3 Pace of delivery	1.3.1 High-level iterative release planning process (*refer to Agile Practice Guide (2017) Project Characteristics Of Project Life Cycle section)*	**2.3 Pace of delivery**	2.3.1 Requirements gathering and analysis process *(refer to PMBOK sixth edition Part 2 Planning Process Group section*) 2.3.2 Formal documentation process (*refer to PMBOK sixth edition Part 2 Planning Process Group section*) 2.3.3 Organizational Approval and Authorization Process. (*refer to PMBOK sixth edition Part 2 Initiating Process Group section*)
1.4 Stakeholder interest	1.4.1 Rigorous stakeholder identification process (*refer to PMBOK sixth edition Part 1 Project Stakeholder Management section*) (*Refer to PMBOK seventh edition Stakeholder Performance Domain section*)	**2.4 Stakeholder interest**	2.4.1 Rigorous stakeholder identification process (*refer to PMBOK sixth edition Part 1 Project Stakeholder Management section*) (*Refer to PMBOK seventh edition Stakeholder Performance Domain section*)
Quadrant	**Process**	**Quadrant**	**Process**
Quadrant 3	**Strong Agile Processes**	**Quadrant 4**	**Balanced Traditional Agile Processes**
3.1 Project scope and purpose	3.1.1 Project vision and conceptualization process (Project statement) (*refer to Agile Practice Guide Life Cycle Selection section*)	**4.1 Project scope and purpose**	4.1.1 High-level Project Initiation Process (*refer to PMBOK sixth edition Part 2 Initiating Process Group section*)

	(*Refer to PMBOK seventh edition Planning Performance Domain section*) (*Refer to PMBOK seventh edition Uncertainty Performance Domain section*)		(*refer to PMBOK seventh edition Planning Performance Domain section*) 4.1.2 High-level Project Planning Process (*refer to PMBOK sixth edition Part 2 Planning Process Group section*) (*Refer to PMBOK seventh edition Planning Performance Domain section*)
3.2 Project Viability	3.2.1 High-level cost estimation process (*refer to PMBOK sixth edition Part 2 Planning Process Group section*) 3.2.1 High-level risk assessment process (*refer to PMBOK sixth edition Part 2 Planning Process Group section*) (*Refer to PMBOK seventh edition Uncertainty Performance Domain section*)	**4.2 Project Viability**	4.2.1 High-level technical viability analysis process (*refer to PMBOK sixth edition Part 2 Initiating Process Group section)* 4.2.2 High-level operational viability analysis process (*refer to PMBOK sixth edition Part 2 Initiating Process Group section)* 4.2.3 High-level financial viability process (*refer to PMBOK sixth edition Part 2 Initiating Process Group section)* 4.2.4 High-level Legal Compliance Process (*refer to PMBOK sixth edition Part 2 Initiating Process Group section*)
3.3 Pace of delivery	3.3.1 High-level release planning process (*refer to Agile Practice Guide (2017) Project Characteristics Of Project Life Cycle section)* *(refer to PMBOK seventh edition Planning Performance Domain section)* 3.3.2 Cross-functional Team Creation Process (*refer to Agile Practice Guide (2017) Team Composition section*) (*refer to PMBOK seventh edition Team Performance Domain section*)	**4.3 Pace of delivery**	4.3.1 Formal release planning process (*refer to PMBOK sixth edition Part 1 Planning Process Group section*) 4.3.2 Multiple Cross-functional Team Creation Process (*refer to PMBOK sixth edition Part 1 Project Resource Management section*)

3.4 Stakeholder interest	3.4.1 Continuous Stakeholder Engagement Process (*refer to PMBOK sixth edition Part 1 Project Stakeholder Management section*) (*Refer to PMBOK seventh edition Stakeholder Performance Domain section*)	**4.4 Stakeholder interest**	4.4.1 Continuous Stakeholder Engagement Process (*refer to PMBOK sixth edition Part 1 Project Stakeholder Management section*) (*Refer to PMBOK seventh edition Stakeholder Performance Domain section*)

Table 18: Development Phase Recommended Methodology Processes Table

Development

Quadrant	Process	Quadrant	Process
Quadrant 1	**Balanced Agile & Traditional Processes**	**Quadrant 2**	**Strong Traditional Processes**
1.1 Project delivery structure	1.1.1 Backlog and sprint planning process (*refer to Agile Practice Guide (2017) Implementing Agile: Delivering in An Agile Environment section*) *(Refer to PMBOK seventh edition Project Work Performance Domain section*) 1.1.2 Release planning process (refer *to Agile Practice Guide (2017) Implementing Agile: Delivering in An Agile Environment section*) *(Refer to PMBOK seventh edition Project Work Performance Domain section*) 1.1.3 Requirements review and verification process (*refer to PMBOK sixth edition Part 2 Planning Process Group section* *refer to PMBOK seventh edition Delivery Performance Domain section*) 1.1.4 Handover process (*refer to PMBOK sixth edition Part 2 Planning Process Group section*	**2.1 Project delivery structure**	2.1.1 Detailed system development life cycle process (*refer to PMBOK sixth edition Part 2 Planning Process Group section*) (*Refer to PMBOK seventh edition Project Work Performance Domain section*)
1.2 Project schedule management	1.2.1 Sprint planning process (*refer to Agile Practice Guide (2017) Implementing Agile: Delivering in An Agile Environment section*)	**2.2 Project schedule management**	2.2.1 Detailed Deployment Planning Process. (*Refer to PMBOK sixth edition Part 2 Planning Process Group section*)

	(*refer to PMBOK seventh edition Planning Performance Domain section*) 1.2.2 High-level deployment planning process (refer *to Agile Practice Guide (2017) Implementing Agile: Delivering in An Agile Environment section*) (*Refer to PMBOK seventh edition Planning Performance Domain section*)		(*refer to PMBOK seventh edition Planning Performance Domain section*)
1.3 Project change request	1.3.1 Incremental delivery process with high-level change request process (*refer to Agile Practice Guide (2017) Implementing Agile: Delivering in An Agile Environment section*) (*Refer to PMBOK seventh edition Planning Performance Domain section*)	**2.3 Project change request**	2.3.1 Formal Change Control Process (*refer to PMBOK sixth edition Part 2 Planning Process Group section*) 2.3.2 Organizational approval and authorization process (refer *to PMBOK sixth edition Part 2 Initiating Process Group section*)
1.4 Project cost estimation and budgeting	1.4.1 High-level budget estimation process *(refer to PMBOK sixth edition Part 1 Project Cost Management section*)	**2.4 Project cost estimation and budgeting**	2.4.1 Detailed Budget Estimation Process *(refer to PMBOK sixth edition Part 1 Project Cost Management section*)
1.5 Project Documentation and Reporting	1.5.1 High-level documentation process (*refer to PMBOK sixth edition Part 2 Planning Process Group section* 1.5.2 Retrospect and Sprint review process (refer *to Agile Practice Guide (2017) Implementing Agile: Delivering in An Agile Environment section*)	**2.5 Project Documentation and Reporting**	2.5.1 Detailed Documentation and progress reporting review process. (*Refer to PMBOK sixth edition Part 2 Planning Process Group section*)
Quadrant	**Process**	**Quadrant**	**Process**
Quadrant 3	**Strong Agile Processes**	**Quadrant 4**	**Balanced Traditional Agile Processes**

3.1 Project delivery structure	3.1.1 Backlog and sprint planning process (refer *to Agile Practice Guide (2017) Implementing Agile: Delivering in An Agile Environment section*) 3.1.2 Story point estimation process (refer *to Agile Practice Guide (2017) Implementing Agile: Delivering in An Agile Environment section*) 3.1.2 Release Planning Process (*refer to Agile Practice Guide (2017) Implementing Agile: Delivering in An Agile Environment section*) 3.1.3 Definition of Done (DoD) process (*refer to Agile Practice Guide (2017) Implementing Agile: Delivering in An Agile Environment section*)	**4.1 Project delivery structure**	4.1.1 Detailed backlog and Sprint planning process (*refer to Agile Practice Guide (2017) Implementing Agile: Delivering in An Agile Environment section*) 4.1.2 High-level system development life cycle process (*refer to PMBOK sixth edition Part 2 Planning Process Group section*)
3.2 Project schedule management	3.2.1 Sprint planning process (*refer to Agile Practice Guide (2017) Implementing Agile: Delivering in An Agile Environment section*) 3.2.2 Sprint goal process (*refer to Agile Practice Guide (2017) Implementing Agile: Delivering in An Agile Environment section*) 3.2.3 Capacity planning process (*refer to Agile Practice Guide (2017) Implementing Agile: Delivering in An Agile Environment section*)	**4.2 Project schedule management**	4.2.1 Detailed deployment planning process (*refer to PMBOK sixth edition Part 2 Executing Process Group section*) 4.2.2 Capacity planning process (*Refer to PMBOK sixth edition Part 2 Planning Process Group section*)
3.3 Project change request	3.3.1 Incremental delivery process (*refer to Agile Practice Guide (2017) Implementing Agile: Delivering in An Agile Environment section*) (*Refer to PMBOK seventh edition Development Approach and Life Cycle Performance Domain section*)	**4.3 Project change request**	4.3.1 Formal release planning process (*refer to Agile Practice Guide (2017) Implementing Agile: Delivering in An Agile Environment section*) (*Refer to PMBOK seventh edition Development Approach and Life Cycle Performance Domain section*)

			4.3.2 Incremental delivery process with formal change request process (*refer to Agile Practice Guide (2017) Implementing Agile: Delivering in An Agile Environment section*) (*Refer to PMBOK seventh edition Development Approach and Life Cycle Performance Domain section*)
3.4 Project cost estimation and budgeting	3.4.1 High-level cost estimation and budgeting process *(refer to PMBOK sixth edition Part 1 Project Cost Management section*)	**4.4 Project cost estimation and budgeting**	4.4.1 Detailed Budget Estimation Process (*refer to PMBOK sixth edition Part 1 Project Cost Management section)*
3.5 Project Documentation and Reporting	3.5.1 High-level documentation process (*refer to PMBOK sixth edition Part 2 Planning Process Group section* 3.5.2 Retrospect and Sprint Review Process (*refer to Agile Practice Guide (2017) Implementing Agile: Delivering in An Agile Environment section*)	**4.5 Project Documentation and Reporting**	4.5.1 Detailed documentation and progress reporting process. (*refer to PMBOK sixth edition Part 2 Executing Process Group section*) 4.5.2 High-level retrospect and Sprint review process (*refer to Agile Practice Guide (2017) Implementing Agile: Delivering in An Agile Environment section*)

Table 19: Implementation Phase Recommended Methodology Processes Table

Implementation

Quadrant	**Process**	**Quadrant**	**Process**
Quadrant 1	**Balanced Agile & Traditional Processes**	**Quadrant 2**	**Strong Traditional Processes**
1.1 Project implementation and evaluation	1.1.1 Sprint or iteration process (*refer to Agile Practice Guide (2017) Implementing Agile: Delivering in An Agile Environment section*) (*Refer to PMBOK seventh edition Development Approach and Life Cycle Performance Domain section*) 1.1.2 User Acceptance Testing and Quality Assurance Process (*refer to PMBOK sixth edition Part 2 Monitoring and Controlling Process Group section*) 1.1.3 High-level requirements review and verification process (*refer to PMBOK sixth edition Part 2 Monitoring and Controlling Process Group section*)	**2.1 Project implementation and evaluation**	2.1.1 System development process (Traditional) (*refer to PMBOK sixth edition Part 2 Executing Process Group section)* *(Refer to PMBOK seventh edition Development Approach and Life Cycle Performance Domain section)* 2.1.2 Testing and quality assurance process (*refer to PMBOK sixth edition Part 2 Executing Process Group section*)
1.2 Project ad hoc changes	1.2.1 Backlog and sprint planning process (*refer to Agile Practice Guide (2017) Implementing Agile: Delivering in An Agile Environment section*) (*Refer to PMBOK seventh edition Development Approach and Life Cycle Performance Domain section*)	**2.2 Project ad hoc changes**	2.2.1 Change management process (*refer to PMBOK sixth edition Part 2 Monitoring and Controlling Process Group section*) 2.2.2 Change control process (*refer to PMBOK sixth edition Part 2 Monitoring and Controlling Process Group section*)

	1.2.2 Release planning process (*refer to Agile Practice Guide (2017) Implementing Agile: Delivering in An Agile Environment section*) (*Refer to PMBOK seventh edition Development Approach and Life Cycle Performance Domain section*)		
1.3 Project communication	1.3.1 Stakeholder collaboration engagement process (*refer to PMBOK sixth edition Part 1 Stakeholder Management section*)	**2.3 Project communication**	2.3.1 Formal stakeholder engagement process (*refer to PMBOK sixth edition Part 1 Stakeholder Management section*) 2.3.2 Progress reporting process *(refer to PMBOK sixth edition Part 2 Monitoring and Controlling Process Group section*)
1.4 Project deliverable package	1.4.1 High-level user training and document review process (*refer to PMBOK sixth edition Part 2 Monitoring and Controlling Process Group section*) 1.4.2 Deliverable review and verification process (*refer to PMBOK sixth edition Part 2 Monitoring and Controlling Process Group section*)	**2.4 Project deliverable package**	2.4.1 User training and document review process (*refer to PMBOK sixth edition Part 2 Monitoring and Controlling Process Group section*) 2.4.2 Handover and maintenance process (*refer to PMBOK sixth edition Part 2 Monitoring and Controlling Process Group section*)
Quadrant	**Process**	**Quadrant**	**Process**
Quadrant 3	**Strong Agile Processes**	**Quadrant 4**	**Balanced Traditional Agile Processes**
3.1 Project implementation and evaluation	3.1.1 Sprint or iteration process (*refer to Agile Practice Guide (2017) Implementing Agile: Delivering in An Agile Environment section*)	**4.2 Project implementation and evaluation**	4.2.1 System development process (*refer to PMBOK sixth edition Part 2 Monitoring and Controlling Process Group section*)

	(*Refer to PMBOK seventh edition Development Approach and Life Cycle Performance Domain section*) 3.1.2 User story development process (refer *to Agile Practice Guide (2017) Implementing Agile: Delivering in An Agile Environment section*) (*Refer to PMBOK seventh edition Development Approach and Life Cycle Performance Domain section*) 3.1.3 Daily stand-up process (*refer to Agile Practice Guide (2017) Implementing Agile: Delivering in An Agile Environment section*) (*Refer to PMBOK seventh edition Development Approach and Life Cycle Performance Domain section*)		(*Refer to PMBOK seventh edition Development Approach and Life Cycle Performance Domain section*) 4.2.2 Sprint or iteration process. (*Refer to Agile Practice Guide (2017) Implementing Agile: Delivering in An Agile Environment section*) (*Refer to PMBOK seventh edition Development Approach and Life Cycle Performance Domain section*) 4.2.3 Requirements review and verification process (*refer to PMBOK sixth edition Part 2 Monitoring and Controlling Process Group section*) (*Refer to PMBOK seventh edition Development Approach and Life Cycle Performance Domain section*)
3.2 Project ad hoc changes	3.2.1 Incremental delivery process (*refer to Agile Practice Guide (2017) Implementing Agile: Delivering in An Agile Environment section*) (*Refer to PMBOK seventh edition Development Approach and Life Cycle Performance Domain section*) 3.2.2 Continuous integration process (*refer to Agile Practice Guide (2017) Implementing Agile: Delivering in An Agile Environment section*)	**4.3 Project ad hoc changes**	4.3.1 Change control process (*refer to PMBOK sixth edition Part 2 Monitoring and Controlling Process Group section*)
3.3 Project communication	3.3.1 Stakeholder collaboration engagement process (*refer to PMBOK sixth edition Part 1 Project Stakeholder Management section*)	**4.4 Project communication**	4.4.1 Stakeholder engagement process (*refer to PMBOK sixth edition Part 1 Project Stakeholder Management section*)

	(*Refer to PMBOK seventh edition Stakeholder Performance Domain section*)		4.4.2 Progress reporting process *(refer to PMBOK sixth edition Part 2 Monitoring and Controlling Process Group section*) (*Refer to PMBOK seventh edition Stakeholder Performance Domain section*)
4.4 Project deliverable package	4.4.1 Release and deployment process (*refer to PMBOK sixth edition Part 2 Monitoring and Controlling Process Group section*) (*Refer to PMBOK seventh edition Development Approach and Life Cycle Performance Domain section*) 4.4.2 Continuous deployment process (*refer to Agile Practice Guide (2017) Implementing Agile: Delivering in An Agile Environment section*) (*Refer to PMBOK seventh edition Development Approach and Life Cycle Performance Domain section*)	**4.5 Project deliverable package**	4.5.1 Release and deployment process (*refer to PMBOK sixth edition Part 2 Monitoring and Controlling Process Group section*) (*Refer to PMBOK seventh edition Development Approach and Life Cycle Performance Domain section*) 4.5.2 Handover and maintenance process (*refer to PMBOK sixth edition Part 2 Monitoring and Controlling Process Group section*)

Table 20: Closeout Phase Recommended Methodology Processes Table

Closeout

Quadrant	Process	Quadrant	Process
Quadrant 1	**Balanced Agile & Traditional Processes**	**Quadrant 2**	**Strong Traditional Processes**
1.1 Project completion	1.1.1 Sprint goal and retrospect process (*refer to Agile Practice Guide (2017) Implementing Agile: Delivering in An Agile Environment section*) 1.1.2 Formal acceptance process (*refer to PMBOK sixth edition Part 2 Closing Process Group section*) 1.1.3 Customer acceptance process (*refer to PMBOK sixth edition Part 2 Closing Process Group section*)	**2.1 Project completion**	2.1.1 Final product validation process (*refer to PMBOK sixth edition Part 2 Closing Process Group section*) 2.1.2 Formal Acceptance Process (*refer to PMBOK sixth edition Part 2 Closing Process Group section*) 2.1.3 Project closure report and documentation process (*refer to PMBOK sixth edition Part 2 Closing Process Group section*) 2.2.4 Lessons learned process (*refer to Agile Practice Guide (2017) Implementing Agile: Delivering in An Agile Environment section*)

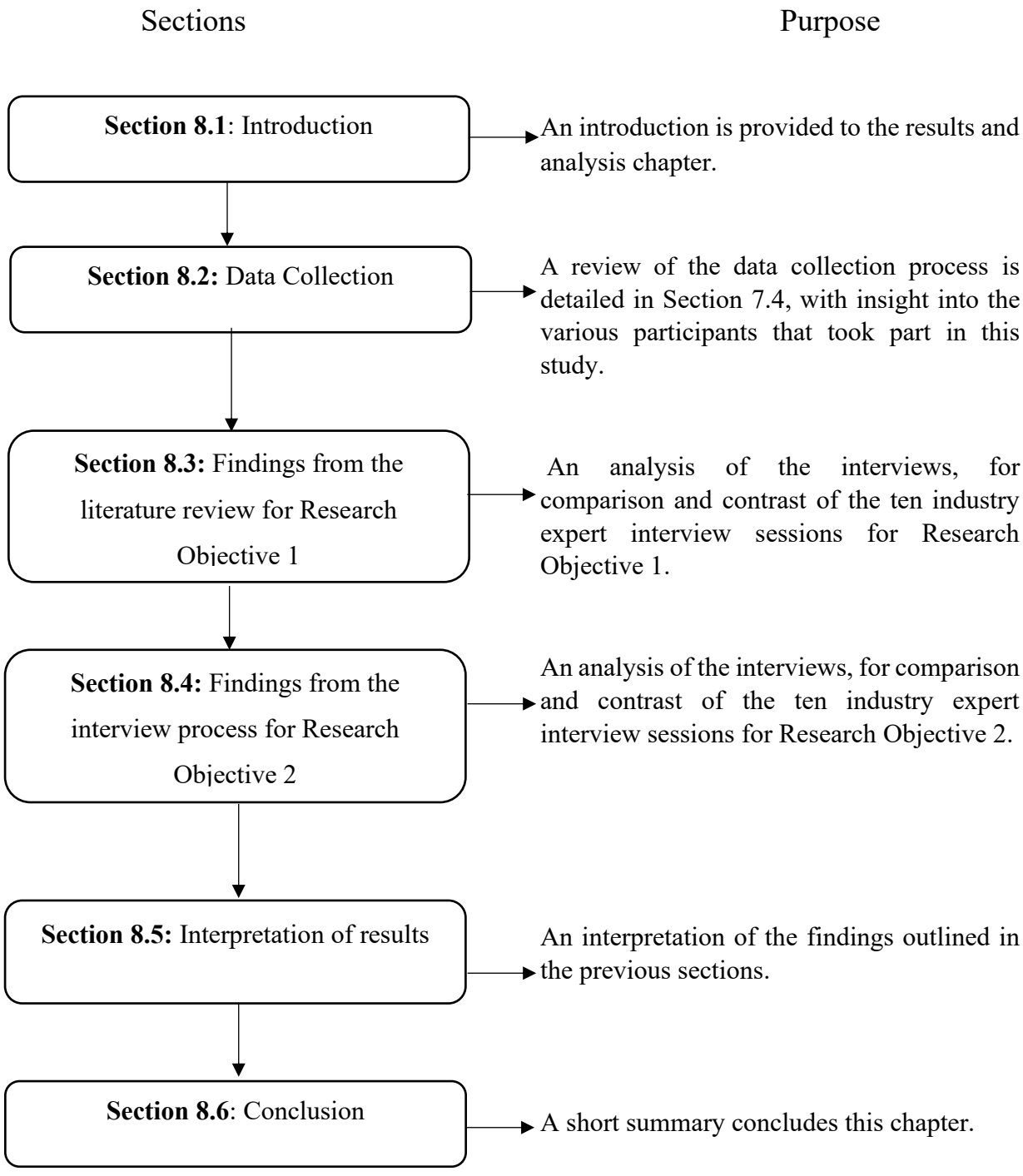
Quadrant	**Process**	**Quadrant**	**Process**
Quadrant 3	**Strong Agile Processes**	**Quadrant 4**	**Balanced Traditional Agile Processes**
3.1 Project completion	3.1.1 Sprint goal and Retrospect process (*refer to Agile Practice Guide (2017) Implementing Agile: Delivering in An Agile Environment section*) 3.1.2 Documentation and knowledge transfer process (*refer to PMBOK sixth edition Part 2 Closing Process Group section*) 3.1.3 Celebration and recognition process (*refer to PMBOK sixth edition Part 2 Closing Process Group section*) 3.1.4 Customer acceptance process (*refer to PMBOK sixth edition Part 2 Closing Process Group section*)	**4.2 Project completion**	4.2.1 Formal acceptance process (*refer to PMBOK sixth edition Part 2 Closing Process Group section*) 4.2.2 Lessons learned process (*refer to Agile Practice Guide (2017) Implementing Agile: Delivering in An Agile Environment section*) 4.2.3 Documentation and knowledge transfer process (*refer to PMBOK sixth edition Part 2 Closing Process Group section*)

7.7 Conclusion

Selecting the appropriate project management methodology and tool that facilitates knowledge transfer and successful project completion is difficult. The decision process in project management methodology selection should include clear, coherent analytical steps and produce results. Decision modelling tools can be regarded as software applications designed to help individuals and organizations make informed decisions. One of the decision models used in their research proposed a framework for assisting a software company. The most frequent Multi-Criteria Decision-Making techniques, which are available methods to answer choice problems, include: The Weighted Sum Method, Weighted Product Method, a Technique for Order Preference by Similarity to Ideal Solution, the Analytic Hierarchy Process, Elimination Et Choice Translating Reality, and VlseKriterijumska Optimizacija I Kompromisno Resenje in Serbian.

Using the decision model created by Thesing (2021) and described by Adam (1996) as the theoretical foundation, an IT Project Management Decision Model is introduced in this thesis. It evaluates project characteristics or attributes, and could assist project managers and practitioners in incorporating professional practice when choosing the appropriate methodology for delivering project phases.

8 RESULTS AND ANALYSIS



8.1 Introduction

The purpose of this chapter is to discuss hox the data were collected, analysed, and evaluated for this study, to address the main research question: *How can an Information Technology Project Management Decision Model (ITPMDM) be systematically developed and evaluated—using literature and practitioner input—to guide the selection of appropriate project management (PM) methodologies per project phase in the South African Information Technology (IT) sector?* This chapter first presents and analyses data collected through Chapters 3–7 of the literature review. These findings were used to develop the draft ITPMDM, and the second part of the chapter evaluates and validates the draft decision model through semi-structured interviews with ten IT project managers in South Africa to answer the third research sub-question. *How do experienced IT project managers evaluate the model (usefulness, clarity, coverage, applicability), and what refinements are indicated?* This chapter is structured as follows:

- Overview of data collection and analysis: Part 1, Literature Review;
- Findings from literature review;
- Overview of data collection and analysis, Part 2 Interviews;
- Findings from the interviews;
- Model improvement suggestions; and
- Summary of findings.

8.2 Data collection process

The data collection for research sub-questions one and two was conducted through document analysis. This was performed through a review of documentation that helped to understand the theory-building of the research question. Over 80 documents were reviewed from different fields or disciplines, and 42 documents from various scholarly sources were selected based on the following criteria: authenticity, representativeness, meaning, and validity toward the research question. The data were used to construct the IT Project Management Decision Model.Table 21 provides a summary of the purpose of each document that was selected.

Table 21: Documents Analysed

AUTHOR	TITLE
Terlizzi et al. (2016)	Barriers to the use of an Information Technology (IT) project management methodology in a large financial institution
Varajão, Fernandes and Amaral (2023)	Linking information systems team resilience to project management success
Varajão, Colomo-Palacios and Silva (2017)	ISO 21500:2012 and PMBoK 5 processes in information systems project management
Matos and Lopes (2013)	Prince2 or PMBOK – a question of choice
Salah and Hefny (2017)	Towards a Hybrid Approach for software project management using ontology alignment
Grebic (2019)	Traditional vs. Agile Project Management in the service sector
Project Management Institute (2017)	A guide to the Project Management Body of Knowledge (PMBOK® Guide)
Rosenberger and József (2021)	Relevance of PMBOK v6 processes for tailored Agile project categories
Dehghanpour, Thomas and Blomquist (2019)	Exploring the value of project management certification in selection and recruiting
Soroka-potrzebna (2021)	The importance of certification in project management in the labour market
Rdiouat et al. (2012)	Towards a new approach of continuous process improvement based on CMMI based on CMMI and PMBOK
Ines Ben Kraiem, Amir Sskka (2022)	Does a Hybrid Approach of Agile and plan-driven methods work better for IT system development projects?
Ines Ben Kraiem, Amir Sskka (2022)	A standardized execution process for the upstream decision-making conceptual model for project management method (PMM) selection
Agile Alliance (2001)	The Agile Manifesto
Thesing (2021)	Agile versus Waterfall project management: a decision model for selecting the appropriate approach to a project

Imani, Nakano & Anantatmula (2017)	Does a Hybrid Approach of Agile and plan-driven methods work better for IT system development projects?
Ratcliff et al. (2016)	Diffusion decision model: current issues and history
El et al. (2017)	A decision model for decentralized autonomous organization platform selection: three industry case studies
Sakka,(2022)	A standardized execution process for the upstream decision-making conceptual model for project management method selection
Yang & Huang, (2000)	A decision model for IS outsourcing
Soares, Tereso & Sousa (2015)	A decision-making model for the rework of defective products
Arakawa & Islam (2022)	Integrated multi-criteria group decision-making model for supplier selection in an uncertain environment
Prabadevi et al. (2021)	A decision model for ranking Asian higher education institutes using an NLP-based text analysis approach
Thakkar (2021)	Multi-criteria decision-making
Das et al. (2021)	An integrated entropy-based multi-attribute decision-making model for phase change material selection and passive thermal management
Etikala et al. (2021)	Automatic generation of intelligent chatbots from Decision Model and Notation (DMN) decision models
Xu et al. (2021)	Data-driven decision model based on dynamical classifier selection
Larbani & Yu (2017)	Challenging decision problems and decision models. In: Wonderful solutions and habitual domains for challenging problems in changeable spaces
Doppler & Rabiser (2019)	Feature modelling vs. decision modelling: history, comparison and perspectives
(Baninemeh, Farshidi & Jansen (2023)	A decision model for decentralized autonomous organization platform selection: three industry case studies
Dhanisetty, Verhagen & Curran (2018)	Multi-criteria weighted decision-making for operational maintenance processes
(Cao et al., 2023)	Artificial Intelligence (AI)-assisted clinical decision-making (CDM) for dose prescription in

Devi, Nayak & Patnaik (2020)	Decision-making models and tools: a critical study
Baloyi & Meyer (2020)	The development of a mining method selection model through a detailed assessment of multi-criteria decision methods
Singh, Upadhyay & Powar (2022)	Developing an integrated social, economic, environmental, and technical analysis model for sustainable development using hybrid multi-criteria decision-making methods
Khosravi et al. (2019)	A comparative assessment of flood susceptibility modelling using multi-criteria decision-making analysis and machine learning methods
Das et al. (2021)	An integrated entropy-based multi-attribute decision-making model for phase change material selection and passive thermal management
Wang et al. (2016)	A weighted-sum method for solving the bi-objective traveling thief problem
Chinda & Rao (2022)	Multi-attribute decision-making approach for placement of dynaflow controllers in a power system network using particle mobility honey bee algorithm
Chagas & Wagner (2022)	A weighted-sum method for solving the bi-objective traveling thief problem
Baninemeh, Farshidi & Jansen (2023)	A decision model for decentralized autonomous organization platform selection: three industry case studies
Meghdad et al. (2020)	Assessment of the performance of nurses based on the 360-degree model and fuzzy multi-criteria decision-making method (FMCDM) and selecting qualified nurses

8.3 Findings from the literature review for Research Sub-question 1 and 2

8.3.1 Characteristics of Traditional and Agile methodologies

Traditional methodology has processes and practices that are widely applied across various projects. The Project Management Body of Knowledge (PMBOK) process groups and knowledge areas drive project process improvement throughout the project management life cycle by utilizing skills, tools, and procedures that enhance the chances of project success (Varajão, Colomo-

Palacios and Silva, 2017),. Therefore, Traditional methodology is structured around processes that describe which activities should be taken in each knowledge area, and the strengths and weaknesses associated with the methodology. In building adequate knowledge and understanding of Traditional methodologies, a summary of the strengths and weaknesses of the Traditional methodology activities raised in the literature review is captured in the table below.

The literature review shows that the Traditional methodology is appropriate for structured, more risk-averse organizations and prescribed IT projects. Table 22 indicates the Traditional activities to consider when implementing IT projects.

Table 22: Summarized strengths and weaknesses of Traditional Methodology activities when considering an Information Technology (IT) Project Implementation

Strengths	Weaknesses
Stable planning for achieving systematic efficiency and well-documented outcomes.	Inadequate planning results in vague specifications of the outcome.
Reliable and timeous estimation of time and budget is critical.	Difficulty in formulating all requirements in detail at the beginning.
Stating fixed roles and processes with clearly defined responsibilities.	Error correction is frequently costly, as a result of complex plans.
The predictive available capacities of team members is high.	At the start, there is a lot of planning and paperwork.
Project progress can be measured using milestones.	There is no continuous customer or user feedback.
Content dependencies can be considered right from the start.	Less flexibility as a result of the project's condensed sequence of phases.

Agile Project Management (APM) methods are frameworks that enable organizations to respond fast to changing client requirements by providing flexibility in project management (Agile Alliance, 2001; Butt, 2016; Thesing, Feldmann & Burchardt, 2021). APM is more dependent on tailoring the project management process and methodology to the situation at hand, focusing on delivering elements of the project or product. The Scrum approach enables problem-solving through complex adaptive system methods that rely on transparency and inspection, and ultimately drives teams to continuous improvement. A summary of the strengths and weaknesses of Agile methodology activities raised in the literature review are captured in Table 23.

Table 23: Summarized strengths and weaknesses of Agile Methodology activities when considering an Information Technology (IT) Project Implementation

Strengths	Weaknesses
Fast recognition of changed requirements.	An iterative approach does not fit the corporate culture.
Fast identification of errors due to short development cycles.	The ability of teams to self-organize is critical to their success.
Flexibility and quick response to changing requirements.	The team members should dedicate and work on the project full-time.
Lower risk of false developments.	Limited and unclear communication for large and scattered teams.
Continuous optimization of project processes.	The use of iterative development may require more time spent on tasks and more budget spent.
High motivation of the team through personal responsibility.	Great presence of users for testing requirements.
Unlimited ways to find process solutions.	Solutions evolve throughout the life cycle of the project.

The literature review shows that a Scrum methodology is best used when addressing IT project requirements that require flexibility in responding to change. Table 23 indicates the Agile activities to consider when implementing IT projects.

8.3.2 Conditions for Hybrid approaches

With recent research suggesting an increasing trend to use a Hybrid approach for highly complex IT projects, it is vital to understand the project context. The goal is to combine the strengths of Agile and Traditional methods while suppressing their drawbacks (Imani, Nakano & Anantatmula, 2017; Salah & Hefny, 2017). The literature review showed that the first known approach used Traditional plan-driven and Agile methodology, depending on the project phase. The identified IT projects can be banking apps and organizations with their own Development and IT Operations (DevOps) team. The second alternative involves utilizing multi methods via Scrum, such as using a Traditional plan-driven estimation tool in Agile development. This approach is regarded as hybrid-by-method and is best suited when having an external consulting IT software development organization. This Hybrid approach would be most effective in large complex system development

projects where organisational structure and contractual issues would hinder the iterative development process that is essential to Agile methodology. TPM and APM are essential and useful for solving different knowledge area challenges that arise during project implementation. These approaches, when used appropriately, can create flexibility when implementing an IT project by allowing the project manager to utilize both approaches at appropriate project stages.

8.3.3 Decision modelling methods and types in project management

A decision model in project management is a tool that helps project managers make informed decisions about project planning, execution, and control. Project management decision models are designed to provide a framework for analysing complex project issues, identifying potential risks, and evaluating alternative solutions. IT Project Management Decision Models are considered critical for project success, and no one methodology can be suitable for all types of projects as they differ tremendously (Chiang & Lin, 2020; Sakka & Ben Kraiem, 2022). As discussed in the literature review, Sakka (2022) developed a decision model for a standardized execution process for the upstream decision-making conceptual model for project management method selection.

The literature review further suggested identifying a particular set of processes deemed most appropriate to the implementation of a successful IT project to guide and support the required decisions. The literature review identified the processes required in the construction of the decision model. These include:

- Identify the project scope and requirements;
- Evaluate project complexity;
- Evaluate project size;
- Evaluate project team experience;
- Determine project budget;
- Evaluate project timeline;
- Evaluate organizational culture; and
- Monitor and evaluate.

As suggested above, these processes need to be incorporated into a decision model to assist in selecting an appropriate method and process to enable a good fit for the most appropriate IT project management methodology.

8.3.4 Synthesis

The literature review that was conducted to learn about Agile (Scrum) and Traditional (Waterfall) methodologies supports the notion that IT projects are different. Moreover, understanding different methodologies is critical to determining the correct type of project at the outset. In building a decision model for selecting between Traditional (Waterfall) and Agile (Scrum) methodologies, the literature further shows that Project managers need to draw on elements of both approaches to assess factors influencing the project's successful implementation. By combining both methodologies, a structured decision model can help streamline the process, increase transparency, and align team and stakeholder priorities. The literature review further shows that the Traditional approach uses process groups and knowledge areas to drive project success, while the Scrum approach enables problem solving through complex adaptive system methods. Decision models analyse and compare options, with consideration of risk, uncertainty, and trade-offs based on parameters. Therefore, an IT Project Management Decision Model needs to have the ability to allow PMs to choose a methodological approach via a weighted average process for the strongest value in a particular phase of a project. The phases in an IT Project Management Decision Model must represent a balance of Traditional and Agile processes.

The following section is used to show the four (4) generic phases of a project and the identified processes that relate to both predictive, Traditional projects as well as iterative Agile projects:

Concept:

- Identify the project scope and stakeholder requirements of a Minimum Viable Product (MVP);
- Assess project feasibility by understanding the business problem;
- Obtain authorization to proceed with the project (approve, modify, or reject);
- Create project success criteria from a selection of doable items;
- Evaluate project task complexity;

- Establish change and release management;
- Evaluate project size and roles required; and
- Estimate project budget and time constraints.

Development:

- Develop project plans and milestones with short description features;
- Evaluate the project timeline by breaking down tasks to a granular level;
- Evaluate the project budget constraints;
- Determine a communication strategy with continuous refinement and adaptation;
- Evaluate project risk, procurement, and quality; and
- Evaluate the project team's skill set and experience.

Implementation:

- Carry out project execution with continuous updates on the product progress;
- Evaluate organizational culture and its impact on conducting the project;
- Facilitate team and issue management with continuous integration; and
- Determine issues, status reporting, and delivery management for regular feedback.

Closeout:

- Obtain formal project acceptance;
- Evaluate project performance and transition;
- Document lessons learnt on how the team can improve; and
- Prepare the project closure report for completion of the project vision.

While the four (4) generic phases may appear to follow a more Traditional (predictive) sequence, the literature review indicates that all projects, including Agile, go through these stages. By using this decision model approach, we can ensure that we select a project management approach that is well-suited to any IT project and that aligns with the organization's needs.

Figure 16 indicates the major constructs of the ITPMDM. The model starts by examining project management phases, referred to as Step 1; it then focuses on Step 2, Traditional vs. Agile vs. Hybrid, and Step 3, the decision model recommendation steps.

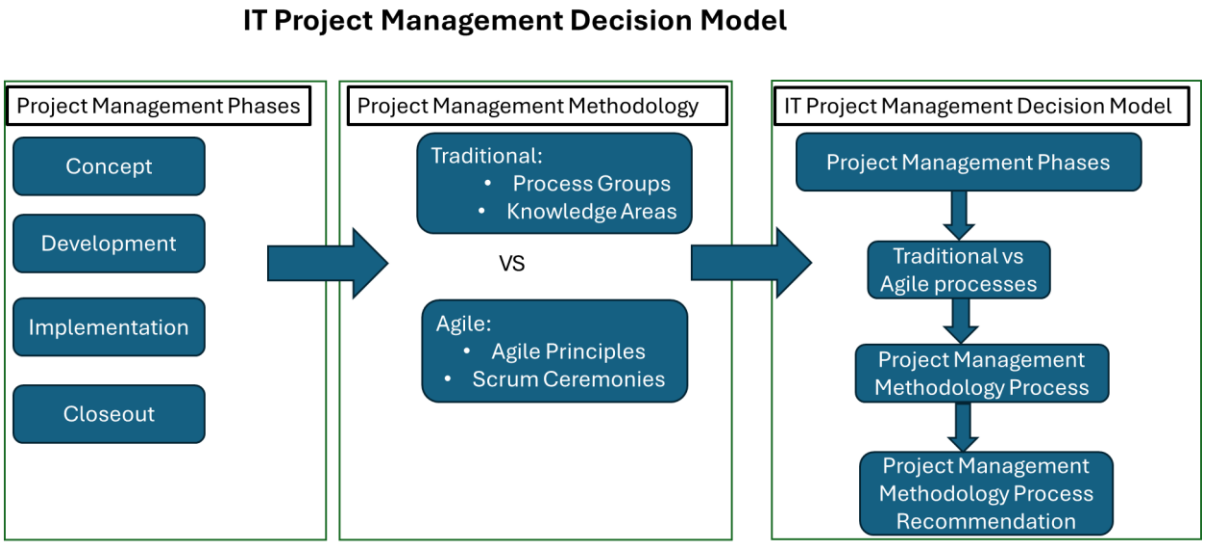


Figure 16: Draft Information Technology (IT) Project Management Decision Model diagram

8.4 Findings from the interview process for Research Sub-question 3

8.4.1 Interview findings for Research Sub-question 2

The participant's demographics, roles, and years of experience are summarised in Table 24.

For this phase, ten IT project management consultants from organizations that operate within the South African software development industry were interviewed to evaluate the literature-built IT Project Management Decision Model.

The evaluation was designed to achieve two key objectives:

1. To elicit professional feedback from IT project managers regarding the practicality and perceived value of the proposed decision model.

2. To refine and strengthen the model through the integration of practitioner insights.

Table 24: Participant Profiles

PARTICIPANTS	ROLE	EXPERIENCE (YEARS)
Participant 1	Program manager	20
Participant 2	IT Project lead	7
Participant 3	Senior IT consultant	36
Participant 4	HR manager OD	15
Participant 5	Program manager	25
Participant 6	Risk and portfolio manager	20
Participant 7	Scrum Master/ Feature analyst	4
Participant 8	Feature analyst	10
Participant 9	Senior project manager	4
Participant 10	CEO	20

Following the research methodology and the interview schedule shown in Appendix A, semi-structured interviews with open-ended questions were conducted with the participants over four months between July and October 2024. The interviews were transcribed, and the transcripts were imported into Atlas.ti for analysis. Notes made during the data collection and analysis stages were

also captured in Atlas.ti as annotations. The average time used for the interviews was 45 minutes, the shortest interview being 35 minutes, and the longest interview being an hour and ten minutes.

It must be noted that Participant 6 is an IT project manager who comes from a previous organisation that utilized a Project Management Decision Model. It is also important to consider that Participant 4 is not an IT Project manager consultant, but has project experience and has assumed an active stakeholder role in a large number of software building and testing organisations that utilise project management. This participant interacts with IT project solutions frequently enough to be knowledgeable in the area, and hence could offer valuable insights to this study. It was decided to consider both participants in the study as they both provided unique perspectives, which added to the reliability and validity of this study. The following section examines the findings uncovered through the analysis processes in Document Analysis and Atlas.ti.

8.4.1.1 Theme 1: Usefulness

As this study intends to develop an IT Project Management Decision Model, it is crucial to evaluate the usefulness of the decision model. It was necessary to assess whether it meets its intended purpose accurately and depicts project managers practitioners' challenges when selecting the best methodology for a given project.

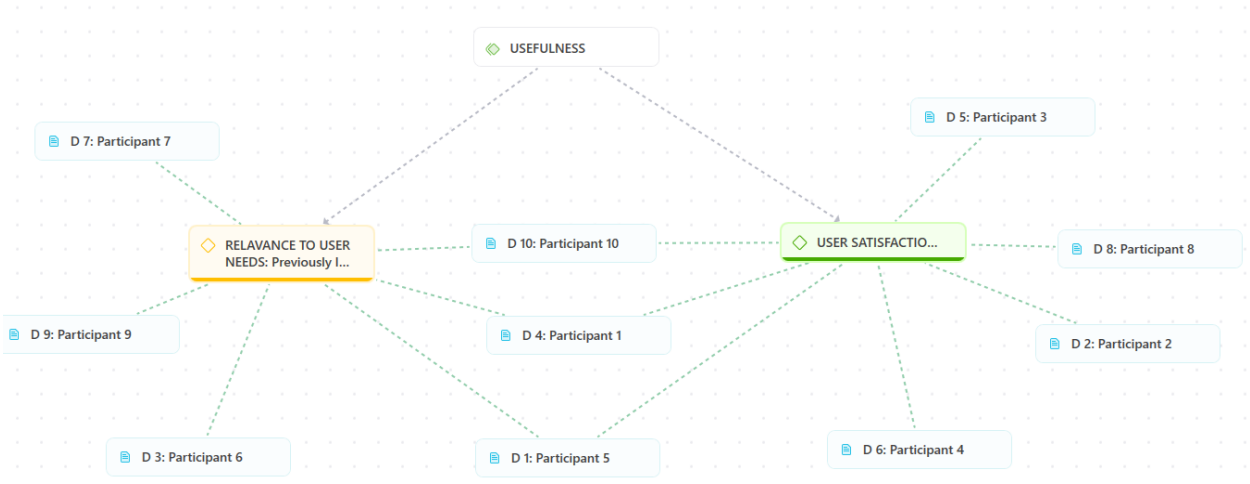


Figure 17 : Atlas.ti Network Diagram of Usefulness of the Information Technology (IT) Project Management Decision Model as per Interview Data

Figure 17 illustrates participants' perspectives on the usefulness of the decision model to project managers, drawing on their experience in managing predictive, planning-intensive projects, or

adaptive, iterative Agile projects, and/or Hybrid projects. In Figure 18, the views were split into two, showing key themes, namely:

- Relevance to user needs; and
- User satisfaction.

Participants 6, 7, and 9 only mentioned relevance to user needs, such as frequency of use and stakeholder expectations. On the other hand, Participants 2, 3, 4, and 8 mentioned user satisfaction, such as increased risk management and security factors, organizational culture, governance, and others. Participants 1, 5, and 10 mentioned relevance to user needs and user satisfaction, such as adaptability.

The following section presents some illustrative comments from the participants:

"In large and complex projects, especially those extending beyond eight months to two or three years, the scope, cost, and timeline need to be well-defined and managed, and using the decision model could assist in avoiding expected risks and reducing waste of resources. The organization and the project manager need to be aware of aligning project management methodology with initiated projects' characteristics to better use the decision model. The model reads well and reaches enough project characteristics described in each of the four generic project phases, catering to both methodologies now that we are discussing it. In identifying the need to assist with project viability and making informed decisions from the onset." – Participant 1

"Yes. We've found that some projects use only Agile methodologies, while others use Waterfall based on project characteristics, showing we have experience in managing predictive, planning intensive projects and/or adaptive, iterative agile projects and/or Hybrid projects. Depending on project size, budget, and resource availability, it is difficult to select a methodology in the beginning unless it is organizationally driven. However, some projects might require a Hybrid approach. So, you are creating a decision model to determine which methodology or processes are needed for each project phase will come in handy. The weighting of the outcome helps in this situation from the model. This offers tangible solutions to real-world problems and fulfils specific functions, and each section takes enough time to understand when you are aware of what it needs." – Participant 3

"For adjusting priorities in a new Agile project, I would suggest adding something like 'locking down the iteration scope this is part of the processes needed to adopt managing a new IT project as stakeholder expectation needs to be considered'. You know, I would suggest phrasing it to have a neutral view as 'continuous customer input and agreement' because you can get input, but it's important to have formal agreement on something like final budget in the real world. The

instructions provided in the model are clear, but the wording is sometimes close to agile and might be seen as bias." – Participant 5

"With today's projects, you need to talk with the marketing people and the compliance teams because we report to them at the end of the day, right? This talks to the integration management process; so, those factors also need to be considered. The decision model takes care of that, saving time delays in activities and making effort required clear as it doesn't take long to populate it and would give the project manager enough time to give feedback to stakeholders on implementation methodology, even though the organisational project delivery mode might not be known, for example, Agile; once we're done, we have to coordinate with these teams to confirm and give final methodology feedback: OK, this is what we want to do. Using the decision model would help with fast tracking the information distribution and decision making for stakeholders," – Participant 8

"The project that you're planning, there's always something about it, like taking stakeholders into account. Yes, as much as the explanation goes, everyone is going to be impacted by the project methodology chosen, but I'm not sure how. The recommended methodological approach tables well-structured guidance on processes. Sometimes it depends on the stakeholders' expectations on what process to choose. The model addresses this in its own way." – Participant 2

"The only thing I would suggest is addressing the environment setup of the model and the challenges it will address as it was confusing to read all the information and also be expected to do it practically. That's important. The one area I would be cautious about or even steer clear of is the budget, the time spent on the model is very important. I think that's quite a difficult one because, generally, in organisations, you have a fixed budget to start with. This is not clearly highlighted in the model how it would help solve this." – Participant 10

The Participants all agreed on usefulness of the decision model for different types of projects, with areas of improvement highlighted. They stated that time, budget, relevance to user needs, and user satisfaction are to be addressed using the IT Project Management Decision Model. The participants viewed the decision model as a useful guiding tool in planning how they could better approach the challenges presented by each methodology.

8.4.1.2 Theme 2: Coverage

It was imperative to detail practitioners' views on Traditional (Waterfall) and Agile (Scrum) methodologies, including preferred methodologies when evaluating the decision model, situations where each methodology is covered, and provides a complete view on limitations. This was done by looking into the key themes:

- Completeness of Traditional and Agile approaches; and

- Scalability elements for Traditional and Agile approaches.

With consideration of the flexibility and adaptability elements for Agile in integrating these methodologies in the decision model and any project processes that should be added or removed to the decision model in Figure 19: Participant 3 focused only on completeness elements; Participants 7 and 10 focused on scalability; and participants 1, 4, 8, and 9 combined completeness and scalability elements.

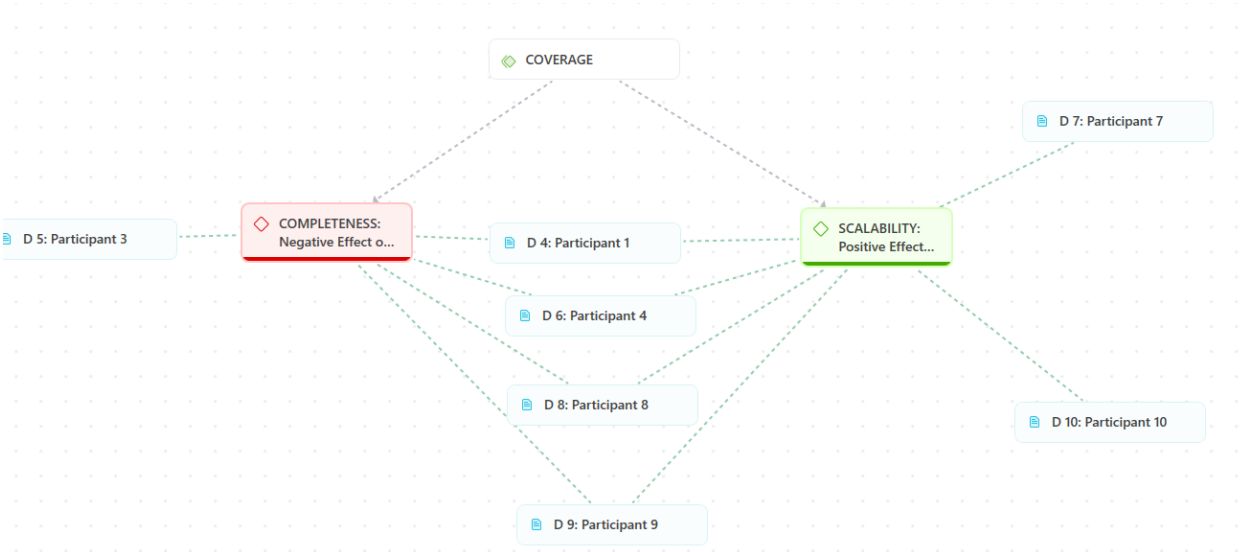


Figure 18: Atlas.ti Network Diagram of Coverage as per Interview Data

When it came to the questions about managing predictive projects, planning intensive projects and/or adaptive, iterative Agile projects and/or Hybrid projects, and finding the decision model providing coverage on processes, the response from the respondents were:

"I think it's an excellent question included in the model for covering all process elements in the knowledge area under review and the project challenges organizations face. It's well-sized and detailed enough to cover processes like risk, quality and scope; I would add value to the response in each section of the model, though. The response should address how the project delivery method aligns with Agile or Waterfall principles, including all necessary scenarios needed to take to topics like project goal and cost. Indeed, Agile is particularly effective in development due to its speed and flexibility, accommodating changes efficiently over Traditional methods but a strength of one methodology can also be a weakness to the other methodology. All model phase sections touch on both Agile and Traditional, and have a complete approach based on the questions and statements. The plotting and aggregation needs better explanation as it might be too technical" – Participant 1

"Yes, based on the question. We've found that some projects use only Agile methodologies, while others use Waterfall. However, to cover all features of all sizes, some projects might require a Hybrid approach. I think we're heading towards, in our context as a company, a hybrid way of working where, although we generally follow a more Waterfall-type methodology, we do find value in maybe not daily stand-ups but definitely weekly connects, but those can be separate. As we are a more agile project team, the processes in the model work well, no need to remove or add, the plotting of the weighting takes a moment of thinking but once linked to the recommendation take it makes sense" – Participant 3

"For example, every three months, we have a ceremony called PI planning; each team presents what they plan to do in the next three months, the model can close this gap created when an inappropriate methodology is chosen during the previous planning sessions. This can be software projects or any other projects. Before presenting what they intend to do, they will have consulted with the different stakeholders that are part of their plan, and using the model in diverse conditions would assist as the project characteristics described work well. So, realistically, we can only deliver this by this time based on the fact that we need A, B, and C to assist us, and we won't be able to do it without them. So, I'm saying it's a combination of both because you need detailed requirements and the flexibility to adapt as you progress, which seems to be covered in the model process steps." – Participant 4

"So that's where we need the stakeholder to be involved at the beginning. This is where you discuss data compliance and security, which is not shown in the model. Once we have a plan, the stakeholders won't be involved as much, but towards the end, particularly during implementation, we would need them to sign off to confirm that this is what they asked for. If they change their mind during a phase, you can show them the decision model and populate it to agree on a new project phase implementation methodology quickly. However, with the Agile approach, we work across Sprints, giving the stakeholders the flexibility to request changes throughout the process. They can approve or reject changes as we go along. So, there are more ongoing interactions from start to finish than the decision model." – Participant 7

"The conversation is that some parts of our projects are more suited to Waterfall, while others are better suited to Agile. The model clear shows this, providing clarity on what processes an IT project should take and no processes need to be added or removed for this part. We don't expect to fully adopt Agile because we still see value in the Waterfall approach. But for certain tasks within a project, we can be more Agile, while other tasks might still follow a Waterfall method. So, our approach is to be Agile in specific areas rather than applying it to the entire project. This is where the model can assist in the organization for growing needs, and the cost/benefit of time vs. utility in using the decision model makes it worthwhile. " – Participant 9

"What I think is, a Waterfall approach has its place when you're building something from scratch. When you're starting a new project, I think following a Waterfall methodology is great. The reason

I say that is because a two-week Sprint, and we've done some things and changed things, but the Agile approach is far too quick initially to try and get things turned around in two weeks when you're starting from the ground up. Just getting the system set up takes longer, and reading the project processes. So yeah, I believe that Waterfall has its place at the start of a project. When you're maintaining a system, I definitely think that Agile works. The model makes the switching from one methodology to the other easy and is guided well with the recommended methodological approach table." – Participant 10

All the participants shared that their perceptions of scalability and completeness should be used in the decision model. Each participant could recognize the methodological difference where elements were perceived as handling diverse conditions within the model, and where the flexibility and adaptability elements are most effective within the model. The project processes were clear, and the model sections were not confusing. All participants identified the distinction between the two approaches in the model and how the model is a tool that fills the gap, making time vs. utility in using the decision model worthwhile. The questions presented in the decision model assisted in the distinction of methodologies for participants when they had a gap in understanding the fundamental differences between Traditional and Agile for a given process, which created a complete view of options for all project sizes. This was found to be relevant by the participants as it guided them in selecting the most appropriate process for a given project phase to accommodate growing needs. Participants agreed that the model effectively captured the essential project characteristics, but suggested that additional factors, such as organizational maturity and stakeholder culture, should also be considered.

8.4.1.3 Theme 3: Applicability

As part of the key processes, it was imperative to evaluate the applicability of the decision model. Discussing practitioners' openness to, or use of, Hybrid approaches, including situations where the combination of Agile and Traditional methodologies is seen as beneficial to a given project. This is done by focusing on the key themes:

- Real-world situations that the decision model offers; and
- Varied environments Hybrid approach can be used.

Participants 7, 8, and 10 primarily mentioned real-world situations, such as rigid processes and iterative processes. Participants 4, 9, and 3 mentioned both real-world situations and varied environment.

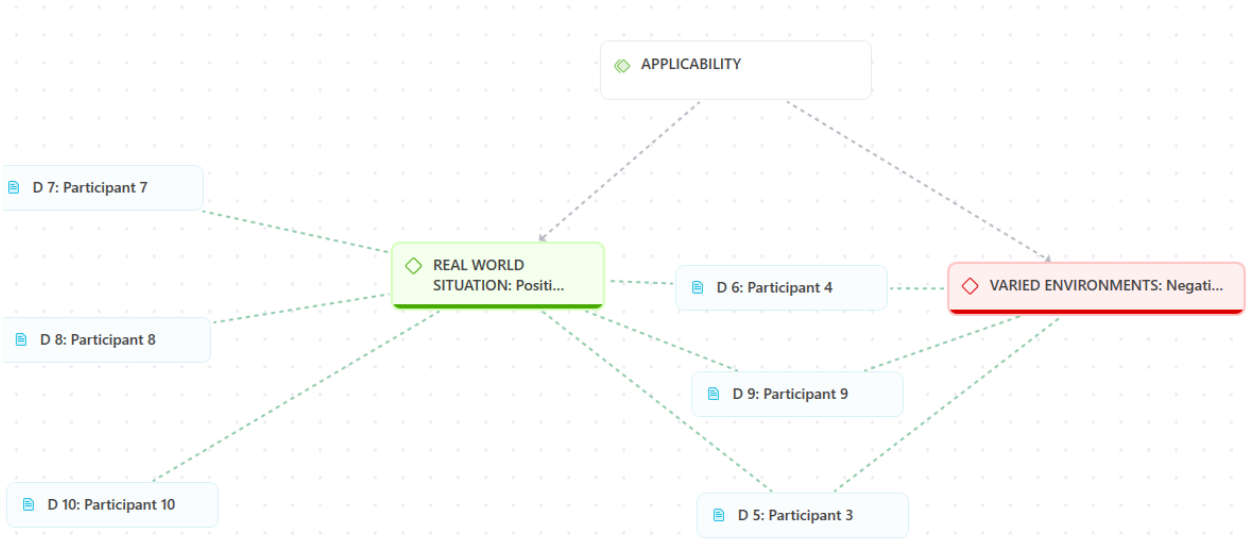


Figure 19: Atlas.ti Network Diagram of Applicability as per Interview Data

"Yes. We've found that some projects use only Agile methodologies, while others use Waterfall. However, some projects might require a Hybrid approach. Using a decision model way of working, where, although we generally follow a more Waterfall-type methodology or Agile, we would find value in using the model in our day-to-day organisation, but in limited projects. The plotting and weighting part of the model takes time to understand and needs better explanations," – Participant 3

"So, what I'm saying is that it's a little bit of both because you do need detailed requirements per se to know how flexible the model is, but at the same time, it's not like you'll have it all down to a tee. You will still have a situation where you see some things as you go along, as different situations arise in the project. So, making changes would be challenging the model because people prefer their current system, but it looks like the model will be flexible enough to be adapted to different use cases?" – Participant 4

"So that's where we need the stakeholder to be involved at the beginning to check if the model is adaptable to different project types, looking at the strength of one methodology over the other. Once we have a plan, the stakeholder won't be involved as much, but towards the end, particularly during implementation, we would need them to sign off to confirm that this is what they asked for

the model needs to cater for that when used in the real world. However, with the Agile approach, we work across Sprints, giving the stakeholder the flexibility to request changes throughout the process. They can approve or reject changes as we go along." – Participant 7

" For a full-range of potential project characteristics that need to be considered when initiating an IT project, you need to give a detailed high-level description of what it is, though it's not detailed. So those details have to be taken in consideration as well at a later stage, though our delivery mode is Agile and all of that, but once we are done, we have to sort of also be Waterfall the use of the four generic phases in the model would be beneficial for our project processes." – Participant 8

"Yes, I think it's a combination of the two. We're not fully Agile yet, but we're working towards it. I'd say a lot of it is still Waterfall — probably about 70% of our portfolio — but we're moving towards being more Agile. Using the decision model provided clarity on processes, even though it took a bit long to understand at first. The use of the decision model references and recommendations table made it clear. So, its hybrid and that distinction becomes clearer with the project type. The conversation is that some parts of our projects are more suited to Waterfall, while others are better suited to Agile. We don't expect to fully adopt Agile because we still see value in the Waterfall approach. But for certain tasks within a project, we can be more Agile, while other tasks might still follow a Waterfall method. So, our approach is to be Agile in specific areas rather than applying it to the entire project. Which using the decision model gives a cost/benefit advantage" – Participant 9

"What I do believe is that possibly. A model can be used in the real world and we've had it where we say to clients sometimes the utility in using the model is worthwhile as it brings efficiency and productivity. But I think that Agile is brilliant when a system, like a decision model is used. And also, when you have small tasks within a phased approach, what happens is they might say, 'We've got X amount of budget for the year'. If there's a fixed budget without predefined outcomes, I think Agile is good because the team collaborates and comes up with what works. However, when you have a defined outcome that you need to achieve, I think you need to follow a more rigid and structured approach rather than an Agile one. The instructions on the model don't provide clarity until the first phase is complete." – Participant 10

All participants shared the view that the outcome of the project when using the decision model will most likely work in the real world, even though it took time to follow the instructions; most of the sections were easy to follow after the completion of the first phase. This is due to the fact that projects have to go through a formal structure before taking the preferred methodology. Furthermore, within the phases, the effectiveness of using a Hybrid approach was evident as the project managers chose a combination of Traditional and Agile approaches within a phase. The outcome is a mixture of both Traditional and Agile processes. Participants found it broadly

applicable, especially for Hybrid and medium-sized projects. Participants highlighted that some methodology statements in the decision model can be applied to both Agile and Traditional approaches, but could be improved for greater clarity. A refinement of these statements needed to be considered.

8.4.1.4 Theme 4: Clarity

Regarding methodology selection, it was essential to evaluate the decision-making factors considered when selecting a methodology, ensuring that the instructions on how to use the model provide adequate clarity to the following key themes:

- Clear documentation; and
- Consistent terminology.

These were points within the decision model in Figure 21. Participants 6, 7, 8, and 10 mentioned clear documentation factors, such as project phases. Participants 3, 4, and 9 mentioned both clear documentation and consistent terminology factors, that is, project management processes.

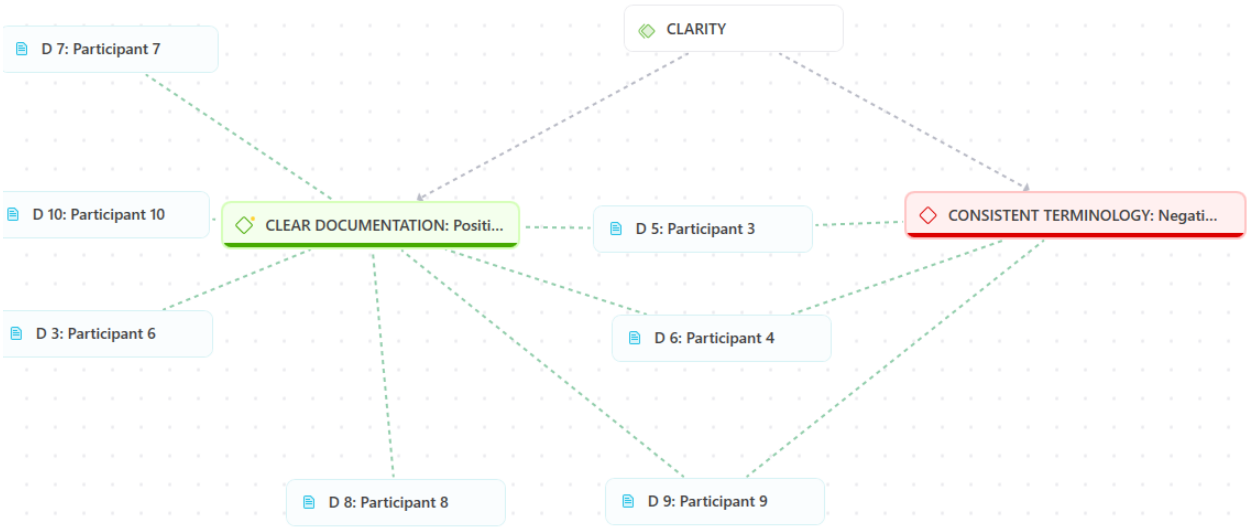


Figure 20: Atlas.ti Network Diagram of Clarity as per Interview Data

"I think resource planning is crucial as a process that the decision model has not incorporated. I don't have any other elements in mind because once you address resources, you usually cover other aspects as well. The process is quite detailed, and it doesn't take that long to complete the model, as it's clearly written with understandable phrases and instructions, so making changes would be challenging because people prefer the current system." – Participant 4

“Yes, I think it can be valuable when updated with the latest practices and tools. The model's weighting and plotting section is valuable but not easily understandable without an example. The first section took me long to understand, and the weighting table. It provides a structured way to decide between different methodologies and ensures that the chosen approach aligns with the project's needs. The recommendation table is a good idea with well-structured information” – Participant 6

"Are there any other security concerns? because these days, there are security issues and processes to be considered. However, there are still standard governance processes for releasing something on the environment. These are the *recommendations on how this decision model could be improved for its utility in using the decision model to be worthwhile even though its clearly documented?” – Participant 8*

"The conversation is that some parts of our projects are more suited to Waterfall, while others are better suited to Agile. This is clearly documented with transparent processes. We don't expect to fully adopt Agile because we still see value in the Waterfall approach. But for certain tasks within a project, we can be more Agile, while other tasks might still follow a Waterfall method. So, our approach is to be Agile in specific areas rather than applying it to the entire project. So, the decision model in this case will be used to improve the time vs. utility question. So, this decision model might assist there, although some tweaks can be made on the go. I agree with the general process of having the model, but just wanted to comment on that nuance.” – Participant 9

All participants shared the view that there are many factors that assist in selecting the appropriate methodology. The decision model consolidates these factors in a manner that makes it easy to identify how to deal with them through clear documentation and consistent terminology used within the decision model. The decision model creates a view that visibly shows which factors needed to be considered at an early stage in the project implementation phase. Participants generally found the model understandable, although a few indicated that the scale and quadrant representation required clearer labelling.

8.4.2 Data analysis process

A thematic analysis was followed at a semantic level to systematically structure and condense the substantial amount of transcribed interview data collected to obtain an organized and concise summary of this study’s main findings (Braun & Clarke, 2006). This systematic process, as guided by Braun and Clark (2006), entailed keeping the research questions clearly in focus. Therefore, it is relevant to revisit this study’s Research Sub-question 3 in this chapter:

• *Research Sub-question 3* – How do experienced IT project managers evaluate the model (usefulness, clarity, coverage, applicability), and what refinements are indicated?

The evaluation seeks to:

- Assess the usefulness of the model in supporting project methodology selection;
- Examine the clarity and logical flow of the model structure;
- Evaluate the coverage of decision factors represented; and
- Determine the applicability of the model to real-world IT project contexts.

With Research Sub-question 3 in mind, the transcribed interviews were read and re-read to become familiar with the data and to gain a sense of the data as a whole. At this point, the transcribed interviews were uploaded to Atlas.ti, and codes were formulated within the software. Higher-level categories were then created, and the codes were grouped within these categories, as indicated in **Table 25**.

A total of 30 codes, four categories, and 181 references were formulated. **Table 25** illustrates the categories, codes, and the number of references associated with each code.

Table 25: Categories and Codes Formulated in Atlas.ti

CATEGORIES	CODES	REFERENCES
Challenges in selecting project management methodology	Change request process	5
Applicability	Changes in requirement process	4
	Emerging challenges	13
	Previous identified challenges	12

	Methodology flexibility	7
	Plan for change requests	3
	Stakeholder process	5
	Steering committee	1
Perceptions of Traditional vs. Agile approaches	Agile processes	20
Clarity	Cost estimation and budgeting	10
	Structure and predictability	6
	Flexibility and adaptability	15
	Monitor and evaluate Process	1
	Organizational project management	3
	Traditional processes	13
Viability of Hybrid approaches	Hybrid method	9
Coverage	Project scope and purpose	8
	Project viability	6
	Seamless integration	4
	Predictable components	16
	Team delivery	15

Decision-making factors for methodology selection	Decision model flexibility	4
Usefulness	Document and reporting	3
	Manage timeline	10
	Model completeness	21
	Constraints	5
	Complexity	18
	Practical application	29
	Project completion	1
	Resource planning	3
	Stakeholder process	5

8.5 Interpretation of results

8.5.1 Unpacking the relationship, pattern, and correlation of Traditional and Agile methodologies

The feedback from the interviewees revealed a pattern of initially not understanding the use of the rating system, the scenario statements, and the choice between the A and B statements in the decision model. The key was explaining the relationship between Traditional and Agile methodologies in the model and how they relate. The literature review reveals that Traditional and Agile methodologies have distinct IT project implementation processes. The decision model was supported by statements that highlighted the differences between the two methodologies. According to Imani, Nakano and Anantatmula, (2017), current IT projects are considered customer-centric in nature; as a result, some strengths and weaknesses in the decision model's

processes can be applied to both Agile and Traditional processes. Furthermore, the interviewees noted that the model had processes that exhibited ambiguity in its methodology. This was particularly true in processes that dealt with project scope and purpose. As each methodology clearly defines its process and steps based on project characteristics, the data from the interviewees suggested that a combination of strengths and weaknesses would be best when reviewing specific projects, and should be catered for in the model. However, the model statements specifically did not focus on highlighting which IT projects they are suited to, and it assumes that the prescribed methodologies would suit the projects being implemented. The interviewees shared that an effective IT Project Management Decision Model should consider combining the strengths of Agile and Traditional methods, while suppressing the drawbacks of both methodologies on project elements (Imani, Nakano and Anantatmula, 2017; Salah and Hefny, 2017). These project elements appear in the decision model but, interestingly, the interviewees suggested that some focus on high-level descriptions may not lead to a defined outcome. This was interesting, as some participants shared that a strength of one methodology can also be a weakness to the other methodology. However, the interviewees shared that it is possible to focus equally on these elements in both methodologies and create conditions for a Hybrid approach, given the organization in which they operate. When the model is used appropriately, these Hybrid approaches can create meaningful flexibility when implementing an IT project by allowing the PM to utilize both approaches at appropriate project phases (Jackson and Brannon, 2018). Therefore, this flexibility can be utilized in a decision model that helps provide a better understanding of which processes are required.

8.5.2 Effectiveness of decision modelling methods, types, and factors in project management

The IT project managers who were interviewed all shared the same view, namely, that the IT Project Management Decision Model has a place in the current IT landscape. Such a tool could arguably equip project managers and practitioners to close the delivery gap created when an inappropriate methodology is chosen (Conforto et al., 2014; Thesing, 2021). The data from the interviewees, as well as Lalmi, Fernandes and Souad (2021), mentioned that a tool that can provide guidance on what the best methodology would be, given the needs for each phase, can provide confidence about the decisions that must be taken during implementation in big, complex, and

multi-functional projects. The data from the interviewees indicated that using the weighted sum model to choose between A and B methodology characteristics allowed the PM to allocate resources appropriately. This was evident from the Sakka (2022) model, which utilizes weighted sum model characteristics to calculate the human resource allocation for software development projects. In building a decision model for selecting between Traditional (Waterfall) and Agile (Scrum) methodologies, the literature further suggests that project managers should draw on elements of both approaches to assess the factors that influence the project's successful implementation. It is noted that the breakdown of the methodology statements in the decision model by phases could assist some of the PMs in remembering the defined phase processes. The key is understanding the characteristics of the Traditional approach, such as knowledge areas, and the principles and ceremonies of the Agile approach, which played a role in how the interviewees engaged with the decision model.

8.5.3 The possibility of linking the methodology and model

With the study evaluating: *How do experienced IT project managers evaluate the model (usefulness, clarity, coverage, applicability), and what refinements are indicated?*, the literature review and data from the interviewees suggest that the characteristics of each methodology can be used in a structured decision model when the combination of methodology and model are aligned. For this study, four themes were identified and grouped to clarify the research question better, as follows:

Usefulness

The first theme evaluates the usefulness of a decision model to guide the selection of the appropriate methodology. This is evident through its relevance to user needs and satisfaction in the literature and industry. These are due to the complexity of issues, including the project size and the organization's nature. Participants confirmed that the model is valuable as a structured reflection tool when selecting methodologies. This aligns with literature calling for context-sensitive decision frameworks (Papadakis and Tsironis, 2020).

Coverage and completeness

The second theme questions the coverage of Traditional and Agile approaches, which share elements such as completeness and scalability. This is relevant to this study, as a relevant IT project management methodology would need to cover both approaches, such as predictive and iterative. These elements address challenges such as rigidity, commonly associated with Traditional approaches, and a lack of documentation, which is often associated with Agile approaches. The model captures key decision-making factors, including project size, complexity, and team maturity. Participants recommended adding organisational maturity as an additional consideration.

Applicability and context

The third theme proposes the applicability of Hybrid approaches by focusing on the real-world situations that the decision model offers, as well as the varied environments in which the Hybrid approach can be used. The data from the interviewees showcase the evaluation of practitioners' openness to, or use of, Hybrid approaches, including situations where combining Agile and Traditional methodologies is seen as beneficial. The model was viewed as adaptable across project types, confirming the practical need for Hybrid and situational project management approaches.

Clarity and structure

The fourth theme evaluates decision-making factors for ensuring the instructions on using the model provide adequate clarity. Clear documentation and consistent terminology were points within the decision model. The data from the interviewees suggest key factors that practitioners consider when selecting a methodology, such as project size, risk level, stakeholder preferences, and resource availability. Findings indicated that the model's visual and logical structure enhances understanding, although some simplification was suggested. Clarity supports wider usability and adoption.

By reviewing the literature on project management and identifying the processes and activities that distinguish the strengths and weaknesses of both methodologies, it can be argued that the decision model, when applied, can enhance effectiveness in guiding methodological choices that require planning, execution, and control by project managers and practitioners. As a result, more themes were observed during the coding process and categorised, as outlined below.

Emergent themes

Themes such as Hybrid acceptance, decision transparency, and context awareness emerged, reinforcing literature on reflective and adaptive project management practice.

IT Project Management Decision Models in the literature are viewed as critical to project success, and no one methodology should be considered suitable for all types of projects, as they differ tremendously (Chiang and Lin, 2020; Sakka and Ben Kraiem, 2022). Therefore, the decision model evaluated in the study arguably has the characteristic of guiding project managers and practitioners in choosing a methodology based on the project characteristics.

8.6 Synthesis

The interviews were to evaluate and validate the need for a Hybrid approach to project management, and for a decision model to support the notion that IT project managers need assistance in choosing the appropriate project management methodology. Moreover, understanding different methodologies is critical to determining the correct type of project at the outset. As part of the decision model validation process, open-ended interview questions were employed to assess participants' understanding and to facilitate an in-depth exploration of project management methodologies. The interview findings were thematically analysed into four themes—Usefulness, Coverage, Applicability, and Clarity—and the most relevant participant suggestions were considered from Figures 18 to 21

Usefulness

It is crucial to evaluate the usefulness of the decision model and demonstrate its relevance to user needs and satisfaction. Participant 1 found that the model reads well and reaches enough project characteristics described in each of the four generic project phases, catering to both methodologies. Moreover, other participants stated that the IT Project Management Decision Model can address time, budget, relevance to user needs, and user satisfaction. Project objectives, cost, and integration management are project challenges identified in Chapters 3 and 4, which the decision model can address through participants' suggestions.

Coverage

It was imperative to detail practitioners' views on preferred methodologies when evaluating the decision model, to specify situations where each methodology is applicable, and to provide a comprehensive view of the limitations. Participant 3 found that some projects employ only Agile methodologies, while others use a combination of Agile and Waterfall methodologies. However, some projects might require a Hybrid approach to cover features of all sizes and processes. One of the participants suggested the addition of a compliance and security process to make the model cohesive. The literature highlights the importance of considering security and compliance challenges in models (Kumar and Goyal, 2019; Chinda and Rao, 2022). The updated model will take these processes into account as a requirement.

Applicability

It is essential to validate how well the decision model works in practice by examining practitioners' willingness to adopt Hybrid approaches. This includes exploring scenarios where combining Agile and Traditional methods benefits projects, with a focus on real-world applications and diverse environments where Hybrid methods are applicable. Participant 7 emphasized the importance of involving stakeholders at the start of a project to ensure that the model is adaptable to various project types managed by the project manager. One of the participants noted that the model would not be effective in projects that manage fleets or transportation due to the nature of the procedures that need to be followed. The rest of the participants did not have a different view on the model's applicability in their immediate environment. The blending of Agile and Traditional methodologies to address project challenges, as illustrated in Chapter 5, validates the model's versatility in various project situations.

Clarity

In selecting the appropriate methodology, it was crucial to assess the decision-making factors involved and ensure the model's instructions offered sufficient clarity. The importance of clear documentation and consistent terminology was also highlighted within the decision model. Participant 6 found it valuable when supported by a practical tool. However, the model's weighting and plotting section is beneficial but not readily understandable without an example. Furthermore, understanding the first section and the weighting table took some time, even though it provides a structured way to decide between different methodologies and ensures that the chosen approach

aligns with the project's needs. It is also important for it to be easy to understand. The introduction of various decision models in the literature assists in understanding the importance of clarity in, and usability of, decision models (Das et al., 2021). This is supported by the literature in Chapter 6, looking at the rationale for selecting the decision model attributes and the wide range of decision contexts and domains.

Cross-Cutting Themes

Beyond the four dimensions, thematic analysis revealed overarching insights, including the need for context sensitivity, the practical acceptance of Hybrid approaches, and the importance of decision transparency. These findings confirm that the model resonates with practitioner experience and enhances reflective decision-making.

8.7 Model feedback and modifications

Table 24 shows the log used to capture participant feedback, the issues identified, and the modifications to the model in response to the evaluation interviews, leading to the creation of the final decision model. The model modification where refined and linked to project management processes in the updated model. All of the participants had positive opinions about the proposed decision model. They thought that the model was relevant, comprehensive, and provided an accurate reflection of project management processes, with only minor alignment needed. Based on practitioner feedback, the following refinement categories were implemented:

- Simplified Likert scale descriptors;
- Enhanced quadrant labels;
- Added an 'Organizational Maturity' factor; and
- Provided additional examples per project phase.

The feedback below was considered in the modification phase.

Table 26: Participant Feedback and Modification

Participant Feedback	Identified Issue or Suggestion	Model Modification Made
"Model seems biased toward Agile; not neutral."	Perceived bias in scoring towards Agile approaches.	Adjusted weighting to reflect equal treatment of

		Agile and Traditional methods.
The weighting table instructions usage is not easy to understand	Step 1 on the weighting instruction is too long to understand for a first-time user	Adjusted wording and the table scale instructions to be clear for A and B scenarios to read easy
The recommendation table is a good idea with well-structured information	The process recommendation table is a critical part to the model. It needs to be clearly highlighted that it covers all phases	Adjusted the recommendation approach process links to be clear and represented them as going across all phases
The plotting and quadrant reading were not clear at first	Users needed guidance on how to plot the weightings and read the position	Adjusted the instruction on how to read the outcomes from the weighting and the recommendation table
The use of the four generic project management phases	The project management phases are in Waterfall model and do not represent the agile methodology	Represent the generic phases in Waterfall and clearly show the agile processes that are needed in each phase
The model seems not to cover all process elements per knowledge area	The model needs to cover all process elements in the questions asked in each knowledge area scenario	Adjust the questions to talk to the specific knowledge area on each phase directly, that is, Scope and Purpose
The handling of diverse conditions in the model	The model needs to show it can handle different project types	Adjusted the scenario statements to accommodate more than software implementation project types
The time taken vs utility of the model questions	The model needs to guide what project sizes need to use the model to manage time vs utility	Adjusted mostly the model statements to be active statements that are short and clear
Resource Planning, Compliance, and Security knowledge area	The model does not cover a project's security, resource planning and compliance aspects and processes	Adjust and added security, resource planning, and compliance questions to make the model comprehensive.
Use graphical representation to enhance the model view	The model will be more desirable and each to understand when it is visually represented on how all these processes come together	Adjusted the graphical representation and created a better view of how each process is integrated in the model and which processes it works with

The model modification table above is based on the interview feedback from a few participants. The feedback is captured based on the four themes created, namely, Usefulness, Coverage, Applicability, and Clarity. These themes are linked to the methodology process components used to build the IT Project Management Decision Model.

8.7.1 Evaluation summary

The table below summaries the areas of improvement the decision model needs. This is achieved by examining the dimensions and strengths.

Table 27:Evaluation Summary

Evaluation Summary Table		
Dimension	Strengths	Areas for Improvement
Usefulness	Supports structured decision-making	Add real-world examples
Clarity	Logical structure and flow	Simplify visual layout
Coverage	Comprehensive factors	Include organizational readiness
Applicability	Useful across project types	Add small-project guidance

8.7.2 Reflection and limitations

The evaluation provided valuable practitioner insights that strengthened the credibility and practicality of the decision model. While the sample represented a range of IT sectors, the small number of participants and qualitative scope limit generalisability. The study also relied on self-reported perceptions rather than longitudinal observation of model use in real projects.

8.8 Model update

Figure 22 outlines a graphical representation of the revised IT Project Management Decision Model, adapted from Figure 21, as the first draft of the IT Project Management Decision Model. Semi-structured interviews and model questionnaires were undertaken during this study to elicit feedback from South African IT project management professionals. Figure 21 illustrates project

management phases, project management methodology, and the project management methodology process recommendation as components that are needed to build the IT Project Management Decision Model. It was essential to evaluate and implement the structural suggestions that the participants brought up in an updated graphical representation. Therefore, the structural suggestions applied to the revised IT Project Management Decision Model are detailed in the following sections as refined from the model feedback Table 26. It should be noted that all processes that were not included in the draft IT Project Management Decision Model are found under the Hybrid processes characteristics.

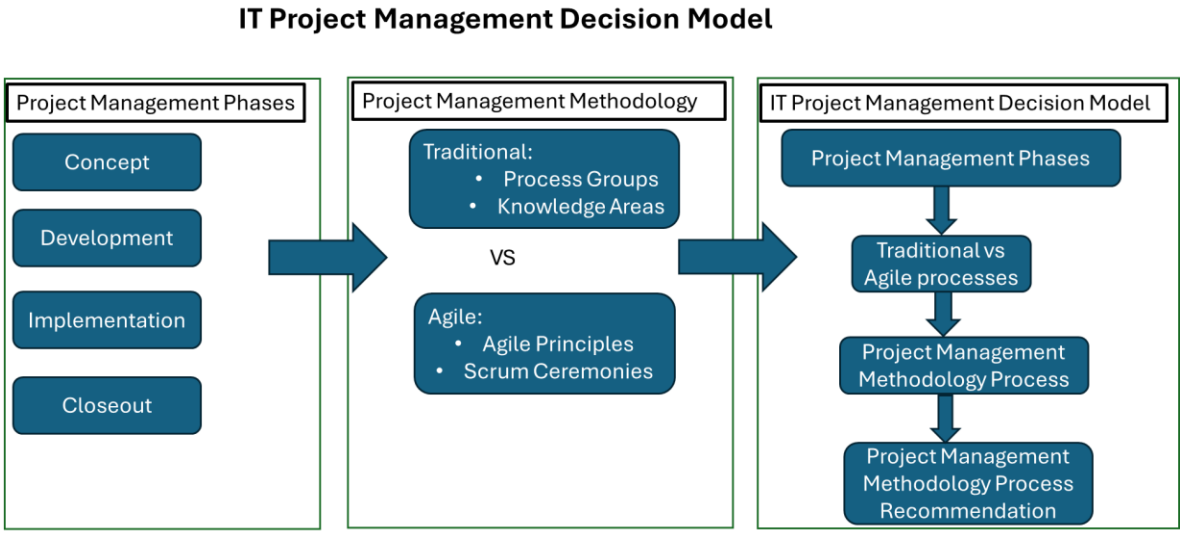


Figure 21: Draft Information Technology (IT) Project Management Decision Model

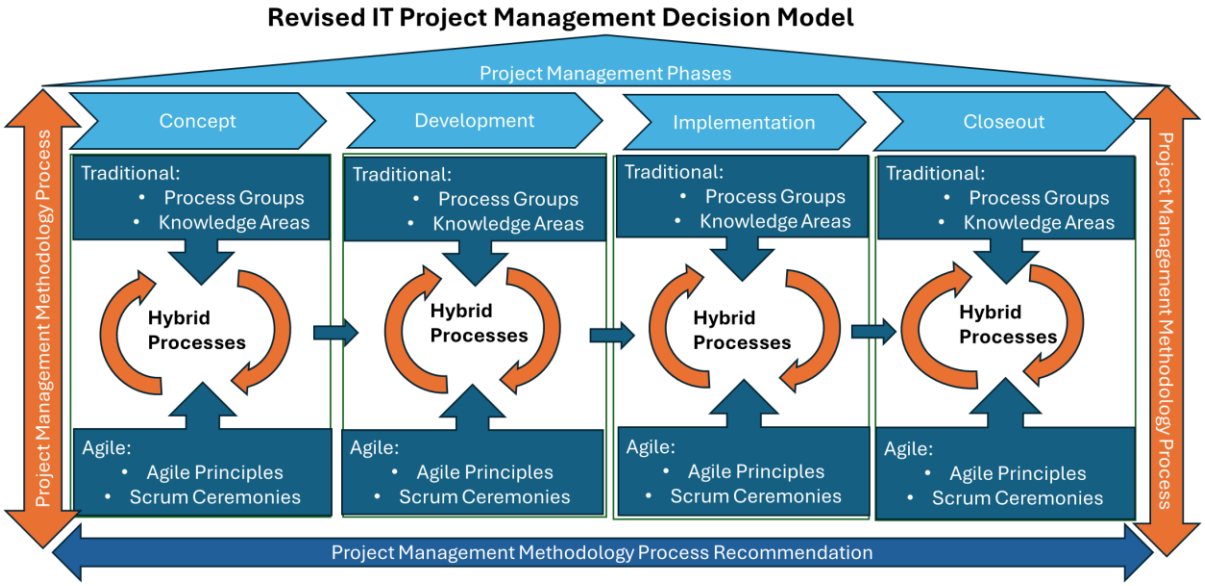


Figure 22: Revised Information Technology (IT) Project Management Decision Model

8.8.1 Project management phases

A blue triangle was added to the top of the decision model, covering all four project management phases, to illustrate the directional flow of the phases while utilizing the decision model, as suggested by the participants. The participants commented on the importance of covering all project processes under the four generic phases. This was captured in the theme: Coverage, and taken into consideration on the modification table. The theme focused on the completeness of Traditional and Agile approaches, examining scalability elements for Traditional approaches and flexibility and adaptability elements for Agile approaches. This analysis aimed to integrate these methodologies into the decision model and identify any necessary adjustments to project processes that should be added or removed from the decision model. When a project manager and practitioner engage with the model, they should typically follow the sequence of project management phases represented. It is essential to note that a project manager and practitioner can begin at any phase, as the decision model is designed to provide process recommendations based on the phase of interest. Participants 1 and 9 suggested that the project management phase be covered under one roof to show an integrated perspective.

8.8.2 Project management methodology processes

To the right of the project management phases triangle, an orange upward and downward bidirectional arrow covers the phases, methodologies, and recommendation activities within the decision model. The participants commented that if the model meets its intended purpose, this was done based on considering the theme: Usefulness. This is drawn from project managers' experience in delivering and managing predictive, planning-intensive projects, or adaptive, iterative agile projects, and/or Hybrid projects. In Figure 23, the participants views were split into two, showing relevance to user needs and user satisfaction. This was illustrated by the presence of project management methodology processes, spanning from project management phases to project management recommendations, and their usage and usefulness. These processes can be utilized across model activities to provide flexibility in handling complexity. Participants 5 and 10 suggested that project management methodology processes are clearly identifiable between Traditional and Agile approaches. It was suggested that the switch between the two methodologies per phase should be visible, and that the processes supported by each methodology should be labelled.

8.8.3 Project management methodologies

Within the project management phase, project management methodology processes, and project management methodology recommendations, the participants suggested capturing the project management methodologies based on flexibility of the project requirements. To address the challenges of selecting a suitable methodology, a Hybrid approach was welcomed by the participants. This was done under the theme: Applicability, and is focusing on the real-world situations that the decision model offers, and the varied environments in which the Hybrid approach can be used. These Hybrid processes would comprise the use of Traditional and Agile processes to provide a scalable and adaptable process recommendation. Furthermore, additional processes were recommended to be included in the model modification and feedback (Table 26). One participant highlighted the importance of resource planning, as it has been a focus point in achieving project quality and completion. Governance and security processes were not considered in the decision model. Participants highlighted this gap and suggested adding a compliance section

to address this. All participants recognized the need for Traditional, Agile, and Hybrid methodologies in the model. This was best represented by having each methodology per phase.

8.8.4 Project management methodology recommendations

Below the project management methodologies runs a navy horizontal bidirectional arrow that covers project management phases, project management methodologies, and project management methodology processes. This illustrates a consolidated approach that the decision model offers to guide project managers and practitioners once they have selected their methodology processes, as one of the participants suggested, ensuring that the instructions on how to use the model are provided in a clear and adequate manner. This is done by looking at the theme: Clarity, focusing on clear documentation and consistent terminology as points within the decision model in Figure 23. It is important to note that, in the project management methodology recommendations section, the direction of the arrow illustrates that one can move across in both directions and use the recommendations at any given phase of the project. Participants 4 and 9 highlighted that resource planning is a crucial aspect that is currently missing from the decision model. They suggested that incorporating this process could enhance the model's effectiveness, particularly in addressing the time versus utility trade-off. Additionally, they noted that the model is clearly written, with understandable phrases and instructions, which should help streamline its completion and summary of findings.

8.9 Conclusion

This chapter outlined the data collected, analysed, and evaluated processes undertaken in order to address this study’s research objective and sub-questions. The research methodology explained in Chapter 7 was followed.

This chapter outlined the data analysis processes undertaken to address this study's research objective and questions. Document analysis was conducted to assess authenticity, representativeness, meaning, and validity of articles that contributed to Research Sub-question 1. The data was used to construct the IT Project Management Decision Model. Thematic analysis, facilitated by Atlas.ti, was conducted to categorize and code the interview data to reveal patterns and trends.

Semi-structured interviews were conducted to elicit feedback from the research participants to evaluate the IT Project Management Decision Model for Research Sub-questions 2 and 3. Ten individual IT project managers from the South African IT project management industry were selected, as explained in Chapter 7, to participate in the study. In order to protect the identities of the individuals, each participant was generically labelled P1, P2, P3, P4, P5, P6, P7, P8, P9, and P10, respectively. Each participant, as briefly explained in Chapter 7, was also anonymized. The data were analysed after conducting and transcribing the interview responses, as described in Chapter 7.

This study aims to develop and evaluate a decision model for IT Project managers when implementing IT projects; therefore, the results of the data analysis are presented as a model. The two areas of interest that link to the research sub-questions, as stated in Section 1.4 of Chapter 1, are the distinguishing characteristics of an Agile approach (such as Scrum) versus plan-driven /stage-gate methods on a Traditional Waterfall process and a purpose-built decision model. These broad areas comprise several main and sub-category codes in the coding frame.

This chapter presented the evaluation of the IT Project Management Decision Model through thematic analysis of practitioner interviews. The findings demonstrate that the model is both relevant and useful in guiding methodology selection for IT projects. Participant feedback led to meaningful refinements that improved clarity, scope, and adaptability. The following chapter provides a broader discussion of the results, theoretical and practical implications, and recommendations for future research.

9 DISCUSSION AND CONCLUSION

Sections	Purpose
Section 9.1: Introduction	An introduction is provided to focus on the data collected.
Section 9.2: Contribution of each chapter	A discussion the contribution of each chapter.
Section 9.3: Theoretical Implications	An overview of theoretical implications.
Section 9.4: Practical Implications	A summary of practical implications.
Section 9.5: Model Update	An overview of the revised model update.
Section 9.6: Recommendations	An overview of the recommendations.
Section 9.7: Conclusion	A summary concludes this chapter.

9.1 Introduction

The purpose of this chapter is to present the discussion, conclusion, and recommendations arising from the analysed data of the previous chapters to address the main research objective:

To develop and evaluate an Information Technology Project Management Decision Model (ITPMDM)

This is achieved by narrowing the focus into the research question:

How can Information Technology (IT) project managers be supported in selecting a suitable project management (PM) approach through the development and evaluation of a context-specific IT project management methodology selection model?

Finally, breaking it down into smaller, manageable research sub-questions:

1. What are the distinguishing characteristics, strengths, and limitations of Agile and Traditional project management methodologies in IT project contexts?
2. What factors should inform the construction of a decision model for selecting appropriate project management methodologies?
3. How can IT project managers' experiences and perceptions be used to examine, refine, and validate a project management methodology decision model?

South African project managers and practitioners experience challenges in choosing the appropriate PM methodology when implementing modern-day IT projects. An IT Project Management Decision Model could assist when choosing the appropriate methodology (Thesing, Feldmann, and Burcnardt, 2021). This chapter is structured as follows:

- Discuss how each chapter contributed to answering the research questions;
- Interpretation of results;
- Theoretical and practical implications;
- Model update;
- Validity and reliability of the research;
- Recommendations; and
- Conclusion.

The chapter interprets the key findings presented in Chapter 8 in relation to the research objectives, literature review, and problem statement, and further outlines the theoretical and practical implications of the study. It acknowledges limitations and suggests directions for future research.

9.2 Contribution of each chapter to answering the research questions

Chapters 3, 4, and 5

Chapters 3 to 5 explore the idea that project management has gained momentum over recent years. However, organizations have not matured enough to handle the demands of change, complexity, and uncertainty when managing projects. Chapters 3 and 4 examine the Project Management Body of Knowledge (PMBOK) as the most common Traditional Project Management (TPM) approach among organizations for developing software and other business areas. They guide project managers who are seeking to implement projects that follow a detailed structure. Moreover, it includes methodologies such as the Project Management Body of Knowledge from the Project Management Institute (PMI), Projects in Controlled Environments (PRINCE2), and the International Project Management Association (IPMA). The PMBOK, as a standardised framework, has knowledge area challenges and limitations observed during a project implementation, as advised by the literature (Ciric et al., 2020; Project Management Institute, 2021a).

Chapter 5 discusses Agile Project Management (APM) methods as frameworks that enable organizations to respond fast to changing client requirements by providing flexibility in project management (PM). The goal is to introduce lightweight development approaches as a viable alternative to established development methods. The key is understanding the advantages and disadvantages of Scrum when addressing IT project requirements, as it requires flexibility in responding to change, encompassing both collaborative and rapid responses to user needs. The Agile methodology has challenges and limitations observed during a project implementation, as advised by the literature during its project implementation (Ciric et al., 2020; Project Management Institute, 2021a). Understanding Traditional and Agile methodologies assists in answering the Research sub-question 1: What are the distinguishing characteristics, strengths, and limitations of Agile and Traditional Project Management methodologies in IT project contexts? This is done by examining the advantages and disadvantages of Agile and Traditional Project Management

methodologies. Risk management processes contribute in the selection process of each methodology characteristic , guiding based on strength and weakness of each methodology.

Chapters 6 and 7

Chapter 6 examines how the PMI's PMBOK and Agile Methodology, specifically Scrum, address the same challenges differently. Traditional and Agile approaches address challenges presented by knowledge areas, considering their distinguishing characteristics, advantages, and disadvantages. This chapter presents the introduction of Hybrid processes in IT project management. Chapter 7 utilises the mechanism of good organisational decision-making, employing the process structure of the Plunung and Entscheidung process model. Chapters 6 and 7 further answers Research sub-question 2: Which principles, components, and decision rules from Traditional (e.g., PMBOK) and Agile (e.g., Scrum) methodologies should be combined to construct the model? Chapter 6 focuses on blending Traditional and Agile methodology with knowledge area challenges, and Chapter 7 focuses on decision-making model processes. The knowledge areas and how they address their challenges for each methodology guides towards the use of a blended approach in project methodologies. The available decision making literature guides the process of creating a model of selection.

Chapter 8

This chapter discusses how the data were collected and analysed for this study to answer the research objective. The data collection of this study for Research sub-question 3 was conducted through document analysis and in-depth interviews; this helped to understand the theory-building of the research sub-question. The data collection findings for the research sub-question was selected based on the following criteria: authenticity, representativeness, meaning, and validity toward the research question. A thematic analysis was followed at a semantic level to systematically structure and condense the substantial amount of transcribed interview data that was collected to obtain an organized and concise summary of this study’s main findings. The interview findings were thematically analysed into four themes—Usefulness, Coverage, Applicability, and Clarity—and the most relevant participant suggestions were considered. Ten IT project management consultants from organizations that operate within the South African software development industry were interviewed to evaluate the literature-based IT Project Management

Decision Model. The IT project managers validated the evaluated model and an updated version of the decision model was created.

9.3 Theoretical implications

This multi-method qualitative study is underpinned by Traditional and Agile methodologies, demonstrating how theory is applied to explain how an IT project manager or practitioner can utilize a decision model to guide their choice of processes in order to deliver a successful IT project. It extends understanding of methodology selection models through qualitative validation, and offers empirical evidence from the South African IT sector. As such, it contributes to the growing body of knowledge of project management in the following ways:

- This study applies Traditional and Agile methodologies to the project management domain within a South African context;
- This study contributes to the theoretical understanding of challenges in choosing the appropriate IT project management methodology (Traditional and Agile) when implementing modern-day IT projects;
- This study addresses how combined Traditional and Agile methodologies can be used in a decision model; and
- This study adds to the conceptual understanding that a decision model can be used in selecting the appropriate IT project management methodology.

9.4 Practical implications

In past years, project managers and practitioners have used various decision models to understand and solve complex situations (Ratcliff et al., 2016; Tali, Nader and Chalal, 2017). The IT Project Management Decision Model in this study attempts to solve the challenges that affect project management methodology selection in the project life cycle. This is done by integrating the advantages and disadvantages of Traditional and Agile methodologies into the decision model framework. The practical implications of this study includes:

- A guideline for training project managers;
- A decision-support tool during project planning; and

- A framework for aligning methodology choice with project characteristics.

IT project managers and practitioners can enhance the effectiveness of their expertise by identifying project characteristics, thereby reducing methodology selection errors through the use of this tool. Additionally, to support their project management methodology selection capability, project managers and practitioners can utilise the revised IT Project Management Decision Model to train newly qualified project managers and practitioners. It promotes balanced decision-making, encourages reflection during project initiation, and supports transparent stakeholder communication. This will aid in closing the gap between experienced and new entrants. The decision model also has observed limitations, as it can only be applied to software development projects. Lastly, South African universities and learning platforms could consider incorporating the revised IT Project Management Decision Model into their curricula and certification programs for aspiring and existing project management professionals. This will enable the upcoming generation of IT project managers and practitioners to adequately prepare for addressing the project management methodology selection challenges that organisations face.

Model Refinement Summary

Following practitioner feedback, refinements were incorporated into the decision model to improve clarity, relevance, and comprehensiveness. These included simplified scales, clearer quadrant labels, and the addition of organisational maturity as a factor. The final refined model is presented in Appendix B.

9.5 Recommendations

9.5.1 For practitioners

IT project managers should use a decision model for strategic planning. The decision model supplements existing project management knowledge. It may be used as a quick guide or check-in exercise to gauge the methodological direction of a particular project. This tool streamlines project tracking and reduces manual planning, freeing up more time for practitioners to navigate complex project issues. The decision model may be instrumental in IT projects that deal with client service software. This can usually be an in-house department that manages IT offerings for its organization. Furthermore, the decision model can assist outsourced IT companies that need to run

multi-functional IT projects with multiple IT offerings such as infrastructure, hardware, and software.

9.5.2 Limitations of the study and future research

This study presented some limitations regarding scope, time, and cost. Firstly, it had limited funding and a set time frame, which limited the scope of the study as it had to be completed within two years. With that in mind, future research into this study could include an additional data collection step whereby expert reviews are conducted to elicit feedback on the revised IT Project Management Decision Model and thus produce a finalised version of the decision model.

Secondly, considering the distinction between in-house and outsourced IT project managers and practitioners, having more in-house IT project managers as part of the research participants (as opposed to one) would have offered a broader range of perspectives. Future research in that regard could focus on investigating whether the perspectives of in-house and outsourced IT project managers vary depending on how they function within an organisation.

Lastly, future research into this study could entail testing or evaluating the revised IT Project Management Decision Model in order to assess its effectiveness and applicability in real-world scenarios. This could include conducting competency-based interviews structured around the understanding of available methodological process gaps, which can be used to evaluate IT project managers' practical knowledge and experience in addressing IT project management implementation process challenges. This would also assist in identifying where the process gaps lie and which specific processes can be developed, integrated, and reconfigured to address IT project management methodology challenges in organisations.

9.6 Conclusion

Several South African project managers and practitioners are experiencing challenges in choosing the appropriate PM methodology when implementing modern-day IT projects. The solution is understanding the relationship between Traditional and Agile methodologies by using an IT Project Management Decision Model. A combination of the strengths and weaknesses of Agile and Traditional methods, based on the project characteristics, is needed to have an adequate IT Project Management Decision Model.

This study provides recommendations and an IT Project Management Decision Model that assists IT project managers and practitioners by highlighting the phases and processes that should be considered when addressing project management methodology challenges in South African organisations. Future research could involve testing or evaluating the revised IT Project Management Decision Model to assess its effectiveness and applicability in real-world scenarios.

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APPENDIX A Interview questions

IT Project Management Decision Model interview guide

Project Title: ***Towards a decision model for guiding the methodological approach to projects in the South African IT sector.***

The purpose of the research project is to generate a decision model that guides IT project managers in selecting the appropriate project management methodology for implementing IT projects in South Africa. Practitioners and project managers are experiencing challenges in choosing the appropriate PM methodology when implementing modern-day IT projects.

1. Demographics:

a) Age group: 18-30, 31-39, 40-49, 50-59, 60+
b) Nationality
c) Gender
d) Race
e) Education: High school, college/technical diploma, university undergraduate degree, university postgraduate degree, doctoral, other.

2. Background:

a) What is your position/title within your organisation?

b) How many years of experience do you have in IT project management?

c) Do you have a formal IT/project management certification?

c) How would you describe your experience in managing predictive, planning-intensive projects and/or adaptive, iterative Agile projects and/or Hybrid projects?

d) Would you say that your organisation is aware of the need to align a project management methodology to the characteristics of a given project?

e) When starting a new IT project, how would you describe your organisation's approach to selecting a project management methodology?

3. This research makes the assumption that IT projects are best managed using methods and processes that are closely aligned with the unique characteristics of a given project.

The study proposes a decision model that IT project managers can use in selecting the appropriate project management methodology for implementing IT projects in South Africa.

With reference to the draft decision model:

a) Would you say the project characteristics described in each of the four generic project phases cater for the full range of potential project characteristics that need to be considered when initiating an IT project?
b) Are there any project processes that you believe should be added to the decision model?
c) Are there any project processes that you believe should be removed from the decision model?
d) How did you find the usability of the decision model?
    i. How long did it take you to populate the decision model?
    ii. Did the instructions on how to use the model provide adequate clarity?
    iii. Was any section/s of the decision model confusing to use?
    iv. Did you find the decision model useful in providing clarity on what processes to adopt in managing a new IT project?

v. Did you feel compelled to use the decision model references to seek further information regarding the recommended methodological approach?

vi. Do you feel the cost/benefit of time vs. utility in using the decision model is worthwhile?

e) Do you have any additional thoughts and or recommendations on how this decision model could be improved?

APPENDIX B Decision model

IT Project Management Decision Model

Introduction

IT project management is complex, and project managers must select from various methodological options to hopefully ensure a project's successful implementation. Compounding this challenge is that some organizations sometimes insist on using a methodological approach that does not necessarily suit the characteristics of a project. IT project managers and practitioners need an approach that deals with characteristics at a project level. Furthermore, an increasing trend is to use a Hybrid approach for highly complex IT projects to combine Agile and Traditional methods depending on the type of project. Agile and Traditional methods are essential and useful for solving different Project Management Body of Knowledge (PMBOK) knowledge area challenges that arise during project implementation. A decision matrix/model is appropriate for making good decisions in most IT project situations. Decision modelling allows decision-makers to understand complex situations, evaluate alternatives, reach decisions, and improve decision-making. A decision model must assist in selecting the appropriate method and process to enable a good fit for choosing the most suitable IT project management methodology. Therefore, introducing an IT Project Methodology Decision Model (ITPMDM) would allow practitioners to evaluate project characteristics and choose the most appropriate project processes in support of successful execution and delivery.

Application of the Model

This decision model is structured around a procedure model used for the methodology selection in an engineering project and five well-known decision model types. This model is structured around the following elements:

- Flexibility and adaptability;
- Structured decision-making process;
- Transparency and communication; and
- Quantitative results.

Using priority weighting, scores or ranking, the model is intended to:

- Guide a wide range of decision contexts and domains;
- Support decision-makers through a step-by-step approach; and
- Provide a clear framework for decision-making, resulting in a more transparent process.

The context for this research study is the selection of a particular set of processes deemed to be most appropriate for conducting a successful IT project.

Step 1: A and B scenario questionnaire statement instructions are as follows:

- Carefully read each numbered item and its statements marked “A” and “B”.
- Assign a point value to the A and B statements as follows:
    - The total point value for A and B added together is five (5).
    - If statement A is most similar to what you would do, mark 5 for A and 0 for B.

- If A is not wholly satisfactory but, in your judgment, better than B, mark 4 or 3 for A and 1 or 2 for B.
- The converse is true: if B is best mark 5 for B and 0 for A and so on.

Step 2: Determine the weightings.

Determine the project approach weighting for the four generic project phases. The scenario questionnaire responses from Step 1 are collected using a table with columns showing A for Traditional and B for Agile.

Step 3: Mapping the results on a Cartesian plane.

Map out the Cartesian plane for each generic project phase, that is, concept, development, implementation, and closeout.

Step 4: Plotting aggregated results.

Plot the aggregated (concept, development, implementation, and closeout) decision-maker's summed-up matrix evaluation on a Cartesian plane, with X coordinates representing Traditional and Y coordinates representing Agile.

Step 5: Review the outcomes.

Review quadrant outcomes: The quadrant outcomes are a result of the plotted points from the summary table (A and B).

IT Project Management Decision Model Instructions

<table>
<tr>
<td>Step 1</td>
<td>
Determine the project phase processes according to the importance of the project characteristics. The project phase processes can vary depending on the project structure and management methodology adopted. The four generic project management phases, namely, concept, development, implementation, and closeout, each has characteristics that guide the project manager in terms of which deliverables are expected at the end of each phase. Data is collected using a survey format and weighted rating scale in an A and B scenario-questionnaire-based form.
The survey instrument uses a 5-point Likert scale response. The points scale is from 0 to 5. The lowest number, which is 0, suggests not suitable, and the highest number 5 suggests strongly agree, with 2 and 4 suggesting disagree and agree, respectively. The last score is three, which suggests undecided. The points of each question are weighed as follows:

Table B.1: Illustrates the Rating Scale and Score
<table>
<tr><th>Score</th><th>Scale</th></tr>
<tr><td>0</td><td>Not suitable</td></tr>
<tr><td>1</td><td>Strongly disagree</td></tr>
<tr><td>2</td><td>Disagree</td></tr>
<tr><td>3</td><td>Undecided</td></tr>
<tr><td>4</td><td>Agree</td></tr>
<tr><td>5</td><td>Strongly agree</td></tr>
</table>

Each scenario question per phase represents a project characteristics or knowledge area that needs to be answered by an A or B statement.
The A or B statements in each phase assist with considering if a Traditional approach (A) or an Agile approach (B) is required.
The answer to the scenario questions is then represented (A and B) in a table that shows the numeric value selected for each scenario statement (1.1 A and 1.1 B) per phase.
</td>
</tr>
</table>

	The values are summed to a total for each statement A and B. The summed values A and B are used to find an interception point (A= X axis and B= Y axis) on a plane. The interception points, once plotted, will lie in one of four quadrants, each of which will provide the recommended project management process and methodology per phase. The A and B scenario questionnaire statement form is used to determine which project management approach is best suited, given the project characteristic in each project phase. The A and B scenario questionnaire statement instructions are as follows: Carefully read each numbered item and its statements marked "A" and "B". Assign a point value to the A and B statements as follows: • The total point value for A and B added together is five (5). • If statement A is most similar to what you would do, mark 5 for A and 0 for B. • If A is not wholly satisfactory but in your judgment better than B, mark 4 or 3 for A and 1 or 2 for B. • The converse is true: if B is best mark 5 for B and 0 for A and so on. Using the forementioned instructions, score the following: **1. Concept Phase** **1.1. In identifying the project scope and purpose, the response should be:** • ____4___A, The project idea is conceived and defined with a comprehensive plan upfront. • ____1___B, The project idea is initially explored, and a high-level vision is established, identifying a Minimum Viable Product (MVP) with incremental and early product releases. **1.2. In identifying the need to assess the projects' viability, the response should be:** • _____A, The project objectives, scope, and requirements are determined through documentation and assessing the skills and experience of the potential team.

- _____B, The detailed requirements are not available and will be determined as the project progresses.

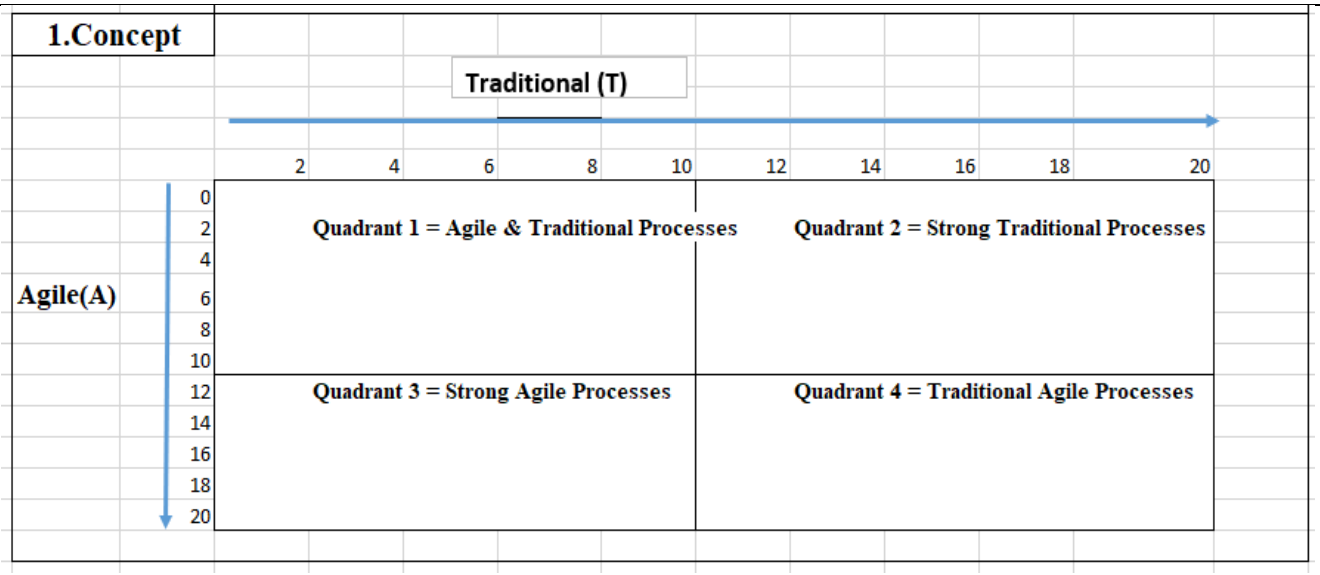
1.3. In identifying the need to understand the pace of delivery of requirements, the response should be:

- _____A, Initial planning is established, including a project charter and high-level project plan with fixed timelines and milestones due to understanding the size of the project.
- _____B, Partial requirements are established in a less formal and more collaborative approach to cater to flexible timelines and evolving or uncertain requirements.

1.4. In identifying the stakeholder interest in the project, the response should be:

- _____A, Stakeholder involvement will mostly feature at the beginning and end of the project.
- _____B, The decisions on the project are made on whether to approve, modify, or reject a requirement by ongoing stakeholder collaboration and feedback.

#	**Project Characteristics**	**A (Traditional)**	**B (Agile)**
1.1	Project scope and purpose		
1.2	Project viability		
1.3	Pace of delivery		
1.4	Stakeholder interest		
	Total:	**_ /20**	**_ /20**



2. Development Phase

2.1. In identifying how the project will be delivered, the response should be:

- _____A, The development and construction activities of the project will take place sequentially, developing a work breakdown structure (WBS).
- _____B, The project delivery is divided into a series of time-boxed iterations (Sprints in Scrum), based on the team's size and expertise.

2.2. In identifying the need to manage the timeline of the project, the response should be:

- _____A, The project is typically divided into sequential phases with strict dependencies (requirements, design, development, testing, and deployment).
- _____B, Development, testing, and quality assurance activities occur concurrently within each iteration.

2.3. In identifying the need to plan for change requests of project requirements, the response should be:

- _____A, The changes to project scope are generally discouraged or follow formal change requests processes in conjunction with a project steering committee
- _____B, The requirements evolve and are refined with each iteration based on feedback from stakeholders by adding new items, clarifying existing ones, and adjusting priorities.

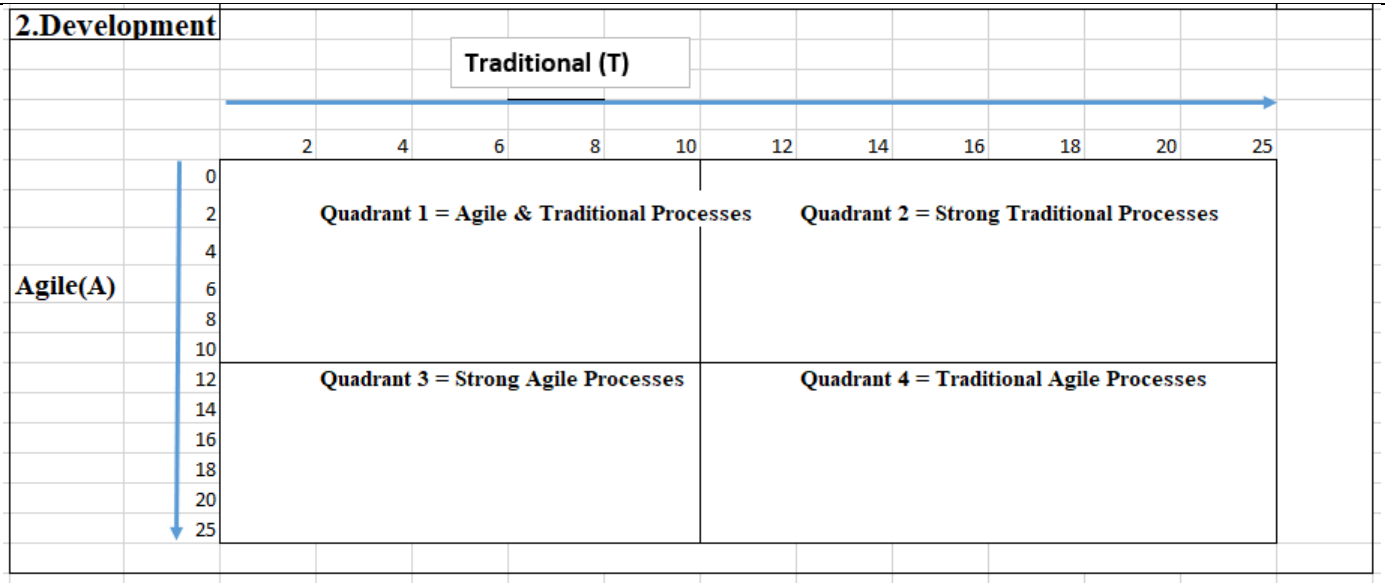
2.4. In identifying the need to manage the cost estimation and budgeting of the project, the response should be:

- _____A, The project involves creating a detailed budget, including cost estimates for all project activities and resources once planning is complete.
- _____B, The project involves flexible budgeting and costing with continuous Customer input.

2.5. In identifying the need for documentation and reporting of the project, the response should be:

- _____A, Creating comprehensive documentation of project issues, delays, or scope changes to keep track of project outcomes.
- _____B Documentation is captured by a description of features or functionality in short one to two-sentence form.

#	**Project Characteristics**	**A (Traditional)**	**B (Agile)**
1.1	Project delivery structure		
1.2	Project schedule management		
1.3	Project change request		
1.4	Project cost estimation and budgeting		
1.5	Project Documentation and Reporting		
	Total:	**_ /25**	**_ /25**



3. Implementation Phase

3.1. In identifying the need to monitor and evaluate the actual implementation processes of the project, the response should be:

- _____A, Having a formalized, structured, and controlled process to identify better and resolve issues.
- _____B, Having an ongoing process throughout the project, with increments of the product being delivered at the end of each iteration.

3.2. In identifying changes in the requirements as the project progresses, the response should be:

- _____A, Any change requires formal communication and hierarchical approval.
- _____B, Changes are allowed with more flexibility and adjusting requirements to facilitate ongoing delivery better.

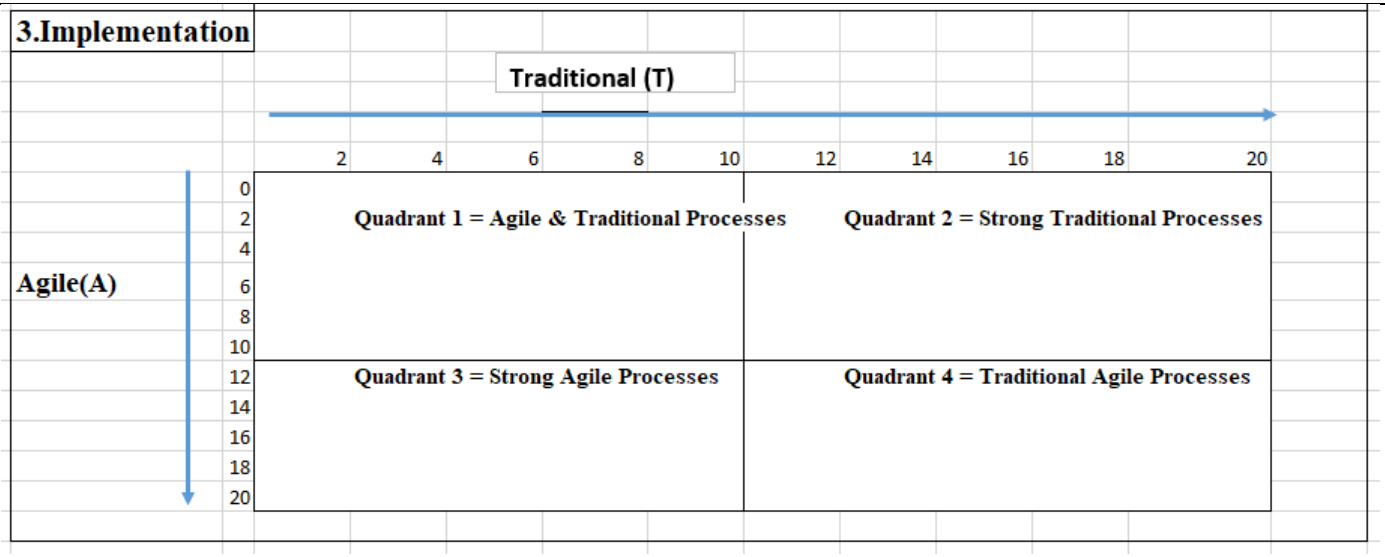
3.3. In identifying the need to support how the team gives feedback on the project's progress, the response should be:

- _____A, The team meets at fixed formal periods and reports on the entire project process.
- _____B, The team gathers for daily short meetings (Standups) and collaborates to complete the work according to the Definition of Done (DoD).

3.4. In identifying the need to know the way the team delivers the work package, the response should be:

- _____A, The final unit testing, user acceptance testing (UAT), and user documentation process will be followed and completed.
- _____B, The user training and system rollout will occur incrementally as features are completed.

#	**Project Characteristics**	**A (Traditional)**	**B (Agile)**
1.1	Project implementation and evaluation		
1.2	Project ad hoc changes		
1.3	Project communication		
1.4	Project deliverable package		
	Total:	**_ /20**	**_ /20**



4. **Closeout Phase**

4.1. In identifying the need for the way in which the project is defined as complete, the response should be:

- _____A, Obtaining formal acceptance of project deliverables, documentation, and finalizing all project-related activities from the stakeholders.
- _____B, A final retrospective and review will occur, and documentation of lessons learned and feedback is updated.

#	**Project Characteristics**	**A (Traditional)**	**B (Agile)**
1.1	Project completion		
	Total:	**_ /5**	**_ /5**

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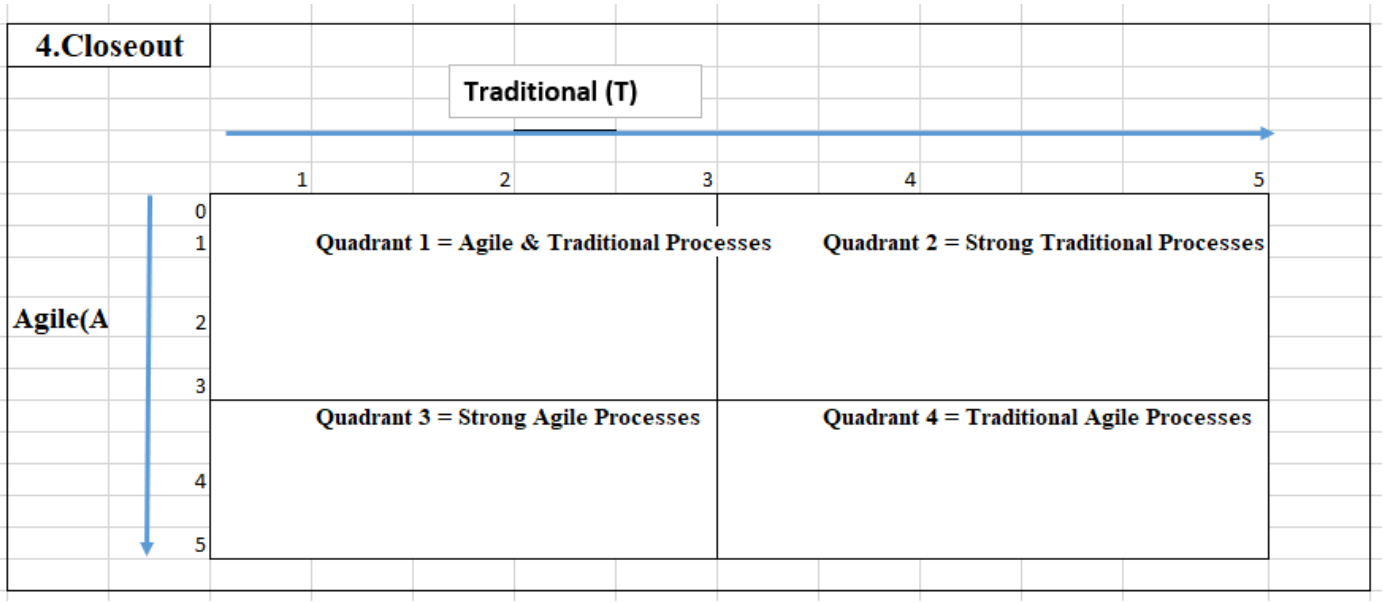
<tr><td></td><td> 
</td></tr>
<tr><td>Step 2</td><td>Determine the project approach weighting for the four generic project phases. The scenario questionnaire responses from Step 1 are collected using a table with columns showing A for Traditional and B for Agile. The table columns start with the column ID number #, followed by the project characteristics column then the approach columns Traditional (A) and Agile (B). The approach columns A and B are populated with weightings from 0 to 5 for each project characteristic noted. These weightings are collected from the response statements in the scenario questionnaire in Step 1. Once the questionnaire for each phase is completed, the answers are grouped between Traditional (T) or Agile (A), and are summed at the bottom of the table to give a total weighting per approach A or B.</td></tr>
</table>

<table>
<tr><td></td><td>
<table>
<tr><th>#</th><th>Project Characteristics</th><th>A (Traditional)</th><th>B (Agile)</th></tr>
<tr><td>1.1</td><td>Project scope and purpose</td><td></td><td></td></tr>
<tr><td>1.2</td><td>Project viability</td><td></td><td></td></tr>
<tr><td>1.3</td><td>Pace of delivery</td><td></td><td></td></tr>
<tr><td>1.4</td><td>Stakeholder interest</td><td></td><td></td></tr>
<tr><td colspan="2">Total:</td><td>_ /20</td><td>_ /20</td></tr>
</table>
</td></tr>
<tr><td>Step 3</td><td>Map out the Cartesian plane for each generic project phase, that is, concept, development, implementation, and closeout. From the table in step two, the weighting (0 – 5) given for each project characteristic in response to the scenario questionnaire in Step 1 is summed at the bottom of the table to give a total weighting per approach A or B. Once these two categories (A and B) are placed in the last two columns of the questionnaire, the categories are weighted and interpreted on a four-quadrant graph.</td></tr>
<tr><td>Step 4</td><td>Plot the aggregated (concept, development, implementation, and closeout) decision-maker’s summed-up matrix evaluation on a Cartesian plane with X coordinates representing Traditional and Y coordinates representing Agile. The total column of the table in Step 2 will give a summed value from each project characteristic out of a possible total per project phase (XX/20). These values are used as points on a Cartesian plane, with each value A and B representing X and Y coordinates. Once the A and B coordinates are plotted, an intercept point can be read.</td></tr>
<tr><td>Step 5</td><td>Review quadrant outcomes: The quadrant outcomes are a result of the plotted points from the summary table (A and B). The point of interception lies on one of four quadrants, and each quadrant will provide a set of recommended project management processes and methodology.</td></tr>
</table>

Note, Annexure I shows an example of a project review under concept with the resultant Cartesian plane illustrated.

ANNEXURE I

The table below illustrates a concept phase table used in Step 2 of the IT Project Methodology Decision Model (ITPMDM), with columns A for Traditional and B for Agile. The table columns start with column ID number # showing for sequencing, followed by the project characteristics grouped from the Step 1 scenario statements, and then the approach columns Traditional (A) and Agile (B).

Table 1 Concept: The proposed IT Project Methodology Decision Model (ITPMDM) phase attribute matrix

#	**Project Characteristics**	**A (Traditional)**	**B (Agile)**
1.1	Project scope and purpose	5	0
1.2	Project viability	1	4
1.3	Pace of delivery	0	5
1.4	Stakeholder interest	0	5
Total:		**6_ /20**	**14_ /20**

The figure below illustrates the concept phase Cartesian plane, with four of the quadrants referring to the project management methodology processes that are most likely to be used. These project management methodology processes give guidance by referring to the recommendation methodology process table created. The four quadrants each represents a set of project management processes suited for the identified project characteristics in Step 1 of the IT Project Methodology Decision Model. Quadrant 1 represents Agile processes with a blend of Traditional processes. Quadrant 2 represents strong Traditional processes, and Quadrant 3 strong Agile processes. Finally, quadrant 4 represents Traditional processes with a blend of Agile processes. The Recommended Methodology Process table guides each quadrant process.

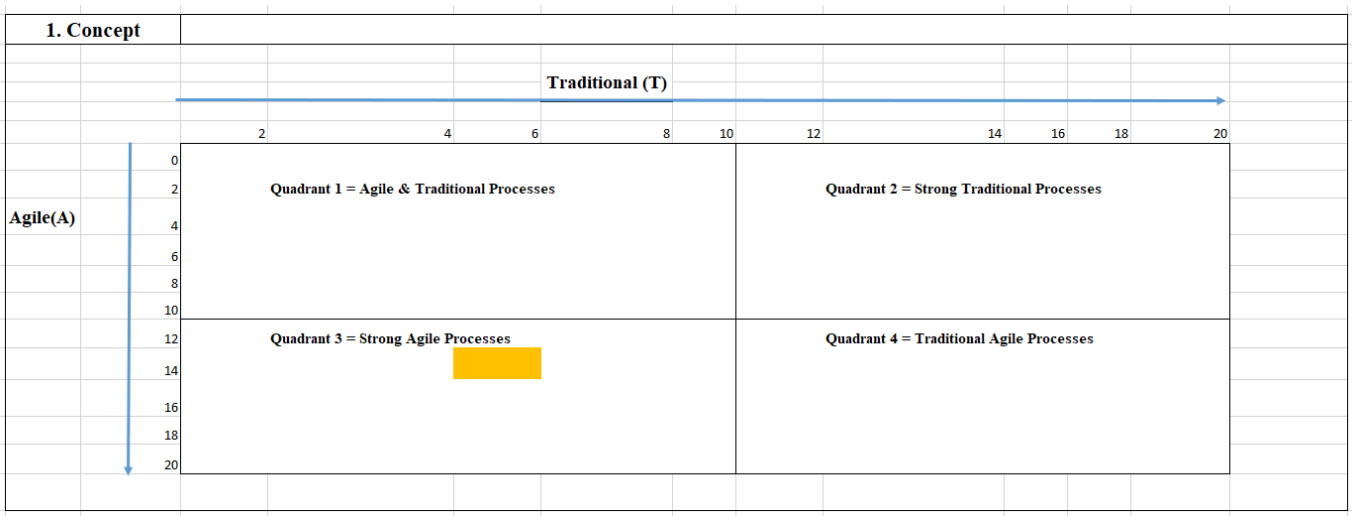


Figure 1 The proposed IT Project Methodology Decision Model (ITPMDM) concept phase Cartesian plane

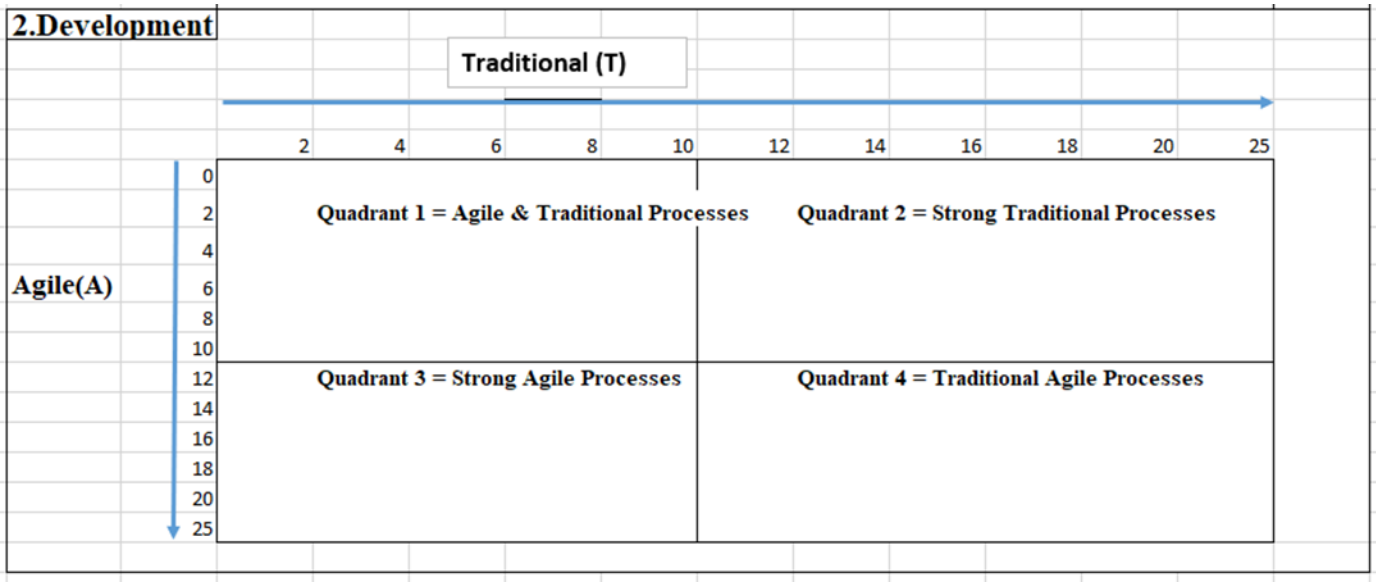


Figure 2: The proposed IT Project Methodology Decision Model (ITPMDM) development phase Cartesian plane

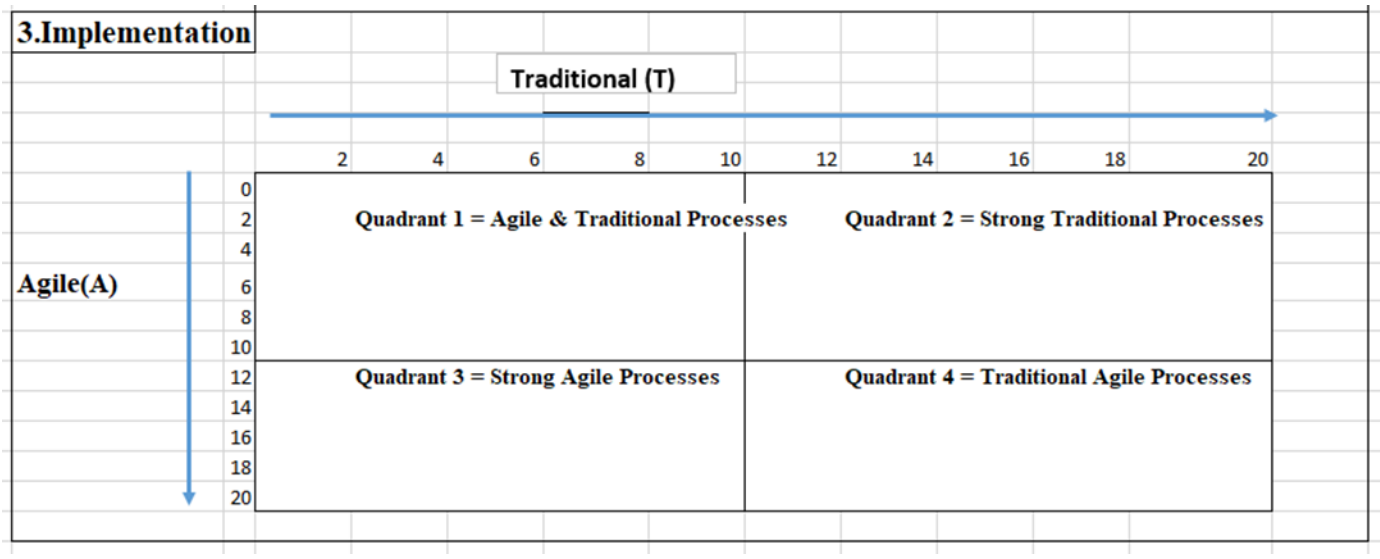


Figure 3 The proposed IT Project Methodology Decision Model (ITPMDM) implementation phase Cartesian plane

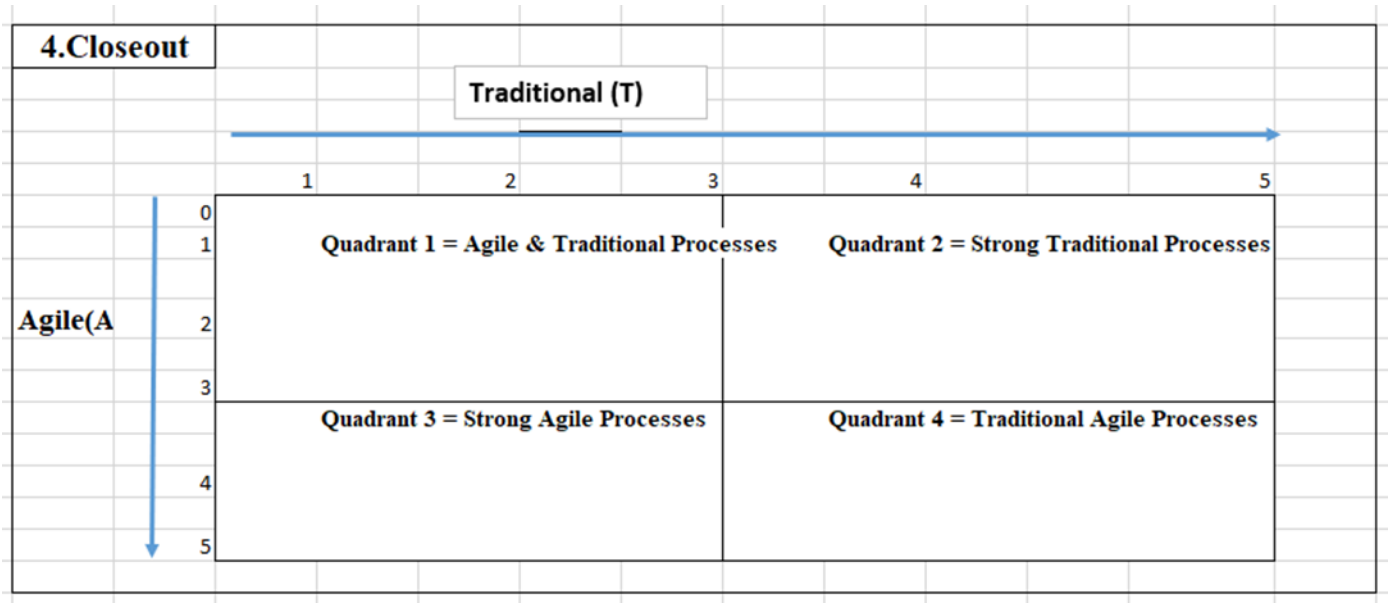


Figure 4 The proposed IT Project Methodology Decision Model (ITPMDM) closeout phase Cartesian plane

Recommended Methodology Processes Table

The Recommended Methodology Process table section highlights the generic phase of the project and its processes. The table below has a quadrant and a process column. The quadrant column represents the quadrant number and shows the project characteristic per quadrant. Each quadrant has a set of processes that are linked to the project characteristic which refer to a project management methodology framework.

Concept

Quadrant	**Process**	**Quadrant**	**Process**
Quadrant 1	**Balanced Agile and Traditional Processes**	**Quadrant 2**	**Strong Traditional Processes**
1.1 Project scope and purpose	1.1.1 High-level requirements gathering process *(refer to Agile Practice Guide (2017) Project Factors That Influence Tailoring section).* 1.1.2 High-level cost estimation process (*refer to Agile Practice Guide (2017) Project Factors That Influence Tailoring section).*	**2.1 Project scope and purpose**	2.1.1 Project initiation process (refer *to PMBOK sixth edition Part 2 Initiating Process Group section*). 2.1.2 Project planning process (refer *to PMBOK sixth edition Part 2 Planning Process Group section*).
1.2 Project Viability	1.2.1 High-level feasibility assessment process *(refer to Agile Practice Guide (2017) Project Characteristics Of Project Life Cycle section).* 1.2.2 High-level risk assessment process *(refer to Agile Practice Guide (2017)*	**2.2 Project Viability**	2.2.1 Technical viability analysis process (refer *to PMBOK sixth edition Part 2 Initiating Process Group section*). 2.2.2 Operational viability analysis process (refer *to PMBOK sixth edition Part 2 Initiating Process Group section*)

	Project Characteristics Of Project Life Cycle section).		2.2.3 Financial viability process (refer *to PMBOK sixth edition Part 2 Initiating Process Group section*). 2.2.4 Legal compliance process (refer *to PMBOK sixth edition Part 2 Initiating Process Group section*).
1.3 Pace of delivery	1.3.1 High-level iterative release planning process (*refer to Agile Practice Guide (2017) Project Characteristics Of Project Life Cycle section).*	**2.3 Pace of delivery**	2.3.1 Requirement gathering and analysis process *(refer to PMBOK sixth edition Part 2 Planning Process Group section*). 2.3.2 Formal documentation process (Refer *to PMBOK sixth edition Part 2 Planning Process Group section*). 2.3.3 Organizational approval and authorization process (refer *to PMBOK sixth edition Part 2 Initiating Process Group section*).
1.4 Stakeholder interest	1.4.1 Rigorous stakeholder identification process (*refer to PMBOK sixth edition Part 1 Project Stakeholder Management section*).	**2.4 Stakeholder interest**	2.4.1 Rigorous stakeholder identification process (*refer to PMBOK sixth edition Part 1 Project Stakeholder Management section*).
Quadrant	**Process**	**Quadrant**	**Process**
Quadrant 3	**Strong Agile Processes**	**Quadrant 4**	**Balanced Traditional Agile Processes**
3.1 Project scope and purpose	3.1.1 Project vision and conceptualization process (project statement) (*refer to Agile Practice Guide Life Cycle Selection section*).	**4.1 Project scope and purpose**	4.1.1 High-level project initiation process (*refer to PMBOK sixth edition Part 2 Initiating Process Group section*). 4.1.2 High-level project planning process (*refer to PMBOK sixth edition Part 2 Planning Process Group section*).

3.2 Project Viability	3.2.1 High-level cost estimation process (*refer to PMBOK sixth edition Part 2 Planning Process Group section*). 3.2.1 High-level risk assessment process (*refer to PMBOK sixth edition Part 2 Planning Process Group section*).	**4.2 Project Viability**	4.2.1 High-level technical viability analysis process (*refer to PMBOK sixth edition Part 2 Initiating Process Group section).* 4.2.2 High-level operational viability analysis process (*refer to PMBOK sixth edition Part 2 Initiating Process Group section).* 4.2.3 High-level financial viability process (*refer to PMBOK sixth edition Part 2 Initiating Process Group section).* 4.2.4 High-level legal compliance process (*refer to PMBOK sixth edition Part 2 Initiating Process Group section*).
3.3 Pace of delivery	3.3.1 High-level release planning process (*refer to Agile Practice Guide (2017) Project Characteristics Of Project Life Cycle section.* 3.3.2 Cross-functional team creation process (*refer to Agile Practice Guide (2017) Team Composition section*).	**4.3 Pace of delivery**	4.3.1 Formal release planning process. (*Refer to PMBOK sixth edition Part 1 Project Stakeholder Management section*) 4.3.2 Multiple cross-functional team creation process (*refer to PMBOK sixth edition Part 1 Project Resource Management section*).
3.4 Stakeholder interest	3.4.1 Continuous stakeholder engagement process (*refer to PMBOK sixth edition Part 1 Project Stakeholder Management section*).	**4.4 Stakeholder interest**	4.4.1 Continuous stakeholder engagement process (*refer to PMBOK sixth edition Part 1 Project Stakeholder Management section*).

Development

Quadrant	**Process**	**Quadrant**	**Process**
Quadrant 1	**Balanced Agile and Traditional Processes**	**Quadrant 2**	**Strong Traditional Processes**
1.1 Project delivery structure	1.1.1 Backlog and sprint planning process (*refer to Agile Practice Guide (2017) Implementing Agile: Delivering in An Agile Environment section*). 1.1.2 Release planning process (refer *to Agile Practice Guide (2017) Implementing Agile: Delivering in An Agile Environment section*). 1.1.3 Requirements review and verification process (*refer to PMBOK sixth edition Part 2 Planning Process Group section.* 1.1.4 Handover process (*refer to PMBOK sixth edition Part 2 Planning Process Group section).*	**2.1 Project delivery structure**	2.1.1 Detailed system development life cycle process (*refer to PMBOK sixth edition Part 2 Planning Process Group section*).
1.2 Project schedule management	1.2.1 Sprint planning process (*refer to Agile Practice Guide (2017) Implementing Agile: Delivering in An Agile Environment section*). 1.2.2 High-level deployment planning process (refer *to Agile Practice Guide (2017) Implementing Agile: Delivering in An Agile Environment section*).	**2.2 Project schedule management**	2.2.1 Detailed deployment planning process (*refer to PMBOK sixth edition Part 2 Planning Process Group section*).

1.3 Project change request	1.3.1 Incremental delivery process with high level change request process (*refer to Agile Practice Guide (2017) Implementing Agile: Delivering in An Agile Environment section*).	**2.3 Project change request**	2.3.1 Formal change control process (*refer to PMBOK sixth edition Part 2 Planning Process Group section*). 2.3.2 Organizational approval and authorization process (refer *to PMBOK sixth edition Part 2 Initiating Process Group section*).
1.4 Project cost estimation and budgeting	1.4.1 High-level budget estimation process *(refer to PMBOK sixth edition Part 1 Project Cost Management section*).	**2.4 Project cost estimation and budgeting**	2.4.1 Detailed budget estimation process *(refer to PMBOK sixth edition Part 1 Project Cost Management section*).
1.5 Project Documentation and Reporting	1.5.1 High-level documentation process (*refer to PMBOK sixth edition Part 2 Planning Process Group section.* 1.5.2 Retrospect and sprint review process (refer *to Agile Practice Guide (2017) Implementing Agile: Delivering in An Agile Environment section*).	**2.5 Project Documentation and Reporting**	2.5.1 Detailed documentation and progress reporting review process (*refer to PMBOK sixth edition Part 2 Planning Process Group section*).
Quadrant	**Process**	**Quadrant**	**Process**
Quadrant 3	**Strong Agile Processes**	**Quadrant 4**	**Balanced Traditional Agile Processes**
3.1 Project delivery structure	3.1.1 Backlog and sprint planning process (refer *to Agile Practice Guide (2017) Implementing Agile: Delivering in An Agile Environment section*). 3.1.2 Story point estimation process (refer *to Agile Practice Guide (2017) Implementing Agile: Delivering in An Agile Environment section*).	**4.1 Project delivery structure**	4.1.1 Detailed backlog and sprint planning process (*refer to Agile Practice Guide (2017) Implementing Agile: Delivering in An Agile Environment section*). 4.1.2 High-level system development life cycle process (*refer to PMBOK*

	3.1.2 Release planning process (*refer to Agile Practice Guide (2017) Implementing Agile: Delivering in An Agile Environment section*). 3.1.3 Definition of Done (DoD) process (*refer to Agile Practice Guide (2017) Implementing Agile: Delivering in An Agile Environment section*).		*sixth edition Part 2 Planning Process Group section*).
3.2 Project schedule management	3.2.1 Sprint planning process (*refer to Agile Practice Guide (2017) Implementing Agile: Delivering in An Agile Environment section*). 3.2.2 Sprint Goal Process (*refer to Agile Practice Guide (2017) Implementing Agile: Delivering in An Agile Environment section*). 3.2.3 Capacity planning process (*refer to Agile Practice Guide (2017) Implementing Agile: Delivering in An Agile Environment section*).	**4.2 Project schedule management**	4.2.1 Detailed deployment planning process (*Refer to PMBOK sixth edition Part 2 Executing Process Group section*). 4.2.2 Capacity planning process (*refer to PMBOK sixth edition Part 2 Planning Process Group section*).
3.3 Project change request	3.3.1 Incremental delivery process (*refer to Agile Practice Guide (2017) Implementing Agile: Delivering in An Agile Environment section*).	**4.3 Project change request**	4.3.1 Formal release planning process (*Refer to Agile Practice Guide (2017) Implementing Agile: Delivering in An Agile Environment section*). 4.3.2 Incremental Delivery process with formal change request process. (*Refer to Agile Practice Guide (2017) Implementing Agile: Delivering in An Agile Environment section*).

3.4 Project cost estimation and budgeting	3.4.1 High-level cost estimation and budgeting process *(refer to PMBOK sixth edition Part 1 Project Cost Management section*).	**4.4 Project cost estimation and budgeting**	4.4.1 Detailed budget estimation process (*refer to PMBOK sixth edition Part 1 Project Cost Management section).*
3.5 Project Documentation and Reporting	3.5.1 High-level documentation process (*refer to PMBOK sixth edition Part 2 Planning Process Group section.* 3.5.2 Retrospect and sprint review process (*refer to Agile Practice Guide (2017) Implementing Agile: Delivering in An Agile Environment section*).	**4.5 Project Documentation and Reporting**	4.5.1 Detailed documentation and progress reporting process (*refer to PMBOK sixth edition Part 2 Executing Process Group section*). 4.5.2 High-level retrospect and sprint review process (*refer to Agile Practice Guide (2017) Implementing Agile: Delivering in An Agile Environment section*).

Implementation

Quadrant	**Process**	**Quadrant**	**Process**
Quadrant 1	**Balanced Agile and Traditional Processes**	**Quadrant 2**	**Strong Traditional Processes**
1.1 Project implementation and evaluation	1.1.1 Sprint or iteration process (*refer to Agile Practice Guide (2017) Implementing Agile: Delivering in An Agile Environment section*). 1.1.2 User acceptance testing and quality assurance process (*refer to PMBOK sixth edition Part 2 Monitoring and Controlling Process Group section*). 1.1.3 High-level requirements review and verification process (*refer to PMBOK sixth edition Part 2 Monitoring and Controlling Process Group section*).	**2.1 Project implementation and evaluation**	2.1.1 System Development Process (Traditional) (*refer to PMBOK sixth edition Part 2 Executing Process Group section*). 2.1.2 Testing and quality assurance process (*refer to PMBOK sixth edition Part 2 Executing Process Group section*).
1.2 Project ad hoc changes	1.2.1 Backlog and sprint planning process (*refer to Agile Practice Guide (2017) Implementing Agile: Delivering in An Agile Environment section*). 1.2.2 Release planning process (*refer to Agile Practice Guide (2017) Implementing Agile: Delivering in An Agile Environment section*).	**2.2 Project ad hoc changes**	2.2.1 Change management process (*refer to PMBOK sixth edition Part 2 Monitoring and Controlling Process Group section*). 2.2.2 Change control process (*refer to PMBOK sixth edition Part 2 Monitoring and Controlling Process Group section*).
1.3 Project communication	1.3.1 Stakeholder collaboration engagement process (*refer to PMBOK sixth edition Part 1 Stakeholder Management section*).	**2.3 Project communication**	2.3.1 Formal stakeholder engagement process (*refer to PMBOK sixth edition Part 1 Stakeholder Management section*).

			2.3.2 Progress reporting process (*refer to PMBOK sixth edition Part 2 Monitoring and Controlling Process Group section*).
1.4 Project deliverable package	1.4.1 High-level user training and document review process (*refer to PMBOK sixth edition Part 2 Monitoring and Controlling Process Group section*). 1.4.2 Deliverable review and verification process (*refer to PMBOK sixth edition Part 2 Monitoring and Controlling Process Group section*).	**2.4 Project deliverable package**	2.4.1 User training and document review process (*refer to PMBOK sixth edition Part 2 Monitoring and Controlling Process Group section*). 2.4.2 Handover and maintenance process (*refer to PMBOK sixth edition Part 2 Monitoring and Controlling Process Group section*).
Quadrant	**Process**	**Quadrant**	**Process**
Quadrant 3	**Strong Agile Processes**	**Quadrant 4**	**Balanced Traditional Agile Processes**
3.1 Project implementation and evaluation	3.1.1 Sprint or iteration process (*refer to Agile Practice Guide (2017) Implementing Agile: Delivering in An Agile Environment section*). 3.1.2 User story development process (refer *to Agile Practice Guide (2017) Implementing Agile: Delivering in An Agile Environment section*). 3.1.3 Daily stand-up process (*refer to Agile Practice Guide (2017) Implementing Agile: Delivering in An Agile Environment section*).	**4.2 Project implementation and evaluation**	4.2.1 System development process (*refer to PMBOK sixth edition Part 2 Monitoring and Controlling Process Group section*). 4.2.2 Sprint or iteration process (*refer to Agile Practice Guide (2017) Implementing Agile: Delivering in An Agile Environment section*). 4.2.3 Requirements review and verification process (*refer to PMBOK sixth edition Part 2 Monitoring and Controlling Process Group section*).

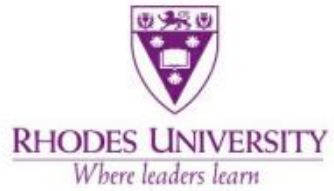
3.2 Project ad hoc changes	3.2.1 Incremental delivery process (*refer to Agile Practice Guide (2017) Implementing Agile: Delivering in An Agile Environment section*). 3.2.2 Continuous integration process (*refer to Agile Practice Guide (2017) Implementing Agile: Delivering in An Agile Environment section*).	**4.3 Project ad hoc changes**	4.3.1 Change control process (*refer to PMBOK sixth edition Part 2 Monitoring and Controlling Process Group section*).
3.3 Project communication	3.3.1 Stakeholder collaboration engagement process (*refer to PMBOK sixth edition Part 1 Project Stakeholder Management section*).	**4.4 Project communication**	4.4.1 Stakeholder engagement process (*refer to PMBOK sixth edition Part 1 Project Stakeholder Management section*). 4.4.2 Progress reporting process *(refer to PMBOK sixth edition Part 2 Monitoring and Controlling Process Group section*).
4.4 Project deliverable package	4.4.1 Release and deployment process (*refer to PMBOK sixth edition Part 2 Monitoring and Controlling Process Group section*). 4.4.2 Continuous deployment process (*refer to Agile Practice Guide (2017) Implementing Agile: Delivering in An Agile Environment section*).	**4.5 Project deliverable package**	4.5.1 Release and deployment process (*refer to PMBOK sixth edition Part 2 Monitoring and Controlling Process Group section*). 4.5.2 Handover and maintenance process (*refer to PMBOK sixth edition Part 2 Monitoring and Controlling Process Group section*).

Closeout

Quadrant	**Process**	**Quadrant**	**Process**
Quadrant 1	**Balanced Agile and Traditional Processes**	**Quadrant 2**	**Strong Traditional Processes**
1.1 Project completion	1.1.1 Sprint goal and retrospect process (*refer to Agile Practice Guide (2017) Implementing Agile: Delivering in An Agile Environment section*). 1.1.2 Formal acceptance process (*refer to PMBOK sixth edition Part 2 Closing Process Group section*). 1.1.3 Customer acceptance process (*refer to PMBOK sixth edition Part 2 Closing Process Group section*).	**2.1 Project completion**	2.1.1 Final product validation process (*refer to PMBOK sixth edition Part 2 Closing Process Group section*). 2.1.2 Formal acceptance process (*refer to PMBOK sixth edition Part 2 Closing Process Group section*). 2.1.3 Project closure report and documentation process (*refer to PMBOK sixth edition Part 2 Closing Process Group section*). 2.2.4 Lessons learned process (*refer to Agile Practice Guide (2017) Implementing Agile: Delivering in An Agile Environment section*).
Quadrant	**Process**	**Quadrant**	**Process**
Quadrant 3	**Strong Agile Processes**	**Quadrant 4**	**Balanced Traditional Agile Processes**
3.1 Project completion	3.1.1 Sprint goal and retrospect process (*refer to Agile Practice Guide (2017) Implementing Agile: Delivering in An Agile Environment section*).	**4.2 Project completion**	4.2.1 Formal acceptance process (*refer to PMBOK sixth edition Part 2 Closing Process Group section*).

	3.1.2 Documentation and knowledge transfer process (*refer to PMBOK sixth edition Part 2 Closing Process Group section*). 3.1.3 Celebration and recognition process (*refer to PMBOK sixth edition Part 2 Closing Process Group section*). 3.1.4 Customer acceptance process (*refer to PMBOK sixth edition Part 2 Closing Process Group section*).		4.2.2 Lessons learned process (*refer to Agile Practice Guide (2017) Implementing Agile: Delivering in An Agile Environment section*). 4.2.3 Documentation and knowledge transfer process (*refer to PMBOK sixth edition Part 2 Closing Process Group section*).

APPENDIX C Ethical Clearance Approval



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NHREC Registration number: RC-241114-045
https://www.ru.ac.za/researchgateway/ethics/

1 July 2024

Mr Motlalepula James

Email: g08J3886@campus.ru.ac.za

Review Reference: 2024-7640-8702

Dear Mr Motlalepula James

Re: Towards a Decision Model for selecting the appropriate approach to projects in the South African IT Sector.

Researcher: Mr Motlalepula James

Supervisor(s): Mr Chris Upfold,

This letter confirms that the above research proposal has been reviewed by the Rhodes University Human Research Ethics Committee (RU-HREC) and **PROVISIONALLY APPROVED PENDING PERMISSION/GATEKEEPER LETTER(S).**

Gatekeeper permission is required from:

Mr. Jurie Schoeman – CEO at Business Systems Group

Mrs. Marion Baxter – Director at Shopright Checkers

Ms. Cathy Sims - Executive Director at SAGEA

Mr. Denzil Morrison – CTO at Open Box Software

Mr. Mark Fairweather - Managing Director at MRI Software

Mr. Nick Kruiskamp – CEO at Singular Systems

Mr. Mvuyisi Scheepers - (Manager of SAP Technical) at Epiuse

Mr. Rodney De Koch - Principal Partner at 1819 Tladi Consulting Group

Once the Gatekeeper permission letter/s has been received please forward it to the Ethics Coordinator, in order to finalize your ethics approval.

If your study also involves participants who do not need gatekeeper permission because they are participating in their individual capacity, and you would like to commence data collection with these participants, you may apply to the committee for Partial Approval to do so. Email your request to ethics-committee@ru.ac.za.

Sincerely,

Janet Hayward

Dr Janet Hayward

Chair: Rhodes University Human Research Ethics Committee, RU-HREC

cc: Ethics Coordinator

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Rhodes University Human Research Ethics Committee
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https://www.ru.ac.za/researchgateway/ethics
NHREC Registration number:RC-241114-045

5 March 2025

Mr Motlalepula James, ,

Email: g08J3886@campus.ru.ac.za

Review Reference: 2024-7640-8702

Dear Mr Motlalepula James

Re: Towards a Decision Model for selecting the appropriate approach to projects in the South African IT Sector.

Researcher: Mr Motlalepula James

Supervisor(s): Mr Chris Upfold

This letter confirms that the above research proposal has been reviewed and **APPROVED** by the Rhodes University Human Research Ethics Committee (RU-HREC). Your Approval number is: 2024-7640-8702

Approval has been granted for 1 year. An annual progress report will be required in order to renew approval for an additional period. You will receive an email notifying you when the annual report is due.

Please apply for a protocol amendment should any substantive change(s) be made, for whatever reason, during the research process. This includes changes in investigators. Email your request to ethics-committee@ru.ac.za.

Please submit a brief report to the ethics committee on the completion of the research. The purpose of this report is to indicate whether the research was conducted successfully, if any aspects could not be completed, or if any problems arose that the ethical standards committee should be aware of.

If a thesis or dissertation arising from this research is submitted to the library's electronic theses and dissertations (ETD) repository, please notify the committee of the date of submission and/or any reference or cataloguing number allocated.

Sincerely,

Janet Hayward

Dr Janet Hayward

Chair: Rhodes University Human Research Ethics Committee (RU-HREC)

APPENDIX D Gatekeeper Invitation Letter

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¶

10 July 2024¶

¶

Dear Sir/Madam,¶

¶

RE: Permission to Conduct Research ¶

¶

My name is Motla James and I am a Masters (MCom) student under the supervision of Mr Chris Upfold in the Information Systems department at Rhodes University. The research I am conducting is titled: *"Towards a Decision Model for selecting the appropriate approach to projects in the South African IT Sector"*¶

I have constructed a decision model for selecting the most appropriate project management methodology given the characteristics of a given project. In order to capture professional feedback on my decision model, I respectfully request permission to conduct virtual semi-structured interviews with some of the IT project personnel in your organisation who are knowledgeable about IT Project Management. This feedback would be invaluable for validation purposes and for improving my decision model.¶

As a requirement of the Rhodes University ethics application system, I am required to receive gatekeeper permission from the leadership of organisations prior to requesting any participation from their staff.¶

Please note that all answers and results from the research will be kept strictly confidential and will be reported in a research paper available to all participants on completion. Upon your gatekeeper approval, I will send a consent form to the prospective participants in your organisation, explaining their right to anonymity and to withdraw their participation for the research study at any time during the process.¶

If you require any further information, please do not hesitate to contact myself at g08J3886@campus.ru.ac.za or my supervisor in the IS Department, Chris Upfold at c.upfold@ru.ac.za¶

Thank you for your time. I would highly appreciate a favourable response.¶
Yours faithfully,¶

¶

Motla James¶

APPENDIX E Research Participation Invitation Letter

Participant Invitation Letter

Project Title: ***Towards a Decision Model for selecting the appropriate approach to projects in the South African IT Sector.***

Dear Sir/Madam/Other

My name is Motlalepula James, and I am a Masters student in Information Systems at Rhodes University. My supervisor is Mr Chris Upfold, c.upfold@ru.ac.za.

I have received ethical clearance [2024-7640-8702] to conduct a study evaluating a Project Management Decision Model that I have constructed via a literature review process.

Your participation

Should you agree to participate in this study, I will send you a copy of my Project Management Decision Model so that you can familiarize yourself with the model prior to a virtual meeting. The purpose of the virtual meeting will be to discuss the model and to hopefully elicit feedback from you regarding your perception of the usefulness of the model for guiding the methodological approach to a new IT project. Your participation is voluntary and all responses will be kept strictly confidential and anonymous. Should you agree to participate in this study, you may withdraw from the research process at any stage.

Benefits

While there will be no direct benefit (remuneration) or personal costs to participants other than your time, it is hoped that your feedback will guide the refinement process of the decision model such that the model may ultimately guide and support the project methodology selection process in support of the IT industry.

Please could you respond to the following email address indicating your willingness to participate in this study. G08J3886@campus.ru.ac.za. Your participation would be greatly appreciated

A separate consent form will be provided to you, should you agree to participate in my research.

If you require further information, please contact Motlalepula James, my supervisor Mr Chris Upfold, or the Rhodes Human Ethics Committee (details below).

Researcher:

Motlalepula James

G08J3886@Campus.ru.ac.za

Supervisor:

Chris Upfold

c.upfold@ru.ac.za

APPENDIX F Informed Consent Form

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PARTICIPANT INFORMED CONSENT DECLARATION

(To be signed by research participant/s)

Project Title: ***Towards a Decision Model for selecting the appropriate approach to projects in the South African IT Sector.***

Motlalepula James from the Department of Information Systems, Rhodes University has requested my permission to participate in the above-mentioned research project.

The nature and the purpose of the research project and of this informed consent declaration have been explained to me in a language that I understand.

I am aware that:

1. The purpose of the research project is to generate a Decision Model that guides IT Project Managers in selecting the appropriate PM methodology for implementing IT projects in South Africa.
2. Rhodes University has given ethical clearance to this research 2024-7640-8702 and I have seen/may request to see the clearance certificate by contacting the Ethics Coordinator (ethics-committee@ru.ac.za).
3. By participating in this research project, I will be contributing towards the enrichment of the Project Management domain, and assisting consulting IT project management organisations to guide Project Managers to better understanding of the PM methodologies in implementing IT projects. It will give an opportunity to add value towards the goal of having a more precise Project Management decision tools and help academic institutions for curriculum development purposes.

4. I will participate in the project by Completing a set of questions embedded in the decision model. My involvement in the research project will include:
    a. Reviewing and answering question embedded in the decision model so as to determine the utility of the model for determining the appropriate methodology for given the characteristics of an IT project.
    b. Participating in a virtual meeting with the researcher so that I can provide feedback on that I can provide feedback on the decision model and its intended use.
5. My participation is entirely voluntary and should I at any stage wish to withdraw from participating further, I may do so without any negative consequences.
6. I will not be compensated for participating in the research, but my out-of-pocket expenses will be reimbursed.
7. The following risks are associated with my participation: Not having fully understood the research questions will result in taking longer to complete the session.
8. The Researcher intends to publish the research results in the form of Research journal. However, confidentiality and anonymity of records will be maintained, and my name and identity will not be revealed to anyone who has not been involved in the conducting of the research, ***unless I indicate to the contrary/recognize that as a public figure my identity will inevitably be/become known, in which case I agree to accept the loss of anonymity.***
9. In terms of the Protection of Personal Information Act (No. 4 of 2013) it remains my right to request the Researcher to provide me with a detailed explanation of exactly how confidentiality and anonymity of the data I provide will be achieved. I may also request to know exactly how my personal information will be stored securely, for how long it will be stored.
10. Data collected from me for this research project will not be used for any further study. If any data collected from me for this research project is to be used by the Researcher for any further study, I am to be informed in writing and my written consent requested again. I need not give consent for the new research if it is incompatible with the initial purpose of the present study (POPIA, s15(3)). Equally, I can simply reject the request. In such cases, a formal request needs to be made to me by the researcher via the Ethics Coordinator (ethics-committee@ru.ac.za).

11. In terms of the POPI Act, I possess the right to receive feedback about this research. This will take the form of email unless ***I elect not to receive this feedback.***
12. Any further questions that I might have regarding the nature of the research and/or my participation in it will be answered by Motlalepula James g08j3886@campus.ru.ac.za
13. By signing this informed consent declaration, I am not waiving any legal claims, rights, or remedies. A copy of this informed consent declaration will be given to me, and the original will be kept on record by the Researcher.
14. I ***agree*** to the Researcher's use of voice recording of my comments and opinions during interviews, the purpose of which is to ensure the accurate recording of my views/responses. Furthermore, I have the right to request a copy of the interview transcriptions to confirm that my opinions are accurately recorded

I, ……., have read the above information / confirm that the above information has been explained to me in a language that I understand and I am aware of this document's contents. I have asked all questions that I wished to ask, and these have been answered to my satisfaction. I fully understand what is expected of me during the research.

I have not been pressurised in any way and I voluntarily agree to participate in the above-mentioned project.

……. …… …….

Participants signature Witness Date