IT INFRASTRUCTURE PROJECT MANAGEMENT METHODOLOGY SELECTION ON A SPECTRUM BETWEEN PREDICTIVE AND ITERATIVE

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Abstract

This qualitative research consisted of an exploratory approach and a qualitative inquiry method to investigate how organizations select project management methodologies that may integrate aspects of iterative methods into traditional, predictive project environments in the IT infrastructure field. The selection of the correct project management methodology for a project might be the single most critical decision the organization and project manager will make for their projects. This research seeks to understand how project managers make this methodology selection for IT infrastructure projects and address a gap in the available literature on this subject. This research aimed to identify applications of project management practice on a spectrum of methodologies between predictive and iterative to provide project managers with information to select appropriate methods that will contribute to project success in future IT infrastructure projects. A group of 12 project managers with experience managing IT infrastructure projects for large (greater than 1,000 employees) organizations in the United States was interviewed and asked about their experiences with various methodologies for these projects. In each case, the methodology chosen was less of a step-by-step how-to requirement but rather a framework in which projects are free to operate. The boundaries within this framework are the domain of the project manager. Through a thematic analysis of project manager interviews, this research confirmed that IT infrastructure project managers are making these methodology integration decisions for their projects. It documented three key recurring themes that can be applied to future projects considering this type of integration. While many factors influence the decision of methodologies used on projects, three primary recurring themes were reported by the project managers surveyed. First, the participants' consensus was that awareness

and training in agile methods were necessary. Second, effective and appropriate communication was also critical. Third, the ability to adapt methodologies even within individual projects is ideal. The ultimate responsibility for the successful implementation of any methodology and the successful delivery of any project falls to the project manager.

Dedication

This doctoral dissertation is dedicated to my first teacher, Christopher "Mr. Chris" Miller. He taught me to read by the age of four… and many, many more wonderful things in the four decades since. I am forever your student.

And, to my children, Bron, Emma, and Ivy. You are my greatest creations and you inspire me daily. The world can expect amazing things from you. Tag… you're IT.

And to my wife, Shannon. My light in dark places. My partner in this, and everything else in life that I have ever done that was worth doing. This one is for us. - J.

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CHAPTER 1. INTRODUCTION

Introduction

The Project Management Institute ([PMI], 2017, p. 4) defines a project as a "temporary endeavor undertaken to create a unique product, service, or result" Described further, the term temporary indicates that there is a finite end to a project at a point where the project is either complete or otherwise terminated. In modern business enterprises, and especially in information technology (IT), projects and the practice of project management to facilitate the delivery of IT capabilities have become core competencies (Morris, 2011). While the inherent assumption in project management methodologies is that a project is expected to be managed in such a way that the stated goals are achieved, many factors could drive an organization to decide to terminate a project before it achieves its goals (Khan, 2018).

Stated another way, a project can define its ability to achieve the intended result or service as the measurement of success. However, in approximately 20 years since the turn of the millennium, as many as 70% of IT projects have failed (Khan, 2018). Another core component of a project, per the PMI (2017), is the investment of resources toward achieving the goals set out for the project, with the understanding that projects that do not meet their goals are often considered a waste of invested resources. Due to the lost investment of time and financial resources, even one failed project can ruin individual careers or destroy entire companies (Ahonen & Savolainen, 2010; Serrador, 2015). To counter this issue, organizations have taken and continue to take steps toward improving their processes to increase project success (Al-Dubai & Alaghbari, 2018). One of the decisions that project managers face is how to manage

their projects and what methodology they will choose to follow. Tiwana and Keil (2004) posited that the selection of the correct project management methodology for a project might even be the single most critical decision the organization and project manager will make. PMI echoes this methodology selection decision in their preview of the forthcoming seventh edition of their *Guide to the Project Management Body of Knowledge*, that is due out this August (PMI, 2021).

In this chapter, the general background of the project management environment will be established. The current business problem facing leaders and project managers is discussed and defined, and a research purpose and question are identified. A rationale for the research and a conceptual framework in which to study the project management environment follows, and the chapter concludes with definitions of terms and assumptions and limitations of the research.

Background

Project management as a practice in the delivery of IT efforts dates back to the end of World War II (Hussein & Seymour, 2014; Morris, 2011). Early project management methodologies displayed a linear, phased approach that came to be known as a waterfall model (Benington, 1987; Boehm, 1987, Hosier, 1987; Royce, 1987), so named based on its model of cascading phases or stages of a project, the conclusion of each leading to the next. Each project would go through a structured process, including a requirements phase followed by analysis, program design, coding, testing, and finally, operation. Like water running down a series of cliffs, each phase or activity leads to a waterfall into the next, until the end of the relevant cycles (Royce, 1987).

While this waterfall model was accepted practice in project management for decades, more recent developments in project management have shifted to more of a non-linear, iterative,

or *agile* methodology in an attempt to increase project success and decrease project time and resource investments (Baseer et al., 2015; Kisielnicki & Misiak, 2017; Saunders, 2018). This method relies upon a more autonomous and less structured approach, allowing opportunities for frequent feedback and adjustment in the process (Hummel, 2014).

Through the 1990s and early 2000s, the IT industry was the primary driver of project management as a discipline, and methodologies continued to evolve to keep up with the ever-growing needs of newer technologies (Hussein & Seymour, 2014). The traditional method of managing projects seemed unable to match the increasing demands of current businesses, mainly in the area of software development. This need to maintain pace with an industry that was rapidly changing and developing became known by a single word – agile. While no unique documented definition of agile exists as related to project management methodology, the most commonly recognized set of guiding principles for agile project management is *The Agile Manifesto*, published in 2001 by a group of project management practitioners who later dubbed themselves The Agile Alliance (Beck et al., 2001; Hummel, 2014).

By 2001, there were many agile methodologies in use in the IT industry, such as Iterative, Scrum, and Extreme Programming ([XP], Baseer et al., 2015). The Agile Alliance, whose members were relative subject matter experts across many of these agile methodologies, sought to find common ground and a set of guidelines that could establish a clear basis for agility in project management. What they developed were their 12 Principles of Agile Software, which would become *The Agile Manifesto* (Beck et al., 2001).

Many researchers have seen agile as an alternative methodology to the traditional waterfall method (Baseer et al., 2015; Dingsøyr & Dybå, 2008; Ghilic-Micu et al., 2016;

Kisielnicki & Misiak 2017; Saunders, 2018) with these researchers studying a choice of either agile *or* waterfall. However, while stated and emphasized differently between the methodologies, many of the concepts promoted by *The Agile Manifesto* can find parallels in traditional waterfall methods, as presented by the de facto industry standard for the traditional waterfall model, PMI's Guide to the Project Management Body of Knowledge, also known as The PMBOK Guide (Beck et al., 2001; PMI, 2017). This position would seem to indicate that these methodologies could complement, rather than contradict one another.

Recent literature has begun to highlight the idea of a spectrum of methodologies based on a perceived level of agility (Baird & Riggins, 2012; Cooper & Sommer, 2016; Kisielnicki & Misiak, 2017; Kulak & Li, 2017; PMI, 2017; Turk et al., 2014). On this hypothetical spectrum, the purely predictive, or waterfall, approach would be at the 0% agility end, where a strictly iterative, or agile, project would be at the 100% end. While agility is not quantifiably measurable in this theory, project management experts could subjectively assess the perceived agility of their methodologies through discussion of their professional experiences. Understanding this spectrum as a range of choices rather than an either predictive or iterative decision will assist project managers in selecting appropriate methodologies for their projects.

Business Technical Problem

Many project managers in IT infrastructure organizations struggle with the selection of appropriate project management methodologies from a spectrum between predictive and iterative methods for delivering their projects. Selecting an inappropriate methodology can often result in increased project failure in the forms of inefficient use of resources, lost opportunities, and even

failure of the underlying organization itself (Ahonen & Savolainen, 2010; Al-Dubai & Alaghbari, 2018; Davis, 2014).

Given the evidence of the evolution of methodologies in the historical record of project management methodologies (Boehm, 1987; Hummel, 2014; Hussein & Seymour, 2014; Morris, 2011), the practice of project management exists in a state of constant improvement. Project managers continue to search for new methods to better address the needs of organizations by improving the successful delivery of projects. This state of continuous methodology development and progression was born out of necessity to improve efficiency in projects from ancient to modern, and multiple studies conducted since the 1950s, considered to be the modern era of project management (Beck et al., 2001; Hussein & Seymour, 2014; Morris, 2011), document the journey to improve project management methodology.

A primary point of debate in several studies was whether the traditional waterfall approach *or* the iterative agile method produces a higher frequency of project success—with an emphasis placed on the word *or*. Several studies have centered primarily on a binary selection of waterfall or agile as a path toward increased project success (Baseer et al., 2015; Ghilic-Micu et al., 2016; Kisielnicki & Misiak, 2017; Litchmore, 2016; Mayfield, 2010; Pedersen, 2013; Saunders, 2018). While these studies have shown that project managers can yield benefits that are more significant by selecting and transitioning to agile methodologies over waterfall approaches, the waterfall methodology is still widely used, specifically in the IT infrastructure world. In many cases, it is still preferred when an agile method does not suit the purpose, such as in larger and more complex projects (Balaji & Murugaiyan, 2012; Dingsøyr & Dybå, 2008; Schwaber & Sutherland, 2012).

Several studies also reported the conclusion that organizations prefer agile to waterfall, particularly in the software development field, but findings from other studies identified that agile does not work in all project situations (Balaji & Murugaiyan, 2012; Dingsøyr & Dybå, 2008; Hakim, 2019; Schwaber & Sutherland, 2012). In contradiction to the studies suggesting a binary project methodology selection, studies by Baird and Riggins (2012) and Turk et al. (2014) described a spectrum of methodologies from predictive to iterative with most methodologies falling somewhere in between. Additionally, Dingsøyr and Dybå (2008) also stated that integrating agile into waterfall projects is possible, and Hakim (2019) provided recent evidence in the medical field of this integration of methods. However, there is insufficient research into how IT infrastructure project managers are selecting methodologies or under what conditions individual components of agility are being integrated with traditional models to improve project success in the enterprise IT infrastructure field. The criticality of the method selected as an input to project success (PMI, 2021; Tiwana & Keil, 2004) and the reported consistently high failure rate for IT projects (Khan, 2018; Wojewoda & Hastie, 2015) indicate that further study will assist project managers in this selection and that improved methodology selection could lead to more successful projects.

Research Purpose

Agile methodologies have a general aim to simplify the design and implementation of systems and increase organizational benefits by delivering value early and often (Beck et al., 2001). The general approach is to deliver functioning pieces of the system at intervals throughout the project, rather than only the entire project when it is complete. This approach of delivering early and often increases the value to the organization because there is an opportunity to begin

consuming the system even while portions of it are still in development (Bird, 2010; Hummel, 2014; Mayfield, 2010). However, as Dingsøyr and Dybå (2008) wrote, implementing this approach can be challenging in more complex projects, and the agile approach does not always make logical sense in these cases.

In situations in which systems are not easily segmented into smaller deliverables or where the project effort or project team is larger and more diverse, a more traditional, or waterfall, project approach remains more applicable (Tomanek et al., 2014). A traditional waterfall methodology is often more practical than an agile model in large IT infrastructure efforts due to the size and complexity of the system and the inability to deliver significant value without providing at least a substantial portion of the system. Many complex IT infrastructure systems cannot provide significant value to an organization until they are entirely or at least significantly complete, putting them at direct odds with the deliver early and often agile methodology (Dingsøyr & Dybå, 2008). These projects can be relatively long in duration (several months to several years) and can consist of large interdependent teams and work streams. These cases require significant planning and coordination due to the need to coordinate substantial amounts of work across these various teams. This situation is an example where the waterfall approach may be more applicable than an agile method.

Several studies investigated the possibility of integrating agile methodologies into an otherwise waterfall environment. Tomanek et al. (2014) investigated the case of integrating agile into web development projects. They found that there were indeed benefits to integrating agile models into a traditional methodology. Still, there were limitations and characteristics of the project or the team that made this integration of little value or even a detriment to the project.

Hakim (2019) found similar results in the health care industry. In this study, which was in a medical (non-IT) environment, Hakim found that at various times and in various conditions, the healthcare industry operated in situations where agile methodologies could apply and be beneficial. Still, there were also situations where the opposite was true. Hakim argued that there was a *place* for agile in healthcare, but only in those situations where the conditions supported obtaining benefits from doing so (Hakim, 2019).

The research contained in this study investigated and identified how current IT infrastructure project managers select methodologies from a range between predictive and iterative models and in what circumstances they may be able to integrate iterative and predictive methods to promote project success in future projects. In situations where iterative methods currently integrate with predictive models, this research attempted to determine the conditions in which these organizations find value in doing so in the form of increased project success. Given the identified lack of depth in research into this hybrid model of project management methodology, specifically within enterprise IT infrastructure organizations, the research in this study will be of use to the IT industry to identify potential sources of efficiency that could apply to future projects.

This research used a generic qualitative inquiry approach to interview a sample of experienced project managers with current or prior experience with IT infrastructure projects using agile or waterfall methodologies. The purpose was to determine what strategies project managers are using in selecting methodologies and assess how they may be integrating principles from a spectrum of methods into IT infrastructure projects. Where this integration is occurring, the project managers were asked to evaluate whether the integrated agile principles had an

impact on the success of their projects. The objective was to obtain and present the collected opinions of several experienced project management practitioners to determine how they select methodologies for their projects.

Research Question

The research question (RQ) was "In enterprise IT infrastructure environments, how do IT infrastructure project managers select project management methodologies from a range of options between predictive and iterative to improve the successful delivery of projects?"

Rationale

PMI (2017, p. 52) defined the role of the project manager as "the person assigned by the performing organization to lead the team that is responsible for achieving project objectives". Thus, the project manager is empowered to achieve the anticipated value outcomes for the project. Recognizing the high rate of projects deemed failures due to not achieving their desired results (Khan, 2018), and the impact such project failures can have on organizations and individual careers (Ahonen & Savolainen, 2010; Serrador, 2015), project managers are motivated to make choices to influence the achievement of project goals. This study aimed to add to the available body of knowledge for project managers to assist them in making these project management methodology choices on future projects.

Specifically, many prior studies have focused on the choice of project management methodology as a binary decision between waterfall or agile (Baseer et al., 2015; Ghilic-Micu et al., 2016; Kisielnicki & Misiak, 2017; Pedersen, 2013; Saunders, 2018). The rationale for this proposed study was to investigate whether IT infrastructure project managers can integrate components of agile and waterfall when selecting methodologies for the delivery of their

projects. Through this exploration, this study aimed to provide additional knowledge for future project management methodology choices that face IT infrastructure project managers.

Conceptual Framework

According to Morris (2011), the application of project management methods to deliver IT solutions has become a core competency for IT organizations. The practice of project management from the origins of the waterfall (Royce, 1987) and agile (Beck et al., 2001) methods, as illustrated by researchers such as Baseer et al. (2015), shows a clear evolutionary progression in methodologies. This progression demonstrates that the project management discipline exists in a state of continuous improvement through the ongoing evolution of methodologies. This evolution underscores a portion of the conceptual framework for this study that there is no defined right or wrong way to manage IT infrastructure projects.

The iterative methods known commonly as agile arose directly as proposed improvements to their traditional, or waterfall, predecessors, when the traditional approach appeared unable to meet current project needs (Bjarnason et al., 2011; Tomanek et al., 2014). However, iterative and agile methods have not been able to supplant the traditional methods completely, which are still more applicable in many project situations (Balaji & Murugaiyan, 2012; Bentley, 2020; Schwaber & Sutherland, 2012). Thus, two competing methodologies were identified as relevant to IT projects. Additionally, the implied decision is that project managers must make a methodology selection between two tightly coupled systems. This decision sets the stage for an "either waterfall or agile method" decision, and this decision has received significant study in available literature. Tiwana and Keil (2014) described this situation by stating that much of the available literature assumes that one methodology is inherently superior to another. PMI

has further acknowledged that a decision point exists between methodologies as a key framework for their upcoming seventh edition of the PMBOK Guide due to publish in August 2021 (PMI, 2021).

Recognizing the evolution of methods and the decision point they must make, project managers and researchers have continued to develop and identify methodologies that balance the benefits of the predictive and iterative approaches with minimizing the deficiencies of each. Baird and Riggins (2012) and Turk et al. (2014) referred to this balancing attempt as a *spectrum* of methodologies ranging from purely predictive to purely iterative from which project managers could select a method that best suits their project. This position was also supported by Tiwana and Keil (2004), who described this selection of methodology as potentially the most critical decision a project manager makes. In their *Agile Practice Guide*, PMI (2017, p. 19) graphically illustrates this spectrum as a continuum between predictive and agile. This would seem to imply that project management methodology is a loosely coupled system enabling the picking and choosing of pieces of methods from both ends of the spectrum, and not a tightly coupled choice of either-or.

This dissertation used a qualitative inquiry method of study to interview and obtain a consensus of experience from project managers regarding their selection of project methodologies (Josselson, 2013). The goal was to gather collective experiences and opinions from recognized project management practitioners through guided, interactive interviews. In contrast to a quantitative methodology, the present study did not seek to statistically or mathematically measure or compare responses from individuals or populations, but rather to understand the experiences of the study participants to inform others of current practices in

project management and establish a basis for further research (Josselson, 2013; Jupp, 2006; Markham, 2018). Through these experiences, the framework of a loosely coupled, continuous evolution of project management methodologies for IT infrastructure projects was explored.

Significance

This research study is significant to members of the IT project management practitioner community who have a personal and organizational commitment to delivering successful projects. By the nature of the industry, these project managers must continually evolve their methods to keep up with the evolution of the technologies implemented and the ever-increasing speed with which new technologies are introduced. PMI (2017) discussed this need for continuous improvement when presenting project quality concepts with the goal being to strive for progress and success in projects continually.

The role of the project manager is to facilitate the successful delivery of projects (PMI, 2017). Therefore, the choice of approach, or methodology, with which a project manager endeavors toward project success, is a crucial, strategic decision. This study adds to the existing body of knowledge in IT project management practice to assist project managers in making these strategic methodology decisions.

Definition of Terms

Agile project management methodology. No clear industry definition of agile exists (Hummel, 2014), but agile typically refers to project management methodologies that favor a minimal planning, iterative approach that relies on autonomy, close cooperation and expertise among project team members (Beck et al., 2001).

Iterative project management methodology. Iterative describes non-traditional project management methods characterized by simplified, repetitive iterations of project steps as opposed to a linear approach to project delivery (Sheffield & Lemétayer, 2013). Agile project management methodology would be a subset of this generic descriptor.

IT infrastructure. The portion of an organization's IT environment concerned with the support of enterprise initiatives comprises its IT infrastructure. Resources are often shared across applications, organizational units, and business initiatives (Weill et al., 2002). In short, IT infrastructure provides the platform upon which business IT applications operate.

Predictive Project Management. Predictive methodologies seek adherence to a pre-established plan, as well as presumed certainty, stability, and ease of targeting/controlling existing processes (Ahimbisibwe et al., 2015; Medvedska & Berzisa, 2015). Waterfall project management methodology would be a subset of this generic descriptor.

Project. "A project is a temporary endeavor undertaken to create a unique product, service, or result" (PMI, 2017, p. 4).

Project critical success factors (CSFs). CSFs are a set of 10 factors deemed critical to the successful delivery of projects as defined by Pinto and Slevin (1987): project mission, top management support, project schedule/plans, client consultation, personnel, technical tasks, client acceptance, monitoring and feedback, communication, and troubleshooting.

Project quality. PMI defines project quality as the degree to which a set of deliverables meets a set of defined requirements (PMI, 2017).

Project stakeholder. Any individual or group who can potentially impact a project or could potentially be impacted by it (PMI, 2017).

Traditional project management methodologies. Traditional methodologies seek adherence to a pre-established plan, as well as presumed certainty, stability, and ease of targeting/controlling existing processes (Ahimbisibwe et al., 2015; Medvedska & Berzisa, 2015). Waterfall project management methodology would be a subset of this generic descriptor.

Waterfall project management methodology. Waterfall is a sequential project management methodology credited primarily to Royce (1987) that demonstrates an approach that flows from initiation through implementation with each stage completing before the next begins.

Assumptions and Limitations

This study was limited in scope to include project managers in the United States who possess an industry recognized project management certification such as PMP, PMI-ACP, Scaled Agile, PRINCE2 Practitioner, or CSM and are either currently managing or have previously managed IT infrastructure projects. In the absence of a formal certification, project managers with greater than 10 years of experience were also considered as potential participants. While the following research may have implications that could have global applicability to IT infrastructure projects outside the United States, the pool of respondents was all from within the U.S.

As the initial target group of respondents consisted of individuals with whom the researcher has a prior personal or professional relationship, any such relationships were fully disclosed and documented by the researcher, with concurrence from the participant, as part of the interview process. Individuals with whom the researcher had a current professional relationship at the time of the research were ineligible for inclusion in the proposed study due to any actual or perceived undue influence that may arise from their participation.

The researcher interviewed respondents about their expert opinions based on their careers and experience, which span multiple current and former employers. As the questions planned did not specifically pertain to the organizations the respondents are or were affiliated with, individuals were not asked to disclose the names of organizations where they have worked. Additionally, specific site permission was not obtained for each participant's current or former employers, as each respondent's answers were about their general career experiences as a whole and not their employers specifically. However, the individual informed consent document defined that respondents' employers, if disclosed during the interview process, will be treated anonymously and in confidence by the researcher.

The researcher conducted interviews via online teleconference tools that facilitate the recording of audio and video for later review and generation of transcripts by the researcher. Per Capella University IRB requirements, all recordings, transcripts, and related data will be stored securely by the researcher for seven years, upon which the data will be destroyed.

Organization for Remainder of Study

This dissertation consists of five chapters. Chapter 1 introduced the research, detailed the business problem, and the questions to be studied. This chapter also defined other parameters of the study itself, including research rationale, purpose, framework, significance, definition of terms, and study assumptions and limitations. Chapter 2 includes a review of current literature relevant to define project management methodologies and to substantiate the framework of the study itself. This chapter also discusses the identified gap in the available literature to which the research will contribute. Chapter 3 details the methods and approaches used in the research study and how data will be collected and reported. Chapter 4 includes analysis of the data collected

with a focus on organizing findings, where appropriate, to identify trends or themes in responses. The final chapter concludes the study with a summary of findings, responses to the research questions, and recommendations for further future research.

CHAPTER 2. LITERATURE REVIEW

Introduction

The following chapter will provide a summary of relevant literature reviewed for the purpose of this dissertation, beginning with a framework for the research as well as details regarding how sources were located and defined. As the present study is concerned only with IT infrastructure, a brief explanation of IT infrastructure is provided as well as a differentiation between these projects and other IT and software development projects. Next, the history of project management and its evolution into current models is discussed. The concepts of project success and failure are discussed in detail to assist in the determination of how projects are assessed. Evidence is presented where the literature indicates iterative methods are more effective than predictive, and rebutting evidence is presented explaining circumstances where these iterative models have not succeeded and predictive models remain superior.

Discussion then moves to the emergence of a spectrum of project management methodologies, and the factors that can influence projects to align with various points on this spectrum. The role of the project manager is presented in relation to making this determination of methods on the spectrum. Finally, research is presented discussing project management as a tightly or loosely coupled system. The chapter concludes with a summary and critique of the literature reviewed.

Methods of Literature Searching

The following literature review intends to help establish the theoretical framework with which to conduct the accompanying research. The literature review facilitated a more thorough understanding of the perceived gap relative to project methodology selection for IT infrastructure

projects. This review focused on establishing how current methodologies came to be, how project success is measured, evidence of the success of existing methodologies, and the role of the project manager in methodology selection. Online databases and search tools used to obtain literature included Business Source Complete, the Capella University Library, Google Scholar, ProQuest Central, SAGE Journals Online, and Science Direct. The terms used for searches included *project management, agile, waterfall, hybrid, iterative, predictive, traditional project management, project success, project failure, project cancellation, critical success factors, project manager, and IT infrastructure*.

Conceptual Framework and Basis for Research

The present research is based on the theories demonstrated in the literature that the practice of project management and the selection of methodologies is an ever-evolving discipline (Baseer et al., 2015). Further, the desire for continuous improvement is inherently part of project management, and the understood goal of project managers is the successful delivery of their target outcomes (Beck et al., 2001; PMI, 2017). The history of project management tells us that the traditional waterfall model predates iterative methods, and, in many instances, iterative is presented as an answer to the question of, "How do we improve upon the waterfall method?" (Bentley, 2020; Hummel, 2014; Morris 2011). However, the literature also reveals that agile has not completely supplanted this older methodology despite its understood benefits over waterfall. This fact yields the theory that the predictive method is not obsolete and still holds some value in the body of knowledge. This leads us to the question of methodology selection that is presented to project managers on each new project.

This theory of methodology selection is presented in the literature as a spectrum between two poles of purely iterative/agile and purely predictive/waterfall (Hohl et al., 2018; Turk et al., 2014). As described in the literature, these methods are often presented as tightly coupled systems forcing a binary choice between agile or waterfall. The theoretical implication from many studies is that project managers can choose one or the other, but not components of each. However, more recent investigations into hybrid project methods yield the theory that these polar methods may be more loosely coupled, enabling project managers to pick-and-choose components from each to form hybrid models to fit their projects best (Baird & Riggins, 2012; Cooper & Sommer, 2018; Turk et al., 2014).

While there are ready examples of models that fit at the poles of this spectrum, the area in between is far less defined. Similarly, the subject of the present research is how project managers can select methods from this spectrum to apply to their projects. Additionally, are project managers able to choose from loosely coupled systems of methods, or are methodologies more tightly-joined, forcing an either-or decision? The literature review that follows explores the basis for these theories and establishes the conceptual foundation for the proposed study.

Information Technology Infrastructure

IT infrastructure includes the technological systems and competencies within an organization that facilitate communication, interaction, and integration of applications that support business functions (Bailey, 2015; Khan et al., 2013). In an analogy in which IT applications are cars and trucks, IT infrastructure would be the roads, highways, traffic signals, and parking lots. There is no single recognized definition for IT infrastructure (Raghavan, 2013). However, everyday items considered part of IT infrastructure would include the laptops and PCs

used in business daily, the networks that connect those PCs to each other and to the shared applications they utilize, as well as the data centers that house the servers and storage that support the applications. Generally speaking, the infrastructure domain stops short of any software development efforts.

Given the loose definition of what is considered infrastructure and what is not, Raghavan (2003) expanded on this distinction by proposing some items that are infrastructure-related, and others that are not. Items the author included in IT infrastructure were networks, operating systems, email and communication environments, telecommunications and videoconferencing systems, to name a few. The primary item listed as outside the infrastructure set included business applications, whether commercially purchased or internally developed. While infrastructure may include the deployment of developed applications, this exclusion specifically applies to the actual development of software applications which is considered outside of the domain of infrastructure.

IT infrastructure projects are unique from other IT projects, particularly those concerned with the development of software. Khan et al. (2013) described these efforts as complex endeavors, including decisions about large-scale systems. Xu et al. (2010) described IT infrastructure as the base of an organization's IT portfolio. Often the value from infrastructure projects cannot be substantially realized until the total project is substantially complete.

In the context of the present discussion regarding project management methodologies, these infrastructure projects frequently find themselves at direct odds with the agile principle of *deliver early and often,* as discussed in *The Agile Manifesto* (Beck et al., 2001). The *Manifesto* itself was specifically written to apply to the domain of software development, and as the basis

for most modern agile methods, this implies that these methods also apply primarily to software development. Given the size and complexity of IT infrastructure projects, particularly in larger enterprise organizations, the most common methodology for project management has typically trended more toward the traditional, predictive models (Mersino, 2018; Schwaber & Sutherland, 2012), and there is an identified gap in the available literature on the subject of integrating agile methodologies into IT infrastructure efforts. This leaves an opening for the question of whether agile methods or techniques can be used in infrastructure projects.

Origin and Evolution of Current Project Management Methodologies

The theory of project management traces back to ancient civilizations such as Mesopotamia and in great marvels of ancient engineering that still stand today, such as the Pyramids of Giza and The Great Wall of China. Evidence of organized design, planning, and execution are in these examples, even if documentation of project management practice was not yet in existence (Hussein & Seymour, 2014). The term *project management* has most commonly been traced back to the 1940s and the end of World War II. The Manhattan Project, the U.S. military's program aimed at the development of the first atomic bomb, is an early example of modern project management. The practice of project management expanded rapidly in the defense and aerospace industry during the Cold War era, as the U.S. military sought ways to speed up the design and production of nuclear-capable intercontinental ballistic missiles efficiently and effectively. This same methodology would later apply to the space program with NASA's programs, such as Apollo, that put the first men on the moon (Morris, 2011).

Throughout this expansion in its use, the practice of project management has continually changed and evolved to address contemporary problems (Baseer et al., 2015; Kisielnicki &

Misiak, 2017). As methods were found to not meet evolving business needs, the methods themselves needed to evolve. The following paragraphs detail some of that more modern evolution into two somewhat opposing methodologies: iterative and predictive.

Modern Era of Project Management

Morris (2011) described the Modern Era of Project Management as the period since approximately the 1950s. Hussein and Seymour (2014) further broke the historical record of this Modern Era of Project Management into four periods. The first began in the post World War II boom and lasted until the late 1950s and saw rapid growth in defense spending and public works projects such as the interstate highway system. The second followed into the late 1970s with introductions of formalized methodologies such as Program Evaluation and Review Technique (PERT) and the formation of the first project management industry organizations. The third period extended from 1980 into the mid-1990s, which ushered in the era of the personal computer and the rapid rise of the IT and software industries. The fourth period, from 1995 to the present, has been highlighted by a period of continuous improvement and evolution in project management methodologies with the accompanying need to keep up with the rapid pace of today's industries (Hussein & Seymour, 2014; Morris, 2011).

The boom of the IT industry from the late 1980s and 1990s led to the rapid expansion and use of personal computers in business, which led to the development of software and systems used for complex project management (Hussein & Seymour, 2014). The increased use of project management as a discipline led to the need for standards by which project managers could apply their practice. The formation of the PMI and the first publication of their Guide to the Project Management Body of Knowledge (also known as the PMBOK Guide), and the original

definitions of Scrum, an early agile methodology, would come about in this era (Hussein & Seymour, 2014).

In the latter half of the 1990s, the need for specialized project management methodologies for software development gave rise to multiple disciplines that have collectively become known as Iterative or Agile methodologies (Hummel, 2014). The guiding principle of Agile aims to minimize up-front detailed planning in favor of early and frequent delivery of useable outputs in an iterative approach (Bird, 2010). Agile focuses on the expertise of the project team and communications between the unit and all relevant stakeholders as a method of streamlining the management and delivery process (Ahimbisibwe et al., 2015; Baseer et al., 2015; Bentley, 2020; Bird, 2010).

Waterfall Methodologies

From 1970 onward, most project management practices traced their origins back to the work of Walter Royce (Ghilic-Micu et al., 2016). Royce was a software development project manager in the aerospace industry in the 1960s. His experience there led him to document what later became known as the waterfall model (Royce, 1987), so named based on its model of cascading phases or stages of a project, the conclusion of each leading to the next. Royce's originally published his paper on the subject in 1970, but the article does not appear widely in current documented scholarly literature until 1987's *Proceedings of the 9th International Conference on Software Engineering.* In this publication, Barry Boehm authored a comparison of Royce and two predecessors in software development for the defense industry, Herbert Benington and W. A. Hosier. This 1987 conference publication included all three of the works Boehm analyzed in the same volume along with Boehm's analysis, enabling current researchers

to find all four articles simultaneously (Benington, 1987; Boehm, 1987, Hosier, 1987; Royce, 1987).

Bennington presented his original model at a symposium on advanced programming methods for digital computers, in Washington, D.C., in June of 1958. In his presentation, Benington described the methods used in the development of an air-defense system called SAGE, where the team developed software on a scale that at the time they had not yet attempted (Benington, 1987). His work became one of the first descriptions of a large-scale project implemented in a phased approach. Three years later, Hosier's research built upon this necessity for a process to deliver software systems also in scales not previously ever created. Hosier (1987) utilized a detailed flowchart explanation to further expand on the phased approach for the development of large, complex systems.

While academic literature frequently cites Royce as the originator of the waterfall method (Pederson, 2013; Saunders, 2018), models from Benington and Hosier, which date back to 1956 and 1961 respectively, predate Royce by several years (Bennington, 1987; Hosier, 1987). Given that all three authors were in the defense industry at the time, Boehm (1987) used the three as a collective benchmark representation of project management methodology of the time. While Benington and Hosier proposed systematic approaches to software development, Royce's model first visualized the process that referred to as a waterfall. Frequent references in scholarly literature to Royce's model, which built upon the work of Benington and Hosier, cite this era as the beginning of modern project management and the origin of the waterfall methodology (Boehm, 1987; Pederson, 2013; Saunders, 2018).

In his 1970 article, Royce described his vision of the most efficient method for delivering large-scale software development projects based on his experience in the defense industry in the 1960s. He envisioned a linear approach. It begins with requirements, which are analyzed and then put into program design. Developers design code and then test it before finally moving into operation (Royce, 1987). Like water running down a series of cliffs, each phase or activity leads to a *waterfall* into the next, and so on, until the end of the relevant cycles. Royce indicated that he found this model to work, but admitted that it could be prone to failure and subject to future improvement.

Agile Methodologies

While the waterfall model has been accepted practice in project management for decades, more recent developments in project management methodologies have shifted to non-linear, iterative, or agile methods in an attempt to increase project success and decrease project time and resource investments (Bentley, 2020; Baseer et al., 2015; Cooper & Sommer, 2018) Kisielnicki & Misiak, 2017; Saunders, 2018). This method relies upon a more autonomous and less structured approach, allowing opportunities for frequent feedback and adjustment in the process (Hummel, 2014).

Through the 1990s, project management as a discipline continued to be primarily driven by the IT industry, and methodologies continued to evolve to keep up with the ever-growing needs of newer technologies (Hussein & Seymour, 2014). The traditional method of managing projects was unable to match the increasing demands of current businesses, mainly in the area of software development. This need to maintain pace with an industry that was rapidly changing and developing became known by a single word – agile. Many so-called agile methods of

delivering projects arose in this period. While there is no unique identified or documented definition of agile as relates to project management methodology, the most commonly recognized set of guiding principles for agile is *The Agile Manifesto*, published in 2001 (Beck et al., 2001; Hummel, 2014).

In 2001, a group of 17 project management practitioners in the software industry who would later dub themselves The Agile Alliance (Beck et al., 2001) came together at a Utah ski lodge to develop a single applicable set of principles by which agility should apply to project management. By 2001, there were many agile methodologies in use in the IT industry, such as Iterative, Scrum, and Extreme Programming (Baseer et al., 2015). The Agile Alliance, whose members were relative subject matter experts across many of these agile methodologies, sought to find common ground and a set of agreed-upon guidelines establishing a clear basis for agility in project management. What they developed were their *12 Principles of Agile Software*, which would become *The Agile Manifesto* (Beck et al., 2001). They published their concise 12 principles – consisting of fewer than 200 words – publicly at *agilemanifesto.org*, and encouraged others to share their work freely in an attempt to influence those engaged in projects to think about software development in new, more agile ways (Beck et al., 2001).

While many researchers trace the origins of current agile practice back to *The Agile Manifesto*, evidence of these principles is in the literature even earlier. Takeuchi and Nonaka (1986) documented evidence of agile principles they described as a *rugby approach*, which by today's definition would be a Scrum-like agile methodology. Even as far back as his 1970 work on what became known as the waterfall approach, Royce laid the basis for what would later evolve into the agile methods in use today. "One frequent objection to the waterfall model is that

it forbids prototyping. People interpret it to say, 'Thou shalt not write one line of code until every detailed design specification is complete.'" (Boehm 1987, p. 298). Royce, however, had already incorporated prototyping – a frequently used agile tool – in his model as a "do it twice" approach (Bentley, 2020; Boehm, 1987, p. 298; Hohl et al., 2018).

Agile methodologies have developed from their origin as an alternative to the traditional project management approaches into what is now a mainstream project management methodology (Bentley, 2020; PMI, 2021). While there remains no one single definition of agile (Bentley, 2020; Hummel, 2014), the literature record shows a line of evolution of methods that present themselves as agile methods (Baseer et al., 2015). A study in 2018 involving interviews with 14 of the original 17 drafters of *The Agile Manifesto* found that 17 years after its publication the principles put forth in *The Manifesto* remain an accurate guiding model for agile methodologies (Hohl et al., 2018). While methods and standard continue to evolve (PMI, 2021), the underlying principles of agile are still tied to *The Manifesto*.

Predictive Versus Iterative Terminology

As evidenced by studies that attempted to define and place labels on the various project management methodologies in the historical and contemporary record (Baseer et al., 2015; Kisielnicki & Misiak, 2017; Litchmore, 2016; Moniruzzaman & Hossain, 2013; Saunders, 2018), pinpointing a name or label to a methodology can be a source of significant debate. The abundance of research that highlights the benefits of newer methods over traditional approaches similarly shows a trend in the literature toward the evolution of methodologies.

With the evolution of methods comes the need to describe and classify them to facilitate academic discussion accurately. As Hummel (2014) highlighted, there is no one definition of

agile, but there is similarly no single definition for traditional or waterfall approaches. In the course of this research, two words recurred significantly in the available literature as descriptors of these methodologies: *predictive* and *iterative*. Predictive is associated with the more traditional or waterfall approach of sequential planning and control. Iterative refers more to what is commonly described as agile where repetitive iterations with less structure and control, and more informal and frequent communication are prominent (Ahimbisibwe et al., 2015; Baseer et al., 2015; Bentley, 2020; Kisielnicki & Misiak, 2017; Radujković, & Klepo, 2021).

As there is significant debate in the literature regarding how best to describe many of the labels identified for various methodologies, this research focused primarily on using these two descriptors of *predictive* and *iterative* to describe methods that fall into these two sub-sets of project management methodology. However, for purposes of this discussion, iterative and agile were treated synonymously, and predictive, traditional, and waterfall were similarly grouped as one meaning for the duration of this work.

Project Success/Failure

As discussed in Chapter 1, the inherent assumption in project management methodologies is that projects are managed in such a way that the stated goals are achieved (Khan, 2018). However, to paraphrase Benjamin Franklin from *Poor Richard's Almanac*, project success, like beauty, is supported but by opinion. Defining, clarifying, decomposing, and developing ever-improved methods to achieve success are constant themes throughout project management literature. Ambler (2013) and Besteiro et al. (2015) summarized this by merely saying there exists no universal definition of project success, and how success is defined depends significantly upon the perspective of the organization.

Project Failure

Organizations rarely make it their purpose to pursue projects that fail, and even one pursuing that goal would essentially be pursuing success through those failures. One such example would be business that seeks to produce a financial loss for tax benefits of the overall organization. In this case, by losing, the organization is achieving a goal successfully. Therefore, to understand success better, one must first to review the alternatives of project escalation, abandonment, and failure.

In their summary of the *2015 Chaos Report* (Standish Group, 2015), which studied details of more than 50,000 projects across the globe, Wojewoda and Hastie (2015) provided an explanation of many of the findings as well as an interview with a representative from the publishers of the report. The first and probably most eye-catching set of data presented is the measured success rates of projects on a scale of successful, challenged, or failed. The report found that only 29% of the projects succeeded, while 71% were challenged or failed, showing that there is significant room for improvement in the area of project success. Khan (2018) similarly placed that estimate at close to 70% for failed projects, indicating that despite advances in methodologies, many projects still struggle and fail. This high failure rate for projects lends credibility to the stated business problem that project managers struggle with selecting appropriate methodologies for the successful delivery of their projects.

Before failing, many projects endure a period of challenges or struggles in which the effort seems equally likely to move forward toward success or to fall into failure or abandonment. Ahonen and Savolainen (2010) discussed that many projects that find themselves in this situation could have succeeded but for mistakes made by the project team that did not

correct the project's trajectory sufficiently. Reel (1999) cited that many project failures could be traced back to factors that occur at, or before a project's initiation, a point on which Ahonen and Savolainen (2010) agreed. Keil (1995) described a situation referred to as project escalation that can occur with struggling projects where leadership continues to put efforts into correcting a project that may be already lost. Keil stated (1995, p. 422), "One of the most difficult management issues that can arise in connection with IT projects is deciding whether to abandon or continue a project that is in trouble". Often reputational or other self-justifying factors for leadership can lead to a situation where a project continues, and organizations expend additional resources when the best course of action would be to abandon the effort and allow it to fail (Stray et al., 2013).

Abdel-Hamid and Madnick (1990, p. 40) specifically discussed project failure as "a silver lining. For only through experience and costly errors can managers develop effective, intuitive judgment." As highlighted above in the discussion of project escalation, project leaders often attempt to hide or cover-up their mistakes rather than accepting and learning from them. A key component of project management methodologies is the concept of lessons learned (PMI, 2017) and retrospective reviews (Beck et al., 2001). Failed projects must serve as a learning tool to prevent future failures, and bolster future success (Abdel-Hamid & Madnick, 1990; PMI, 2017).

Project Success

While there remains no clear definition of project success, characteristics of what contributes to successful projects are abundant in the literature. Davis (2014) provided a useful chronological summary of prevailing success measurements that correspond roughly to Hussein and Seymour's (2014) description of the four periods of modern project management. Davis

(2014) described the period of 1970s and prior as focused on the *holy trinity* of project management - the triple constraints of scope, cost, and schedule. In this manner, projects measured success after completion of the effort based on the proper implementation and balance of the triple constraints, but without regard to the output of the initiative.

In the 1980s, Davis (2014) cited a shift to focus on the organizational benefits derived from the project and a focus on executive leadership's approval of project success. Davis (2014) also discussed that the project manager, as an agent of leadership, acts as the judge of the definition of project success. The 1990s and into the 2000s saw the rise of the concept of critical success factors (CSFs) as factors identified from historical retrospective reviews of past projects to apply to future plans as a means of driving project success (Davis, 2014; Pinto & Slevin, 1987). Finally, in the 21st century, Davis (2014) described a focus on project stakeholders who per PMI (2017) are individuals or entities who could affect or be impacted by the project's efforts or outcomes. The focus now is on delivering value to these stakeholders as the eventual user of the result of the project versus measuring the project factors themselves. Tam et al. (2020) defined current project success as measured in time, cost, and customer satisfaction which illustrates an evolution over the triple constraint of scope, schedule, and cost alone.

Critical Success Factors

There is extensive literature on the concept of CSFs for projects with many authors building upon their predecessors in attempts to further develop or specialize an individual model to be applied universally or specific to industries or types of projects (Chow & Cao, 2008; Müller and Jugdev , 2012; Pinto & Slevin, 1987, Serrador, 2015). Serrador (2015) focused mainly on project planning as a means to drive project success. His book stated that while some

project environments do not necessarily benefit from the detailed up-front planning associated with traditional project management methods, the author did not necessarily indicate ignoring planning in those environments. Serrador, instead, stated clearly that the benefits of project planning as relate to project success be proven through the successful practice of project management.

While there are mentions of critical success factors earlier in the literature, the seemingly seminal source for CSFs and one cited by most studies that followed is that of Pinto and Slevin (1987). In this paper, the authors proposed a list of 10 critical success factors for project implementation. Much of the subsequent literature on CSFs directly cite or can be linked back to work by Pinto and Slevin (1987, p. 34) and their 10 critical success factors:

1. Project Mission: Initial clarity of goals and general direction
2. Top Management Support: Willingness of top management to provide the necessary resources and authority or power for project success
3. Schedule and Plans: Willingness of top management to provide the necessary resources and authority or power for project success
4. Client Consultation: Willingness of top management to provide the necessary resources and authority or power for project success
5. Personnel: Recruitment, selection, and training of the necessary personnel for the project team
6. Technical Tasks: Availability of the required technology and expertise to accomplish the specific technical action steps
7. Client Acceptance: The act of "selling" the final project to its intended users
8. Monitoring and Feedback: Timely provision of comprehensive control information at each stage in the implementation process
9. Communication: Provision of an appropriate network and necessary data to all key actors in the project implementation
10. Troubleshooting: Ability to handle unexpected crises and deviations from the plan

Müller and Jugdev (2012, p. 758) would later include a quote from Pinto and Slevin in their 2012 work, "There are few topics in the field of project management that are so frequently discussed and yet so rarely agreed upon as that of the notion of project success." Pinto and Slevin

(1987) did not distinguish between project methodologies in their list of CSFs; however, many studies that followed would pursue various lines of thought that deviated toward a recommended or pre-determined methodology selection before they defined their proposed CSFs. Doherty (2011) discussed that helping project managers select the proper success factors to apply to their projects is instrumental in project success and using the wrong or even too many of these factors can have a detrimental effect. Fernandez and Fernandez (2008) similarly proposed that matching a proper project management methodology to the project is crucial to success. Radujković, and Klepo, (2021) even more recently stated that project managers implement multiple different factors or methods to deliver successful results.

A frequently cited and re-studied article is that of Chow and Cao (2008), where the authors specifically investigated success factors in agile projects. They defined success factors in categories such as organizational, people, process, technical, and project. Chow and Cao placed the most significant emphasis on strong leadership support and the proper application of agile methodologies. Darwish and Rizk (2015) later built upon Chow and Cao with a proposed approach for applying and evaluating adherence to an organized set of CSFs similar to Chow and Cao's proposed categories.

Several studies between Chow and Cao's 2008 work and the present have looked at various factors and reached sometimes-conflicting conclusions. Lech (2013) cited that success was a factor of a produced system's ability to solve the problem and gave client satisfaction as the most critical success factor. Misra et al. (2009) and Stankovic et al. (2013) similarly cited the end customer's satisfaction as the key to success. Turner and Zolin (2012) expanded on the

current theme that the traditional triple-constraint model of measuring project success is no longer sufficient, and focus instead should be on the business objectives and outcomes.

Other contributory sources in literature explored various CSF models specific to certain project types (Nasir & Sahibuddin, 2011a, 2011b), individual project management methodologies (Litchmore, 2016; Misra et al., 2009; Sudhakar, 2012; Wan et al., 2013), organizational support (Fossum et al., 2020), or enterprise organizational factors (Markus, 2014). The recurring theme in each study was that critical success factors exist and can be defined, but will vary significantly across organizations, methodologies, and project types.

Effectiveness of Iterative Over Predictive Methodologies

When researching iterative and predictive methodologies, a common theme emerged where most studies reviewed on the topic of agile methodologies positioned themselves as an improvement upon traditional predictive models. Thus, the trend was a discussion of iterative models as a preferable option to predictive. While most studies showed a strong preference for iterative methods, they did not take a stance that a predictive model was the wrong choice. Instead, many studies consistently presented agile as an improvement upon the baseline predictive model.

In his 2018 dissertation, Saunders (2018) discussed government project environments in the software development field, and he conducted an interview-based Delphi study among project managers in the public sector. The author discussed project management methodology selection as a binary choice between a traditional waterfall approach and an iterative/agile method. He concluded that in the software industry, specifically, the agile approach has typically proven to be a better fit versus the traditional method. Similarly, Pedersen (2013) also based a

dissertation on the selection of agile instead of waterfall as a methodology choice but chose a quantitative approach to the comparison versus Saunders (2018) qualitative. The conclusions were mostly the same – that agile should be selected instead of traditional methods.

Even a cursory search for iterative or agile methods yields many results showing a clear preference toward newer, iterative methods versus perceived older, predictive methods. López-Alcarria et al. (2019) highlighted agile as a newer method in opposition to traditional waterfall methods. Ambler (2013) discussed that on average agile methodologies were more effective than traditional methods. Litchmore (2016), Pedersen (2013), and Saunders (2018) based their doctoral dissertations on the selection of iterative over predictive methods. Bashir and Qureshi (2012) cited that iterative methods provide a more customer-centric approach to projects and help to create a more satisfying relationship with the end client. Bird (2010) mentioned many benefits to the selection of iterative methodology over predictive such as decreased investment and cost/time savings as well as increased speed in delivery and ability to respond to change.

Bhasin (2012) cited the inherent quality assurance factors present in iterative models that do not exist in predictive methods. Baseer et al. (2015) discussed the need to achieve higher levels of customer satisfaction and cited iterative methodologies as a preferred method to accomplish this goal. Bjarnason et al., (2011) and Tomanek et al. (2014) cited the need to adjust to change and cited this as a shortfall of predictive methods and a strength of iterative. Markus (2014) discussed the need to increase speed and respond to change as arguments in favor of iterative methods. Fulgham et al. (2011) detailed the FBI's successful Sentinel project, which implemented successfully after transitioning to an iterative method after experiencing failures under a predictive model.

Dybå, Dingsøyr, and Moe (2014) are three authors who frequently recur in project management literature as cited sources both individually and in their collaborative works. Their 2014 collaboration is a stand-alone publication of a textbook chapter specifically discussing agile as an evolution over older, traditional methods. In their 2008 study, Dingsøyr and Dybå proposed that agile methods address the challenge of adaptability to change by relying on "people and their creativity rather than on processes" (Dingsøyr & Dybå, 2008, p. 835). These authors also collaborated in 2015, where they described agile as a *newer* model compared to the *older* traditional methods with citations of large projects successfully delivered via agile methods.

Multiple other studies reviewed all reached similar conclusions showing favorability toward iterative methods over predictive in various studies, interviews, and focus groups (Matharu et al., 2015; Moniruzzaman & Hossain, 2013; Senapathi & Drury-Gognan, 2017; Radujković & Klepo, 2021; Senapathi & Srinivasan, 2012; Usman et al., 2014; Zhang & Dorn, 2011). There is no shortage of available literature on the subject of iterative models, and the overwhelming consensus point to iterative methodologies being preferable to predictive, which raises the questions of scenarios where iterative models may not work and whether predictive models are still in use.

Evidence Where Iterative Models Have Proven to be Ineffective

Despite extensive available literature citing the benefits of iterative models, there remain situations in which iterative models conflict with or do not adequately address business needs. Ahimbisibwe et al. (2015, p. 8) cited that despite their benefits, iterative models are not a *silver bullet* that will ensure project success in every case. Pace (2019) elaborated that even the

successful completion of a project using one methodology does not guarantee success using the same methodology for a subsequent project in the same environment.

Larger projects have shown indications of not being able to be managed via iterative methods. Dingsøyr and Dybå (2008) specifically cited that evidence supported the notion that agile methods are not necessarily the right choice for larger projects. Baird and Riggins (2012) reported that iterative methods were best suited to efforts with smaller teams where facilitation of communication is more accessible. Laufer et al. (2015) agreed, stating that iterative methods seemed best suited for small projects and teams. Tomanek et al. (2014) also cited longer duration projects as similarly not being perfectly suitable for iterative methods. Drury et al. (2012) agreed that iterative models are best suited for efforts that fit into smaller durations. Carbonara et al. (2016) and Špundak (2014) cited large project size, large team size, and additionally, increased project complexity as being indications that iterative methods would be less successful than traditional models.

Špundak (2014) also discussed factors around organizational change management that may prevent iterative models from being successful. Mainly, organizations that may have a well-established traditional methodology may be reluctant to try newer iterative models. West et al. (2011) proposed that organizations with an aversion to organizational change may struggle with the frequent releases and deliveries associated with iterative methodologies. These authors also discussed that organizations that have long-standing support mechanisms around finance, accounting, planning, and controls might struggle to transition those external services away from a traditional project management model that aligns with these structures to an iterative one that has less structure and governance. Cao et al. (2013) and Sirkia and Laanti (2015) discussed the

direct misalignment between iterative project methodologies and traditional finance and budgeting cycles that exist in many large organizations. They outlined how agile does not always align with conventional funding methods, which are often cyclical and based on calendar or fiscal years.

Other authors discussed models around project requirements definition and ability to mitigate risk as indicators where iterative models may not yield increased benefits. Balaji and Murugaiyan (2012) presented that if requirements are precise and well known, then a predictive approach may be more appropriate than an iterative one. Bjarnason et al. (2011) cited an example of requirements gathering called requirements engineering, which entailed significant detailed planning, which conflicts directly with agile models. Iterative methods are described frequently as having built-in quality assurance and risk reduction mechanisms. Still, Walczak and Kuchta (2013) questioned this notion in their study, which raised questions about whether iterative methods reduce risk sufficiently enough to justify their application as a specific risk reduction measure.

Perhaps the best estimation of where agile or iterative methods may not be the best choice comes from the seminal source on agile, *The Agile Manifesto* (Beck et al., 2001). In 2018, Hohl et al. conducted interviews with 14 of the original 17 signers of *The Agile Manifesto* 17 years after it was initially published. While they found that the original authors still supported *The Manifesto* as a basis for agile project management, the authors also had concerns about its proper application in practice. They discussed the commoditization of the word *agile* in terms of the agile *idea* packaged and sold to senior executives based solely on the face value of the name and its perceived benefits, but without proper application end to end. In short, the authors felt

many organizations would consider themselves *agile* by merely stating that they were *agile* or by utilizing pick-and-choose features of the methodology without actually applying the model as a whole. In this manner, agile has become more of a trend, and a bandwagon that everyone wants to join rather than a disciplined approach applied through an organizational change in project delivery.

Evidence Predictive Methods Still Widely Used

The 2015 Chaos Report (Standish Group, 2015) showed a strong favorability toward agile projects as a factor in measuring project success. At all sizes of projects, the report found higher levels of success on projects that used agile methodologies. Mersino (2018) reviewed a more recent Chaos report from 2018 and concluded that agile projects were twice as likely to succeed over their traditional counterparts and that over time, projects were succeeding at a higher rate than in the past implying that improvements in methodologies are driving that increased success. Serrador and Pinto (2015) conducted a quantitative review that found similar results showing that agile was indeed widely adopted and showed significant increases in contributing to project success versus traditional methods.

With such a clear indication that agile produces higher levels of project success than traditional project management methods, it begs the question of why some project managers and project environments continue to retain and use these traditional approaches instead of implementing agile practices. Balaji and Murugaiyan (2012) summarized this well by stating that despite the cons associated with predictive models, the pros still make it one of the most popular methodologies in practice. Schwaber and Sutherland's (2012) work suggested favorability toward iterative models but clearly stated that there are circumstances where a predictive model

is more appropriate. Bentley's 2020 work specifically addresses the combination of agile and predictive models illustrating the current relevancy of this topic.

Persistence of Predictive Despite Agile Advantages

Without restating the section immediately prior, many of the limitations of agile can conversely be reported as favorable toward predictive models thus reasoning for their continued use. Examples cited above include larger-scale projects that frequently have larger teams and increased complexity as being more suited to predictive models. These examples represent the opposite position of smaller project/team/complexity projects, which favor iterative methods.

A frequent topic found in the literature indicated a preference toward iterative by stating what predictive models cannot do. However, several sources cited that in many cases, these assertions are not entirely accurate. Thummadi et al., (2011) reported there is a common misconception that agile methods are iterative, and the traditional or waterfall approach is not. However, as far back as 1987, Boehm cited Royce's work on what became known as the waterfall model as having built-in iterative principles. Royce's original work proposed a *do it twice* approach using prototyping that showed integrations of functions most commonly associated with an iterative model. As discussed above, Walczak and Kuchta (2013) cited that iterative models often function as a method to reduce risk even though evidence does not support this as a consistent risk reduction method over predictive models that stress risk planning and responses. However, as Bhasin (2012) discussed, quality assurance is not unique to iterative methods and simply occurs differently in predictive models.

Organizational Justifications for Predictive Models

Some organizations may have enterprise structures in place that simply align better with predictive models than iterative ones. Larger projects where documentation is a driving factor or requirements do not align well with iterative or agile models that minimize documentation needs (Bashir & Qureshi, 2012; Markus, 2014). Firms that have employed a detailed requirements engineering model, which is associated with a great deal of structure and planning around requirements, would be better suited to a predictive project management model that better aligns to this process (Bjarnason et al., 2011; Kumar et al., 2013). Organizations where frequent and consistent communications with the end-user or customer are not facilitated easily may struggle with the regular communications needs iterative models demand, and thus may conform more to a predictive model (Inayat et al., 2015).

A far less convincing argument for why predictive models are still widely accepted and used can be summed up by the common excuse of "that's the way we've always done it." As discussed above, Špundak (2014) cited the organizational change management obstacles as reasons why organizations may stay with their established predictive models rather than adapt to newer iterative ones even in the face of evidence demonstrating the benefits of doing so. Cooper and Sommer (2016) concurred by stating that firms may prefer to stay with their tried and true approach, despite any known limitations, rather than adapt to an untested iterative model. They referred to senior leadership as being, at times, skeptical of iterative models and their ability to function correctly in their environments.

Further worsening of this issue of illogically clinging to predictive models appears in Ahimbisibwe et al. (2015), who reported that fewer than 20% of all projects exhibited

characteristics of a predictive model. Still, organizations continue to try to force projects to fit this methodology. Sheffield and Lemétayer (2013) cited that projects tend to organize themselves similarly to the organization and hierarchical organizations with increased levels of controls and reporting needs may tend more toward retaining predictive models. Cooke-Davies et al. (2011, p. 29) quoted Abraham Maslow as saying, "If the only tool you have is a hammer, you tend to see every problem as a nail." This situation often results in organizations that maintain a traditional or predictive model to continue to force projects into this model even when the selection of another methodology may be more appropriate.

Discussion of a Spectrum of Project Management Methodologies

Evolution of Methodologies

Baseer et al.'s (2015) paper documented their thorough literature review of current project management practices and the general comparative characteristics of each. Their search cataloged approximately 1,600 articles comprised primarily of conference papers but supplemented with published journal articles from 2001 through 2014. Their objective was to create a map of various methodologies mentioned in current literature and develop a reference matrix categorizing and comparing the different methods. They achieved this objective through a detailed table in their published study that provided a comparison across methodologies. Among their categorizations was a comparison of whether the article reviewed mentioned waterfall methods, agile methods, or both. Their findings showed that that the materials reviewed were 10 times more likely to discuss both methodologies rather than only one, which indicates that there is a prevalence in the literature to discuss the two methods together.

The authors explained that while some may generalize predictive/waterfall and iterative/agile methodologies, there are, in fact, many subtle varieties of each of these general methodologies. Hohl et al. (2018) similarly noted that even the authors of *The Agile Manifesto* acknowledge that many leaders are not aware of the vast array of methodologies that make up models referred to as *agile.* Baseer et al.'s (2015) conclusions also provide a good foundation for research into the assertion that the practice of project management has shown distinct evolution over time. This article discussed several methodologies, but the key theme was that selecting the best methods from the various toolsets available is a crucial step to delivering successful projects.

In a similar approach to the study above, Ghilic-Micu et al. (2016) conducted a review of agile methodologies with a strong focus indicating that agile is an evolution and thus an improvement upon the older waterfall model. They envisioned a pyramid model of agile that has a base of philosophies that guide agile project development, such as lean improvement methods. Following was a tier that proscribed individual agile practices such as Scrum or Kanban and a layer composed of techniques such as sprint boards or backlogs. The authors then dove deeper into an analysis of Scrum and Kanban individually and subsequently as part of a hybrid model called Scrumban. Their argument for Scrumban stated that by combining the two methods, projects could realize the benefits of each, and the limitations of one could at least partially offset the other. They concluded by stating the opinion that all business models should eventually migrate to an agile model versus other methods, and that the evolution of methodologies favors this conclusion.

Introduction of Hybrid Models

Dingsøyr et al. (2012) also reviewed literature in the 10 years following the publishing of *The Agile Manifesto*. They found that despite a significant amount of study into the benefits of iterative models, discussions clearly showed a trend toward plan-driven iterative approaches, which displayed a preference for hybrid project methodology models. Dingsøyr, along with Dybå, had also written in 2008 that evidence suggested that instead of outright abandoning traditional methods, organizations should embrace hybrid models and combine them with agile principles (Dingsøyr & Dybå, 2008).

Cram (2012) studied the need for organizational alignment of values and requirements with the proper project development approach or method. The author cited that task-oriented environments and organizations that value adaptability would tend toward an agile method. In contrast, organizations that place a higher value on consistency and hierarchical controls would lean toward a more traditional approach. This study found that the underlying culture of an organization has a direct influence over methodologies chosen for projects. In looking to make the transition to a hybrid model, the organization must consider the existing culture. Organizations inclined to support one method or another may struggle with integrating the two.

Hakim (2019) discussed the idea of incorporating agile methodologies in a medical practice setting. In background materials, Hakim described the journey from traditional waterfall to agile as one that follows the patterns of continuous quality improvement. He illustrated that it is possible to improve upon traditional approaches by incorporating newer agile methods without entirely leaving behind the structure and control of the traditional model. The author cited that extensive literature is available demonstrating the benefits of agile in the software industry, but

that further study is needed to bring these agile methods and their benefits to other sectors such as the medical project field. Similar to Hakim, López-Alcarria et al. (2019) proposed adapting agile methods to the educational classroom teaching process to integrate with traditional methods. The authors even proposed an alternative to *The Agile Manifesto* aimed at this goal. Bashir and Qureshi (2012) cited a similar opinion that success increased through the integration of agile methodologies, even in more traditionally structured environments outside of software development.

Methodology Selection

Balaji and Murugaiyan (2012) proposed a model for methodology selection based on questions of requirements stability, target end-users, project size, and location of project teams. They showed that waterfall was still successful despite its limitations, but that parameters related to the factors they suggested could help drive a transition to agile methods. Carbonara et al. (2016) discussed selection factors such as project size and complexity as deciding factors in the selection of methodology from available options.

Turk et al. (2014) stated that methodologies should vary by project and organization, with some being more suited to an agile environment while some may fit better in a predictive model. The authors proposed that rather than an either/or selection of project management approach, that methodologies exist on a spectrum of options relative to their degree of agility with one end of that spectrum being truly agile projects and the other being entirely traditional, predictive projects. In general, projects would expect to fall somewhere in the middle of the range versus at the absolute ends. Baird and Riggins (2012) also proposed the concept of a spectrum of methodologies similar to that of the authors above. This theory implies that one could more

commonly expect most project management methodologies to be some level of hybrid between the two extremes of purely iterative and purely predictive.

Iterative Beyond Software Development

Cooper and Sommer (2016; 2018) conducted a case-study based research effort aimed at disproving the notion that agile methodologies are only for software development environments and that traditional stage-gate models could incorporate agile methods. What the authors found in their case study with the Danish toy manufacturer LEGO was that the theorized agile stage-gate was entirely possible and found to be alive and well at LEGO. The goal the researchers sought was the ability to leverage some of the speed and adaptiveness of the agile methods in the development of new products while not completely giving up the control, structure, and familiarity of the traditional stage-gate. The authors described a pendulum swing with the goal being not to swing too far in either direction in trying to choose the benefits of one or avoid the limitations of the other (Cooper & Sommer, 2016; 2018). They found that in finding this balance, the project could realize significant benefits in efficiency and reduced effort.

Kisielnicki and Misiak (2017) wrote that while the waterfall model was accepted practice in project management for decades, more recent developments in project management methodologies have shifted toward incorporation of non-linear, iterative, or agile methods in an attempt to increase project success and decrease project time and resource investments. Tomanek et al. (2014) investigated projects in the web development industry looking for ways that agile and traditional methods interacted with each other across multiple projects, and concluded that the integration of both methods was ideal dependent upon the project team and project characteristics. Kumar et al. (2013) reported that requirements engineering projects, which

typically follow predictive methods, also saw benefits from integrating aspects of iterative models. Nicholls et al. (2015) studied projects in academia and similarly found that projects may slip in and out of methodologies at various stages in the project lifecycle, utilizing the method that best addresses the need at the time.

Balancing Iterative and Predictive

Špundak (2014) discussed that predictive and iterative methodologies have advantages and disadvantages, so forcing all projects in an organization to fit one or the other is not ideal. Raval and Rathod (2014) agreed that most projects do not align entirely with one extreme of the spectrum or another and that a hybrid model incorporating the two could balance the limitations of each while reaping the benefits of both. Theocharis et al. (2015) found that despite the assumed superiority of agile methods, firms prefer a hybrid approach where iterative and predictive models are combined. Bentley (2020) continued the debate with the assertion that there could be a middle ground between methods.

Kulak and Li (2017) discussed the need for project teams to transform to integrate agile and predictive teams and methods. The authors described a perception of agile teams being newer, or more evolved and thus they are *the good guys* where the more traditional, predictive teams are *the bad guys.* The authors also disagreed with this perception and showed ways that agile and waterfall can integrate such as mapping a traditional stage-gate process with an agile-scrum approach.

As part of their organizational project management model, Müller et al. (2019) detailed a hybrid strategy approach to project management. The authors proposed a balanced approach of

project and portfolio management strategies to maximize utilization of benefits from multiple methods. In doing so, project can hope to achieve higher-level objectives.

Finally, the PMI has specifically stated the need for an evolution to their published *Standard for Project Management* and the accompanying *PMBOK Guide*. In 2021 the 7th edition of the *PMBOK guide* will be released and it will represent a fundamental shift away from a stricter predictive model to also include iterative and hybrid models (PMI, 2021). This represents a dynamic shift away from the process group format of prior PMBOK versions going back over 10 years, and it is the first PMI document that specifically calls for project management practitioners to select methodologies from a range of options.

Factors that Influence the Agility of Methodologies

Aligning Method to the Project

Based on the assumption that project management methodology should be a selection on the spectrum and not an extreme version of one or the other, many researchers have explored what factors project managers should consider when making a selection of project management methodology. Tiwana and Keil (2004) highlighted that while much of the literature assumes one methodology is inherently superior to another, it is aligning the method to the characteristics of the project that promote project success. Given the documented history of project management as a means for driving project success and the evidence that literature describes iterative methods as an evolution from established predictive methods, much of the available research expounds upon what is required to increase the degree of agility versus a purely predictive model. In this manner, many of the factors reviewed focused on what was necessary to be *more agile* versus what is required to be *more predictive*. However, the two are directly related, so if increasing a

factor increases agility, similarly having less capability in that factor would lend itself toward more predictive means. The factors below are, therefore, from the perspective of increasing project agility versus the alternative of increasing predictability.

Maylor and Turner (2017) stated that project teams and methodologies should be selected such that they align with the project itself. Balaji and Murugaiyan (2012) suggested asking questions of the organization such as availability of requirements, the identity of end-users, size of the project, and composition and location of project teams when deciding how to select an appropriate methodology. Dingsøyr and Lindsjørn (2013) also proposed asking similar questions about the project when determining methodologies, such as aspects of team leadership and team and organizational communication capabilities.

In their analysis and presentation of many of the currently available project management methodologies, Baseer et al. (2015) also discussed many factors that might influence the selection of each method on the list. Each methodology presents different tools and benefits that may affect a selection choice. In line with the discussion of a methodology spectrum discussed in the section above (Baird & Riggins, 2012; Turk et al., 2014), many factors that the authors considered here as impacting the methodology solution correspond to what degree of agility is ideal on the spectrum for a given project, within a given organization.

Organization Influences on Methodology Selection

Al-Dubai and Alaghbari (2018), and Al-Dubai et al. (2018), reviewed the concepts of organizational factors that influence project success and the role of the project team in ensuring that success. In the first study, the authors cited the historical record of project management as a contributor to organizational success, and they identified that a desire for continuous

improvement exists to keep up with industry needs (Al-Dubai & Alaghbari, 2018). In the latter study, the authors focused on the role of the project team and the importance of their alignment to the success factors of the organization as a contributor to project success (Al-Dubai et al., 2018). Pace (2019) hypothesized that perhaps tailoring the project methodology to the organization could be a path to increase project success.

Serrador (2015) focused mainly on project planning and the degree to which it represents an essential factor. The author recognized early that the hallmark of agile methodologies is often the implication that planning is not necessary. While some project environments do not necessarily benefit from the detailed up-front planning associated with traditional project management methods, the author did not necessarily state to ignore planning in an agile environment completely. He, instead, said clearly that the benefits of project planning as relates to project success prove themselves through the successful practice of project management.

Given that the literature provides evidence that project planning is inherently contributory to project success (Serrador, 2015), the question seems to be how much planning is appropriate versus whether or not to perform planning at all. The signature attribute of agile methodologies is a focus on doing versus planning (Beck et al., 2001), so an argument could state that less planning leads directly to increased project agility. While recognizing that agile methods do decrease the amount of effort spent on planning versus their traditional counterparts, Serrador's focus was on optimizing the amount of planning needed to fit the given project situation, not eliminating it properly. Stated more directly by the author, "Planning requirements vary in different industries and between projects" (Serrador, 2015, ch. 6).

Project Team Factors in Methodology Selection

Many authors focused on the composition and size of the team as a deciding factor in methodology. Bird (2010) and Chow and Cao (2008) underscored the need for a skilled team with supportive management for an agile method to succeed. Baird and Riggins (2012) cited that agile methods work best versus waterfall when teams are small to medium in size. Dingsøyr and Dybå (2008; 2015) highlighted that individuals and teams need to be able to function with autonomy and be able to rely on their skills to succeed. Gren et al. (2018) discussed that not every individual on a team needs to have every required skillset. Still, the team's collective skill set must complement each individual and incorporate the skills required for successful delivery. Senapathi and Drury-Gognan (2017) also emphasized the technical competencies of the team members as a critical factor in the ability to be agile. Hoda et al. (2011) cited the need for teams to be able to self-organize while remaining motivated to cross-specialize on critical skillsets. Lindgren and McAllister (2014) discussed self-organizing teams as well and highlighted the need and flexibility to reorganize as needed to adapt to changing project conditions. Lalsing et al. (2012) focused not only on keeping the team small in an agile methodology but also on the importance of colocation of the team and the benefits derived from that colocation.

Melo et al. (2011, 2013) also researched the importance of team factors in methodology and success. In their 2011 study, the authors stressed that the success of a project, even when incorporating agile methods, was directly related to the integration of the team members. In their 2013 study, the authors expanded upon this to include interactions between teams performing roles across the projects or between related projects as also influencing success.

Along with team factors, communication was also an essential item in determining the appropriate level of project agility in a methodology selection. Hoda et al. (2011) cited the inherent need for constant communication and collaboration with the end customer, and they stated that agile methods would not fit well in environments where the end customer is not consistently available and engaged in this type of communication. Mishra et al. (2012) discussed establishing a physical workspace that encouraged collaboration among a collocated team. Martini et al. (2013) agreed that an open communication environment increases agility. Inayat et al. (2015) echoed this need for precise identification and involvement of the end customer in an agile methodology. Tonelli et al. (2013) went so far as to state that customer involvement is the most critical factor in selecting a more agile project methodology.

Several authors listed communication as essential to agile projects. While many focused on the needs of increased communication to increase agility, none suggested that organizations should select a predictive model solely to reduce communication needs. Instead, the focus is on the fact that agile requires more communication than predictive models, so organizations with communication barriers would be more suited to predictive methods (Al-Dubai et al., 2018; Dingsøyr & Dybå, 2008; Lalsing et al., 2012).

Enterprise Environmental Factors in Methodology Selection

What PMI (2017) referred to as enterprise environmental factors greatly determine how organizations manage projects. These are factors inherent to the organization, but not necessarily the project itself that may influence a methodology selection. Sheffield and Lemétayer (2013) wrote that leadership's willingness to support the flexibility and their acceptance of the potential riskiness of adjusting to a more agile methodology were essential factors. The authors stated that

the project management methodology would often mirror the structure and hierarchical organization of the corporate environment.

Brown et al. (2016) discussed that project management methodology is usually an established practice in an enterprise and that the organization will use experience with that methodology as a hiring criterion for project managers. Thus, a self-fulfilling prophecy establishes itself where an organization prescribes a method and only hires people who know that method, so the organizations' application of methods is no surprise. Ingold et al. (2013) wrote that organizations often require a great deal of retooling and retraining to adapt to more iterative methodologies when a predictive model has been well established in the organizational process. Additionally, overall leadership style of both organizational leaders and project managers can also influence the direction and success of projects (Mughal et al., 2019).

Role of the Project Manager in Methodology Selection

Role of the Project Manager

Building upon the idea of a coexistence of traditional and agile, Ahimbisibwe et al. (2015) conducted a literature review on the topic of a *contingency fit* model for project management by mapping out the relevance and frequency of certain critical success factors mentioned in the reviewed articles. Some of the key findings that the authors documented were that while fewer than 20% of projects had characteristics that made them clear fits for a traditional methodology, project managers were continuing to try to force their project to utilize this method. The implication was that despite available alternatives, project managers were not considering these alternate methods. They concluded with the position that the project manager

should select the appropriate methodology based on analysis of the relevant critical success factors, influenced by the project and organizational environment.

In a study published by the *MIT Sloan Management Review*, Laufer et al. (2015) outlined the role of the project manager as a leader who develops collaboration, integrates planning with review and learning, works to prevent significant disruptions to the project, and strives to maintain forward momentum on the project. Following the above discussion on team factors, Melo et al. (2011, 2013) focused on the project manager as the leader of the project team and the individual charged with driving project success. PMI (2017) agreed that the project manager is the individual leader of the project effort and the person identified by the organization as responsible for driving project success. PMI's (2021) website previewing the forthcoming *PMBOK Guide Seventh Edition* due out in August of 2021 highlights the role of the project management practitioner as the individual charged with deciding the project methodology.

Besteiro et al. (2015) described project managers as practitioners on the front line and identified their knowledge and application of project management methodologies as critical to driving project success. As success is subjective from project to project and can even vary between stakeholders (Davis, 2014; Mir & Pinnington, 2014), the project manager must own the alignment responsibility to match the project outcomes with the organization's goals. Drechsler and Ahleman (2015) proposed a Delphi research design for the development of an agile methodology framework. Their research centered on the need for skilled project management practitioners as their expert study participants, which underscores the role of the experienced project manager as an expert in methodology. Medvedska and Berzisa (2015) and Usman et al. (2014) agreed with the above by saying that there exist several available choices. Still, the

project managers are responsible for increasing project success through the proper methodology selection. Fernandez and Fernandez (2008) highlighted the need to select a methodology from the spectrum of methods available and discussed the need for project managers to be versed in iterative and predictive methodologies ideally.

Project Manager Influences

Al-Dubai and Alaghbari (2018) cited that as the needs for effective project management increased, so increased the need for effective project management practitioners. Similar to how organizational environments can influence the selection, so can the culture and experience of the project manager. Doherty (2011) wrote that the experience of a project manager could significantly affect their choice of a methodology. Project managers more accustomed to directly controlling project work tend more toward predictive methods, while project managers more interested in collaboration with stakeholders may lean more toward agile methods. Nicholls et al. (2015) discussed project managers more accustomed to predictive models might have to let go of some of their needs for controlled planning and strict focus only on the triple constraint to promote an agile methodology. Lindgren and McAllister (2014) highlighted that as leaders, project managers must be able to adapt to the leadership and communication methods required in more iterative methods to increase project agility.

Project Managers as Leaders and Subject Matter Experts

Britto et al. (2012) conducted a study that attempted to identify factors for project team allocation that could improve project success quantitatively. They found that teams allocated using their method were no more effective than those selected by an experienced project manager. This study further underscored the importance of the role of the project manager in

many factors that influence project success, including team selection. Špundak (2014) stated that iterative and predictive models each have their respective pros and cons, but that it is through the proper application of the methodology by the project manager that greatly influences success.

Joslin and Müller (2015) discussed project governance models and defined methodology as a tool to support more predictable success for the project manager. The authors specifically studied the relationship between this methodology and project success. They found that a need existed to adapt project management methodologies to the project's goals, and that project managers should have access to a broad set of tools and the experience to know when to use each of them.

Jugdev et al. (2013) conducted a survey-based study to investigate relationships between success factors, project management tools, methods, and software, and they then performed a quantitative analysis of the measured relationships. The study found many correlations between the use of tools and project success, with the sharpest focus being on fundamental triple-constraint tools such as Gantt charts, work breakdown schedules, and critical path models. However, they saw less use of more advanced tools in areas such as risk management. These advanced tools varied more significantly in variety than those at the basic triple-constraint level, implying a broader knowledge and toolset of advanced practitioners. Their findings also showed that certified project management practitioners showed more frequent and more varied use of different tools and methods than their uncertified counterparts did. This fact lends credit to the theory that more experienced project managers are more likely to be aware of more available toolsets, and are more likely to use those toolsets in the delivery of projects.

Project Management as a Tightly or Loosely Coupled System

Sterman (1992) defined a tightly coupled system as one where the parts are interdependent upon one another to such an extent that the absence or removal of one could have an overall impact on the system as a whole. In such a system, strict adherence to the model for the overall system is considered paramount to the success of the system. Conversely, in a tightly coupled system, it would be inefficient if not impossible to only utilize only part of the model or system rather than the system as a whole. Burke (2014) identified that there are two main qualities that distinguish a tightly coupled system – hierarchy and interdependency.

Söderlund (2002) described the traditional waterfall approach to project management as a classic example of a tightly coupled system. In its traditional application, it is assumed that waterfall projects must follow the overall model of one phase flowing to the next in order for the effort to be successful. Under this theory, failure to follow the overall model of plan-then-do decreases the efficiency of the effort or may cause it to fail entirely.

However, agile projects are also not immune to this theory of tight-coupling. As discussed above, agile has been shown to be most effective in smaller, co-located teams and tends to lose effectiveness as the effort and team grow which decreases the ability to maintain close control (Rolland et al., 2016). Agile also does not work as effectively when supporting functions such as project financing are not able to also integrate with the agile methodology (Cao, Mohan, Ramesh, & Sarkar, 2013). Both of these conditions would appear to describe agile similarly as a tightly coupled system where the interdependencies ability to function with one another influences the function of the system as a whole.

Burke (2014) also described the tendency of organizations to pursue the either-or line of thinking which implies that decisions are often binary. Option A is preferable to Option B, or Outcome A is more desirable to Outcome B. The author highlights that while this thinking is prevalent in many instances, the reality is often not quite as clear. One example given is the choice of high profit versus low profit. Most organizations would clearly choose the high profit choice, but such logic would not necessarily apply to a non-profit organization. This illustrates the theory the authors proposed that while decisions may present themselves as an either-or choice, but the answer may be highly subjective to the situation surrounding the decision.

As discussed above regarding the presence of a spectrum of project management methodologies, this selection decision has been discussed in many studies as either waterfall or agile (Litchmore, 2016; Pedersen, 2013; Saunders, 2018). This could be presented as a choice between two tightly coupled systems on either end of the proposed spectrum, but this approach would ignore the possibility that there exists a set of loosely coupled systems somewhere in the middle. Recent literature highlighting the presence and success of these hybrid methods (Hakim, 2019; Lopez-Alcarria et al., 2019; Bashir & Qureshi, 2012) points to the theory that project management methodologies may be more loosely coupled enabling a selection of methods from the overall total set.

Overview of Research Methodologies

The literature reviewed was a balance of quantitative and qualitative studies. Most sources reviewed case studies involving retrospective project reviews without participants or were studies involving project leadership participants who gave qualitative data in the form of interviews. The retrospective case studies reviewed archival data from past projects as a means

of assessing project success or failure factors. The interview-based research focused on assessments of individuals about the success or failure of projects in their direct experiences.

Critique of Literature

In all of the case studies and interview research, valid data was gathered and presented that can paint a picture of available expert views on the subject project success and project methodologies. The case study and literature review based sources reviewed appeared thorough in discussing project success and methods, but in many cases, restricting reviews to only what is documented throughout a historical project can be limiting as a source of data (Ahonen & Savolainen, 2010; Cooper & Sommer, 2016; Mersino, 2018; Söderlund, 2002). Without actual participants to add detail, context, or explanations, the archival materials are subject to the potential misinterpretation of the reviewer. Additionally, the human subject-based interviews and surveys seemed to be disproportionately concerned with the perceptions and opinions of senior leaders, who may not have been directly involved in the projects, versus inclusion of assessments from participants in the projects themselves (Fulgham, Johnson, Crandall, Jackson, & Burrows, 2011; Khan, Khouja, & Kumar, 2013). While assessing senior leaders' opinions about the success or failure of the outcomes of projects is undoubtedly appropriate, diving deeper into why projects succeed or fail may require more involvement from those at the methodology practitioner level.

Most of the leadership opinions obtained in several of the studies reviewed were based upon these leaders reviewing and assessing a project as a whole, focusing primarily on the completion criteria or output. As most projects are inherently unique, these opinions often resulted in statements that a particular methodology did or did not work on a specific project

based only on the output (Bhasin, 2012; Darwish & Rizk, 2015; Saunders, 2018; Tam et al., 2020). When success or failure criteria and the methods used to achieve them are identifiable, these leadership evaluations represent valid data points that collectively can lead to conclusions about methodologies across similar projects. However, when the only evaluation criterion is the output, the ability to objectively evaluate how the output was arrived at becomes limited. Therefore, stating that success was the result of the methodology is somewhat inaccurate given that the outcome could have been achieved in spite of a poorly applied methodology - often through extended costs and time. In this situation, the end does not necessarily justify the means, and evaluation of methodology requires evaluation of much more than just the project output.

Success is also often subjective and nuanced, and most projects experience some level of struggle at some point in their lifecycles (Al-Dubai & Alaghbari, 2018; Davis, 2014; Pinto & Slevin, 1987). Thus, further research is necessary at the project practitioner level to assess projects from the *front lines.* Significant research is published attempting to define, qualify, and quantify what project success means. Many researchers reviewed in this work seemed to be striving for what they felt was the *best* way to measure success objectively. In the end, success remains a subjective topic that remains much in the eye of the beholder. Given this subjectivity, what defines success in one field or industry may not universally apply to another. Numerous sources reviewed on the topic of project success stated this fact, namely in the repeated attempts by many studies to define a universal set of critical success factors for projects. Specific to this research, this carries that the well documented success of iterative methods in the IT software field do not necessarily automatically apply to the IT infrastructure field.

Synthesis of Literature

The literature reviewed seemed to agree on several points. There is almost no argument about the origins of the two main categories of methodologies, nor is there a dispute about the fact that methods continue to evolve. Looking at the research chronologically, the evolution of methodologies is apparent, with each improving upon its direct predecessor. The theory of continuous improvement over time is evident in the volume of research still being conducted and published regarding project management methods.

Scholarly opinions deviated on the subject of methodologies concerning whether iterative methods eclipse and possibly replace their predictive predecessors or whether predictive and iterative methods should or do co-exist. Many sources reviewed took the former opinion stating that iterative, or agile, principles are a clear all-serving improvement over predictive models, which project managers should discard as a relic of the past. Other studies recognized the benefits that iterative practices have brought to the discipline but cited examples where they cannot fully replace the traditional predictive models, which remain the preferred methodology. A third school of thought emerged in the literature that indicated that the predictive and iterative models represent two ends of a spectrum and that most applications of project management methodology will fall on that spectrum somewhere in between the extremes. However, there is little guidance or best practice in the literature regarding how project managers should define or select their methodology from this available spectrum.

Additionally, much of the available literature regarding projects and project methodologies in the IT industry has focused on the software development field. Minimal research is published on the subject of project management methodologies for IT infrastructure

projects, which, by their nature, can have different methodology needs and requirements versus software projects. As previously discussed, project success is subjective and unique to the aspects of each project or industry category. What constitutes and drives project success in other areas of IT may not be universally applicable to the IT infrastructure field. Thus, further research is necessary in the IT infrastructure project arena to evaluate project methodology needs and how project managers should define methods to fit their projects to increase the chances of the project's success.

Review of Recent Literature

As the duration of this dissertation has encompassed a period of just over two years from 2019 to 2021, much of the preceding literature review was conducted in the first half of 2019 as the concept for the dissertation research was forming. Given the identified evolving nature of the field of project management, upon the completion of the study, a follow-up literature review was conducted to incorporate some of the more recent literature relevant to the present dissertation. This section details those literature findings following the same general framework as the prior review sections above.

On the topic of project success, Khoza and Marnewick (2020) confirmed the theory that success remains a highly researched topic based on the common theme that adhering to only the triple constraint of project management is simply no longer sufficient. Gemino et al. (2021) elaborated on project success specifically related to methodology approaches by stating that methodology selection as a factor of success is a topic that has not been well explored in the literature. This statement ties directly to the present dissertation. Additionally, Gemino et al. (2021) echoed the concern that the triple constraint is insufficient by demonstrating that agile

methods help to address a commonly mentioned fourth constraint of customer/sponsor satisfaction. While acknowledging that the traditional models better address the triple constraint of projects (scope, schedule, cost) better than their agile counterparts, the inherent feedback loops and communication that accompany agile methods help to ensure improved alignment with the stakeholders who affect the customer/sponsor perception constraint of success (Gemino et al., 2021).

Several studies continued to present iterative and agile methods as the preferred model over predictive. Despite identifying the benefits of predictive models in addressing the triple constraint, Khoza and Marnewick (2020) also presented agile in the framework of a solution to a problem whose name is waterfall. Their description of waterfall models echoes those of other authors discussed previously in this literature review who refer to them as outdated, and their depiction of agile principles is that of a more modern answer. Thesing et al. (2021) cited the origins of iterative practices in the software development industry but stated that the benefits of agile are seeing it start to emerge into other industries. Lalmi et al. (2020) discussed how agile methods can be integrated into traditional waterfall construction projects, and Corejova et al. (2020) explored the use of agile methods in enterprise digital transformations. Both sets of authors highlighted the perceived benefits of iterative models in integrating these methods with existing methodologies as part of a migration toward agile models. Bhavsar et al. (2020), Emami (2020), Jinzenji et al. (2020), Shastri (2020), and Thesing et al. (2020) all also discussed various aspects of the emergence and preference for implementing agile principles into existing project management methodologies.

However, there remains evidence in the literature that traditional/waterfall methods still exist and are prevalent in areas where agile may experience limitations. Emami (2020) cited that waterfall is still the most widely used methodology, even for software projects. Chandre and Kumar (2020) repeated the statement seen in earlier literature that not all projects can conform to agile models. Corejova (2020) wrote that implementing agile can address some of the limitations of waterfall, but this typically increases the workload on stakeholders who may push back by returning to their old waterfall ways, thus defeating the intent. Thesing et al. (2021) reiterated the limitation that agile models do not always align with existing organizational structures and processes which can lead to challenges in implementing agile projects versus waterfall. Bhavsar et al. (2020) took this a step further by saying that agile has inherent limitations and gaps and that waterfall models contain answers to these gaps. This would seem to state the converse of the previously stated theory that waterfall is the problem and agile is the answer.

Recent literature shows more frequent use of the word hybrid to explain modern project management models. The concept of an agile model called Scrumban, a combination of *Kanban* and *Scrum*, was discussed previously in this review (Ghilic-Micu et al., 2016). However, Bhavsar et al (2020) take this model a step further into a Scrumbanfall which also brings in the benefits of waterfall to address the gaps that exist with purely agile methods. Kuo-Wen (2020) described a hybrid model as providing the best overall value in large technical projects as it gains the benefits of agile without losing the structure of waterfall. Gemino et al. (2021) discussed that there is still not much research available in the field of hybrid projects and their inherent expectations and limitations, but the authors cite the increase in their appearance in project management practice. These mentions of hybrid models from the authors above as well as Baigu

et al. (2020), Lalmi et al. (2020), and Thesing et al. (2021) all highlight the appearance of the previously discussed spectrum of methodologies and the balancing act that project managers are executing between iterative and predictive models. As discussed briefly above, even PMI has acknowledged the prevalence of hybrid models in their website highlighting their forthcoming *PMBOK Guide Seventh Edition* (PMI, 2021). This core reference book in the project management industry has undergone a complete re-write versus prior versions to better address the emerging changes in the practice around agile and hybrid models.

Recent literature reviewed also repeated many of the same topics previously discussed as factors that influence agility or the ability to implement agile models for projects. Jinzenji et al (2020) discussed some of the challenges with implementing agile that may influence a trend toward more traditional models. The authors specifically cited that some organizations may struggle to adapt agile project models with their potentially incompatible organizational processes. Additionally, the authors posited that due to the lack of fixed scope in most agile models, organizations are struggling to measure performance to know whether or not they are succeeding against targets. As previously mentioned, Kuo-Wen (2020) confirmed that there still exists an opinion that not all projects are well suited for agile models, and characteristics of project size and complexity can influence this decision. Bagiu et al. (2020) and Corejova et al. (2020) both discussed aspects of agile awareness and training and the presence or absence of this knowledge is critical to the successful implementation of agile principles. Corejova et al. (2020) also detailed that successful agile implementation requires frequent and consistent collaboration and that absent the ability to facilitate this collaboration, agile models may not succeed.

The role of the project manager remains a topic of discussion, especially in agile circles where certain agile theories may state that there should not need to be a single project leader. Shastri et al. (2020) highlighted this opinion in agile models that because on paper, agile teams should be self-organizing, there should be no need for the role of the PM. However, they found that a project manager was still present in over 70% of the projects the authors surveyed. They credited this to the theory that most organizations are not able to go fully agile and thus at least some overhead remains that must be managed by a PM. Lalmi et al. (2020) repeated the previous position presented by Tiwana and Keil (2004) that methodology selection by the project manager is perhaps the single most critical decision made on a project. Because methodology is one of the first decisions made on a project, this decision can have lasting impacts on the future direction of the effort. In discussing the need for agile awareness and training, Emami et al. (2020) also discussed the role of project manager as a source of this knowledge, and Shastri et al. (2020) concurred saying that the influence and leadership style from the PM had a significant impact on projects overall.

Finally, further evidence was found of authors presenting agile and waterfall models as two tightly coupled systems from which a project must choose one or the other. Khoza and Marnewick (2020) provided a clear example of this in their characterization of waterfall as old and agile as new and improved. The authors present the decision clearly as a choice of either agile or waterfall without any discussion of the spectrum in between. This would seem to describe this choice of methodology as between two tightly coupled systems that cannot be split up and merged. However, the authors highlighted above who have indicated the significant emergence of hybrid models (Bhavsar et al., 2020; Lalmi et al., 2020; Thesing et al., 2021)

demonstrate that this split and merge is happening in regular practice. The clear presence of these hybrid models in the literature supports the theory that agile and waterfall are more loosely coupled and they are being merged to form hybrid models that balance the benefits against the limitations of each model.

Overall, the literature reviewed in this secondary literature review confirms much of what was found in the initial discussion. Some areas were elaborated further and some confirmed to still be as relevant as they were in previously cited sources. Additionally. some very recent articles mentioned and explored the same gap in research that the present dissertation has undertaken. These points have confirmed that the prior literature review remains applicable to the present study and that many of the questions previously identified as gaps are still present in the most recently available literature.

Summary

The scholarly literature reviewed for this study demonstrated a clear definition of project management as an ever-evolving practice. With roots in what literature defines as traditional project management methods and a present and future aimed at more iterative and agile methods, the available research illustrated a clear evolutionary path, driven by an underlying theme of continuous improvement and a focus on increased project success. While many studies described iterative and predictive methodologies as a binary decision of one or the other studies that are more current have highlighted a strong trend toward more hybrid methods, and a spectrum of available methods between the two extremes has begun to be defined. Project methodologies and the success they yield can be subjective to the type of project and the environment or industry in which it exists. The literature identifies the project manager as the methodology expert and the

individual that should be empowered to select the appropriate approach to apply to the project at hand. Specific to the IT infrastructure industry, there exists a gap in the literature concerning the study of methodologies and project success for these projects, and the present research seeks to address aspects of that gap.

CHAPTER 3. METHODOLOGY

Introduction

Using a qualitative inquiry methodology, this research collected and studied the experiences of project management practitioners in the IT infrastructure field. The qualitative inquiry method is specifically suited as this method addresses *how* questions (Goodyear et al., 2014) like the central research question in this study. By using semi-structured interviews, the researcher attempted to gain insight into how these practitioners are applying aspects of iterative and predictive project management when selecting methodologies for their projects (Josselson, 2013). After collection, the researcher analyzed the data using thematic analysis to determine if common patterns emerge, describing when practitioners are integrating these methods.

This chapter details the methods used to conduct this research, the participants and setting for the study, and the collection and analysis of data. The analytical methods selected are explained, and the logistics of obtaining data are detailed. Additionally, the researcher pays specific attention to the selection of participants and the protection of those individuals and the data they provide, as well as other ethical considerations.

Design and Methodology

This qualitative research consisted of an exploratory approach and a generic qualitative inquiry method to investigate how organizations select project management methodologies that may integrate aspects of iterative methods into traditional, predictive project environments in the IT infrastructure field. The goal of this research was to identify applications of project management practice on the discussed spectrum of methodologies between predictive and iterative to provide project managers with information to select appropriate methods that will

contribute to project success in future IT infrastructure projects. Utilizing a qualitative inquiry method facilitated the collection and evaluation of experiences of project management practitioners, along with their assessments of the success or failure of certain methods. These experiences shed light on techniques and practical applications of project management that may warrant further in-depth research and study.

Generic Qualitative Inquiry

Research conducted via a qualitative inquiry method aims to answer questions such as *how* or *why*. According to Goodyear et al. (2014), answering these *how* and *why* problems requires understanding levels of complexity and nuance that quantitative methods may fail to address. This method acknowledges that the researcher is studying the environment and experiences in which their subjects exist, and seeks to discover how the participants perceive the world in which they live and work.

Given that an individual's understanding of their environment is subject to their observations of their collective experiences, the qualitative inquiry method uses the interview process to collect these experiences in the form of narratives shared between interviewer and interviewee. The purpose of the collected narratives was to provide data for analysis that addresses the research question (Josselson, 2013). This data was co-constructed in that the interviewer and interviewee shared in the creation of the narrative, with the interviewer contributing questions or prompts that yielded a narrative response from the interviewee (Josselson, 2013). The interviewee's contribution was straightforward and takes the form of their responses. The interviewer also contributed to how answers are elicited in the wording of questions or prompts, or through context conveyed in the communication of the question. In this

manner, the interviewer and interviewee collaborated to produce conversational narrative accounts that the researcher is then able to analyze.

Interview Guidelines

Josselson (2013) stated that the planning of interviews as a data collection method requires identifying a structure to facilitate and invite participants to share their experiences. Interviews are inherently open-ended and designed to generate narrative answers. Interviews must also remain focused on the research topic at hand and should be conducted objectively across subjects to provide correlational data for analysis.

For this research, interviews were conducted in a semi-structured format using a pre-planned set of questions aimed at assessing the subject's expertise in the field of project management, their experiences leading IT infrastructure efforts, and their experiences with iterative and predictive methodologies. While this structure established the basis, the researcher granted leeway to deviate if an interview led down a path that potentially generated additional useful data. The researcher interviewed each subject once, analyzed the data collected, and conducted any follow ups necessary via email correspondence.

Participants

The target population for this study consisted of the set of industry certified or senior-experienced (greater than 10 years) project managers with current or prior experience leading IT infrastructure projects for large IT enterprises (greater than 1,000 employees). As the desire was that the sample participants be considered experienced practitioners in the field of project management, the additional criterion of possession of an industry recognized certification in project management such as PMP, PMI-ACP, Scaled Agile, PRINCE2 Practitioner, or CSM was

a requirement for all participants. In the absence of a certification, an equivalent of 10 or more years of experience was considered in lieu of the certification requirement.

The researcher recruited participants using a purposive technique known as a snowball approach (Cowles & Nelson, 2005; Singh, 2018) through existing professional connections and networks. Participants came from one of two groups: the first being individuals with whom the researcher connected directly through existing networks, and the second being connections to whom the researcher was introduced by members of the first group. All participants, regardless of their present location, possessed experience leading projects within the United States. The target sample of participants was 20 respondents, subject to expansion or contraction as necessary to obtain saturation and consensus and to allow for potential attrition of respondents throughout the study (Boyatzis, 1998; Landeta, 2005). Approximately 50 individuals were directly contacted, which led to initial screenings with 21. Of those 21, 12 met the study criteria and fully participated in the study.

Setting

The researcher conducted all interviews via a two-way video conference utilizing Zoom and recorded the meetings to enable the capture of the verbal conversation as well as any non-verbal communication aspects of the interviewer's questions and interviewees' responses. Each interview varied in length, but ranged from 30-75 minutes. The researcher subsequently transcribed the interviews to record the details of the narratives in text form. A similar structure was followed in each interview to establish consistency. The researcher allowed for deviations from the structure as needed to facilitate normal conversation or to explore further any new topics that emerged.

Instrument

The basis of the present research recognized that the practice of project management is in a state of continuous improvement and evolution (Baseer et al. 2015; Hussein & Seymour, 2014; Morris, 2011), that there exists a spectrum of project management methodologies ranging from purely predictive to purely iterative (Baird & Riggins, 2012; Ghilic-Micu et al., 2016; Hohl et al., 2018), and that project management practitioners are the identified experts in the selection of the appropriate methodology to drive project success in a given project (Laufer et al., 2015; Melo et al., 2011, 2013). The researcher created and the following interview questions, all of which were designed to solicit narrative experiences from the interview subjects. These questions were reviewed by a panel of experts from the University and a field test was conducted with an impartial project manager who was not part of the actual study. Constructive inputs from these reviews were incorporated into this final list of questions.

1. Can you describe the project management methodologies you have used in IT infrastructure projects you have managed?
    a. Did your project follow a more traditional or waterfall methodology or were they more iterative or agile?

2. Can you explain how or why these project management methodologies were selected, or why other methodologies were ruled out?
    a. How and to what extent do you, as the project manager, influence the selection of project management methodologies in IT infrastructure projects you have managed?

b. How and to what extent does the project team influence the selection of project management methodologies in IT infrastructure projects you have managed?

c. How and to what extent does any form of senior leadership or project management office influence the selection of project management methodologies in IT infrastructure projects you have managed?

d. How and to what extent does the end customer or client influence the selection of project management methodologies in IT infrastructure projects you have managed?

e. How and to what extent, do factors such as budget, size, or complexity influence the selection of project management methodologies in IT infrastructure projects you have managed?

3. What best practices have you developed throughout your practice of project management?

   a. Are there any specific steps, processes, methods, or activities you do on every project?

   b. Are there any specific tools or techniques that you use frequently?

   c. Are there any tools or techniques that you know other project managers use that you don't, and why don't you use them?

4. How would you describe the underlying project management culture in the organizations where you've managed projects?

a. How would you describe the culture at the organizations where you have managed projects?
b. Is the overall organization more traditional/hierarchical or less formally structured?
c. Does the organization have a formally organized methodology for projects, and if so, can you describe it?
d. If you've worked with multiple organizations, what differences did you observe in project management methodologies between organizations?
e. To what extent do external factors such as industry regulation or requirement influence the selection of project management methodologies in IT infrastructure projects you have managed?
f. To what extent do factors internal to the organization but external to the project (i.e., Finance, HR, Operations, etc.) influence the selection of project management methodologies in IT infrastructure projects you have managed?
g. To what extent does the location of the project team influence the selection of project management methodologies in IT infrastructure projects you have managed? (Co-location, remote)
h. To what extent do international or geographic factors influence the selection of project management methodologies in IT infrastructure projects you have managed? (Global teams, Global clients, Global cultural factors, etc.)
i. What other factors, if any, influence the selection of project management methodologies in IT infrastructure projects you have managed?

5. What is your definition of a successful project?
    a. Can you describe a project that you managed that you feel was successful and why?
    b. Can you describe a project that you managed that you feel was unsuccessful and why?
    c. How, and at what point in the project, has project success been measured or assessed in IT infrastructure projects you have managed?
    d. What factors, qualities, or metrics have your projects used to define and measure success?
    e. Are there any specific tools or approaches that you have used in managing projects to track and measure success?
    f. Were there ever conflicting views of the success or failure of an effort among various stakeholders, and if so, can you describe?
    g. What best practices have you learned or documented based on successful projects?

Credibility and Dependability

As discussed in the selection of interview participants, all interviewees were required to possess an industry recognized project management certification or 10 or more years of relevant experience. As each of these credentials has established professional, educational, and examination evaluation criteria, the industry recognizes them as indicators of credible project management practitioner expertise. In addition to certification, the interviewer asked participants to describe their experience leading IT infrastructure projects to establish their credibility as

sources of experiences in these types of projects further. In lieu of formal certification, the possession of 10 or more years of relevant experience was accepted as a qualifying criterion. The researcher assumed that the respondents provided accurate and thoughtful responses and had no ulterior motives to mislead.

Interview subjects were relied upon to provide reliable and accurate narratives in response to interview questions. The interviewer scheduled meetings at a time and setting that was comfortable for the interviewee, and the structure of the interview was established as a conversation to facilitate the free exchange of information. The researcher assured all subjects that their anonymity and the confidentiality of any information they provide will be protected to encourage them to be as open and honest as possible in their responses. Through these means, the researcher intended to establish an environment where interviewees' answers can be assumed true and accurate, and therefore dependable.

Data Collection

Interviews were conducted in a semi-structured format with a consistent set of questions used in all interviews to provide continuity. Interviews allowed for off-script follow-up and clarifying questions as needed to elaborate data or further explore topics that may emerge through conversation with the subject. This procedure ensured that responses informed the RQ while also allowing flexibility for the interviewee to share their experiences in a format that is most comfortable for them.

All data collection activities were approved by the governing Institutional Review Board (IRB), and no data collection was conducted before obtaining this approval. Prior to recruitment of candidates, expert reviews of the interview protocol were conducted, and a trial interview was

completed. Incorporated feedback from these activities improved upon the final interview protocol that was used for the study. The initial selection of subjects consisted of obtaining informed consent followed by a series of basic screening questions to ensure selection criteria were satisfied. Data was collected in the form of recorded videoconference interviews further captured in written transcriptions. Additionally, any hand-written notes by the interviewer were subsequently captured and stored electronically. The interviewer advised participants verbally and in writing before the start of each meeting that all recordings, notes, and transcripts will be kept confidential and will be reviewed only by the researcher and, as needed, by the review committee or IRB.

Data Analysis

Following data collection, the researcher analyzed the collected materials using thematic analysis. By definition, "thematic analysis is a process for encoding qualitative information" (Boyatzis, 1998, p. vi). Themes are further described by Boyatzis as patterns that describe or organize observations, or that interpret aspects of a phenomenon. Braun and Clarke (2006, 2014) advocated for the practice of thematic analysis specifically for applied research or in policy and practice studies. The authors offered thematic analysis as a structured way to analyze qualitative data and present it in such a way that it is easily understood within and outside of academia. As an academic and professional practitioner, the researcher selected thematic analysis for its simplicity in identifying and organizing qualitative data, and due to its ability to facilitate the presentation of findings in a way that is useful to the target audience – the project management practitioner community. Braun and Clarke (2006) described six phases of thematic analysis as

1. Project Mission: Data analysis is facilitated by and in-depth knowledge of, and engagement with, the data set. Familiarization – reading and rereading transcript, listening to audio recordings, making notes of any initial analytic observations – helps the researcher to move the analysis beyond a focus on the most obvious meaning.
2. Coding: A systematic process of identifying and labelling relevant features of the data (in relation to the research question). Coding is the first step in the process of identifying patterns in the data because it groups together similar data segments.
3. Searching for Themes: The process that involves sorting the different codes into potential themes, and collating all the relevant coded data extracts within the identified themes. Related codes are collated into overarching themes.
4. Reviewing Themes: The researcher pauses the process of theme generation to check whether the candidate themes exhibit a good fit with the coded data and with the entire data set, and each has a clear, distinct essence – or central organizing concept. Reviewing may lead to no or few changes, or to discarding the candidate themes and restarting the previous phase.
5. Defining and Naming Themes: Writing theme definitions (effectively a brief summary of each theme) and selecting a theme name ensure the conceptual clarity of each theme an provide a road map for the final write-up.
6. Writing the Report: The researcher weaves together their analytic narrative and vivid, compelling data extracts. Themes provide the organizing framework for the analysis, but analytic conclusions are drawn across themes.

Following the above model, the researcher collected and reviewed the interview recordings and transcripts to become familiar with the data available. From this familiarization, the researcher attempted to identify and code themes that appeared in the data. Data was then be reviewed again for evidence documenting the presence or absence of the identified themes. These themes were then defined in detail based on the information provided by the interview subjects. The researcher utilized the themes and their definitions to analyze and present relevant findings and conclusions in Chapters 4 and 5 of this research.

Ethical Considerations

First of importance was the protection of the human research participants and the safeguarding of the data they provided. Before participation, the researcher briefed all interview subjects on the purpose of the study, the intended benefits of the research, and any risks of participation. The researcher advised all participants at each point of interaction that they were free to withdraw from participation at any time. Interviewees indicated their willingness to participate and their ability to withdraw at any point by signing a written informed consent following IRB governance. Additionally, at each recorded interview, the participant was verbally asked to reaffirm that they have understood and signed the informed consent, their continued willingness to participate, and their option to withdraw at any time. The research will keep in confidence the identities of all participants throughout the study, with specific attention paid to preventing the ability to reverse-identify participants through their provided answers. Only the researcher, and upon request to review collected data, the dissertation committee or IRB will have any access to the identities of participants.

The subject matter of the present research concerns the practice of project management as an industry discipline. While the researcher asked participants about their experiences in managing projects in the organizations they have been a part of, the researcher did not ask participants to reveal the names of their present or former employers or any other professional affiliations they may have. The one exception to this rule was the disclosure of any project management certification credential as a criterion for participation. As with any other sensitive disclosures, these certification verifications will be kept confidential. The researcher assured participants at each interaction that if they should at any time, for any reason, reveal any such associations, that the researcher will keep these affiliations in strict confidence, and that names or descriptions of individuals or entities will not appear in this final published work.

The practice and application of project management are considered public knowledge, and this study contributed to that body of knowledge. However, in some cases, organizations may feel that their practices, procedures, and application of project management constitute intellectual capital or trade secrets. At no time were participants be asked to disclose any information that their present or former affiliations may consider intellectual capital or trade secrets. As stated above, if any such disclosures occurred in the course of the conversation, the researcher has kept these in strict confidence. As part of the informed consent, the researcher advised participants that they can decline to answer any questions or withdraw at any time for this or any other reason, without further explanation required. After each interview, the researcher asked participants if there is anything they have discussed that they would like excluded from the research due to any type of confidentiality concerns. The researcher has respected any such wishes of the participants.

The nature of the research in this study investigated the experiences of the interview subjects concerning their practice of the profession of project management potentially in their present and past employment or affiliations. As such, the site for this study was the general practice and industry of project management and was not constrained to any specific organization or entity. Further, the discussion or disclosure of particular organizations by name, industry, or any other identifying characteristic was not required. The researcher informed participants that they need not disclose any organization or individual names when discussing their experience, but if they chose to do so of their own free will, any such information disclosed will be confidential. Since the researcher did not use any individual sites for data collection, the researcher did not obtain site permission from any particular organization. The researcher obtained IRB approval for this waiver before any data was collected.

All data collected was stored electronically on encrypted and password secured cloud storage procured by the researcher. The researcher captured any physical notes or documents electronically and destroyed the physical copies. Following IRB procedures and requirements, the researcher will retain all data collected will for seven years from the date of publication of this research, at which point the researcher will permanently destroy the data.

Researcher Professional Disclosure

The researcher for this study has been a certified Project Management Professional (PMP #495609) from November 2007 to the present and currently works in the practice of project management in a leadership capacity. The researcher has been involved in IT infrastructure support, management, and projects for more than 25 years, including the delivery of projects using a range of methodologies from predictive to iterative. The researcher is also an adjunct

instructor of project management at the undergraduate level, and more specifically, the researcher teaches preparation courses for students pursuing the Project Management Professional certification. These credentials and experiences established the researcher's expertise and skill set with which to evaluate and analyze the project management practice data collected in this study. Additionally, as a certified PMP, the researcher is bound not only by the ethical guidelines established and governed by the reviewing IRB for this research but also by the professional and social responsibility requirements established by PMI and required for all holders of any PMI certification.

As the researcher used their professional network to recruit candidates for data collection interviews, there were research participants with whom the researcher has some form of prior professional relationship. In these situations, the researcher and participant have disclosed this prior relationship and discussed any relevant details as a part of the semi-structured interview process. Participants with whom the researcher held a peer-equivalent association were considered acceptable interview candidates. However, the researcher excluded any participants with whom any type of prior supervisory relationship existed between researcher and participant. Additionally, the researcher excluded any subjects with whom the researcher has a current professional relationship to eliminate any potential bias that may result from such a relationship. Also excluded were any potential participants who have been enrolled students in any of the researcher's classes.

Summary

This chapter summarized the structure and organization of this qualitative inquiry research. The researcher conducted a series of semi-structured interviews with identified project

management practitioners. Following which, the researcher applied thematic analysis to identify relevant findings in the data. This research concludes with the presentation of results and conclusions drawn from this analysis in the chapters that follow.

CHAPTER 4. RESULTS

Introduction

The research contained in this study investigated and identified how current IT infrastructure project managers select methodologies from a range between predictive and iterative models. It also looked into the circumstances under which they can integrate iterative and predictive methods as part of that selection to promote project success in their projects. In situations where iterative methods currently integrate with predictive models, this research attempted to determine the conditions in which these organizations and these practitioners found value in doing so in the form of increased project success. Given the identified lack of depth in research into this hybrid model of project management methodology, specifically within enterprise IT infrastructure organizations, this study will be of use to the IT industry to identify potential sources of efficiency that could apply to future projects.

Data Collection Results

Research Protocol

This research used a qualitative inquiry approach to interview a sample of experienced project managers who possess experience with IT infrastructure projects using iterative/agile or predictive/waterfall methodologies. The purpose was to determine their familiarity with basic agile principles and assess whether they integrate these principles into infrastructure projects. Where this integration is occurring, the project managers were asked to evaluate whether the integrated agile principles had an impact on the success of their projects. The objective was to obtain and present several experienced project management practitioners' collected opinions to determine how they select methodologies for their projects.

A semi-structured interview research protocol was developed by the researcher and consisted of a summary of the study's scope and a restatement of the research question. Primary questions were designed to address specific components that support the research question, and optional follow-up questions were created to provide additional context or optional points for elaboration for the interview candidates where necessary. The protocol followed the semi-structured format, allowing respondents to respond with narrative stories from their experience and with latitude to deviate as they saw fit as part of their overall narrative. This co-creative process enabled the data produced to be a collaborative effort by the researcher and interview subject through structured questions that generated narrative responses that can create an interactive discussion between researcher and respondent.

A panel of recognized experts reviewed the protocol to screen for appropriateness to the research and any outward appearances of bias. This panel consisted of two current Capella University doctoral faculty members and one former faculty member. Feedback from these experts included a consolidation of proposed questions to reduce any redundancies and to simplify the gathering of data inputs for thematic analysis. Further, the addition of a question regarding specific challenges faced by the respondents was added at the suggestion of one of the panel reviewers. Inputs and suggestions for improvement from these experts were incorporated into the final protocol utilized for the study.

Concurrent with and incorporating the inputs from this expert review, a field test of the protocol was conducted with a current coworker of the researcher who otherwise qualified for the study based on their prior experience but was excluded due to a current coworker relationship. A post-interview discussion followed this field test with the coworker to obtain

feedback and inputs from this field test. These inputs, which included minor clarifications to the wording of some questions, were also factored into the final protocol used for the remainder of the study.

Credibility, Reliability, and Addressing Bias

Credibility speaks to the validity of the data being provided by the participants in the study. In this case, the experiences and opinions being expressed are those of individuals identified as experts in their fields. The researcher established this expertise through recruitment and verification that each participant possessed experience with IT infrastructure projects and either held an industry certification in project management or greater than 10 years of experience in the absence of a certification. It so happened that each participant interviewed possessed 10 or more years of relevant experience regardless of certification status, and this experience was considered sufficient to establish their credentials as experts to provide inputs to the present study.

Reliability speaks to the accuracy of the data provided. It establishes that, in addition to coming from credible sources, the data can also be relied upon to be accurate and factual. Before meeting, interview participants were provided with and agreed to an IRB-approved informed consent advising them of their protections as participants in the study. Further, each was informed of the voluntary nature of their participation, and each was invited to decline to participate at any time. Participants were also advised that no questions were intended to ask for any sensitive or identifying information. Any sensitive information disclosed in the course of the conversation would be protected and held in strict confidence. Each interview setting was a casual one-on-one setting intended to encourage the free and open sharing of experiences. For all

of the above reasons, the researcher has no reason to question the truthfulness and accuracy of the responses provided. Thus, these responses have been relied upon as true and accurate representations of the experiences of these participants.

Outside of the credibility and reliability of the interview participants' data, there is the possibility of unconscious bias in the development of the interview protocol, in the conducting of interviews, and the thematic analysis conducted by the researcher. The researcher is also a practitioner of IT infrastructure projects and would meet the above-described criteria as an industry expert. Additionally, the researcher is an instructor at the undergraduate level in project management methodology. While this expertise was of significant use in this study, there exists the possibility of unconscious bias because of the researcher's own experience and opinions. For example, the researcher has experience in rigidly controlled methods dictated by an employer and situations where no method is proscribed. He can operate in both, but as an experienced practitioner, he holds a preference toward loosely defined organizational structures but tightly defined and individualized project structures set by the project manager. While this may bias the researcher toward assuming that experienced project managers know best, the research questions were specifically structured in an attempt to give equal weight to all influencers on project methodology. Additionally, the researcher teaches PMI's more traditional project management methodology which might sway bias toward this methodology approach, but every attempt was made to keep questions neutral regarding one methodology or another to prevent biasing respondents' answers.

Recognizing this potential for unconscious bias, every attempt was made to remove any conscious bias in developing the protocol. Questions were structured in a way as the not show

preferences toward one response versus another and were written in a consistent, repetitive manner to avoid any appearance of leading toward one end or another. Expert reviews of the protocol were sought and obtained to confirm the protocol's neutral intent and applicability before the interviews were conducted and to provide a check and balance against unconscious bias in the questions.

The researcher is not a professional interviewer, and while every attempt was made to conduct interviews in a consistent and unbiased manner, the closeness of the researcher to the development of the protocol and the subject matter leaves open the possibility of unconscious bias in the asking of questions and in replying to the participants' responses. To help address this potential, transcripts from the first two interviews were reviewed with the dissertation chair, and suggestions for improvement to remove bias were made. This included less back and forth agreement conversation with or prompting of the respondents to attempt to remove any potential for unintentional leading or rewarding of the participants for specific answers. Subsequent interviews flowed more smoothly and responses from participants continued to provide consistent data.

However, this potential for unconscious bias is recognized as an inherent component of the semi-structured interview method. In this co-creative process, the researcher constructs and asks questions that generate narrative prompts, while the participant provides data in the form of answers to those questions. Despite all the best efforts to craft a protocol free of unconscious bias, there remains a possibility that this bias may still exist. The research was undertaken with full awareness of this risk, however low it may be, and further consideration of the results presented here should account for this possibility.

Additionally, the researcher was the sole reviewer and preparer of the thematic analysis and relied heavily upon expertise in the subject matter to identify and code the themes documented. Every effort was made to objectively document the process and steps taken in the analysis to eliminate as many opportunities as possible for biased results. Additionally, quotes and context that yielded the themes have been presented as part of the results to support the validity of the themes identified and provide backward traceability. However, the qualitative analysis's subjective nature leaves open the possibility that unconscious bias may still exist in the results, despite the researcher's best efforts. Therefore, the results in this study are presented with that understanding, and they represent the researcher's best effort at unbiased findings.

Phenomenological Context

The practice of project management lends itself greatly toward subjectivity. There are no prescribed rules for the right or wrong ways to manage projects, and there are no definitive measurements of success or failure. However, as discussed previously, the goal of all project managers is to choose appropriate methodologies and that effectively and efficiently deliver their projects successfully. Therefore, this study sought to explore project management practitioners' experiences through the telling of their own narrative experiences with past and present projects. Through this process, the goal is to obtain information about how project managers navigate this critical and challenging choice of methodology and how they assess this decision's impact on their projects' successes or failures.

The available literature has established a spectrum of project management methodologies between predictive and iterative, so the experiences of these project practitioners were explored relative to this spectrum. The goal was to look for recurring themes or practices among project

practitioners that have led to success in IT infrastructure projects, with specific attention to incorporating predictive and iterative models when making a methodology selection.

Interview Participants

This study's target population consisted of the set of industry certified or senior-experienced (greater than 10 years) project managers with current or prior experience leading IT infrastructure projects for large IT enterprises (greater than 1,000 employees) in The United States. Participants for this study were recruited using a purposive technique known as a snowball approach (Cowles & Nelson, 2005; Singh, 2018). Initially, approximately 50 direct colleagues and network contacts of the researcher were contacted via email with an invitation to participate. Additionally, the researcher posted recruiting messages to LinkedIn via public project management groups, potentially reaching as many as 250,000 potential participants. As individuals responded and subsequently participated in the study, they were also asked to identify additional potential candidates, which yielded secondary contacts for interview candidates. When identified, these individuals were contacted directly via email with an invitation to participate.

Individuals who responded were further screened via email correspondence to determine their eligibility under the study's criteria. Those that were found to meet all required standards were provided an IRB-approved informed consent form to read and agree to before participation. Due to current IRB research requirements dictating that all interviews must be done remotely, some consents were obtained electronically using an IRB-approved method to solicit and obtain each participant’s informed consent. Once consent was obtained, a Zoom videoconference was scheduled to conduct the interview. After the interview, follow-up questions and clarifications

were conducted via email, as needed. During each interaction, participants were advised of their participation's optional nature and given opportunities to ask any questions they may have about the process or the protection of their involvement and any data they may provide.

Table 1
Study Participant Demographics

Participant	Education	PM Certification	Years of PM Experience	Industries
A	Master's	Yes	11	IT Consulting, Travel, Automotive
B	Bachelor's	Yes	15	Automotive
C	Bachelor's	Yes	12	IT Consulting
D	Master's	Yes	25	IT Consulting
E	Master's	Yes	10	Telecom, Travel, Financial Svcs.
F	Bachelor's	Yes	15	Correctional Facility Management
G	Master's	Yes	10	Healthcare
H	Bachelor's	No	10	Healthcare
I	Bachelor's	Yes	14	Travel, Insurance
J	Bachelor's	Yes	37	IT Consulting
K	Bachelor's	No	30	Software, Telecom
L	Bachelor's	Yes	17	Food/Beverage, Insurance

A total of 21 respondents were screened for participation, but six were found to not meet one or more criteria either by being located outside the United States or possessing too little experience. After the initial contact, three respondents declined to respond to the screening questions and were lost in subsequent follow-up attempts. This recruitment yielded a sample of 12 individuals who were interviewed over three months in early 2021. Those interviewed possessed between 10 and 37 years of IT project management experience, and the average across

the participants was approximately 17 years of experience. A total of 10 participants held Project Management Professional or Certified Scrum Master certifications, while the remaining two held no certifications but possessed sufficient experience to otherwise qualify for the study. Participants resided and worked in multiple areas of the United States. All had global IT infrastructure project experience and experience across the U.S. across a range of industries. While some international work was discussed, the focus was on projects occurring in the United States. All projects discussed had at least some portion of work conducted in the U.S.

Interview Setting

Following current IRB research restrictions on in-person interview research, all interviews were conducted remotely via Zoom teleconference. Where possible, sessions included video interaction, but technology limitations from the participants limited some interviews to be audio-only. While the video interaction was helpful in establishing a personal connection with the interview subjects, there was no discernible difference in the data collected between audio-video participants versus audio only. The absence of video participation from some participants did not appear to alter or influence their responses which were treated the same as those who appeared on video. The researcher conducted all interviews from a home office setting, and participants were either in their home, office, or other remote locations. As many of these interactions took place in private homes, the occasional child or pet interruption may have occasionally and briefly interrupted the flow of conversations. Additionally, a couple of interviews experienced brief technology issues that were resolved before resuming the discussions. Still, there were otherwise no observed hindrances for any respondents to speak freely and openly about their experiences. None of the participants hesitated to answer any

questions posed, and there were no observable restrictions on their ability to respond freely and openly.

Data Collection

All interviews were audio and video recorded via Zoom, and the audio portions were later transcribed using audio-to-text services from Microsoft Office 365 or the website Otter.ai. As no automated transcription services can produce perfect transcriptions from recorded voices, the researcher reviewed each transcript and made wording, punctuation, or formatting changes necessary to clarify the transcription versus the original recordings. Extreme care was taken to make these corrections without altering the intended message of the participants. The raw data transcriptions and the audio and video recordings were stored according to the data retention provisions previously described. They were made available for review by the dissertation committee and university IRB upon request. This data will similarly be retained in line with the provisions previously described.

Saturation

Yin (2018) described saturation as the condition when additional instances of data yield little new information. After interviewing approximately nine participants, a point of potential data saturation began to appear where respondents gave similar answers to prior participants. No new revelations were being discovered in new responses. Research continued with three additional participants to confirm this saturation state had been reached. After the twelfth interview, no further data points had appeared, and participants were covering or reinforcing the same topics discussed by earlier participants. At this point, a level of saturation was assumed to

have been reached, and further interviews were deemed likely to provide little or no additional value. Data collection activities then concluded, and data analysis began.

Data Analysis and Results

In their explanation of thematic analysis, Braun and Clarke (2006, p. 10) described themes as "something important about the data in relation to the research question, and represents some level of patterned response or meaning within the data set." Following the thematic method outlined by these authors, the analysis presented here began with a project mission phase where the collected data was reviewed multiple times to gain in-depth familiarity. This review was accomplished through repeated viewings of the recorded interviews and the preparation and editing of the written transcripts. As the transcripts were generated via an automated tool, the researcher needed to read and re-read these transcripts and the recorded audio to make corrections to the text where the automated tool may have transcribed incorrectly. This multiple review process yielded a strong familiarity with the dataset as a whole which then supported later analysis steps.

Coding requires identifying and labeling relevant points of data that align or contribute to answering the research question. After reviewing the datasets, several topics emerged that could be used to develop overall themes further. The codes presented as general topics such as project management methodology, project success, and project management strategies or lessons learned. These identified topics were then used to extract quotes from the interviews that provided related data points. Reviewing these quotes grouped by topic allowed for the emergence of consistent messages or themes present in multiple participants' responses.

These themes were reviewed and framed in a way to support the exploration of the central research question. Each theme was defined and named, and a brief definition was developed to summarize and explain the theme as it relates to the overall research question. The themes, codes, and theme definitions discovered in the research are presented in Table 2 with analysis to follow.

Table 2
Thematic Analysis–Themes, Codes, and Definitions

Theme	Identified Codes	Theme Definition
The predictive/waterfall methodology is still used prevalently in IT infrastructure projects.	Waterfall, Predictive, Structured Control, Detailed Planning, Infrastructure vs. Software Development Projects	Predictive or waterfall methodologies are still used and favored consistently in IT infrastructure projects. Respondents discussed strong leanings toward these models as a matter of habit/culture as well as from the perspective of a better fit to project scope and delivery expectations.
Multiple factors and influencers determine project management methodologies for IT infrastructure projects.	Influences on Methodology, Degree of Flexibility in Adapting Methodologies, Methodology Decision Making	There are many factors and stakeholders that influence the selection of methodologies for projects. Responses ranged from the methodology being the absolute choice and prerogative of the project manager to situations where the organization dictates one and only one methodology regardless of whether it is a fit for the projects. In situations where a method was dictated, project managers were inclined to comply. However, in some cases, the project managers also worked around the requirement by maintaining separate project management artifacts aligned to a different methodology that the project manager felt was better suited to deliver the project successfully.

Table 2 continued

Thematic Analysis–Themes, Codes, and Definition

IT Infrastructure project managers are integrating iterative/agile principles and methods into their projects.	Integrating Agile/Waterfall, Hybrid Methodologies, Adaptive Methods, Understanding Project Environments, Kanban, Scrum, Sprint	As identified subject matter experts in project management for IT infrastructure projects, the project managers interviewed were aware of the concepts, benefits, and limitations of both iterative and predictive methodologies. Each respondent discussed methods in which iterative principles can be, or actively were being integrated into their projects, even if this required integrating with an already present predictive model.
IT Infrastructure project managers are integrating iterative/agile principles and methods into their projects.	Integrating Agile/Waterfall, Hybrid Methodologies, Adaptive Methods, Understanding Project Environments, Kanban, Scrum, Sprint	As identified subject matter experts in project management for IT infrastructure projects, the project managers interviewed were aware of the concepts, benefits, and limitations of both iterative and predictive methodologies. Each respondent discussed methods in which iterative principles can be, or actively were being integrated into their projects, even if this required integrating with an already present predictive model.
Challenges remain in adapting iterative methods in IT infrastructure projects.	Challenges, Difficulty, Obstacles, or Limitations in Adapting Iterative Methods	While each project manager interviewed acknowledged their ability or direct experience with integrating iterative and predictive models, they admitted that doing so is not without challenges. Several respondents reported issues with application, adoption, or cooperation among stakeholders. In some cases, the respondents claimed that the difficulties were sufficient to determine that the iterative models may not align when project requirements call for a more predictive model.
Project success remains a highly subjective measurement. Project managers develop strategies to improve project success for future projects via their experiences on past projects.	Project Success, Project Failure, Success Factors, Customer Satisfaction, Triple Constraint, Best Practice, Lessons Learned, Rules of Thumb	While all project managers still adhere to the triple constraint definition of project success of scope, schedule, and cost (PMI, 2017), most recognize that other factors such as sponsor or customer satisfaction with the output are also critical indicators of success. As such, these project managers develop strategies through the course of their careers to meet all of these definitions of success to the best of their ability.

Table 2 continued

Thematic Analysis–Themes, Codes, and Definition

Iterative/Agile methodology awareness, education, and favorability among stakeholders influence the ability to adapt iterative methods.	Agile Training, Agile Education, Agile Awareness, Leadership Cooperation/Favorability with Agile methods	Implementing iterative or agile methodologies requires knowledge of the method, and often this knowledge must be shared with or taught to stakeholders. Without proper knowledge or training, organizations may not implement iterative methods in ways that yield the greatest contributions to project success.
Appropriate communication is a critical success factor in IT infrastructure projects.	Communication, Meeting Structures, Meeting Frequency, Communication Audiences, Communication Tools, Communication Forums, Communication Challenges	Communication represents approximately 90% of a project manager's time (PMI, 2017). A majority of the interviewed project managers reported communication factors as critical to project success and that communication challenges could hinder success. Some elaborated further that appropriate communication was essential to ensure the right message reaches the proper stakeholders at the appropriate time. Appropriately adjusting communication styles is a critical strategy that contributes to increased project success.
Project managers will adjust and adapt their methodology as needed to drive project success.	Adaptive methods, Changing Methods, Applying Multiple Methods, Adopt Methods	Project managers are motivated sufficiently to deliver project success that they will adjust and adapt their approach and methodology as needed to meet expectations of project success. This can result in applying multiple methodologies between different projects or even simultaneously on a single effort.

Analysis of Results

Through the thematic analysis process described, several themes were discovered to be present across the responses received from the project managers interviewed. First, despite the emergence and popularity of iterative/agile methods, the predictive/waterfall methodology is still prevalent, and in many cases preferred, for IT infrastructure projects. Despite this preference for waterfall, IT infrastructure project managers are selecting methodologies that successfully

integrate agile principles into their predictive/waterfall projects with varying degrees of success, and many factors affect this methodology decision. However, there were also many challenges reported in integrating predictive and iterative methods. Awareness and education levels of agile principles and practices vary significantly among project stakeholders, and that awareness impacts the ability to implement agile methods effectively. Additional themes presented themselves in the strategies respondents used in making methodology selection decisions.

Among these themes was a significant focus on appropriate communications that are timely, relevant, and specifically targeted to the correct audiences. Challenges included lack of agile training, awareness, or buy-in from leadership or stakeholders, or overly prescriptive methods dictated by a project management office or other leadership entity that may not fit the project's needs. Overall, project managers have learned to become adaptive in their application of methodologies, often implementing multiple methods or varying the methodology within individual projects to increase project success probability.

Prevalence of Waterfall in IT Infrastructure Projects

The Predictive/Waterfall methodology is still used prevalently in IT infrastructure projects. All of the project managers that participated reported that predictive/waterfall methodologies are widely used in their infrastructure projects. Topics discussed that yielded codes used in analysis included direct descriptions that referred to “waterfall methods”, mentions of “predictive schedules” for project efforts, and the distinct differences between IT infrastructure projects and software development efforts. Respondent E stated it plainly by saying, “The existing PMO is engrained with waterfall.” Others gave similar responses such as Respondent J, “Mostly, the infrastructure side, in my experience has been waterfall.” Respondent

G also mentioned the “tighter control” of the waterfall method and that waterfall was “the best” for the IT infrastructure projects they had supported. These repeated phrases led to the theme that predictive/waterfall methodologies are still used and favored consistently in IT infrastructure projects. This prevalence for waterfall was attributed to both a better fit to the projects as well as organizational habit and culture toward this method.

Waterfall often best suits IT infrastructure projects. Each participant had minimal or greater experience with agile methods, and several possessed one or more industry certifications in agile project delivery. However, a consensus was observed that the waterfall method best suits most infrastructure projects because the often binary aspect of the scope of infrastructure projects does not necessarily fit the cyclical or iterative deliver-early-and-often nature of agile (e.g. a server is either installed or it is not). Respondent G described a “stage-gate kind of approach” for infrastructure projects that was best suited to waterfall. Respondent F compared the waterfall to existing IT infrastructure support models that “predict if you do this, then this is your outcome.” Additionally, these projects' linear paths and the inflexible dependencies between steps prevent work from being done in parallel or iterative cycles (e.g. equipment must be installed before cabling can be connected). In many instances, individual steps are performed by different teams, and the work may often require being in the same physical space, such as in a data center. In these cases, it better suits the project to have one team finish and leave the project space before another team enters. This type of hard dependency between groups and physical location does not fit well in an agile model, and these types of projects will tend to be more predictive in nature. Similarly, as infrastructure projects grow in size and complexity, this often leads to the need to coordinate multiple otherwise autonomous teams. Respondent K described these

infrastructure projects as “massive scale global projects” that have been primarily waterfall managed. These situations where teams intersect and depend on one another’s work but do not necessarily need to work collaboratively tend more toward an overall linear and predictive schedule of work versus an iterative one. When these described conditions present in IT infrastructure projects, project managers may be more inclined to select a waterfall method.

Waterfall is often built in to company culture or practice. As stated above, Respondent E reported that the existing organizational culture was “engrained with waterfall.” Other respondents reported that other supporting structures such as IT ticket management systems contributed to this more linear approach to projects. Respondent F cited the IT Infrastructure Library (ITIL) framework for IT service management as a complementary function that may dictate project methods. These IT service management systems can become synonymous with how an organization delivers IT services, and thus the IT ticket system can have the potential to influence project methods significantly. Additionally, respondents reported that some organizations prefer one overall approach for all projects for simplicity and consistency’s sake and would push this method to fit their projects. Respondent A discussed the presence of “a PMO that’s providing lots of templates for charters and schedules of how everything has to be outlined and organized.” This PMO structure is often a strong influence on methods that are applied and they are often aimed at a one-size-fits-all approach. Often this preferred method was waterfall based on either historical precedent or reluctance to fix something that was not perceived as broken. Respondents A and C both expressed that their organizations would reject projects outright if they could not be presented and managed in the preferred methodology. As

with the conditions of the project in the section above, when conditions in the operating environment align better with predictive work, a waterfall method is more likely to be selected.

There is evidence that methodologies are evolving toward agile. While over half of the respondents acknowledged that infrastructure projects are evolving into utilizing aspects of agile, most infrastructure projects trend toward the predictive side of the methodology spectrum. Whether this is out of habit, necessity, or choice varies by organization, but the *default* methodology for infrastructure projects appears to be the predictive model. Deviations into iterative models appear to be primarily situational when these processes align to project needs. Respondent K cited, "a 70/30 split" between waterfall and agile, and Respondent A described, "an agile transformation… a very large push to run as agile." Most respondents expressed a genuine interest in integrating agile principles when selecting methodologies and quickly identified both the benefits and challenges of doing so.

Factors That Influence Methodology Selection

Multiple factors and influencers determine project management methodologies for IT infrastructure projects. The codes that presented in the interviews included direct discussions around "influences on methodology" where participants were asked what they felt influenced the selection of methods. In their responses, the project managers interviewed described varying "degrees of flexibility" in their ability to choose methods. Respondent E reported they were "able to assist in influencing" agility based on their experiences, while Respondent J reported that the "methodology is always driven by the client" organization. Cultural factors such as "layers of leadership" were cited, as were factors of the projects themselves such as size, duration, or complexity. Respondent C worked at one organization where the senior leader was

"a big proponent of agile" while at another organization, the multiple layers of leadership had their "own methodology which aligns to PMI" and was more waterfall in nature. When combined, these responses led to this multi-factor theme of influence on the selection of methodologies for IT infrastructure projects.

Sources of influence ranged from strict organizational requirements to autonomous methodology selections by the project managers. In some situations, the sponsoring organization dictated and enforced the methodology selection from a leadership or project management office perspective. In others, there may be loosely defined or no requirements for a methodology, and the decision was left to the project manager. As previously mentioned, Respondents A and C both worked in organizations where the methodology was mandated absolutely by the organization. Meanwhile, Respondents F, G, and H reported varying levels of the methodology being "left up to the PM." While the actual application of any method was mainly the project manager's responsibility, different organizations had different ways of enforcing one method or another through the use of required reviews, documents and artifacts, or required reporting structures and formats. The organizations cited by Respondents A and C enforced compliance through required project management artifacts and by withholding project funding. Specifically, respondent A cited, "there was a very large push of 'this project needs to be run as agile' if it's going to get funded." Some respondents even reported a bit of an "identity crisis" in some organizations whose outward representations of their organization follow one methodology (often agile) versus their actions and requirements, which dictate another (often waterfall). Respondent E described a situation where leadership said, "Yeah, we're doing Scrum. We're practicing agile... but then their manner and method of applying that is really not following agile

because of expectations of reporting or key performance indicators (KPIs) to deliver more of a waterfall" structure. This contradiction underscores organizations' desire to be seen as agile, even if their actions do not directly conform to the methodology. This can create a significant challenge for project managers to select a methodology that is not only best suited for their project but one that also conforms to the pressures of leadership and the organization.

Some respondents cited the maturity of the organization and its supporting processes as contributing factors. Larger, more mature organizations with well-established supportive functions (HR, Finance, IT service management, etc.) were more likely to have an established project management framework that aligns with and integrates these other business functions. These organizations had more robust structures around methodologies, even if those structures allowed the project manager to tailor the method at the project level. Respondent G relayed, "If you're on a larger project, there's certain requirements, certain things or milestones, prescriptions." Smaller, more entrepreneurial organizations may be more willing to allow for flexibility or the absence of rigorous project methods. Respondent F explained this from a smaller organization where "there were things that that we did on the fly that are very much in the agile mindset. But they were allowed because oftentimes there was flexibility." Respondents indicated these organizations might find that they do not need control and governance levels that larger organizations do. However, some instances were reported of organizations that started projects in one methodology when in the organization's early stages, but as the organizations grew, there was a need for the project management methods also to evolve. Per Respondent C, "We do the walk Crawl run model. We start off slow. We've kind of learned we do we go

through a few iterative processes of trial and error or pilot phases and then we just do traditional waterfall."

Respondents also reported that in some organizations, one and only one project methodology was allowed for all projects. In these cases, this requirement was regardless of any other influences. In one of these cases (Respondent C), the decision of project management methodology selection came down to a single leader who had an affinity for a specific methodology (in this case, agile). This leader also held a leadership position with one of the many agile industry organizations and was in a sufficient position with this respondent's firm to influence the decision that all projects must follow a single agile methodology. In another case (Respondent A), the overall organization had a culture that if a project could not be executed in an agile methodology, the project's necessity was called into question. The requirement for agile delivery was so much a part of the company culture that projects that proposed a traditional method were often not funded, even if the project managers felt a traditional model was better suited. In these cases, project managers had learned that if they wanted their projects funded, they must present them in such a way as being at least seen as complying with this requirement, even if behind the scenes, actual project activities were otherwise. It is this condition that led to the reports from two respondents that they were selecting one methodology to conform to organizational requirements, but they were selecting another to operate on their own to best align to the work.

Other respondents reported a strong cultural preference for waterfall and that organizations had developed their own custom methods for executing projects. In some of these cases, the waterfall-based model had been developed over many years and had become so much

a part of the way projects were delivered that there was not much opportunity to integrate iterative principles. This concept of "that's the way we've always done it" ran strong in these organizations, and there was little awareness or interest in any value that new methods might introduce. Their model was established, and the organization saw no reason to change it. This was particularly strong at one of Respondent C's employers who operated in a very hierarchical management structure and preferred their well-established traditional method because it aligned to their culture. Respondents B, I, J, and K reported varying levels of the methodology being dictated by the culture of either leadership or the organization itself. They described situations such as methods being "dictated by the mothership" or where project managers operated as "part of a PMO, who followed a specific process." These situations were described as operating procedures that had been established by the organization, not necessarily in response to specific project requirements. Regardless of other conditions that might influence methodology, these influences strongly steered projects to operate in a predictive model.

The project manager's role significantly influences the methodology chosen on top of any organizational requirements or influencers. Irrespective of any organizational requirement, it is ultimately the project manager who applies the method to the project's delivery, so which tools and techniques are used is left greatly up to this individual. "Really… it's left up to the PM," according to Respondent H, and Respondent I relayed that there is an, "enterprise PMO structure that helps define what the standards are around that. It comes to the PM to decide which one of the structures to use." In these cases, the project manager can choose to fully comply with an organizational requirement or decide to take an alternate path if they feel it best suits the project. Most project managers interviewed expressed that they had at least some latitude with managing

their projects, even if other structures were strictly enforced. One organization may require a specific structured reporting format but not dictate how the data for it is gathered (Respondent J). Another might implement certain linear checkpoints but leave the activities between those checkpoints to the project managers' discretion (Respondents F and G). In each case, the methodology is less of a step-by-step how-to requirement but rather a framework in which projects are free to operate. The boundaries for methodology selection within this framework are the domain of the project manager.

The degree to which project managers deviate from an organizational culture or methodology appears to depend on the maturity and skillset of the project manager and the organizational structure. Some respondents reported that when they were more junior in their roles, they felt a more substantial need to conform and follow the rules established by those in more senior positions. As they developed experience, they felt more comfortable and more empowered to deviate from the norm as they saw fit. According to Respondent C,

> Whenever I was a much lower-level PM, I wasn't given that freedom. During my earlier years, I wasn't as fortunate and I had to play by the rules and put it through these proper processes. Even when it didn't make sense.

Respondents also reported observing this same phenomenon in their more junior colleagues who tended to operate more "by the book," while more senior colleagues operated more autonomously. However, even the more senior and skilled practitioners reported that they might not be free to explore alternative methods from the company standard in a more rigid corporate environment or if the framework in which they operated was more restrictive. Respondent G summarized this as,

> I've done pure waterfall, I've done agile, I've done both of them. And after doing both of them for a few years, I realized that one size doesn't fit all. You've got to understand what

> you're doing... you've got to understand what project management is... and how you blend the two together into the environment in which you're trying to execute.

In some of these cases, project managers reported they were deviating from required methodologies anyway and often operating two different methods simultaneously – one to meet the organizational requirements for following the standard process and one that was more suited to accomplishing the project's work. Respondent C reported,

> I would have to put it into [Agile tool] and use their programs for all that, but at the end of the day I've lost my project plan so I would build my own project plan on the back end, meet the company's needs and format in the way they want, but still understand how it's actually going to be run is based off of my project plan.

While this may appear to be inefficient double-work, these project managers reported that they saw what they were doing as complying with project and sponsor requirements while also doing what they felt needed to accomplish the work. Effectively, the project artifacts in these situations became part of the project deliverables instead of tools to facilitate delivery. They were an output required by the organization to satisfy stakeholders that specific processes were being followed regardless of whether those processes contributed to the project or not. These project managers reported that it was easier to comply and do extra work than to disrupt the system by disputing the organizational methodology. Respondent I described this by saying, "As a project manager, or a program manager, there's a certain amount of flexibility associated with being able to adopt a certain standard and put that into implementation." The project managers who described this double-work environment did not seem overly bothered by the extra work that the situation created. They simply saw it as a challenge to which they must adapt to achieve their projects' goals. By adapting their style into following two methodologies, they were successfully leading their projects while also complying with organizational mandates.

Integrating Agile and Waterfall in IT Infrastructure

IT infrastructure project managers are integrating iterative/agile principles and methods into their projects. While there was a strong tendency toward the waterfall model for IT infrastructure projects in the interviews conducted, there were also examples of agile principles making their way into these projects in varying degrees and with varying levels of success. Respondent C mentioned that they would occasionally "run little Sprints or run a little agile with your waterfall," and Respondent G mentioned the need to "blend the two together into the environment in which you're trying to execute." Other responses included mentions of agile components of "Kanban," "Scrum," and "DevOps." These mentions of agile methods along with the underlying context of the prevalence of waterfall methods led to the theme that IT infrastructure project managers are integrating iterative/agile principles and methods into their projects.

Some respondents reported environments where agile methods were required by the organization despite conditions favorable to waterfall. As presented above, Respondents A and C both encountered this situation where a specific methodology was required that may be contrary to the needs of the project. This led to situations where the project managers did not feel that agile models best suited the project, or that a waterfall model would better apply, but they were required by their organizations to operate using agile methods anyway. Other project managers reported that agile methods were not required but were encouraged either directly through recommendation or indirectly through implications or to mimic other teams (such as software developers) who applied agile methods. Respondent C detailed situations where they were, "doing some software development integrations between big out of the box platforms" and this

required integrating with agile frameworks when their project was more waterfall. In many cases, the overall methodology decision was left entirely up to the discretion of the project manager. In these cases, the project managers could integrate iterative principles where they felt these methods would best serve the project's goals. Regardless of the environment, each project manager still believed it was their responsibility to effectively lead the project toward the stated goals using whatever tools were at their disposal. They simply reported varying levels of flexibility in which to work within their overall project management frameworks.

Situations where agile methods were introduced included projects where there may be an inherently cyclical or repetitive nature to the project scope. This situation was seen in projects such as the physical installing of servers and equipment in data centers. This type of work could occasionally lend itself to an iterative method of repeating specific steps cyclically as part of an overall linear project rather than completing each task fully before beginning the next. Respondent D cited an example of, "The way that I could build in some agility in that is in the sequencing of the build-outs within the data centers." Rather than installing all of the multiple racks of equipment at once and delivering when the entire data center was complete, small batches of racks may be built and delivered while subsequent batches were still in work. This approach aligns with the agile principle of delivery early and often and allows work to be broken into smaller functional deliverables versus one large one.

Other projects may have a series of steps or processes through which each unit or component of work would need to progress to reach the desired future state. In these situations, a Kanban, or card-and-process-based approach, could be used to track each work process's progress through the linear work steps. In a Kanban example, each unit of work is represented by

a card, either physically or in a project management software program, and this card moves from phase to phase as work steps are completed. The set of all cards represents the entirety of the project work. Thus, by observing all of the cards in each relative phase, the project's status as a whole can be observed. Respondent E reported, “There are some flavors, if you will, of Agile that I feel work best for infrastructure teams. In my current situation, the team is doing Kanban.” Respondent I concurred stating, “I initially saw Kanban as a primary method of a transformation” in infrastructure projects. As a practical example, the configuration steps for an individual server among a group of servers could represent the phases, and a Kanban card would represent each server. As the server progresses through sequential steps, its card moves visually through the Kanban board phases to represent its progress along with all other serves/cards on the board. When all cards complete all phases, the project effort is complete. In these situations where an agile model fits the work, infrastructure PMs may be more willing to deviate from the waterfall method.

A frequently mentioned aspect of agile methods being integrated with infrastructure projects was the concept of adapting to change. Respondents indicated an impression in many organizations that the predictive model was too inflexible to deal with the inherent changes required by the organization or industry. In these cases, aspects of agile’s flexibility and openness to incorporating change made their way into the overall project methodology. Respondent F shared an experience responding to change where “there were things that that we did on the fly that are very much in the agile mindset. But they were allowed because oftentimes there was flexibility.” In the organizations where the culture was a bit more open to agile methods, the ability to incorporate changes or new developments was seen as a positive outcome.

In organizations that were more rigidly waterfall, requirements tended to be more fixed. If changes were allowed, they followed a much more structured process for introduction to the project, and this process often served as a barrier to prevent change that was often equated with scope creep. When these barriers are not present, an agile approach is more likely to evolve and be effective.

Challenges With Integrating Iterative Principles

Challenges remain in adapting iterative methods in IT infrastructure projects. Respondents reported that the integration of predictive and iterative methods is not without its obstacles. As Respondent C explained, “You can't always fit a square peg in a round hole. You can't shove agile into a traditional waterfall project.” Respondents were asked directly about any challenges that had encountered when trying to integrate agile methods into their projects. This led to mentions of these challenges, obstacles, or limitations of agile. Respondent E reported a “drive for a lot of the scrum teams to operate more as Kanban teams and ironically what you end up with is they kind of end up being project schedules or they're not working.” Obstacles mentioned included size with descriptions that “agile projects have all been on the smaller scale” (Respondent A) followed by descriptions that agile was not used on larger infrastructure efforts. Respondent A also reported that some items “that used to be easily solved in the waterfall world, in the scrum world become more difficult.” Lastly, two respondents (A and C) reported that in their organizations “everything had to be agile”, but that this method did not always fit with the way the work was presenting itself. These reports of difficulties and obstacles in implementing agile yielded the theme that challenges remain in selecting methods that integrate agile and waterfall in IT infrastructure projects.

Infrastructure project managers see agile methods as useful when the project situation calls for them. Still, there are often conditions within the organization or specific to the project that will determine if agile methods are applicable, and agile should not simply be used for agile's sake. Per Respondent A, "Agile was kind of for when things could work in parallel and things could one thing could slip and that would impact anything else. And obviously, infrastructure projects don't always work that way." As discussed above, some project managers were required to use agile methods even when a predictive model was better suited. Some would choose to run a second "behind the scenes" methodology to execute project work effectively. Respondents E and G found that the application of agile methods simply did not work, and the team just naturally fell into a more predictive mindset instead of agile because this aligned better with the work at hand.

Some project managers cited the size and complexity of their projects as a reason to lean more toward waterfall versus agile models. Smaller projects with smaller teams were more likely to have the flexibility necessary to see success in integrating agile. In comparison, larger, more complex projects tended to need more control and oversight that accompanies waterfall. Respondent A stated that agile "doesn't really scale well" relative to the tasks required for large infrastructure efforts. The consensus was that while agile works in a smaller single-team environment, it cannot necessarily also work in a sizeable multi-team environment because many of the agile benefits are lost or become too cumbersome to obtain, thus diminishing their overall value. Respondent A elaborated by explaining,

> You have entire platforms that are organized in the scrum teams. And then each one kind of has to integrate, you know, as a portfolio to accomplish work across multiple projects. You can kind of create delays if you miss one team's sprint and have to get in the next one.

In this way, there were reports that attempting to use agile to manage infrastructure projects was perceived as detrimental to some projects instead of helpful. In trying to implement and manage an agile framework in an environment where it did not work well, more work was being done to maintain the methodology than was being done on actual project delivery. Agile was also sometimes seen as short-sighted and prone to lose the bigger picture that may be seen more clearly with a waterfall method. The focus in an agile environment can become so focused on delivering only the short-term gain that the overall long-term goal can become lost. Overall, it was observed from the respondents that increased size and complexity in IT infrastructure projects led to a decrease in the applicability of agile methods and a stronger tendency toward waterfall.

Even if an agile method was best suited, other resistances from within the organization could derail the effort to integrate processes. In situations where the project conditions fit an agile method very well, if project sponsors and key stakeholders did not understand or support the agile methodology, often this could lead to difficulty in trying to implement it, and the project may suffer as a result. Respondent E described this in terms of the "maturity level and the flexibility or the eagerness of leadership" to accept agile methods. Alternately, in some situations where agile was mandated, but a waterfall method was better suited in the opinion of the project manager, leadership was inflexible in allowing deviation from their standard. As mentioned above, some organizations refused to fund projects based solely on whether or not they could follow the predetermined methodology. In these cases, leadership forced the project into compliance by requiring stage-gate-type reviews or other artifacts that push the project to operate in a waterfall fashion. In this situation, no attempt is even allowed to introduce any benefits

derived from alternate methods and the selection decision is effectively made before the project is even initiated.

Project Success

Project success remains a highly subjective measurement. Every project manager interviewed repeated some form of the triple constraint of scope, schedule, and cost management as part of their answer to the questions, "How do you define a successful project?" but no two gave completely similar answers. The respondents all acknowledged that the baseline to start measuring project success is relative to this triple constraint and whether the project delivered the desired scope, in the desired timeframe, at the desired cost. This was seen in their responses through their direct reference to the triple-constraint by name, or through their mention of satisfying "scope, schedule, and cost." A common misconception about project management was cited as false by one project manager who indicated project success is not simply about "completing all of the project management artifacts." Respondents added that there was a deeper meaning to project success through less subjective terms of "customer happiness", "customer requirements" or "client satisfaction". Project managers reported that they saw it as their goal to develop practices to best deliver not only the objective measurements of the triple constraints but also satisfy these more subjective measures of success. This presented the theme that project success measurement remains highly subjective, and project managers continue to strategies to improve success for future projects via their experiences on past efforts. Respondent B summarized it by saying, "If the clients unhappy, it's not successful. But happiness and success for a client that you're working and delivering for is relative, so that can be difficult."

While recognition was given to the triple constraint project management theory, it was recognized that only managing these factors was not enough. It was also possible to deliver a successful project under those constraints but still be deemed a failed effort if the sponsor's needs were not satisfied. However, the converse is also not true. A project cannot simply focus on making the customer happy at the expense of the triple constraint and still expect to be considered a successful venture. Respondent A explained,

> I think explicitly a successful project is not one that (only) completes all the project management artifacts. I think too often the project management becomes the end goal instead of the goal of the project. The project management should facilitate the end of the project. It should not be the thing you're doing just because.

Respondent K tied this to customer satisfaction with, "A successful project is when the customers defined requirements, as they understand them, have been implemented successfully on time within budget." The overall opinion of those interviewed is that the project manager must strike a balance between driving delivery on time and budget while also ensuring that in doing so, the needs of the project's sponsor are being met. If either of these goals is not achieved, the perception of the project's success diminishes. Therefore, it is in the interest of the project manager to select a methodology approach that satisfies both the triple constraint and customer or sponsor happiness with the outcome.

Project managers develop strategies to improve project success for future projects via their experiences on past projects. During the discussion of methodologies, respondents were asked to discuss any specific project management strategies that they had developed over their careers. Responses yielded direct answers to the question in the form of descriptions of strategies, and additional context and strategies were extracted in their responses to other questions such as the questions around challenges. These evolved into three distinct recurring

strategy themes. With the balanced goal of project success in mind, project managers have developed many approaches that they implement to drive projects forward while working toward satisfying these definitions of project success. In many cases, these strategies have grown out of lessons learned from prior project experiences where their efforts may not have been as successful. The lessons learned or retrospective review is a crucial component of many project management methodologies. It enables project managers to learn from their past efforts to improve their future ones. Project managers determine over their careers which practices work and which do not and in which situations. This becomes part of their overall practice of the discipline of project management.

As part of the interview process, respondents were asked about projects they felt were successful and those that were not. They were asked to follow up with their experiences of what they learned from each and how those drive strategies on their future projects. Three primary themes emerged relative to strategies these project managers use in selecting methodologies for their projects: agile awareness/training, effective and appropriate communication, and the emergence of adaptive methodologies.

Agile Awareness/Training

Iterative/agile methodology awareness, education, and favorability among stakeholders influence the ability to adapt iterative methods. In all organizations, leadership agreement with and awareness of the methodology was cited by several respondents as a key factor to the successful implementation of any method. Respondent I explained that,

> [agile methods] require teaching. How to do them. I think waterfall is very easy to understand... there's always a sequential nature to the human aspect of how to analyze a specific problem. Waterfall is able to be very intuitive. In the case of [agile], you need to teach the specific event ceremonies or meetings.

Respondents B and E expressed challenges such as, “management to some degree… there's a disconnect because they're still not understanding the variations” of agile. If the project manager did not have their leader or project sponsor on the same page concerning the methodology applied, this had a detrimental impact on project success. This fact applied to all methodologies. Whether an organization promoted agile or waterfall, if there was a disconnection between the expectations of leadership and the actions of the project manager, the project was likely to be negatively impacted.

A theme that emerged in the interviews conducted was the need for agile methodology awareness and training for project stakeholders and leaders for agile adoption to succeed in any environment. Waterfall is seen as very “intuitive” as it follows a “linear, step-by-step” approach that most individuals can understand and follow easily. In contrast, agile practices must be taught and understood to be implemented appropriately. Respondents describing their attempt to implement agile reported that acceptance of agile was attributed most to “the maturity level and the flexibility of leadership” (Respondent E). Some project managers reported being able to “influence” or “train” teams and leaders in agile methods and Respondent B stated they had to “reiterate what agile meant.” There was also reported “resistance to agile” in some organizations due to a lack of familiarity. Citing a lack of training, Respondent D explained, "They didn't bring an agile expert on iterative... somebody who had done that in an infrastructure environment... nobody was even talking about it." These indicators led to the theme that iterative/agile methodology awareness, education, and favorability among stakeholders influence the ability to select and adopt iterative methods. Working iteratively rather than sequentially or predictively is

often a new way of approaching project work. Without proper training, individuals and leaders may inappropriately apply predictive/waterfall paradigms to agile situations or vice versa.

Examples provided by Respondents A and E were those of leaders who told the project teams they must work in an agile methodology but then demanded to see a full end-to-end predictive project schedule. These two statements are contradictory as agile projects typically do not operate with detailed overall schedules. Instead, they plan as they go. Another example reported by Respondent B was when project teams worked in agile sprints, and the customer would frequently introduce changes. “We had to at least train the clients and be on board with that so that we could actually finish a Sprint.” The project team was open to integrating these requests, but only at the start of the next sprint, much to the customer's frustration who thought agile delivery meant they could change whatever they wanted at any time. Even waiting a few weeks for a change was frustrating for a customer who felt they could change at any time because the team was “agile.” In both cases, a lack of education and awareness of the project methodology created a barrier for these stakeholders to interface with the project effort effectively. The gaps in understanding and alignment led to frustrations for the project and stakeholders.

The presence or absence of agile training is a critical factor in the success of implementing agile methods. They noted that it is not good enough to simply state, “We’re working in agile!” if proper awareness and training are not made available to all stakeholders, from individual contributors to senior leaders. Respondent D expressed, “People moving from their standard checklist and the comfort of knowing the process... to something different and thinking about how would you be agile in implementing” infrastructure projects led to issues of

insufficient skillsets. In some cases, the project managers themselves had to train or educate stakeholders if no other resources existed, which pulled them away from their primary responsibility of delivering the project. Respondents reported that situations where agile training was a standard practice of the organizational culture or formal training was provided by the organization resulted in better adoption of iterative methods and more success in delivering agile projects. Agile has its own "language" and ways of doing things. Without proper education in these terms and techniques, stakeholders may struggle even with a strong project manager at the helm when attempting to implement agile models.

Effective and Appropriate Project Communication

Appropriate communication is a critical success factor in IT infrastructure projects. The project managers interviewed consistently cited effective and appropriate communication as a critical strategy for successful project delivery in any methodology. The most commonly repeated word relative to project management strategies across all respondents was "communication." Every respondent used this word in describing how they execute their projects or how they were leveraging practices to drive successful projects. When elaboration was pursued, respondents focused on communicating with the "right people" or "setting expectations." Keeping stakeholders "informed and engaged" was also cited. Respondent C discussed setting up forums or communication tools while Respondent A stressed, "just getting people in a room as often as they need to, even every day, even if it's 10 minutes, 15 minutes" The theme that emerged was that appropriate communication is a critical success factor for IT infrastructure projects, and that being effective in communicating is a key competency for project managers.

Every participant reported some factor of communication as contributory to project success or insufficient communication leading to challenges. The overall focus of these project managers was around effective and appropriate communication. Respondent E highlighted, “Ensuring that we have not just the management, but the engagement piece and ensuring that we've got the right communication with those stakeholders." Emphasis was placed on not simply communicating, but communication was considered appropriate if it adhered to the right message, to the right people, at the right time criteria. It was deemed to be effective if this appropriateness led to successful outcomes on the project. General examples were the need for personal interaction among stakeholders, whether those stakeholders were project team members, customers, sponsors, or senior leaders. Project managers cited the benefits of frequent, short engagements “even if it’s 10, 15 minutes” (Respondent A) versus longer communications at less regular intervals. The implication was that communication consistency was most critical as it establishes and maintains expectations (Respondent E). Stakeholders know what to expect from the project in terms of communication, which helps to keep their engagement at appropriate levels to contribute to the effort's success (Respondent I). A preference was noted among those interviewed for in-person interactions where possible (Respondents A, C, and G). However, several acknowledged that effective and appropriate communication was being accomplished via remote means in their current situations (Respondents A, H, and K). Therefore, in-person communication was understood as a preference but not a requirement to communicate effectively on projects.

Project managers constantly tailor and adjust their communications to fit the needs of their projects. In one example of tailoring communications for appropriateness and effectiveness,

Respondent G described a situation of addition by subtraction in communication channels. A project was struggling to progress and had multiple resources and stakeholders attending weekly meetings. Discussions dragged, and solutions were not readily forthcoming. The project manager "reduced the team to four people and... said, let's do daily scrums" (Respondent G). Scrum meetings are typically characterized as short in duration and focused not on problem solving but on the status of tasks since the last meeting, status of upcoming tasks, and defining any obstacles. After these meetings, these four individuals were then charged with carrying out project tasks with the extended teams and reporting back each day. Productivity improved, and the project course-corrected itself. This project manager highlighted this strategy as a decision he has used on other projects to remove barriers and streamline communication when faced with similar situations.

Project managers reported using a myriad of communication channels and tools to achieve effective communication. This included face-to-face, videoconferencing, online collaboration tools, and team forums. The communication method and media varied by individual and organizational culture, but the consistent variable was the project manager determining the most effective communication toolset with critical stakeholders' inputs. Each participant described different ways they use to communicate with their stakeholders, and most utilized multiple channels. Respondent E stated, "One best practice that I think is very key and critical is definitely establishing that content, that regular communication." Establishing communication expectations at the earliest stages of a project was also cited as critically important. Several expounded on this to explain how they will alter their communication style when needed to fit the culture, environment, or specific project. The theme that emerged was the

need for the project manager to identify and implement the most effective communication strategy to complement the overall methodology selection to ensure projects remained on track and delivered successfully. Additionally, if one approach was not effective, it was incumbent upon the project manager to adapt and refine the communication strategy or alter the methodology approach. Respondent E cited the importance of managing "the engagement piece and ensuring that we've got the right communication with those stakeholders" and Respondent C discussed using "forums, breakout sessions, or using other collaboration tools" as needed to facilitate necessary communication. The focus was on ensuring that communication channels were maintained to support the methodology selected for the project.

The need for increased effective communication is not unique to any specific methodology. A somewhat surprising point relative to communication was that respondents did not equate increased communication needs with one methodology or another. As Respondent K explained, "What I have learned in the last couple of years is that your tool is not nearly as important as your process and the information available to your team." Effective and appropriate communication was discussed in terms that transcend methodologies. While there was an acknowledgment that agile methods add to communication needs, there was no converse opinion that waterfall methods somehow lessen this communication need. Communication remains one of the core competencies for an effective project manager. There does not appear to be a tangible difference in opinion on this matter, regardless of the methodology implemented. Similarly, failure to communicate effectively and appropriately can result in project failure in any methodology.

Barriers to communication may impact agile methods more so than waterfall. Although increased communication was not attributed to one methodology or another, it was observed that the differences in communication required for iterative methods could influence the selection of methodology. Multiple respondents cited that working in agile models requires changes in how teams and individuals function as a project team, and this includes how they communicate. Respondent A highlighted the desire for frequent "even 10,15 minute" discussions, and Respondent E cited the need to "establish… regular communication" to be successful in agile environments. If barriers to this type of frequent communication exist it can make adapting these iterative methods more difficult. Examples of such barriers given were team size and co-location as well as international or cultural barriers. Respondent H explained, "It makes things so much more difficult to get approval to move forward to do anything if you have to have 10 different people's okays before you can move forward with something." Because of the more linear approach to communication and management, the predictive model may often be better suited when these barriers prevent successful agile adoptions.

The Emergence of Adaptive Methodologies

Project managers will adjust and adapt their methodology as needed to drive project success. A recurring theme that developed across the interviewed participants' responses was the concept of the project manager adapting to and overcoming challenges as they arose by implementing different methodologies. As Respondent G put it, "I am not a believer of a [single] methodology. I think there are places and their approaches on how you execute and manage projects." Respondents described situations where they had to "adapt" or "modify" methods and tools to fit the needs of their projects. Respondent C said, "I would have to put it into [Agile tool]

and use their programs for all that, but at the end of the day I've lost my project plan so I would build my own project plan on the back end." Here, the project manager described utilizing one methodology to satisfy one requirement while using another to meet another deliverable on the same project. Respondent G described adjusting methods to "what I need to do to maximize productivity." The emergent theme was around adaptability and the practice that project managers will adjust and adapt their methodologies as needed to drive project success.

Project managers frequently used words such as "adapt" or "adjust" or "on-the-fly" to describe their methodologies in delivering projects. While some did acknowledge that some projects are "cut and dried" and may follow a routine or predictive model every time (Respondent H), these projects tended to be smaller and less complex. Respondent H elaborated that, "Larger and more complex projects had more freedom to adapt to fit to the needs." As projects grew in size and complexity, so did the need for constant change and adjustment of methodologies. When projects leaned toward waterfall conditions, such as a leader asking for an overall schedule, the project managers would behave in a more predictive model. If a project leaned more toward iterative, such as repetitive phases or cycles, or need for rapid adaptivity or change, the project manager would shift to a more agile approach. The above two scenarios could conceivably happen at the same time on the same project. Respondents E and G both used the word "blend" to describe this phenomenon of merging the methodologies as needed. They explained that it is incumbent upon the project manager as the methodology subject matter expert to recognize, assess, and adjust methodologies to fit each project situation.

The concept of adaptive methods was also illustrated relative to project success influencers. Very few mentions were made by respondents about measuring adherence to process

or methodology. The focus was on measuring outcomes, with the most frequently mentioned success outcome being the satisfaction or happiness of the customer or project sponsor. Respondent A cited that, "The project management should facilitate the end of the project. It should not be the thing you're doing just because." Project managers do not look at successful projects as to whether they successfully implemented one methodology or another. Instead, they assess whether the methods they applied led to the most successful outcome. Assessments specifically of the methodology are limited to those that may potentially yield better future outcomes, not just better future methods. Project managers are empowered and motivated to deliver successful projects, so it is in their interests to continue evolving and developing their ability to adapt their practice of multiple project management methodologies, even within individual projects. Put simply by Respondent G, "I literally adjust what I need to do to maximize productivity."

The evidence for adaptive methods was perhaps no more easily seen than in the examples given by participants who stated that their organization required one methodology, but as the project manager, they were maintaining a second method or set of artifacts to execute their work most effectively (Respondents A and C). These individuals who discussed this potential duplicate work effort did not describe it as if it were a burden or even necessarily a problem in need of a solution. They reported that it was simply a methodology they selected to drive their projects forward while also complying with requirements from their organization for certain artifacts or methods. The organization saw the need for one methodology, and the project manager saw work that best fit another technique. These project managers did not see this as a conflict or a problem, but rather it was simply part of a holistic project management approach

that may include multiple methodologies that blend and morph together throughout the project. This adaptivity of experienced project managers across methodologies in response to changes in project conditions became the cornerstone finding of the present research.

While participants acknowledged using predictive and iterative models at various points in their careers, some also pointed to hybrid methodologies. The concept of hybrid methods was brought up by multiple respondents who each had different perspectives on the idea. Further review found no one definition of a hybrid model for IT infrastructure projects, and project managers reported even altering methodologies in the middle of a project if the situation called for it. This review evolved into the concept of *adaptive methodologies,* where the expert project practitioner constantly tailors the methodological approach as needed to drive project success. Respondent K explained, "Infrastructure project managers are making extremely complex things happen, and bringing people together to solve problems. And so if at the very basic core, that's what we do, then you can probably do that many different ways." This approach contrasts the idea that a project methodology is chosen at the beginning of a project and maintained throughout. Instead, it paints a picture of methods changing and evolving as project needs change. Several project managers interviewed described implementing some sort of hybrid approach that was not purely predictive or iterative but pulled pieces from each methodology. This yielded the theme that experienced project managers are very fluid in the methodology selection and are open to blending methodologies where appropriate or even change methods mid-project.

Summary

The results discussed in this chapter outline the thematic findings from a series of semi-structured interviews conducted over three months with 12 identified experts in the field of IT infrastructure project management. These project managers reported a substantial prevalence for the predictive methodology in IT infrastructure projects, but they also saw an increasing number of uses for iterative methods. Many factors motivate project managers to integrate predictive and iterative models, and these may vary across projects, organizations, or environments. However, due to IT infrastructure projects' tendency to still favor the more linear, predictive model, challenges can be encountered trying to integrate iterative methods in situations where these methods may not apply. Ultimately, increased awareness and knowledge of iterative methodologies and effective, appropriate communication with stakeholders can improve these methodology integrations' success rate. It then falls to the experienced project manager to become adaptive in their application of methodologies, applying methods when and where they best contribute to the project effort's success.

CHAPTER 5. DISCUSSION, IMPLICATIONS, RECOMMENDATIONS

Introduction

This study's qualitative inquiry research sought to investigate how project managers select project management methodologies from a spectrum between iterative and predictive models for IT infrastructure projects. The study based itself on the theory of the existence of a spectrum of methods that ranges from predictive to iterative, or in other terms, between waterfall and agile. The research found evidence of this spectrum and instances of both methodologies that make up its ends. Evidence was also found to support the theory that there is no single hybrid approach in between waterfall and agile that balances the two, but rather there exists a range of possible methods with varying degrees of agility. It was also observed that experienced project managers will move freely along this spectrum when selecting methods for their projects. Finally, the research also sought to identify themes in the responses received from these experienced practitioners cited as contributing to their methodology selection with the goal of addressing the business problem of reducing project failures.

Evaluation of Research Questions

This research's primary question was: in enterprise IT infrastructure environments, how do IT infrastructure project managers select project management methodologies from a range of options between predictive and iterative to improve the successful delivery of projects? To identify a condition for studying this *how* question, the research first established that predictive project management models exist and are prevalent in IT infrastructure projects. The respondents confirmed that predictive models are widely used and applicable to IT infrastructure projects based on their current and prior career experiences. Several examples were provided by the

respondents discussing how predictive models were better suited for many infrastructure projects and how iterative models may be less applicable. In some cases, the project manager followed a predictive model even if the organization required an agile one.

Next, the research identified that integrating iterative methods with predictive was happening in at least some instances in IT infrastructure projects. The respondents interviewed were knowledgeable in iterative/agile methodologies and their application and most indicated that they were using components of these models in their projects. There are many internal and external factors to these projects that influenced these iterative models' applicability and the contributions they can make to project success. While several project managers acknowledged that they had used agile methods on infrastructure projects, this was typically only done in situations where the project's conditions suited this method. This point satisfied the research condition that IT infrastructure projects can and do utilize both predictive and iterative models in combination with each other, and not solely as mutually exclusive selections.

The research next established that project managers have varying opinions on defining a successful project. Still, they seem to agree that satisfying the triple constraint of scope, schedule, and cost must also be consistently balanced with customer or sponsor satisfaction with the project’s output. Failure to balance both the triple constraint and customer satisfaction yielded less than optimal assessments of project success. The participants interviewed reported that they were motivated to drive projects toward success. There was a clear cause-and-effect relationship between their actions as the project managers and their projects' eventual success or failure. Success or failure of projects is often reviewed and remembered well by these project managers, and each respondent could relate a situation where a project had been successful or

not and what was learned from each. This highlights the project managers' focus to constantly improve their practice to succeed in future projects.

Additional themes were identified from the respondents' interviews as contributors to project success when selecting methodologies to address the "how" portion of the research question. Firstly, respondents agreed that successful implementation of iterative methods requires training and awareness, as these methods often are not linear or as inherently intuitive as their predictive/waterfall counterparts. Teams must be instructed on operating in iterative models to take full advantage of these methods' benefits, and implementing without this training may yield lesser or even detrimental results. Often it may fall to the project manager to provide this education to project stakeholders, but this is not a hard requirement of the role. Some organizations were reported to have offered agile training for their project stakeholders, which was seen as productive in driving the adoption of agile methods. Whether delivered by the project manager or by an outside party, this training in the use of agile methods was seen as contributory to whether or not the project manager would select to apply an iterative method. In situations where this training and awareness did not exist and could not easily be facilitated, project managers may be more likely to select a more traditional or predictive approach to best suit the stakeholders or project environment. Conversely, if there was a high degree of agile awareness and capability among stakeholders, then methods from the iterative end of the spectrum were more likely to be selected.

Secondly, project managers must target effective and appropriate communications with project stakeholders to maintain projects on a successful trajectory. Ensuring that the right information reaches the right stakeholders at the right times is critical to project success in all

methodologies. However, communication becomes even more important when methodologies become more iterative and when pieces of different methodologies are being integrated. Utilizing a predictive methodology did not necessarily lead to less required communication, but iterative methods require different communication types to maintain the methodology in practice. In situations where communications may have challenges due to non-co-located teams, language or cultural barriers, or spanning across diverse teams, agile approaches may struggle to achieve the level of communication required to be successful. In these situations, selecting methods from the predictive end of the spectrum may be more appropriate. However, as these communication barriers disappear, such as in smaller, co-located teams, the benefits of agile methods can be more readily achieved. Therefore, the ability and degree to which project managers can achieve effective and appropriate communications can have a significant impact on how a project manager may choose to apply their methodological approach and the degree of agility they are able to implement.

Thirdly, project managers have developed an adaptive methodology style where multiple methods from both the iterative and predictive sides of the spectrum may be used across efforts or within individual projects. This adaptive methodology approach provides options for the project manager to comply with organizational frameworks for project management while also implementing the tools they feel best suit the project. While the topic of methodology selection may appear to present itself as a point in time decision that is made and then subsequently applied without deviation, the reality is that projects inherently change over time. As projects change, so may the methodology that will deliver the best chance of project success. Thus, project managers have shown that they are very willing to adapt and change their methods to

drive project success. Specifically, even if one methodology is selected or mandated, the project manager will adapt, add, or change methods on the fly as needed to best suit the project's needs at the time. How and when to implement any methodology is ultimately left up to the experienced project manager to adapt to the environment and the organization in which the project is operating.

Overall, the primary observation in the research was that the respondents interviewed certainly did not adhere to the tightly coupled theory of methodologies. Based on their experience, they felt very free in picking and choosing components and tools at will from various points along the spectrum of methodologies. The respondents were all very well informed of both ends of this spectrum and could describe the benefits and downfalls of each in great detail. Like a mechanic describing the use of every wrench in their toolbox or an artist explaining the use of every paintbrush, the experienced project manager can very clearly detail the appropriateness of various methods and tools on the methodology spectrum, and how and when they should be applied. These PMs will then exercise that expertise on their projects by using whichever tool or technique they feel best suits the situation to best drive success on their projects. This illustrates and confirms the loosely coupled theory that agile and waterfall project management methodologies are not mutually exclusive and can be broken into their parts and reassembled into hybrid models.

Fulfillment of Research Purpose

The purpose of this research was to identify and investigate the selection of project management models for IT infrastructure projects. Often this may mean integrating iterative models in environments where predictive models are prevalent due to historical practice or

organizational requirements. The themes observed centered around the theory that waterfall and agile practices exist as loosely coupled systems instead of tightly coupled, and practitioners can pick and choose methods at will to best deliver their projects instead of simply selecting one or the other. The predominant theory in the literature was an either-or choice between methods, implying that these are tightly coupled systems that are not easily separated into their individual pieces (Ambler, 2013; Bhasin, 2012; López-Alcarria et al., 2019). The outcome of the research showed more of a loosely coupled theory of methodologies with practitioners picking and choosing techniques from various methodologies at their discretion with the outcomes of doing so benefiting the overall success of their projects.

Given that the general benefits of iterative models are well documented in the literature (Baseer et al., 2015; Dingsøyr & Dybå, 2008; Fulgham et al., 2011) adopting these methods has been shown to yield significant benefits to organizations. However, there may be situations where practice or necessity dictates that fully adapting these methods is impossible or impractical. In these cases, learning how to integrate these methods when they cannot be fully adopted in whole will be a benefit to the discipline of project management for IT infrastructure project managers. This builds upon the loosely coupled theory that methodologies can be separated and pieces of one can be used successfully with pieces of another. In doing so, project managers can select and create methodologies from the range of available iterative and predictive models to best suit their projects.

Prior research outlined in Chapter 2 showed significant study attention given to the theory of adopting iterative instead of predictive models. This assumes that these systems are tightly coupled and cannot be separated into their components without reducing their

effectiveness. The assumption of many of these studies was also that iterative models are a newer and improved version of their older predictive predecessors, and that the newer models were therefore inherently superior (Cooper & Sommer, 2018; Khoza & Marnewick, 2020; Litchmore, 2016; Pedersen, 2013; Saunders, 2018). However, additional literature indicated that specific types of projects may still be better suited to the traditional/predictive model based on conditions of the project itself or the environment in which it is executed (Ahimbisibwe et al., 2015; Bentley, 2020; Bhavsar et al., 2020; Carbonara et al., 2016; Pace, 2015; Špundak, 2014). Little has been researched on integrating components of iterative and predictive models into a hybrid methodology specifically for IT infrastructure projects. Such a proposed approach would follow the theory that agile and waterfall methodologies are loosely coupled systems that can be effectively melded together by experienced practitioners into hybrid or adaptive methods that achieve greater project success than the previously assumed tightly coupled waterfall or agile options. In establishing the theory of the methodologies as loosely coupled systems and the ability for project managers to pick and choose from them based on their professional experience on prior efforts, this research contributes to the research question regarding how methodologies are selected.

As a result of this evidenced selection of methods by the project manager, the literature and the present research revealed an emerging spectrum of methodologies that ranges from pure predictive to pure iterative which yielded credibility to the loosely coupled theory of methodologies. Evidence was presented in the literature of examples of hybrid solutions on this spectrum that integrated agile methods with waterfall in IT infrastructure efforts. However, little attention was paid to conditions that led project managers to make these methodology decisions,

and the present research sought to investigate this aspect. Through the interviews obtained, the loosely coupled theory was confirmed, and themes were identified that guide project managers in their selection of methodologies.

This research has fulfilled its purpose by confirming that IT infrastructure project managers are making these methodology selection decisions from a range of iterative and predictive models and toolsets. This study has also identified and documented recurring themes that can be applied to future projects when selecting methodologies. It was further demonstrated that evidence exists in the experiences of these practitioners of methodologies being used as loosely coupled systems and the roles of the project manager in selecting and integrating methods from these systems. This phenomenon was observed through the integration of practices from one methodology with those of another with the outcome yielding greater success than if only a single tightly coupled method had been applied.

While many factors influence the decision of methodologies used on projects, the participants' consensus was that awareness and training in agile methods were necessary if iterative or agile methods were going to be selected. Further, effective and appropriate communication was critical in all projects, but if there were barriers to communication, agile methods may struggle and project managers may be better served in choosing more predictive models for delivery. The ability of project managers to adapt methodologies even within individual projects is ideal. Project managers should select methodologies from the spectrum that best fit their project's needs at a given point in time, and should be ready and willing to modify them if the project conditions change and a methodology change is warranted to contribute to project success. The ultimate responsibility for the successful implementation of any

methodology and the successful delivery of any project falls to the project manager. Together, these three primary recurring themes represent ways in which these project management practitioners are selecting project management methodologies to drive project success in IT infrastructure.

Additionally, these themes align closely to the Critical Success Factors (CSF) identified by Pinto and Slevin (1987) outlined in Chapter 2. The theme around stakeholder and leadership awareness and training in agile aligns with the CSFs of Top Management Support, Personnel, and Technical Tasks. Understanding the functions of agile methods is critical and this awareness likely is not achieved without leadership engagement and support. Communication is a specifically defined CSF, but the theme as presented here also encompasses aspects of Monitoring and Feedback, and Client Acceptance. The key to communication here is both in the availability of communication and the degree to which the project manager uses that information gained in selecting methodologies. The theme is concerned with adaptability of methodologies and this aligns with the CSFs of Monitoring and Feedback as well as Troubleshooting. Feedback is constant on projects and often, change is inevitable. Project managers must be able to recognize these factors and utilize them in selecting their overall management methods. The alignments of these currently observed themes with these Critical Success Factors published over 30 years ago show the sustained relevance of these factors throughout the evolution of underlying methodologies.

Contribution to Business Technical Problem

The root business problem addressed in this research relates to how the selection of methodology can influence projects' success or failure. Project failure is a recognized issue

within the IT project management practice, as documented by Khan (2018), The Standish Group (2015), and Wojewoda and Hastie (2015). These authors place the project failure rate well above the halfway mark for all IT projects and potentially as many as 70% of these projects are considered failures. These failures can result in inefficient use of resources, lost opportunities, and even failure of the underlying organization itself (Ahonen & Savolainen, 2010; Al-Dubai & Alaghbari, 2018; Davis, 2014). The selection of methodology by which the project is managed can be the most critical decision made on a project (Emami et al., 2020; Tiwana & Keil, 2004).

Therefore, it is in the interests of IT project management practitioners to continue to pursue new ways of implementing IT project efforts that yield greater chances of project success. This research contributes to the pursuit of this solution by providing the perspectives of several recognized experienced practitioners in the field. By analyzing and summarizing these practitioners' experiences into recurring themes, future project management practitioners and researchers can benefit from the lessons learned from these experiences and apply them in future project management methodology selection.

When looking to implement iterative or agile practices, it is incumbent upon the project manager to assess the project's stakeholders' awareness and knowledge level with these methods. Agile methods are often less intuitive than their predecessor predictive methods. This research found that obtaining and providing training in agile methods is critical to the successful application of these methods. This training or awareness may or may not come directly from the project manager, but as part of implementing these methods, the project manager must first determine if the required understanding and skills are present in the project stakeholders. It is certainly not necessary for all project participants to attend formal training or obtain

certifications to participate in agile projects, but the project manager should at least ensure that the stakeholders understand the methods being applied and how these are contributory to project success before attempting to select this type of method.

Building on the need for training, effective and appropriate communication with stakeholders is critical to integrating project methodologies. Agile models inherently require increased communication levels (Hoda et al., 2011), and often as agile methods are integrated, the need for consistent communication increase. Agile's increased requirement for communication is not intended to imply that predictive models can succeed without effective communication, but rather the needs for communication change and increase with agile. This communication needs to be effective in ensuring the accuracy and timeliness of information flows and must be appropriate and targeted to the correct audience. In some cases, this can even mean streamlining communication to specific individuals who then flow to other stakeholders versus a model where all communications are broadcast widely to the entire stakeholder group. It is up to the project manager to ensure that these effective and appropriate communications occur on their projects. If barriers exist to successful communication, agile methods may struggle to yield success more so than predictive models, and thus in the presence of such barriers, a predictive methodology selection may be better suited.

Research from the literature and from the respondents to this study confirmed there is no one correct answer to this methodology selection problem. There is also no single hybrid methodology that best encapsulates the benefits of both iterative and predictive while minimizing each's limitations. This research revealed the need for adaptive methodologies that may vary between projects or even within a single effort. Predictive and iterative methods represent tools

in a project management toolbox. It remains the practice of the project manager to know which tools to apply to the task, and when, to improve the efficient and successful attainment of project objectives. The project manager bears the ultimate responsibility for the successful delivery of the project (PMI, 2017), so the application and integration of methodologies rest in their hands.

Recommendations for Further Research

During the literature review for this research, there was minimal available scholarly research found in the area of IT infrastructure projects. Most of the research discovered in IT projects tended to focus more on software development which operates with different constraints and requirements versus infrastructure. Further research into what methods IT infrastructure project managers are implementing may help contribute to the general understanding and integration of project management methods for these types of projects. Future research efforts may wish to explore other aspects of project management methodology in the IT infrastructure field in general.

Throughout the responses received from the project managers interviewed for this study, two primary variations of agile methods were mentioned most frequently – Scrum and Kanban. The present study was not concerned with adopting any specific iterative or agile methodology but instead considered all agile methods as a single area of practice. Future research may choose to delve into the particular application of Scrum or Kanban in IT infrastructure projects. This research could further build on a project management toolbox concept by providing further guidance on where these specific methodological approaches may be used.

Additionally, the present research yielded several factors that may influence the selections of methodologies, such as project size and complexity, or the presence of an

established methodology precedent within specific industries or organizations. This research's scope was generic to the IT infrastructure of organizations in the United States with greater than 1,000 employees. Narrowing the scope of future studies by industry or potentially by the organization's size may lead to additional information on adaptive project methodologies' applicability.

The present research also did not narrow the field of IT infrastructure to any specific practice or discipline. One could reasonably infer that a network project may be very different than a server project. While both would be considered IT infrastructure, methods for delivering projects may vary between them. This variance may be worthy of further future study to elaborate the applicability of methodology selection and integration at the specific technology category level.

Conclusions

The goal of all project managers is the successful delivery of projects. The practice of project management itself arose from the identified need for structures and methods to successfully implement efforts with defined starts and desired ends goals. History can show evidence of what we now call project management as far back as Egypt's pyramids, but the discipline has grown and evolved into the practice that exists today. However, the evolution is never finished, and project managers continue to look for new and better practices to improve their projects' success. This research sought to further that goal and contribute to the evolution of the project management practice in IT infrastructure.

This research consulted several recognized experienced practitioners and interviewed them about their experiences in managing IT infrastructure projects. Through the narratives

provided by these individuals, recurring themes were extracted based on decades of trial and error throughout many millions of dollars spent on many projects over the collective careers of those interviewed. These themes provide glimpses into what these practitioners have learned throughout their careers. In collecting and sharing their experiences, this study seeks to contribute to the collective body of knowledge in project management.

By interviewing project management practitioners with experience in the IT infrastructure field, it was confirmed that a strong preference exists for the traditional or predictive/waterfall approach to project management. Many reasons were given for this preference, but even so, there was significant recognition that iterative or agile approaches can also yield benefits to these projects. These practitioners also reported that they saw more opportunities for integrating these methods to maximize the benefits and minimize the limitations of each. They indicated that they would select tools and techniques from both iterative and predictive methods to best suit their individual projects.

This study found that in selecting project methods that decrease the potential for project failure, certain recurring themes frequently influenced these selections. There is a need to educate project stakeholders on these methods and follow this with effective and appropriate communication approaches to maintain applied methods. Finally, there exists a requirement for project managers to become adaptive in their application of methodologies as no one method solves all problems. However, by integrating methodologies and adapting to the project environment, the project manager can contribute significantly to their project efforts' successful delivery.

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