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Agile Adoption in Information Technology Departments at Research Universities

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AGILE ADOPTION IN INFORMATION TECHNOLOGY DEPARTMENTS AT RESEARCH UNIVERSITIES

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Sofia C. Trelles

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To: Dean John F. Stack, Jr.
Steven J. Green School of International and Public Affairs

This dissertation, written by Sofia C. Trelles, and entitled Agile Adoption in Information Technology Departments at Research Universities, having been approved in respect to style and intellectual content, is referred to you for judgment.

We have read this dissertation and recommend that it be approved.

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DEDICATION

To my children, Chase Alexander and Lauren Elise. Do not just exist, live. Remember to "take massive, imperfect actions towards your goals, the time will never be just right." - Derric Yuh Ndim

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I did not travel on this journey alone. Thank you to those who encouraged, empowered, and pushed me. Your time, dedication, and love are appreciated. To my family, thank you for taking the time to nurture me and for being a safe space for me to share my fears and hopes. I love you all.

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Erick, I cannot say enough how much I appreciate you. You humble me and have supported me every single day. Thank you for always reminding me this is one chapter of our life and that it is about time I finished. On to the next.

ABSTRACT OF THE DISSERTATION

AGILE ADOPTION IN INFORMATION TECHNOLOGY DEPARTMENTS AT RESEARCH UNIVERSITIES

by

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Florida International University, 2021

Miami, Florida

Professor Sukumar Ganapati, Major Professor

This dissertation analyzes Agile methods and how they are adopted by Information Technology (IT) departments in research universities. Existing literature has focused on Agile adoption in private and public sectors. This study fills a knowledge gap in the research literature on Agile adoption in university contexts. Three research questions guide this study: What are the uses of Agile methods in research universities? What are the specific factors that affect adoption of agile methods in research universities? Why do research universities adopt (or not adopt) Agile methods? By answering these questions, the present study contributes to the growing literature on the opportunities and challenges of adopting Agile methods.

Methodologically, the study is based on a survey of the Chief Information Officers (CIOs) of 418 research universities (response rate of 41.4%) and elite interviews. The survey included questions about Agile adoption in terms of purpose, methods, challenges, and organizational environment. The elite interviews explored the factors affecting Agile adoption and were supplemented with secondary documents about the organizational characteristics of the IT departments.

The survey results show that many IT departments (nearly 60%) in these universities have adopted Agile. Agile is used to accelerate software development, manage projects, and increase productivity. The challenges of adopting Agile include pervasiveness of traditional waterfall methods, funding limitations, lack of skills, inconsistent process and practices, and organizational resistance to change. With respect to organizational factors, the level of research university is a determinant for adopting Agile. R1 Doctoral Universities (i.e., very high research activity) have more adoption of Agile methods compared to R2 Doctoral Universities (i.e., high research activity) or R3 Doctoral/ Professional Universities (i.e., D/PU). CIOs' experience with Agile is a critical factor for adopting Agile. Elite interviews with the CIOs show the significance of the organizational context to adopt Agile.

IT departments support university research and teaching; hence, these departments have a constant need to address the university departments' needs. Leadership of these departments influences Agile adoption. Agile fosters frequent and effective communication among the team members. Overall, IT departments adopt Agile to increase their organizational efficiency in delivering their services efficiently within the universities.

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1. Introduction

This dissertation is an exploratory study on the use of Agile methods in Information Technology (IT) departments within research institutions; this investigation focuses on universities that are designated by the Carnegie Classification of Institutions of Higher Education as Research Doctoral Universities. Agile methods comprise a set of project management and development practices that were first utilized in computer software development. Use of Agile approaches has expanded to a wide range of professional and educational contexts, including IT departments in private and public sectors. Previous studies on Agile have been primarily conducted in the context of private organizations (e.g., software engineering firms). The present study contributes to the research literature on organizational change and innovation adoption among IT departments in research universities. By examining Agile in research institutions, the present study fills a significant gap in the literature on higher education and public administration. The application and adoption of Agile is a relatively unexplored topic within higher education. Public administration scholars have increasingly begun to focus attention on Agile methods in the last 20 years. Thus, this dissertation adds to the public administration research literature by examining the use of Agile methods in IT departments within research universities.

Agile methodology and adoption in higher education and public administration is important to study because it provides a framework for universities to be responsive and innovative. Agile is a set of frameworks for delivering products, such as IT services and software. Agile methods—which emphasize adaptive, dynamic, and collaborative

approaches, among other innovative features require changes in organizational management to facilitate adoption. Agile is distinguishable from the waterfall method that is often used in IT. The traditional software development of the "waterfall" methods—in which progress typically moves in a linear, single direction—prioritizes documentation, contract negotiations and strictly follow the designed plan, which is typically created at the initial client meeting. The waterfall method emphasizes the process and tools needed rather than collaboration and responding to change. Criticisms of waterfall development methods include slow response to change, which can result in high costs and project timing inefficiencies; however, institutions continue to use such methods because they are the default approach.

Background of the study

Agile is not a new organizational concept. Gerwin (1987) was an early proponent of what is known today as agile thinking, and he conceptualized the need for manufacturing flexibility in the wake of programmable automation. McGaughey (1999) suggested that the Internet could be used for agile through sharing of data and information gathering for various tasks, activities, and processes. That the technology used by an organization must match the need of the consumer and support the organization. That speed of successful response is a crucial factor for an organization to be successful in a competitive environment that is always changing. Likewise, Van Oosterhout et al. (2006) argued that agility implies the ability to change business processes swiftly and easily, beyond the normal level of flexibility for responding to unpredictable external and internal changes. Agile is also closely linked with adaptive governance. Nelson, Howden, and Smith (2008)

described adaptive governance organizations as those that can effectively manage complexity and uncertainty and is receptive to learning.

Although Agile methods emerged initially in the context of software development, they have been adopted for organizational management in an effort to keep pace with the evolution of the digital world. The Agile framework has been expanded from software development to project management, policymaking, human resources, and procurement. The Agile Principles were codified with the Agile Manifesto in 2001. Agile methods prioritizes four main values: (i) individuals and interactions (over processes and tools); (ii) working software (over comprehensive documentation); (iii) customer collaboration (over contract negotiation); and (iv) responding to change (over following a plan) (Beck et al, 2001).

Agile practitioners emphasize user-centric design, which use a people-first approach process that provides client-centered service through shorter development cycles. Shortening project management development cycles allows practitioners to be innovative and forge essential collaboration with the client at each phase of the project. Components of the project are presented to clients in smaller chunks continuously throughout the timeline and are tested to expedite processes and achieve goals in a timely fashion.

Agile methods differ from traditional, waterfall software development methods. The waterfall method follows a linear process in which individual components of projects are completed prior to moving to the next component. Agile methods are iterative and incremental. Agile methods aim to keep up with the rapid evolution of the digital world with short, sprints instead of fulfilling long-term contractual obligations in one attempt. Agile includes clusters of incremental milestones that are reached using sprints, while the

waterfall methodology often delivers a completed project at a predetermined, final deadline. The waterfall method is rigid, and process driven. In contrast, Agile methodology allows for changes to occur after the initial planning and start of a project. It allows developers to revisit the project or service continually and it is adaptive to changes in client needs. Agile is also flexible in adapting to technological and environmental changes.

Prominent Agile methods include: Extreme Programing (XP), Scrum, Kanban, Lean, Feature-Driven Development (FDD), Dynamic Systems Development Methods (DSDM), Adaptive Software Development (ASD), Crystal, and Rational Unified Process (RUP). Each of these methods focus on a specific component of software process and development practices, which are known for facilitating the delivery of working products frequently. Agile is often associated with Scrum, where project activities occur in short sprints, as well as other methods in manufacturing processes, such as Lean and Kanban.

Adoption of the above Agile methods provides IT departments the opportunity to quickly assess and respond to the changing environment of higher education, where there are new teaching modalities available, expectation of community engagement and innovative research to aid solutions to current societal challenges. Agile is defined as "a collection of evolving delivery and management frameworks for dynamic and innovative delivery environments" (Measey, 2015, xviii). The highest priority in Agile methodology is customer satisfaction through early and continuous delivery of valuable products. The purpose of "agile is to allow organizations to react to the increasingly dynamic opportunities and challenges of today's business world, in which IT has become one of the key enablers" (Measey, 2015, xviii). Within IT departments, Agile is often referred to as organizational agility, workforce agility, and specific technological competency. These

departments are generally university-wide, supporting the core IT functions for various academic and administrative units, internal management, faculty services, and student services. They support basic communication services (e.g., email), website management, software deployment, hardware management, and others. They may also engage in software engineering or customization based on specific university needs.

While a formal theoretical foundation does not exist for studying Agile methodologies in higher education, this dissertation begins to build the foundation by examining private and public sector Agile practices and assessing them within higher education.

The Empirical Context

This dissertation is based on the research universities in the United States. The Carnegie Classifications indicate the level of research activities/programs at Research Doctoral University. These universities award at least 20 research/scholarships doctoral degrees, excluding professional practice doctoral degrees. Research Doctoral Universities are classified into three categories based on their research activity:

R1 - Doctoral Universities - Very High Research Activity (previously *R1: Highest Research Activity*)

R2 - Doctoral Universities - High Research Activity (previously *R2: Higher Research Activity*)

R3 - D/PU: Doctoral/Professional Universities (previously *R3: Moderate Research Activity*)

The classification titles have evolved through the years. Previously referred to as R1 status, the nomenclature subsequently changed to "Highest Research Activity" and is now referred to as Very High Research Activity. R2 status changed to High Research Activity, R3 status changed to Doctoral/Professional Universities or D/PU. The categories are still colloquially referred to R1, R2, and R3. Herein, research category terms will be used depending on the context and year. The Carnegie Classification was originally published in 1973, and subsequently updated (in 1976, 1987, 1994, 2000, 2005, 2010, 2015, and 2018) to reflect research classification changes among colleges and universities.

Research activity levels of universities are classified based on research activity. The Carnegie Classification Basic Classification Methodology assesses research activity using research and development expenditures; research staff, including postdoctoral positions; and doctoral degrees awarded. The data points used to evaluate research activity are "statistically combined using principal components analysis to create two indices of research activity reflecting the total variation across these measures (based on the first principal component in each analysis)" (Indiana University Center for Postsecondary Research, 2016). The first of the two indices represent the aggregate level of research activity, and the second captures per-capita research activity using the expenditures and staffing measures divided by the number of full-time faculty within the assistant, associate, and full professor ranks. The 2015 edition of the Carnegie Classification was the latest edition available at the start of this dissertation study. This edition covered more than 4,660 colleges and universities in the United States. Of these universities, 337 were classified as Research Doctoral Universities. They comprised: 116 R1 institutions, 108 R2 institutions,

and 113 R3 institutions and depict the highest level of innovation and the intent to be at the forefront of research (Indiana University Center for Postsecondary Research, 2016).

Subsequently, the 2018 edition of the Carnegie Classification identified 418 Research Doctoral Universities: 131 R1 institutions, 135 R2 institutions, and 152 Doctoral/Professional Universities. These 418 institutions account for 6.9 percent of all institutions in the U.S.; the 7,229,265 students enrolled in these 418 institutions account for approximately 36 percent of students enrolled at institutions across the U.S. Branch campuses(when a University has more than one main campus) are counted separately if such branches are reported separately in the *Integrated Postsecondary Education Data System* (IPEDS).

Significance of the study

The present study is significant in that it aims to identify the extent to which universities adopt Agile methods and why universities adopt or do not adopt Agile practices. Scholars in the field of information science and technology have examined how Agile frameworks have been used in software firms. IT departments in universities do not focus primarily on software development; these departments have many additional responsibilities. Yet, they provide a vital support function to the universities in terms of internal organizational management (e.g., human resources, training, and classroom support). Motivations for adopting Agile in universities could, thus, differ from software firms. Universities are typically managed as nonprofit enterprises where the IT departments have a crucial function to increase the organizational efficiency. It is in this context that the present study sought to fill a gap in the research literature regarding the use of Agile

methods in university IT departments. This study examined the organizational factors in the adoption of Agile in higher education. It contributes to the public administration literature by elucidating how Agile practices are adopted and used in these nonprofit contexts.

Research question and hypothesis

The following research questions and hypotheses guided this dissertation research:

1. Research Question 1 (RQ1): What are the uses of Agile methods in research universities?

   Hypothesis 1 (H1): Universities adopt and use Agile methods to fulfill internal university-wide functions, rather than faculty or student services.

2. Research Question 2 (RQ2): What are the specific factors that affect adoption of Agile methods in research universities?

   Hypothesis 2 (H2): The adoption and use of Agile methods will be influenced by leadership support, the IT department's organizational capacity, and the organizational complexity (in terms of size and funding).

3. Research Question 3 (RQ3): Why do research universities adopt (or not adopt) Agile methods?

   Hypothesis 3 (H3): A university's research classification (R1, R2, or D/PU status) influences the adoption of Agile methods.

Research Design and methodology

This study employed a quantitative and qualitative research design, including a survey and elite interviews of Research Doctoral Universities Chief Information Officers.

The survey addressed RQ1 and RQ2. The elite interviews aimed to answer RQ2 and RQ3. RQ 1 aimed to identify the extent to which universities have adopted Agile methods and the functions for which they are used in research universities. This exploratory question sought to examine the extent to which research universities have adopted Agile because there is no such empirical examination of the adoption of Agile methods at research universities. Universities depend on IT departments to perform their functions, including human resources, procurement, student and faculty services, and other procedural functions in the university. The hypothesis (H1) that corresponds with RQ1 is that universities adopt and use Agile methods to fulfill these internal university-wide functions. The IT departments support these internal functions through customization and specialized software development—where Agile methods can be employed. RQ1 is examined through a survey instrument that was administered to the Chief Information Officers (CIOs) of research universities. The survey comprised 24 questions, sent online to the CIOs using Qualtrics (an Internet-based survey tool). It was sent to CIOs of 418 doctoral universities. The survey results were analyzed for the extent to which the IT departments use Agile methods. A total of 173 out of 418 institutions responded to the survey, resulting in a 41.4% response rate. The survey analysis indicated collaborations, opportunities, and obstacles in practicing Agile methodologies. The analysis included the types of support that academic and administrative units receive, how innovation is promotion, and the way projects are prioritized. The survey revealed some of the main obstacles institutions faced while adopting Agile, and how the institutions assess project progress, if leadership creates an environment that promote innovation, risk-taking, and new approaches?; did the institution

view funding IT projects as an investment, rather than an expense?; and were investments made in the latest Agile methodologies/tool training?

RQ2 (i.e., What are the specific factors that affect adoption of Agile methods in research universities?) examined the university-wide factors that affect the adoption and implementation of Agile methods in IT departments. The literature review on adoption of Agile methods in the private sector revealed that the most significant factors are organizational leadership and capacity. In addition, collaboration with other organizations could also affect Agile adoption through mimetic isomorphism. In the context of higher education in universities, organizational demands may also affect the adoption and use of Agile. Specifically, the size of the university (e.g., number of students, faculty, and support staff), the number of departments, the budget allocated to the IT departments, and other factors may provide insight into how leadership decides to adopt or not adopt Agile. Hence, the hypothesis (H2) for RQ2 is that the adoption and use of Agile methods will be influenced by leadership support, organizational capacity of the IT department, and organizational complexity (in terms of size and funding) of the institution. It is hypothesized that the research classification (R1, R2, or D/PU status) influences the adoption of Agile methods.

Information on university attributes (e.g., size, research funding, etc.) is available through the Carnegie Classifications Public Data File, the latest version of which is available through the Carnegie Classification website hosted by the Indiana University Center for Postsecondary Research. The latest version of the raw data used in this dissertation is version 15 (updated on February 28, 2018). Classifications are time-specific snapshots of institutional attributes and they are based on data from 2013 and 2014.

Institutions could be classified differently in a different timeframe. The survey questionnaire used to answer RQ1 and RQ2 included questions data which are not available through IPEDS. These questions related to Agile adoption, leadership, organizational capacity, and other variables.

RQ3 [i.e., Why do research universities adopt (or not adopt) Agile methods?] was used to examine the motivations for the adoption or non-adoption of Agile methods in research universities; it builds on the information collected from RQ1 and RQ2. The main intent was to examine why CIOs have adopted or not adopted Agile at their respective institutions. Unlike the previous questions, RQ3 explored the contexts in which Agile methods are used through qualitative methods. Elite interviews were conducted over the Internet through Zoom, a video conferencing platform. The purpose of the interviews was to examine the motivations that were not captured by the survey and to understand how each university administrator identifies the role that agility may or may not play within the universities IT department. A convenience sample was used for the elite interviews and may not be representative. Although not representative, these interviews provide deeper insights into why the CIOs did or did not adopt Agile methods.

Overview of chapters

This dissertation is organized as follows: Chapter 2 reviews the literature on Agile methodologies and organizational agility. This chapter analyzes, in detail, the features of Agile in higher education and subsequent possible use of Agile methodology and techniques in higher education IT departments—noting the gap in the research literature.

Chapter 3 presents the examination of the first two research questions (RQ1 and RQ2). This chapter describes the quantitative component of this study. The chapter describes the survey instrument used to collect data and how Agile has been operationalized in the analysis. The results of the survey are then presented. The results pertaining to the RQ1 and RQ2 are provided.

Chapter 4 examines the motivations for why IT departments do adopt (do not adopt) Agile using a qualitative research design. This chapter explains the purpose of conducting the elite interviews, examines the selection criteria, and outlines methods of investigation. In addition, Chapter 4 presents the results of the elite interviews for each of the universities. RQ3 is examined in this chapter.

Chapter 5 concludes the dissertation and discusses the results of the analysis and the limitations of the study. It aims to integrate present study results into the existing literature and into the higher education context. The chapter also provides implications for practitioners and summarizes the research contributions of each research question. This concluding chapter provides a summary of findings to assist in developing and disseminating Agile principles and methodologies in IT departments of research universities.

2. Literature Review

This chapter introduces the foundations of Agile and common Agile techniques and practices. This chapter describes how higher education institutions operationalize Agile to respond to change and describes prominent Agile frameworks. It also provides a review of Agile scholarly articles and books published within the last 20 years.

While the fields of information technology and computer science have generated research related to adoption of Agile practices and methodologies in software firms, there is a knowledge gap regarding the use of Agile in research universities. There is a lack of, and a need for, research on Agile practices and methodologies in the context of public administration and higher education. This dissertation sought to address this gap in the literature by examining research universities.

Fundamental Concepts of Agile

Agile is defined as "a collection of evolving delivery and management frameworks for dynamic and innovative delivery environments" (Measey, 2015, xviii). The highest priority in Agile is customer satisfaction through early and continuous delivery of valuable products. The purpose of "agile is to allow organizations to react to the increasingly dynamic opportunities and challenges of today's business world, in which IT has become one of the key enablers" (Measey, 2015, xviii). The concepts related to Agile are adaptability, innovation, collaboration, visibility, and speed. Agile is labeled as an organization's ability to adjust(adapt) and respond quickly(speed) to changes in an innovative and collaborative manner while maintaining transparency to enhance decision-making processes. Innovation is an organization's ability to be forward thinking and

creative, to generate new approaches, and use technology to provide alternatives to challenges faced by the organization. Collaboration aligns knowledge sharing and building rapport to accomplish goals effectively and efficiently. When public agencies are Agile, they should be able to respond to client needs seamlessly and efficiently.

Agile requires integration and collaboration. Integration propels organizations to become more competitive and sustainable. In the higher education environment, this means that administrators should be able to respond quickly and efficiently to students, stakeholders, and community demands, while producing products that satisfy the customer's needs. Singh and Vinod (2017) argued for combining the concepts of agility and sustainability so that organizations can quickly adapt to change and survive in the long term. In a changing competitive environment of higher education, universities must develop frameworks and modalities that are significantly more flexible and responsive than existing ones.

Agile is an alternative to the waterfall development method that has been traditionally used in software development and is defined process. The waterfall model originated in the field of engineering; to limit changes in product timelines that may increase the cost or extend the timeline. The methodology specifies—upfront—the requirements and analysis, design, build, and test phases. By establishing the analysis and design phase of a project upfront, the development team operates under the assumption that errors will be limited and that the project will be completed in a timely manner. Milestones are predetermined and the process is heavily documented to facilitate communication with all parties. Figure 1 presents the traditional waterfall development model.

Sequential in nature, the waterfall method strives to complete individual components of projects before moving forward and does not move backwards. Like a waterfall, where water cascades from the top down, activities in this method advance from top to bottom. The "core belief is that by finishing each phase and eliminating any possible mistakes from this phase, future phases won't be impacted by mistakes and the project team won't lose time and money by going back to fix the mistakes" (Mergel, 2016, p.517). This method relies on a fully developed plan from the beginning of a project and project leads having insight as to any changes that may be required during the process. The waterfall method does not consider timelines, product development, project delivery and the evolving needs of the consumer as a project progress. A team using the waterfall method for project management must meet project deadlines and expectations that were established prior to commencement. A change required after commencement of the project would require the team to work on a parallel project simultaneously.

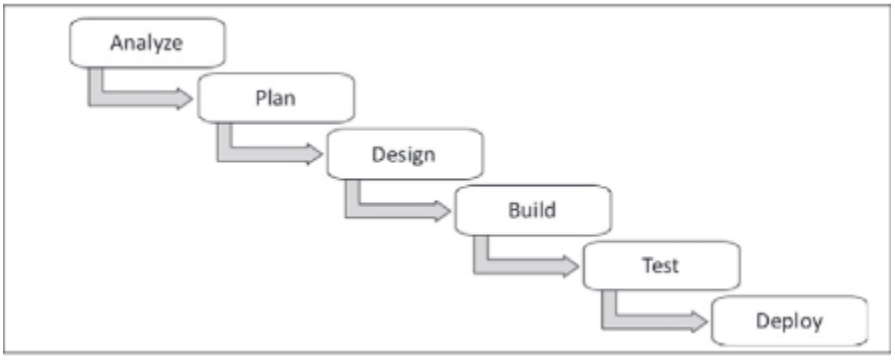

Figure 1. Traditional waterfall method

Agile methodology makes it possible for modifications to be made after the initial planning and after commencement of a project; it allows for the possibility of revisions to the program or service if the client decides to make changes. Because change is expected, it is easier to add features or create alterations as needed. Meeting the user's needs is the

end goal and the project team aims to achieve intermediate objectives efficiently while achieving that goal. The team continually learns as it measures achievements (or lack thereof) in a continuous cycle and adjusts accordingly. The Agile method follows short sprint cycles that allow for issues to emerge and for development teams to fail often and early in the process. Failing early is not perceived negatively, but rather as an opportunity to improve. At the end of each sprint cycle, the project is evaluated, requirements are changed, feedback is introduced, and technological innovation occurs. Failing early and frequently makes it easier to correct issues, integrate customer feedback, and reduce financial loss before commencing the next sprint. The Agile process is collaborative in nature, with continuous communication with the client (Agile Manifesto, 2001 & Mergel, 2016).

The Agile process model is depicted below in Figure 2. The team delivers products created during the iteration/sprint process. Daily stand-ups occur with a sprint or iteration cycle occurring less frequently, often within a period of two weeks to a month. Members of the team can continuously monitor sprint status through visual boards. After the team is ready to deliver the product, the team meets with the customer and provides an opportunity to comment; then, the next planning period begins. Any risks identified are added to the R.A.I.D. log (risks, actions, issues decisions) and monitored continuously. Prior to commencing the next sprint, the team conducts a retrospective- to discuss what went well, and what could be improved.

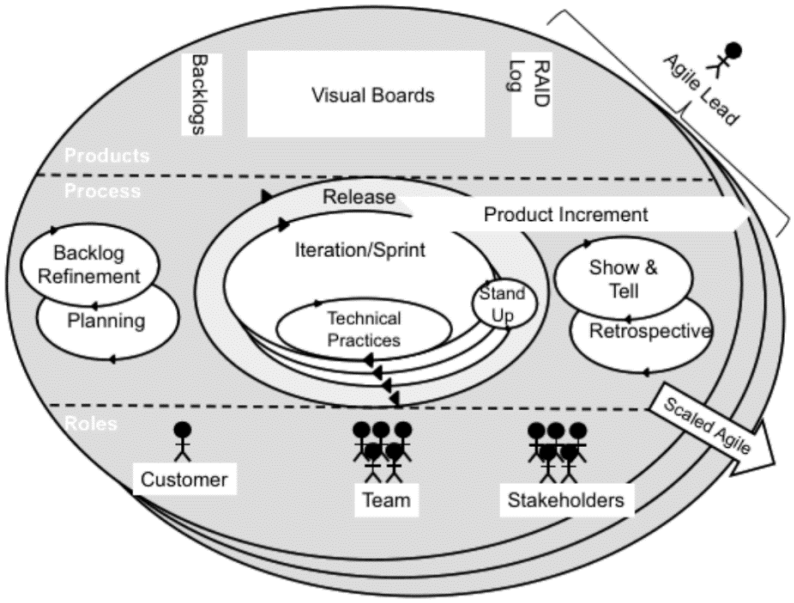

Figure 2. Agile Process Model

Evolution of Agile

The beginnings of Agile can be traced to the mid-1980s when Barry Boehm worked on Spiral and when Rapid Application Development (RAD) was first documented (Measey, 2015, p. 3). Early Agile philosophy can be connected to the Toyota Production Systems (TPS) process, including visual boards. Gerwin (1987) was an early proponent of Agile-like methods who conceptualized the need for manufacturing flexibility in the wake of programmable automation. McGaughey (1999) suggested that the Internet could be used for organizational agility through sharing of data and other information for various tasks, activities, and processes. Speed of successful response to a changing environment is a crucial factor for dynamic innovation. In the late 1990s, Ken Beck published *Extreme Programming (XP) Explained* (Beck, 2004) and then two years later in 2001, the Agile Manifesto was created (Agile Manifesto, 2001). On February 11-13, 2001, seventeen software developers from various backgrounds gathered in Snowbird, Utah, driven by a

desire to create an alternative approach to software development. During this meeting, the Agile Manifesto was drafted, and it has since served as the guiding principle for Agile project management. During the same year, the first Scrum book was published, which evolved from the Takeuchi and Nonaka (1986) Harvard Business Review paper, Scrum is a framework for developing, delivering, and maintaining complex software and product while using iterative and incremental practices (Tekeuchi & Nonka, 1986; Measey, 2015, p. 4). The Agile Manifesto (2001) provided a framework for Agile, defining four values and 12 principles. The values are:

(1) Individuals and interactions over processes and tools,

(2) Working software over comprehensive documentation,

(3) Customer collaboration over contract negotiation, and

(4) Responding to change over following a plan.

In Agile product development, an engaged and effective team, and the use of lean and deliberate documentation is desired. Lean focuses on eliminating waste to amplify learning and delivering product as fast as possible while empowering the team, building integrity, and seeing the whole picture. Adding value for the stakeholders is at the forefront of Agile, and this is demonstrated through timely incremental deliveries of product in an iterative manner, designed to enable flexibility and adaptation to change. "Agile is not about 'doing' Agile, it is about 'being Agile' and having an Agile mindset" (Measey, 2015, p. 11). The 12 Agile Principles include:

1. *Our Highest priority is to satisfy the customer thorough early and continuous delivery of valuable software.*

Delivering consistent value to customers often. This is accomplished iteratively in sprints or cycles, allowing for the customer to provide frequent feedback regarding the process and product.

2. *Welcome changing requirements, even late in development. Agile processes harness change for the customer's competitive advantage.*

By working in a dynamic manner with the customer, the Agile product team can understand, define, test, and deliver the product rapidly. By welcoming changing requirements and producing the product in sprints, the team can learn, and harness change more quickly, thus lowering the risks of the project—as opposed to waiting until the final product delivery to integrate customer feedback.

3. *Deliver working software frequently, from a couple of weeks to a couple of months, with a preference for the shorter timescale*.

Timely incremental deliveries of product in an iterative manner are at the core of Agile. Providing progress/delivery of product in small increments enables feedback loops and reduces cost and time by having the customer provide direction and not having work be redone.

4. *Businesspeople and developers must work together daily throughout the project.*

All individuals involved should be able to communicate freely and understand each other.

5. *Build projects around motivated individuals. Give them the environment and support they need and trust them to get the job done.*

Agile practices do not function in environments that are not conducive to collaboration and receptive to change. There needs to be buy-in from individuals working on the Agile team or project and trust.

6. *The most efficient and effective method of conveying information to and within a development team is face-to-face communication.*

Face-to-face communication is preferred. Meeting face to face throughout the process aids in open communication, more effective feedback loops and decreases miscommunication as more question can be asked. as product if often produced.

7. *Working software is the primary measure of progress.*

This does not mean that documentation is not required nor important to measure progress. In fact, it indicates that documentation should serve a purpose so that the product is able to be maintained. Software should be created, documented, and supported.

8. *Agile processes promote sustainable development.*

Sustainable development implies constant pace of continuous learning, development, and delivery. The developers and users should be able to maintain a constant pace.

9. *Continuous attention to technical excellence and good design enhances agility.*

Agile methods promote excellence through continuous learning.

10. *Simplicity—the art of maximizing the amount of work not done—is essential.*

Agile methods are not unnecessarily complicated. Simple solutions are preferred over complex ones. Maintenance should be simple.

11. *The best architectures, requirements and designs emerge from self-organizing multi-functional teams.*

Teams should be multi-functional and draw resources of different departments.

12. *At regular intervals, the team reflects on how to become more effective, then tunes and adjusts its behavior accordingly.*

When embracing the principles of Agile, teams need to support the development and not just implement the Agile ceremonies. The "why" the team is doing the work is as important as the "how" the team accomplishes the work. Without understanding the difference, adopting and leveraging Agile will not be successful.

Technical Features of Agile

Several different methods compose the Agile framework. Prominent Agile methods include Extreme Programing (XP), Scrum, Kanban, Lean, Feature-Driven Development (FDD), Dynamic Systems Development Methods (DSDM), Adaptive Software Development (ASD), Crystal and Rational Unified Process (RUP). Each of these methods focuses on a specific component of software process and development practices. Extreme Programming focuses on the technical aspects of software engineering. It is often used when requirements are vague and change frequently. Most teams that use this style are smaller and focus on cost savings, simple design structure. Scrum, Kanban, and DSDM focus on team and product delivery. Scrum is the most popular Agile method. It uses incremental interactive approaches to develop software. It builds on what programmers know is already working. It uses the previous knowledge acquired by the programmer and the user experience. Agile PM and DSDM are used in Agile project governance.

Table 1: Prominent Agile Methods

eXtreme Programming	XP is a software development framework focusing on the technical aspects of software engineering; stories and standups are two common XP practices for Agile The user story is a statement of what a user wants from the program. Stories include the who, what, why and acceptance criteria for iterative design. A standup is a daily meeting of team members. Sprints are known as weekly cycles in XP.
Kanban	Kanban is a communication tool for workflow management. Kanban boards help users visualize their workflow digitally; to help optimize work productivity, boards include the following categories: (1) To do, (2) In progress, and (3) Done.
Lean	Lean focuses on eliminating waste to amplify learning and delivering product as fast as possible while empowering the team, building integrity, and seeing the whole picture.
Scrum	Scrum is a framework for developing, delivering, and maintaining complex software and product while using iterative and incremental practices. It lends itself to cross functional teams and utilizes sprints. Sprints include sprint planning and sprint backlogs, daily scrum meetings, a sprint review and a sprint retrospective. A sprint is an iterative development phase, which occurs during a fixed period of time.

There are four main roles in Agile delivery: the customer, the lead, the team, and stakeholders. The customer is responsible for deciding what will be done and the order in which it will be done. The customer owns the vision of the project, defines what will be delivered, and approves the product after each iteration/sprint delivery. The Agile Manifesto prioritizes the customer thorough early and continuous delivery of valuable software/product. The benefit to the customer is provided by delivering value as early and continuously as possible. Communication between the customer and the lead is critical at this point, as the customer must find value in the deliverable.

User stories connect the Agile process and the main roles. Stories define what customers and stakeholders require from the Agile team. They include the who, what, why, and acceptance criteria for iterative design: 1. Who is requesting the feature- this should be

written from the perspective of the customer. 2. What feature is being requested and 3. why, and 4. the criteria that should be met so that the customer signs off on the story/product as completed. Stories are presented as follows:

- As a (the 'who') …
- I will (the 'what') …
- So that (the 'why') …

An example of a user story and process to draft the story is below. For purpose of this example, the author of this dissertation is the customer:

- As a (the 'who') – doctoral student conducting research for her dissertation on IT departments within Carnegie Research Institutions.
- I will (As the 'what') – I want the ability to identify all IT departments within Carnegie Research Institutions that utilize Agile practices.
- So that (the 'why') – I can identify Carnegie Research Institutions that utilize Agile practices within their IT departments and focus on understanding why certain institutions utilize Agile practices.

In an Agile project management meeting, the user story developed above would be presented as follows:

> ***As a*** *doctoral student and Agile methodology enthusiast,*
>
> ***I will*** *explain the Agile Methodology process and practices through a literature review,*
>
> ***So that*** *my research audience will have a better understanding of what Agile methodologies entail and how they are applicable to higher education.*

Stories are redefined throughout the development process and change as the product is developed and delivered. A backlog is then created where stories are arranged based on priority and delivery sequence. As such, stories are negotiable until they are integrated into a sprint and include testable acceptance criteria. Testing is an important component of the Agile delivery process. Testing should occur throughout the life cycle and should not be left until the end of a release period. Agile testing practices include: Test First Development (TFD) and Test Driven Development (TDD). In TFD, tests are designed prior to the development of a story and utilize a test-build cycle until the customer approves the completion of the story. The TDD is implemented at the unit testing level and includes all components of the TFD plus refactoring.

Agile Delivery

Compared to traditional software development methods, Agile methods are valuable as they facilitate "accelerated time to market, increase in quality and productivity, improved information technology systems, business alignment and enhanced flexibility" (Deemer et al., 2010; Jyothi & Rao, 2011; Nishijima & Dos Santos 2013; Qumer & Henderson-Sellers, 2006; VersionOne, 2013). Agile methods can also facilitate an organization's ability to achieve quality, budget management, alignment with core values and goals, and deliverables (de Azevedo Santos et al., 2011; Glaiel et al., 2013; Nerur et al., 2005).

Agile methodologies are driven by customer needs and evolve throughout the project based on the feedback and direction of the customer. Agile delivery in IT environments is complex because of who the customer is. Agile delivery style can include:

(1) Define product via a business-as-usual delivery, (2) Define product via a project delivery, or (3) Undefine product via a business-as-usual delivery. The first two styles assume that the customer wants a high-level definition of the product/project. The product via a business-as-usual delivery style will develop the product within the agreed upon timeframe. While the product via a project delivery style involves project governance, undefined product via a business-as-usual delivery is often described as pure Agile, flexible delivery, where product is produced in increments through iterations or sprint cycles. This process is repeated continuously until no longer necessary as the deliverables have been met and change is welcomed throughout the process. Effective project flow enables continuous iteration cycles.

Agile in Public Sector

Dwight Waldo challenged the field of public administration by asking 'Efficiency for what?'. Efficiency is a central and prominent value in the field of Public Administration, yet it is important to recognize other values that drive the field, such as accountability, equity, transparency, neutrality, and effectiveness. The school of New Public Management (NPM) was established because of the deficiencies of New Public Administration (NPA). To increase efficiency, NPM focused on reinventing government, providing administrators with discretion, and utilizing values and techniques from the private sector. This is somewhat like Taylor's Scientific Management. The NPM school of thought embraces private sector values and themes and takes it an extra step by shifting them to the public sector, the techniques that were borrowed from the private sector include eliminating redundancies and creating internal audit systems.

New Public Service (NPS) emerged in the 1990s as an alternative to NPA and NPM. Under NPS, people are valued, not just productivity and efficiency. NPS encourages administrators to think strategically and to act democratically. NPS strives for administrators to be accountable to multiple stakeholders and encourages citizen participation, involvement, and engagement (Denhardt & Denhardt, 2000). The NPA and NPS movements triggered a focus on improved service delivery outcomes to benefit the public interest, including providing training to employees to ensure that they have the necessary skills to collaboratively complete their work. the skills to work with each other as well as with citizens. NPS prioritizes the needs and values of citizens and argues that an engaged and enlightened citizenry is critical to democratic governance. NPS seeks shared values and common interests through dialogue and engagement. NPS promotes responsiveness and can be translated to Agile project management. Advances in technology and access to knowledge have enabled public administration and higher education administration to be efficient and effective in providing services.

State and local governments have adopted Agile over the last 20 years, which can be grouped into four time periods (Ganapati, 2021). The first period (from 2001 to 2007) focused on software development practices and the utilization of Agile practices for manufacturing. The second period (from 2008 to 2011) focused on scaling-up Agile and its project management abilities in governance. The third period (from 2012 to 2015) focused on utilizing Agile for process improvement and Lean governance. Lean focuses on reducing waste in product development and creating customer value. Organizations—through iterative and incremental designs—produced and tested products, sought feedback from customers, learned from the process, and repeated the process in a cycle until

completion. The last period (from 2016 to present) focused on User-Centered-Design (UCD) and operates utilizing mainstream Agile methods such as Scrum, Kanban, Lean, and DevOps, wherein each method focuses on a specific component of software process and development practices (Ganapati, 2021). Specifically, Scrum, Kanban, and UCD focus on team and product delivery. Scrum is a popular Agile method. It uses incremental interactive approaches to develop software, building on what programmers know is working. Scrum uses the previous knowledge acquired by the programmer and the individual experience. DevOps enhances the principle of collaboration and connections the programming operations and development teams in their initiatives.

In the public sector, Agile methods are adopted by IT departments and project management offices. The federal government spends more than $90 billion on IT annually, yet, developing and implementing IT projects remains a challenge. The Federal Information Technology Acquisition Reform Act (FITARA) was enacted in 2014 and includes a stipulation that CIOs of agencies must certify that IT investments are effectively implementing incremental development. In response, various government agencies have leveraged Agile principles and methodologies to improve process deliverables and address such challenges. For example, in April 2016, the Department of Homeland Security (DHS) started to transition its IT acquisition process utilizing Agile software development and announced they would pilot five programs utilizing Agile principles (Government Accountability Office, 2020; Government Accountability Office, 2020a). The U.S. Government Accountability Office (GAO) found that the DHS struggled with IT acquisition deliverables. GAO has published reports, assessment guides, and technology spotlights on Agile software development over the past years, stating that “Agile has the

potential to save the government billions of dollars by delivering services more efficiently and effectively" (Government Accountability Office, 2020). For the federal government, leveraging Agile methods enhances flexibility and risk reduction and produces deliverables more quickly. At the state and local government levels, this means that organizations can measure progress frequently to reduce risk and improve processes prior to executing the next sprint and project delivery. If deliverables are produced more quickly, governments can assess if the program is meeting the needs of the customer and doing what it was originally intended to. Utilizing Agile methodologies, deliverables can be produced within weeks to months rather than years, reducing time and financial risk. Viechnicki and Kelkar (2017) reported that approximately 80% of the major federal government IT projects were considered Agile or iterative by 2017.

Agile extends beyond software delivery in public administration. Although the principles were established in software development and engineering, public administration can integrate the principles to improve efficiencies, increase trust, and streamline services. The principles translate to government services, such as project management, policy making, and human resources—including the recruitment and retention of employees. Agile organizations have project management teams that are cross-functional, comprising specialists with skills to guide projects and facilitate collaboration with a variety of teams across platforms. The use of Agile in project management outside of software development reduces risks and waste. Agile project managers encourage the people skills needed to streamline processes and improve efficiencies. These methods may also be used in recruitment, retention, and management of human capital in organizations. Retention and employee cultivation promote collaboration where Agile is not just the

ceremony but rather a mindset. Agile practices function in environments that are conducive to trust and support. Agile principles translate to policy creation and execution where the desired outcome for the policy is known but requires flexibility in the process. Policy creators can leverage iterative cycles and face-to-face communication for feedback loops, to decrease miscommunication and become more effective while adjusting accordingly.

Agile in Higher Education

While the Agile Manifesto (2001) described Agile principles within the context of software delivery, it does not limit the scope of the practice—which can be applied to higher education. The practices are flexible and adaptable. The critical component of Agile in higher education is that the environment should be dynamic and experience unpredictability. The context of higher education faces complex problems that require coordinated, collective action from educators, researchers, and organizational leaders. Not only is the landscape of higher education changing, so is the student. Institutions are serving a diverse range of learners, providing adaptable curriculum, micro-credentials, and apprenticeships while developing relationships with growing industries and expanding on research efforts to provide value to learners. Institutional commitment to continuous improvement and innovation is necessary. Committing to continuous development of people, enabling necessary institutional support foundation, learning together, and collaborating, expand the overall capacity across the field of higher education (Bryk, 2018). This creates more opportunities for people and organizations to engage in transformational work that is Agile.

Innovation enhances a new future for higher education and technology plays a significant role. Technology can be used to collect or obtain data to better understand and support students. Technology and gathered data allow institutions to further understand the role they play in education and become student centric. With innovative technology practices, higher education institutions can create a student-services network to support the entire student life cycle: from prospective student status, admissions application, enrollment, curricular and co-curricular learning, job placement, graduation, alumni engagement, and continuing education. Technology can help foster a student's affinity to the institution by expanding their relationship and experience.

Theories of Agile Adoption

While a formal theoretical basis does not exist for studying Agile adoption in public administration, this dissertation begins to build such a foundation by examining the Agile Manifesto, PSM, the Plan-Do-Study-Act (PDSA) Model, the Schneider Culture of Change model, and the Theory of Planned Behavior (TPB). The Agile mindset goes beyond the traditional bureaucratic mindset of command and control. The theories listed above offer guidance on how the Agile mindset is formed in place of the traditional mindset.

Organizational climate influences organizational functions, including service provision, product development, problem solving, decision-making, communication, and learning. Administrators engage in providing services, which are the core functions of the organization. Problems arise when services and service quality lag or delay. This is where effective leadership is of critical importance for identifying and utilizing Agile values and creating a cultural shift towards Agile. Higher education institutions have evolved quickly

over the last several decades due to access to education and supply and demand of knowledge in the job market. Success cannot be ensured through operational excellence, brand, or financial resources. Higher education institutions must be able to adjust and respond quickly to changes in an innovative and collaborative manner. Organizational culture can either foster or stifle creativity and innovation. High levels of creativity can be fostered when organizations are able to successfully combine supportive and challenging work climates. Collaboration and innovation can be a key enabler for Agile in higher education institutions. Balancing is an important part of Agile, other important aspects of Agile implementation include planning and anticipating, being responsive to current or emerging issues, and always being cognizant of short to long-term project prospects.

Schneider's Culture of Change model

An organization's culture plays a fundamental role in the success of onboarding Agile methodologies. Culture can facilitate, or hinder, the implementation process. Schneider's culture of change model attempts to answer: 'how do we do things here to succeed?' The model is divided into four cultures: collaboration, control, cultivation, and competence. In a *collaboration culture*, the goal is for an organization to work together. In a *control culture*, the goal is for an organization to gain and maintain control. In a *competence culture*, the goal is for an organization to become the best. While in a *cultivation culture*, the goal is for the organization to learn and grow as much as possible (Schneider, 1999, Figure 3.1; Measey, 2015, p. 29). The model is often depicted in a axes diagram.

The Spayd (2011) and Sahota (2012) culture study individually showcased that Agile practices are aligned with collaboration and cultivate cultures. Sahota (2012) mapped the Agile Manifesto, while Spayd (2011) surveyed Agile practitioners to map out key culture profile identifiers- how practitioners do things to succeed. Using Agile methodologies, organizations can assess and adjust in dynamic environments where unpredictability can, and often does, occur. This assessment and adjustment are a founding principle of complexity theory, chaos theory, and evolutionary theory.

Organizational agility explores speed, flexibility, innovation, financial capabilities, leadership, IT capacity, and size of institution, while identifying the organizations the need for change and risks. Workforce agility has been defined as the "organized and dynamic talent that can quickly deliver the right skills and knowledge at the right time, as dictated by business needs" (Muduli, 2013, p.57). Technology is the central focus of IT departments. IT agility includes virtualization, cloud, mobile, or social to delivery models including Software as a Service (SaaS), Platform as a Service (PaaS), Infrastructure as a Service (IaaS), and shared services model (Subhankar, 2012).

IT departments in higher education institutions must identify needed changes and understand how the changes should be implemented. Organizational agility is interconnected with other organizational components. From an organizational perspective, agility should enable IT departments to recognize important trends, opportunities, and problems. Specifically, there are six fundamental processes identified by Seo and La Paz (2008): (1) perceive the change that is needed; (2) process the impact by transitioning the data into knowledge; (3) respond either pro-actively or reactively to the changing conditions; (4) align structures or processes to incorporate changes; (5) learn from the

experience and incorporate the knowledge into future opportunities; and (6) show competence that the processes work and that information is being shared and acted upon at the appropriate time and levels within the organization.

Theory of Planned Behavior

The Theory of Planned Behavior (TPB) aims to predict and explain behavior in certain settings. It postulates that the probability that someone will engage in a specific action depends on his or her intention to perform it (Ajzen, 1985, 1991). TPB is an extension of the Theory of Reasoned Action and responds to that Theory of Reasoned Action limitation to predict or explain behaviors which people do not have control. Of relevance to this dissertation, TPB suggests that if the intent is to predict a particular behavior (i.e., adoption of Agile methods in research universities), the appropriate attitude to measure to predict whether IT departments will engage in adopting and leveraging Agile is the IT departments attitude towards Agile adoption. Understanding an individual's attitude toward a behavior and the intention to complete a task "provides a host of information that is extremely useful in any attempt to understand these behaviors, or to implement interventions that will be effective in changing them" (Ajzen, 1991, pg. 207). Understanding intent can aid the department in adopting Agile methods. The theory is centered around the individual's intention to perform an action. Ajzen (1991) found that intentions:

> are assumed to capture the motivational factors that influence a behavior; they are indications of how hard people are willing to try, of how much of an effort they are planning to exert, to perform the behavior. Generally, the stronger the

intention to engage in a behavior, the more likely should be its performance. (pg. 181)

An individual's intention to complete a task is relevant if the individual can control if they will perform the task or not. In the case of Agile adoption, the behavior of Agile adoption is influenced by the individual intention if they can choose if they will adopt or not adopt Agile in the IT department. The term intention is interchangeable with motivation.

TPB proposes three conceptually independent determinants of intention which are depicted in figure 3. The first is the attitude toward the behavior and refers to the degree to which a person has a favorable or unfavorable evaluation or appraisal of the behavior in question. The second predictor, subjective norm, refers to peer pressure that the individual perceives to perform or not perform the behavior. The third predictor is the ease and feasibility of which the individual could perform the behavior, taking into consideration past experiences (Ajzen, 1991). The theory is a useful framework for predicting attitudes toward behaviors and predicting behavioral intentions.

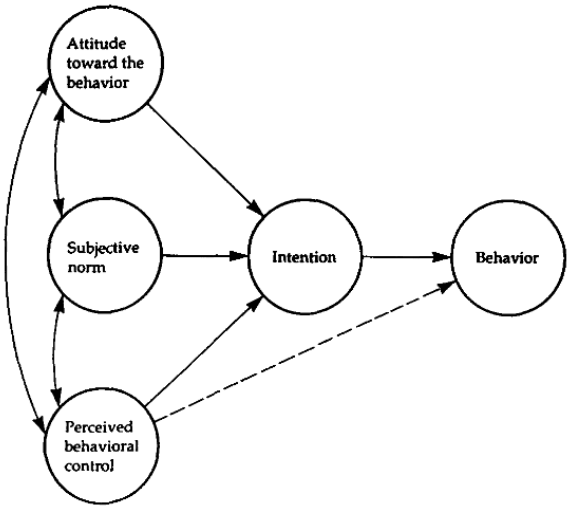

Figure 3: Theory of planned behavior model

The PDSA Model

The Plan-Do-Study-Act (PDSA) Model is a cyclical tool for of improvements and tests a change in a real-life setting. The PDSA model an enhanced version of the Plan-Do-Check-Act (PDCA) model. The PDCA/PDSA models were originally developed in the 1930s by Walter A. Shewhart and later modified by W. E. Demings in the 1950s as part of the Model for Improvement, which consists of two parts: (1) Thinking and (2) Doing. The doing part of the Model for Improvement is the PDSA model. "PDSA is a systematic approach for testing an idea by putting a change into effect on a temporary basis and learning from its potential impact" (Using the PDSA Model, 2014, p. 2). During the Plan phase, the proposed change/intervention is identified, as well as what the expectation is and what data is needed and or setting measurable objectives for subsequent cycles. During the Do phase, the implementation process is described, and testing occurs. The proposed change is attempted for a specific period and the testing is limited to a specific area to control for variables. Data is collected and prepared for the next phase. Shortcomings are identified during the Study phase. Employees should have the intention to continuously learn and improve their own skills and abilities during the Study phase. "Organizations… must develop a system, which, on one hand, nurtures a creative environment and on the other hand is good at handling the creative process, so that the basis for innovation and continuous improvements exists" (Martensen & Dahlgaard, 1999, pg. 879). Organizations must be action-oriented and focus on innovation—maintaining awareness of the customer. It is an organization's responsibility to create opportunities for innovation and agility and to dictate the priorities of the organization.

The results of the Do phase are analyzed; what was learned from the proposed change during the testing phase is considered. Were objectives met? During the Act phase of the model, the results are used to decide the next steps. Poor results from the Do phase equal learning opportunities in the Act phase. During the Act phase, the individual utilizing the model takes the time to understand the problems and learn what they can from the before attempting to solve it. Learning provides the opportunity to foster change and change is what often leads to innovation and progress. It is the need for innovation and improvements that propel institutions toward agility.

At this part of the model, the proposed change is adopted, adapted, or abandoned by the results of the Act phase. Since the model is continuous, if appropriate, the next change is identified, and the next cycle of the model begins. If the change was accepted or adapted, the next cycle of the model will contain the previous change. Fast learning organizations should encourage networking and information sharing and cross-functional teamwork. These organizations should encourage holistic system thinking and learning in addition to narrow problem solving and implore creativity, innovation, and continuous learning—rather than conformity—from managers and employees.

Companies that are successful in innovation continuously evaluate and improve how they address innovation. In higher education, this means understanding current client/customer and anticipating and preparing for the needs of future client/customers. Understanding the workforce and identifying possible challenges students may face as they enter the workforce, provide that when students leave a tertiary education setting that they are hirable and can produce. The learners, while important, is not the only focus - the administration response to continuous evaluation and improvement are indispensable.

There needs to be a learning loop for institutions and then a supplemental loop that addresses the learning and improving after the learning because it is a continuous cycle. Continuous improvements can result from the gaps identified during the study phase of the PDSA cycle.

> These gaps help us to look at things in a new way, and to use this knowledge so that the planning and action activities are performed in a more effective and efficient way in the future. Continuous improvements initiated in the Study phase can thereby be perceived as a driver of fast learning. (Martensen & Dahlgaard, 1999, pg. 884)

Organizations must recognize and understand their strengths and limitations, how peers or comparable organizations perceive them, and the potential that lies outside of the institution. Organizations should assess their own ability to innovate- strengths and weaknesses, their internal history, product performance, and best practices. The organization must understand internal strengths and weaknesses to build on strengths and minimize weaknesses.

Senge (1990) found that five standards must be present in an organization that strives to become a learning organization: (1) Team learning (i.e., learning must occur in teams, so that the synergy by learning in groups can be utilized); (2) Personal mastery (i.e., the energy and the desire to learn in an organization must come from the organizational members striving for personal goals and visions); (3) Mental models (i.e., reduce barriers for learning and this can be achieved by reducing organizational members mental assumptions); (4) Shared values (i.e., efficiency in the learning organization can be assured by strengthening shared values, based on organizational members' vision); and (5) System

thinking (i.e., organizational members' must have a comprehensive understanding of the system). Organizational members must understand how they influence and participate in the organization, and thereby avoid sub-optimization (Martensen & Dahlgaard, 1999, pg. 884).

Innovation requires that "organizations have the competencies to react quickly to new market conditions and customer's needs and see the possibilities that can arise from constantly looking for creative solutions and continuous improvements in product and innovation processes" (Martensen & Dahlgaard, 1999, pg. 878). The important questions are not: are you innovative? Or Are you Agile? But rather: are you innovating fast enough? Are you Agile enough? A similar claim has been made by Stata (1989), who argued that "the rate at which individuals and organizations learn may become the only sustainable competitive advantage, especially in knowledge-intensive industries. So, the future organizational form will be learning organizations—organizations that learn faster than their competitors" (Martensen & Dahlgaard, 1999, pg. 888). Learning is not a stopgap, but an ongoing, continuous process.

Summary

The field of public administration has recently recognized the importance of Agile methodologies and practices as critical skill sets for public service and in higher education. Most of the scholarly work on the topic has focused on how information technology departments, engineers, or private organizations integrate these skills within project management and product delivery. Recent literature has focused on local government

initiatives to adopt Agile principles to increase efficiencies. There is little scholarly work written in the perspective of higher education and public administration together.

This review identified three significant gaps in the literature; thus, this study aimed to (1) define the uses of Agile methods in research universities; (2) identify the specific factors that affect adoption of Agile methods in research universities, and (3) understand why certain research universities adopt Agile while others do not. The findings from this dissertation will inform project management integration, organizational training programs, and future empirical research on Agile methodologies within public administration.

Agile presents an opportunity to shift traditional bureaucracy, seeking to improve value for the public while reducing wasteful practices and continuously learning and responding to feedback. Agile is a mindset with a foundation in innovation and creative problem solving that can be applied to various fields, including higher education and public administration.

3. Agile Adoption in Higher Education

This chapter addresses the two research questions of the dissertation: (RQ1) What are the uses of Agile methods in research universities? and (RQ2) What are the specific factors that affect adoption of Agile methods in research universities? These exploratory research questions examine the extent to which research universities have adopted and use Agile. Previous studies have not examined Agile adoption in higher education; thus, these questions provide insights into the extent of Agile adoption and use in the context of research universities.

Conceptual framework and hypothesis

This study utilizes Ajzen's theory of planned behavior (TPB) as the basis for conceptual framework. The central focus of TPB is understanding and predicting an individual's intention to perform a planned behavior. The "intention" is what motivates or influences the behavior. An individual's intention and ability, and other non-motivational factors, influence the individual's ability to decide if they will perform a behavior. An overview of the conceptual framework and its subcomponents is presented in Figure 4.

Ajzen's assumption is that motivation, ability, and control influence performance of the behavior. *Perceived behavior control* is an individual's perception of how difficult it would be to perform the behavior or complete the task. The individual's perception impacts intention and action; the *perceived behavior control* can change depending on the situation and behavior.

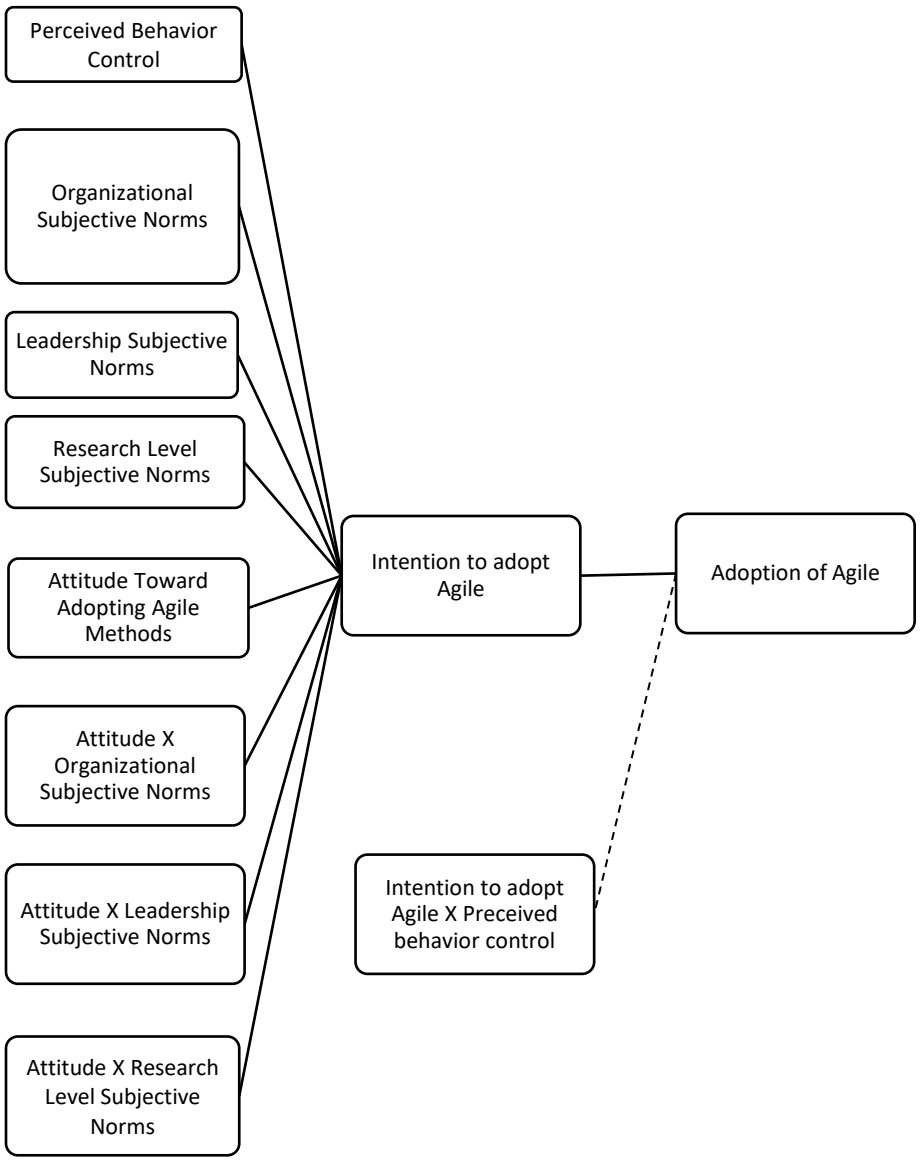

Figure 4. Conceptual model

The concept of self-efficacy is interchangeable with perceived behavior control. Self-efficacy is where an individual's confidence in their own ability impacts their success. The individual's perception of how difficult it would be to accomplish a task, and their intention to accomplish the task, can predict behavior achievement. The theory holds intentions at a constant, where the effort to accomplish the task increases with perceived behavioral control (Ajzen, 1985). Control is the individual's ability to choose to

accomplish the task. To predict the behavior, the intention and perceived behavioral control must be compatible with the behavior that is being predicted. For example, if the behavior that is being predicted is "washing dirty dishes," then the intention that must be assessed is "to wash the dirty dishes" as well as the perceived control over "washing the dishes." The intention and perceived behavioral control need to be stable throughout the process.

Azjen's theory postulates that several aspects must be considered to predict behavior: *subjective norms, attitudes, and perceived behavior control*. Figure 5 illustrates this relationship. *Subjective norms* refer to the social pressures the individual may experience while performing the behavior. *Attitude* refers to the individual's attitude toward the behavior—does the individual like the behavior. The more positive the attitude and subjective norms, the better the *perceived behavioral control*, the greater the intention would result, and the behavior may be predicted.

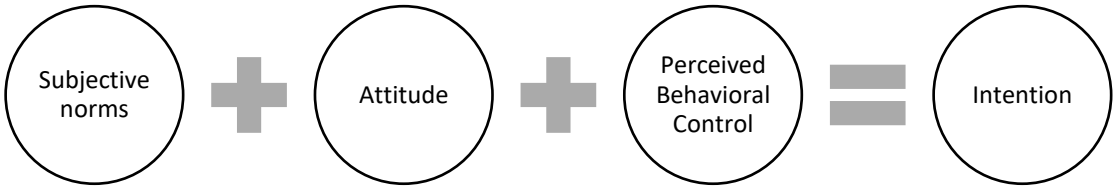

Figure 5. Conceptual model, intention equation

This dissertation considers three subjective norms: research level subjective norms, organizational subjective norms, and leadership subjective norms (see Figure 6). *Research level subjective norms* refer to the social pressures associated with the institution's research classification level that may influence an individual to complete a task, such as adopt Agile. The individual is the representative from the University that is determining if Agile is adopted by their respective institution. *Organizational subjective norms* refer to the social

pressures associated with the institution's organizational design and culture that may influence the individual to complete a task, such as division of labor, hierarchical order, and organizational dynamics. *Leadership subjective norms* refer to the social pressures associated with institutional leadership dynamics that may influence an individual to complete a task. Institutional leaders have the responsibility to share institutional goals and vision within the institution and focus on innovation and efficiency. Leadership is responsible for ensuring that decisions are made to improve governance, services, and the management system in general.

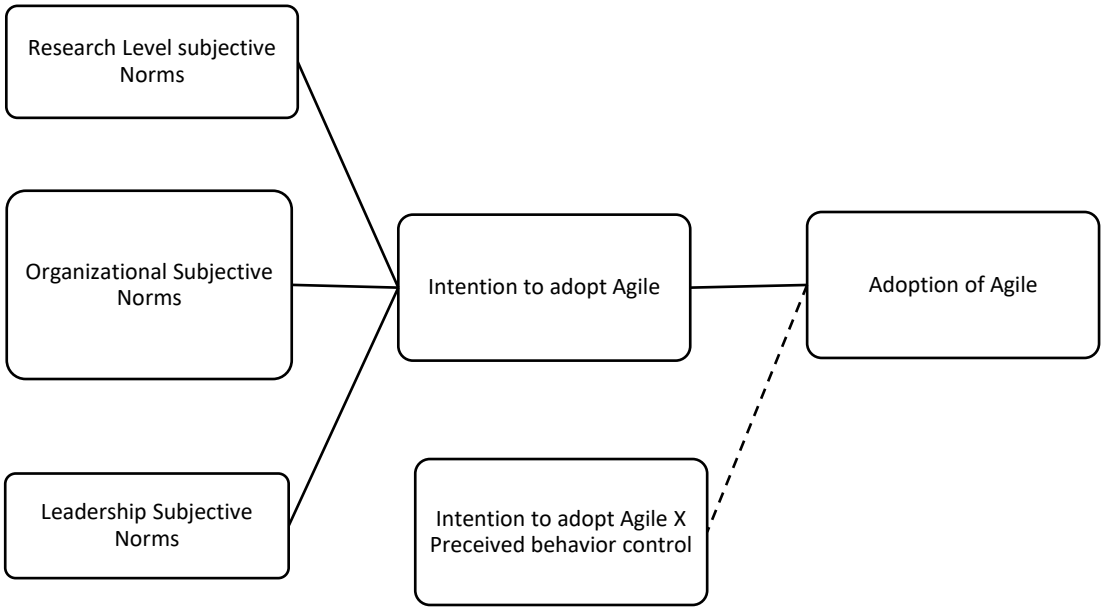

Figure 6. Conceptual model, subjective norms

Attitude denotes a person's perception of a behavior—do they like it or not. Figure 7 depicts four attitudes of the conceptual model: attitude toward adopting Agile methods, attitude/organization subjective norms interactions, attitude/leadership subjective norms interactions, and attitude/research level subjective norms interactions. *Attitude Toward Adopting Agile Methods* denotes an individuals' stance on adopting Agile methodologies—

do they like the methodology. *Attitude X Organization Subjective Norms* refers to the organizational design and culture of the institution that may influence and/or pressure an individual to complete a task and how that individual feels about it. *Attitude X Leadership Subjective Norms* refers to how leadership leads an organization, which may influence and/or pressure an individual to complete a task and how they feel about it. *Attitude X Research Level Subjective Norms* denotes how an individual feels regarding the social pressures that may influence and/or pressure them to complete a task associated with the institution's research classification level.

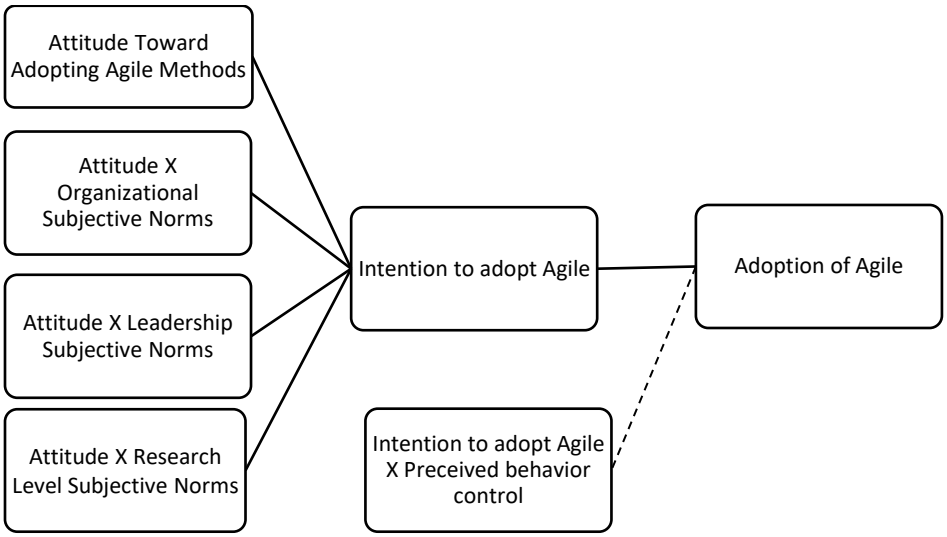

Figure 7. Conceptual model, attitude.

The structure and culture of a university are important components in building an individual's attitude and views of subjective norms. Universities, and their respective cultures, play a role in innovation, research, and development by pursuing research, improving rankings and standings, and recruiting the necessary human capital to be innovative. Universities are multifaceted and lend to this type of development. Innovation through research can be a tool used to improve metrics, standing, and rankings. Universities

can leverage these rankings and research opportunities for recruitment purposes. In terms of Agile, higher education organizations can leverage Agile, some Agile, or no Agile practices. Leveraging Agile practices indicates that an organization holds Agile principles in high priority and that IT departments practice Agile in their daily operations through institutionalization of knowledge, innovation, and dissemination of lessons learned through product delivery. For an institution to leverage Agile, it is necessary that relevant stakeholders participate in moving these attitudes, policies, and practices in a positive direction.

Scholars in the field of engineering and computer science have developed several Agile frameworks and studies. Yet, virtually no Agile research has focused on higher education, and few studies have focused on Public Administration. RQ1 sought to examine the use of Agile methods at research universities. Hypothesis 1 (H1) hypothesized that universities adopt and use Agile methods to fulfill internal university-wide functions, rather than faculty or student services. RQ2 sought to examine the university-wide factors that affect the adoption and implementation of Agile methods in IT departments. As noted in Chapter 2, the literature review on Agile adoption in the private sector revealed that organizational leadership and capacity are significant factors for adoption. Peer collaboration within the organization could affect Agile adoption through imitation. In the context of higher education, the complexity of the organizational demands may also influence Agile adoption. Several factors may provide insight into how leaders create environments that promote innovation, risk-taking, and new approaches with Agile methods. These factors include: the size of the university, the number of students enrolled, the number of faculty and support staff employed at the university, the number of

departments, and budget allocated to the IT departments. The second hypothesis (H2) hypothesized that the adoption and use of Agile methods will be influenced by the leadership support within IT departments, the IT department's organizational capacity, and the organizational complexity (in terms of size and funding). It is hypothesized in this dissertation that the research classification would influence the adoption of Agile methods.

Information on university attributes (e.g., size, research level, university funding, etc.) is available through the Carnegie Classifications Public Data File, the latest version of which is available through the Carnegie Classification website hosted by Indiana University Center for Postsecondary Research. The latest version of that raw data is version 15, dated February 28, 2018. Classifications are time-specific snapshots of institutional attributes and behavior based on data from 2013 and 2014. Institutions might be classified differently in a different timeframe. Other data on Agile adoption, leadership, organizational capacity, and other variables—not available through the Integrated Postsecondary Education Data System (IPEDS)—were collected through the survey instrument used for data collection in the present study.

This question examined the motivation factors for the adoption or non-adoption of Agile methods at research universities. The main intention is to examine why CIOs have adopted or not adopted Agile.

- H1: Universities adopt and use Agile methods to fulfill internal university-wide functions, rather than providing faculty or student services.
- H2: The adoption and use of Agile methods will be influenced by the leadership support, the IT department's organizational capacity, and the organizational complexity (in terms of size and funding).

Data collection and sources

RQ1 and RQ2 were examined utilizing a quantitative approach. The quantitative data collection process consisted of two phases. The first phase included the collection of the 2018 edition of the Carnegie Classification data set. The Carnegie Classification is not a ranking of colleges and universities. The classifications identify meaningful similarities and differences among institutions, but they do not imply quality differences. The classifications process began in 1970 and it was first published in 1973 by the Carnegie Commission on Higher Education. It was designed for researchers who sought to compare similar institutions and to support research and policy analysis. The classification is well respected and valued among researchers. Institutions are grouped based on a variety of measures. The Carnegie Foundation for the Advancement of Teaching transferred responsibility for the Carnegie Classification of Institutions of Higher Education to Indiana University Bloomington's Center for Postsecondary Research on October 8, 2014, and the change became effective on January 1, 2015.

The 2018 edition of the Carnegie Classification data set identified 418 doctoral universities: 131 R1 institutions, 135 R2 institutions, and 152 Doctoral/Professional Universities. The public review period for the 2018 edition ended on February 15, 2019. The institutional data was last updated by the Indiana University Bloomington's Center for Postsecondary Research team responsible for the Carnegie Classification of Institutions of Higher Education in December of 2019 at the time of this dissertation conducted the quantitative analysis. The data set is periodically checked for name changes and if campuses have closed. The 2018 classification data is based on: the IPEDS 2016-17 data set, the IPEDS Fall 2017 enrollment (preliminary) data set, the IPEDS Fall 2017 Human

Resources (preliminary file), the FY2017 National Science Foundation (NSF) Higher Education Research and Development Survey (HERD), and the FY2016 NSF Survey of Graduate Students and Post Doctorates in Science and Engineering (GSS) data sets (Ginder, 2018). The next classification will occur in 2021.

Institutions are categorized as public, private (not for profit), and private (for profit). The 2018 data set includes baccalaureate degrees conferred in the Arts and Sciences field (first and second majors), annual enrollment headcount for the 2016-17 academic year, city location of institution, as well as 93 other variables. Historical data is available in the data set and includes data from years 2000, 2005, 2010, 2015, and 2018. This historical data is not modified once published even if there are changes to the institution. The classifications that universities receive are reflective of the application period and the data submitted from 2016 and 2017. Classifications do not change from year-to-year after they are determined; if an institution aims to change its classification, it must submit a revised application during the next cycle. This occurred to various institutions, and it is reflected in the data set.

The 418 institutions count for 6.9 percent of all institutions in the U.S. In the 418 institutions, 7,229,265 students were enrolled (i.e., approximately 36 percent of students enrolled in the United States). The U.S. postsecondary institutions by degree program level and program focus data for fall 2017 enrollment is presented in Table 2 . Branch campuses and regional locations are counted separately if reported separately in IPEDS. Additionally, fall enrollment does not necessarily reflect the total number of students served over the course of an academic year, and total percentage details may not sum-up to 100 due to rounding for purposes of data display (Carnegie Classifications, 2018). The level of

research activity does not measure the quality, impact, or productivity of a university's research activity. The primary audience for the report and classification is the research community, including academic researchers and institutional research staff, as well as other education analysts.

The Carnegie Classification includes all U.S. degree-granting, Title IV eligible postsecondary institutions that granted at least one degree in the target year (2016-17 for the 2018 classification; 2013-14 for the 2015 classification). The total number of institutions included in the 2018 classification is 4,324, which was 7.3% less than the number in the 2015 classification. This decrease is due to institutional closures and institution mergers. The total distribution of institutions by classification category and institution classification: Doctoral Universities: R1 – 94 (public), 37 (private, non-profit), and 0 (private for profit), and the percentage distribution of each is 5.7%, 2.1%, and 0.0%, respectively; Doctoral Universities: R2 – 91 (public), 43 (private, non-profit), and 1 (private, for profit), and the percentage distribution is 5.5%, 2.5%, and 0.1%, respectively; Doctoral/Professional Universities: 28 (public), 107 (private, non-profit), and 17 (private, for profit), and the percentage distribution is 1.7%, 6.1%, and 1.8, respectively.

The distribution of student enrollment by classification is described based on research classification and institution type. In Doctoral University with R1 classification: 3,137,784 individuals were enrolled at public institutions; 671,633 were enrolled at private, non-profit institutions; and 0 students were enrolled at private, for profit institutions; the percentage distribution is 21.4%, 15.8%, and 0.0%, respectively. In this category, the average enrollment was 33,381 students for public institutions and 18,152 for private, non-profit institutions. In Doctoral Universities with R2 classification: 1,522,709 individuals

were enrolled at public institutions; 424,459 individuals were enrolled at private, non-profit institutions; and 1,004 individuals were enrolled at private, for profit institutions. The percentage distribution is 10.4%, 10.0%, and 0.1% respectively. In this category, the average enrollment was 16,733 students for public institutions; 9,871 students for private, non-profit institutions; and 1,004 students for private, for profit institutions. In the Doctoral/ Professional Universities classification: 390,432 individuals were enrolled at public institutions; 696,049 individuals were enrolled at private, non-profit institutions; and 385,195 individuals were enrolled at private, for profit institutions. The percentage distribution is 2.7%, 16.4%, and 34.2% respectively. In this category, the average enrollment was 13,944 students for public institutions; 6,505 students for private, non-profit institutions; and 22,659 students for private, for profit institutions.

Table 3 shows the changes among Doctoral Research Universities between 2015 and 2018. Of the 131 institutions that were in the R1 in 2015, 115 of them stayed in the corresponding category of the 2018 classifications. Sixteen institutions that were in the R2 2015 category moved into the R1 2018 category. Eighty-seven institutions in the R2 2015 category remained in the corresponding category for 2018, with three institutions moving into the newly created, "Doctoral/Professional Universities" R3 category, to accommodate the professional doctorates. Thirteen Master's institutions and one Special Focus Four-Year Institution moved into the R2 category. Sixty-five of the 111 Doctoral Universities: R3 category remained in the same category for 2018, while 34 moved into the R2 category. Eighty Master's institutions, one Baccalaureate institution and three Special Focus Four-Year institutions moved into the R3. The total distribution of institutions by research classification category is presented in Table 4.

Table 2: U.S. Postsecondary Institutions by Degree Level and Program Focus, Carnegie Classifications 2018 data set

	Institutions		Fall 2017 Enrollment	
	N	%	N	%
Doctoral Universities	418	10%	7,229,625	36%
Master's Colleges and Universities	685	16%	3,955,922	20%
Baccalaureate Colleges	572	13%	898,818	4%
Baccalaureate/Associate's Colleges	262	6%	1,270,740	6%
Associate's Colleges	1,000	23%	5,808,423	29%
Special Focus: Two-Year	432	10%	183,775	1%
Special Focus: Four Year	918	21%	700,442	3%
Tribal Colleges	34	1%	16,424	0.1%
Grand Total	4,324		20,063,809	

Table 3. Changes among Doctoral Research Universities

2018 Doctoral Universities	2015 Doctoral Universities			Other 2015 Institutions			Total
	Highest Research	Higher Research	Moderate Research	Master	Bacc.	Special Focus	
Very High Research	115	16					131
High Research		87	34	13		1	135
Doctoral/Professional		3	65	80	1	3	152
Other 2018 (Master's)		1	12				13
Total	115	107	111	93	1	4	431

Survey instrument and procedure

During the second phase of quantitative data collection, a virtual survey instrument was utilized to identify what specific factors affect adoption of Agile methods at research universities. To construct the survey items, a literature review was conducted to determine the main factors that influence Agile adoption. The literature review revealed the following main constructs: leadership, organization capacity, organization complexity, and research status. The conceptual framework presented in Figure 4 outlines these constructs.

Table 4: Distribution of institutions by research classification category

	# of Institutions	Percentage
R1		
Public	94	5.7%
Private, non-profit	37	2.1%
Private, for-profit	0	0%
Total institutions	131	
R2		
Public	91	5.5%
Private, non-profit	43	2.5%
Private, for-profit	1	.1%
Total institutions	135	
R3		
Public	28	1.7%
Private, non-profit	107	6.1%
Private, for-profit	17	1.8%
Total institutions	152	

Additionally, the survey was designed to collect data needed for analysis in the qualitative phase to address RQ3. The unit of analysis is the CIO or their designee. With 418 CIOs, a survey is the optimal tool for collecting the data. This exploratory study examined the factors that influence adoption of agility in institutions' IT departments; as such, it examined the institutions' perspective on adoption of Agile principles at the university leadership level. The survey contained 24 unique questions, response formats included: multiple choice (using a Likert style scale), ranking order, fill in the blank, and matrix tables (Likert-type scale). The survey included a role identification question that asked participants to identify their role at their respective institution, allowing me to identify if the participant was the CIO or a designee. The complete survey is included in the appendix.

The survey was administered during the summer and fall of 2019. To identify the 418 CIOs that would be invited to participate, the Carnegie Research Classification Public

Data File was downloaded. This file is available on the Carnegie Research Classification website. Each institution's CIO or equivalent was cross-referenced using the respective institution's website to confirm identity and contact information. When information was not readily available, the Office of the President for the institution was called to gather the appropriate contact information. In the case that a university did not have a CIO, the survey was sent to the university's most senior technology officer. If an institution did not have a CIO or equivalent due to retirement or changes in leadership, it was noted, and the survey was sent to the individual identified by the Office of the President or equivalent at the institution.

Branch or regional campuses were counted separately if reported separately in the Integrated Postsecondary Education Data System (IPEDS). IPEDS data provided demographic, enrollment, and financial information. For example, branch campuses for the University of California were counted separately; the following campuses were each represented individually, and their research classifications may have varied: University of California-Berkeley, University of California-Davis, University of California-Hastings College of Law, University of California-Irvine, University of California-Los Angeles, University of California-Merced, University of California-Riverside, University of California-San Diego, University of California-San Francisco, University of California-Santa Barbara, and University of California-Santa Cruz.

Survey participants were grouped based on research category and they received an invitation via email to participate in the anonymous survey. In the email invitations, participants in each research category received the same anonymous survey link, which allowed me to group results by research category. No identifying information was

collected, and CIOs were able designate a representative from their team to complete the survey on their behalf. Because CIOs could designate a representative, a role identification question was included in the survey. This question is not considered to be an identifying question because response options were general position descriptions. The survey emails were sent 5 times between July 2019 and September 2019. The survey was sent to only one representative from each institution to avoid duplication. Some institutions with regional campuses have one central CIO, who oversees the central location and regional locations. This reduced the sample size of each category. Participants were provided with a written statement describing the study, how participation would be voluntary and confidential, the potential benefits of the study, my contact information, and contact information for the Florida International University Office of Research Integrity. Participants were then asked for consent to continue. Email reminders and phone calls were operationalized until saturation occurred.

Survey data was collected using Qualtrics and kept in a password protected computer. When possible, responses were converted to numerical values. Of the 418 institutions, 173 institutions responded, the response rate for the survey was 41.4%. Of the 173 responses, 69 (52.7%) responses were from R1 institutions, 59 (43.7%) were from R2 institutions, and 45 (29.6%) responses were from R3. R1 and R2 institutions were well represented in the survey response. While the R3 research category had the largest number of possible participants, this research category was not strongly represented in the survey results.

Extent of Agile use and adoption

The survey asked participant CIOs if their institutions leveraged Agile methods within the context of higher education and central IT departments. Participants were first asked about adoption of Agile and, if adopted, the duration of time the organization practiced Agile development methods. Thus, the first question was a conditional one: if the participant selected that the institution does not practice Agile development methods, they were directed to questions pertaining to institutional organizational culture and IT structure. Overall, about 39% indicated that they did not adopt Agile methods. Most of the respondents (61%) indicated adoption of Agile methods. The IT departments in the research universities are adopting Agile methods.

The pattern of Agile adoption varies among the IT departments, depending on the research classification. According to respondents in the R1 category, 11 institutions (30.56%) do not use Agile methods, 3 institutions (8.33%) have used of Agile methods for less than 1 year, six institutions reported using Agile for 1-2 years (16.67%) and six institutions reported using Agile for 3-5 (16.67%), and 10 institutions (27.78%) have used Agile methods more than 5 years. A total of 33 institutions did not indicate if they were practicing Agile development methods. Thus, the majority of R1 universities have been early adopters of Agile methods.

According to the 59 respondents in R2 category, 21 institutions (41.18%) do not practice Agile development methods, 5 institutions (9.8%) have used Agile methods for less than 1 year, 9 institutions (17.65%) have used Agile methods for 1-2 years, and 14 institutions (27.45%) have used Agile methods for 3-5 years. Only 2 institutions (3.92%)

have used Agile methods for more than 5 years. Most R2 institutions are, thus, in the early stages of Agile adoption (less than five years).

According to the 45 respondents from Doctoral/Professional Universities, 21 institutions (60%) do not practice Agile development methods, 1 institution (2.86%) has used Agile methods for less than one year, while 2 institutions (5.71%) have used Agile for 1-2 years; 4 institutions (11.43%) have used Agile methods for 3-5 years, and 7 institutions (20%) have used Agile methods for more than 5 years. IT departments in the D/PU category, thus, lag behind the R1 and R2 institutions in Agile adoption.

Research question one analysis: Uses of Agile

The first research question, RQ1, asked: What are the uses of Agile methods in research universities? Survey questions #2, #3, and #4 provide insights into this research question. These three survey questions are presented in table 5:

Table 5: Survey Questions 2 - 4

Survey Question	Answer Choices
#2. Our organization uses Agile for the following purposes:	• Procurement • Instructional software • Faculty/staff evaluations • Back office operations (i.e., admissions) • Other
#3. Our institution adopted Agile for the following reasons (rank order):	• Accelerated software delivery. • Enhance ability to manage changing priorities. • Increase productivity. • Improve IT alignment • Enhance software quality. • Enhance delivery predictability. • Improve project disability. • Reduce project cost. • Improve team morale. • Reduce project risks. • Better manage distributed teams

	• Other
#4. Our institution uses the following Agile methodologies:	• Extreme Programming (XP) • Lean startup • Don't know. • Kanban • Scrumban • Scrum/XP Hybrid • Other/hybrid/multiple • Scrum • Iterative development • Other

As indicated above, Survey Question #2 asked respondents about the purpose for using Agile methods. The answer choices included: for procurement, instructional software, faculty/staff evaluations, back-office operations (e.g., admissions), or other purpose. Most institutions indicated other reasons outside of the options provided. Figure 8 presents a breakdown of the purpose of organizational Agile use per research category. The "Other" (i.e., fill in the answer) option allowed each institution to input their own purpose. A total of 39 out of 60 institutions selected the "Other (fill in the answer)" option; these 39 institutions included 20 R1 institutions, 17 R2 institutions, and 2 R3 Universities. The "Other" responses mainly concerned: IT development (10 institutions), Enterprise Application (4 institutions), IT/Project Management (11 institutions), and Administrative Software Development (7 institutions). Five institutions that selected "Other" did not provide an alternative purpose.

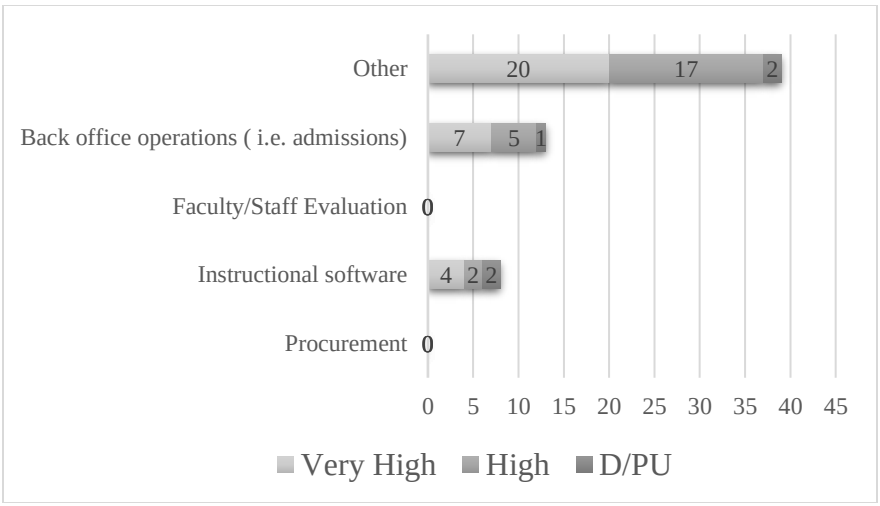

Figure 8: Purpose of organizational Agile use

Survey Question #3 asked institutions to rank the reasons why they adopted Agile. The answer choices included: Accelerated software delivery, Enhance ability to manage changing priorities, Increase productivity, Improve IT alignment, Enhance software quality, Enhance delivery predictability, Improve project deliverables, Reduce project cost, Improve team morale, Reduce project risks, Better manage distributed teams, and Other. Table 6 illustrates the top three reasons for each research category. The rankings show that for the R1 category, the top three reasons for Agile adoption were: Accelerated software delivery (51.61%), Enhance ability to management changing priorities (41.94%), and Increase Productivity (32.26%). The rankings show that for the R2 category, the top three reasons were: Accelerated software delivery (45.83%), Enhance ability to manage changing priorities (33.33%), and Increase productivity (20.83%). In the R3 category, Accelerated software delivery received the highest rank (83.33%), while Increase productivity and Reduce Cost were tied at 33.33% respectively. Enhance ability to manage changing priorities ranked as the third reason for Agile adoption with 33.33%. It is

important to note that all institutions ranked accelerated software delivery as the leading reason for Agile adoption.

Table 6. Top three reasons why institutions had adopted Agile.

Research Classification	Rankings		
	1	2	3
R1	Accelerated software delivery (51.61%)	Enhance ability to management changing priorities (41.94%)	Increase Productivity (32.26%)
R2	Accelerated software delivery. (45.83%)	Enhance ability to manage changing priorities (33.33%)	Enhance ability to manage changing priorities (33.33%)
R3	Accelerated software delivery. (83.33%)	Increase Productivity (33.33%)/ Reduce Cost (33.33%)	Enhance ability to manage changing priorities (33.33%)

Survey Question #4 asked participants about which Agile methodologies were used. The answer choices included: Extreme Programming (XP), Lean Startup, Don't know, Kanban, Scrumban, Scrum/XP Hybrid, Other/hybrid/multiple, Scrum, Iterative development, and Other. Most participants indicated Scrum and Kanban as the preferred Agile methodology of their institution. Scrum was selected as the leading methodology for 29.87% of R1 institution participants, 26.83% of R2 institution participants, and 23.81% of R3 institution participants. Scrum is an iterative and incremental methodology that focuses on transparency, inspection, and adaptation.

The next survey question asked about the common Agile techniques used by IT departments. There were 18 common Agile techniques identified in the question: Daily

standup, Sprint/iteration planning, Retrospective, Sprint/iteration review, Short iteration, Planning poker/team estimation, Kanban, Release planning, Dedicated customer/product owner, Single time (integrated dev and test), Frequent releases, Common work area, Product road mapping, Story mapping, Agile portfolio planning, Agile/Lean UX, Don't know, and Other (fill in answer). The top 3 choices in each category of research university are presented in Tables 7-9.

Table 7. Agile technique within R1 Universities

Agile Technique	Response Rate	
Sprint/Iteration Planning	13.42%	31
Daily Standup	10.82%	25
Retrospectives	6.93%	16
Release Planning	6.93%	16
Dedicated Customer/Product Owner	6.93%	16
Common Work Area	6.93%	16

Table 8. Agile technique within R2 Universities

Agile Technique	Response Rate	
Daily Standup	13.74%	28
Sprint/Iteration Planning	13.74%	18
Single Team (integrate dev and test)	9.16%	12

Table 9. Agile technique R3 Universities

Agile Technique	Response Rate	
Daily Standup	12.50%	5
Sprint/Iteration Planning	10%	4
Short iteration	10%	4
Dedicated Customer/Product Owner	10%	4
Frequent release	10%	4
Common Work Area	10%	4
Single Team (integrate dev and test)	7.50%	3
Story mapping	7.50%	3

Daily standups and sprint/iteration planning were selected as top two Agile techniques used by all categories of research universities. Both techniques are also a

component of Scrum methodologies. Scrum is, thus, the leading Agile methodology across all three research categories. Daily stand-ups are short meetings, 15-20 minutes long, that allow teams to evaluate project progress, plan for the day, and raise red flags. The focus of this technique is that everyone is on the same page; Scrum approaches hold individuals accountable for work completed on the previous day. This is accomplished by structuring updates to include: what did I do yesterday that helped?, what will I do today?, and what are possible red flags that will not allow me to accomplish my daily goals for today? Sprints are 3-week exercises for cross-functional teams to conduct focused work on a specific problem.

With respect to Agile project management tools, respondents were presented with 20 options as part of Survey Question #8. Answer choices included: Axosoft, Bugzilla, Google Docs, Hansoft, HP Agile Manager, HP QC/ALM, In-house/home grown, Jira, LeanKit, Microsoft Excel, Microsoft Project, Microsoft TSF, Mingle, Pivotal Tracker, Rally, Rational Team Concert, Target Process, TeamForge, VersionOne, and Other (fill in answer). This question received very little responses from the D/PU category and did not reveal significant information for this category. The R1 and R2 categories selected "Other" at high rates—16.22% and 24.44%, respectively. This suggests the possibility that important project management tools (e.g., Trello and TeamDynamix) were not included in the original list. A total of 7 institutions indicated use of Trello. Trello is a free visual way software that is used to manage and organize projects. Six institutions indicated use of TeamDynamix: a Software as a Service (SaaS) Cloud solution offering service and project management on one platform. There was no overlap between the institutions that self-reported use Trello and those that use TeamDynamix. Twenty-four institutions from the

R1 category indicated use of Jira as a project management tool. Jira markets themselves as the #1 software development tool used by Agile teams. Trello and Jira are owned by the same umbrella company: Atlassian.

Survey Question #7 questioned the type of challenges institutions faced when adopting Agile. Participants were asked to select all that apply, and the choices included: Organizational culture at odds with Agile values, General organization resistance to change, Inadequate management support and sponsorship, Lack of skills/experience with Agile methods, Inconsistent process and practices across teams, Insufficient training and education, Lack of business/customer/product owner availability, Pervasiveness of traditional, development methods, Fragmented tooling and project-related data/measurements, Minimal collaboration and knowledge sharing, Regulatory compliance or government issue, and Other (fill in answer). The challenges identified represent at a 10% or greater response rate. R1 institutions indicated high challenge levels with: Inconsistent process and practices across teams, Lack of business/customer/product owner availability, Lack of skills/experience with Agile methods, Pervasiveness of traditional software development methods, Organizational culture at odds with Agile values, General organization resistance to change, Insufficient training and education, and Fragmented tooling and project-related data/measurements. R2 institutions experienced similar challenges with: Organizational culture at odds with Agile values, Lack of skills/experience with Agile methods, General organization resistance to change, Inconsistent process and practices across teams, Lack of business/customer/product owner availability, Insufficient training and education, and Pervasiveness of traditional software development methods. D/PU institutions did not indicate as high level of challenges as the

other two research categories. D/PU participants identified the following challenges: Pervasiveness of traditional development methods, Organizational culture at odds with Agile values, Lack of skills/experience with Agile methods, General organizational resistance to change, Insufficient training and education, and Lack of business/ customer/ product owner availability.

In comparison, 142 challenges were identified by R1 respondents, 98 challenges were identified by R2 respondents, and 32 challenges were identified by D/PU respondents. This could suggest that at a lower level of Agile adoption; institutions face lower levels of challenges. R1 institutions self-identified the following additional challenges: fear of failure, staff shortages – open positions, and use of Agile to hide activities. When implementing Agile in an organization or team, the greatest challenge is not understanding the Agile methodology, but rather the organization's ability to adapt and adopt the concept as a whole and not just the ceremonies. Buy-in must occur throughout the organization to reduce challenges.

Research question two analysis: Adoption Factors

Survey questions 15-24 were used to analyze RQ2, namely: What are the specific factors that affect adoption of Agile methods in research universities? These survey items, which included five-point Likert-type scale responses (i.e., strongly agree to strongly disagree), were:

- Members of the organization feel empowered to design and try new approaches.
- Leaders not only explicitly prioritize innovation, but they establish clear expectations and timelines as the basis for making organizational progress.

- Our IT governance process prioritizes IT investment in accordance with institutional goals.
- Use of data is part of our strategic plan.
- We have a culture that accepts the use of data to make decisions.

The above survey items assessed the organizational and leadership subjective norms of the institutions in each research category to better understand what factors influence intention and adoption of Agile methodologies. Participants were asked if: (1) leaders at multiple levels of the organization champion creating environments that promote innovation, risk-taking and new approaches; (2) funding IT projects is viewed as an investment, rather than an expense; (3) their institution invests in the latest Agile methodologies/tool trainings; (4) their institutional IT governance process sets high-level goals for IT outcomes that are aligned with institutional strategy goals; and (5) IT governance process influences and enables IT strategic direction.

When asked if members of their organization feel empowered to design and try new approaches, the R1 respondents somewhat agreed (48.94%). When asked if leaders not only explicitly prioritize innovation but establish clear expectations and timelines as the basis for making organizational progress, the R1 respondents indicated that they somewhat disagree (35.42%). The R1 respondents indicated that they somewhat agree when asked if their institution's IT governance process prioritizes IT investment in accordance with institutional goals (47.92% somewhat agree), uses data as part of its strategic plan (52.08% somewhat agree), and has a culture that accepts the use of data to make decisions (52.17% somewhat agree).

The R2 participants responded similarly to R1 participants, indicating that participants somewhat agreed (53.66%) that members of their organization feel empowered to design and try new approaches. The R2 respondents indicated that they somewhat agreed when asked if their institution's IT governance process prioritizes IT investment in accordance with institutional goals (56.10% somewhat agree), uses data as part of its strategic plan (54.76% somewhat agree), and has a culture that accepts the use of data to make decisions (47.19% somewhat agree). Unlike the R1 category, participants in the R2 category indicated that they somewhat agreed that leaders not only explicitly prioritize innovation, but they establish clear expectations and timelines as the basis for making organizational progress. The D/PU research category had a stronger agreement consensus. D/PU respondents indicated that they somewhat agreed (56%) that members of their organization feel empowered to design and try new approaches. These respondents indicated a neutral position on leaders in their institution prioritize innovation and establish clear expectations + timelines as the basis for making organizational progress (36%). The D/PU respondents indicated that they strongly agreed when asked if their institution's IT governance process prioritizes IT investment in accordance with institutional goals (36% strongly agree), uses data as part of its strategic plan (40% strongly agree), and has a culture that accepts the use of data to make decisions (32% strongly agree). The response illustrates a positive attitude toward these organizational subjective norms.

While maintaining the anonymity of respondents, the last survey items sought to gather information on the individual who completed the survey and the institution including age range as depicted in table 10. In the R1 category, 36.5% of respondents were CIOs, and 25% of respondents held senior leadership roles (e.g., associate vice president,

vice provost, chief information security officer, and chief digital officer). IT department staffing varied from a small department of 8 people to a large department with 540 people; on average, staff size at the responding R1 institutions was 229 people. In the R2 category, 43% of respondents were CIOs, and 28.6% of respondents held senior leadership roles (e.g., vice chancellor, vice president, or associate vice president). IT department staffing varied from a small department of 3 people to a large department with 550 people; on average, staff size at the responding R2 institutions was 98 people. In the R3 category, 45.45% of respondents were CIOs, and 39.39% of respondents held senior leadership roles (e.g., vice president, associate vice president, chief digital officer, and chief technology officer). IT department staffing varied from a small department of 7 people to a large department with 200 people; on average, staff size at the responding D/PU institutions was 49 people. The table below presents the age range of the survey participants within each research category.

Table 10. Participants age range by research category

Age range	Research Category		
	R1	R2	R3
25 and under	0	0	0
26-29	0	0	0
30-39	2	1	0
40-49	14	12	13
50-59	23	19	6
60 or older	7	8	6

Summary

This chapter sought to explore the uses of Agile and the specific factors that affect adoption of Agile methods in research universities. Chief Information Officers of the 418 Carnegie Classified Research Institutions were invited to participate in an internet-based

survey to evaluate and assess subjective norms and attitudes identified in the conceptual model pertaining to organizational culture, collaboration, and strategy. The survey results contribute to building an understanding of university leaders' intentions to adopt Agile.

The survey results provided insight into research universities' use of Agile methods. Findings neither supported or rejected the hypothesis that the adoption and use of Agile methods will be influenced by the leadership support, the IT department's organizational capacity, and the organizational complexity (in terms of size and funding). The data can partially help explain what factors affect Agile adoption. Several data points for various variables in the Agile adoption model were missing and the model was not operationalized. The Carnegie Classification data set included information on each institution's IT department funding, student population, location, public/private status, and university total budget; however, it was not possible to cross reference the data set with the survey data because the survey was anonymous. This is a significant limitation for the study, as it limits the analysis of the data set.

To interpret these factors, participants were surveyed on the types of support that units receive, promote innovation, and prioritize projects. Participants were instructed to identify the obstacles their institutions faced while adopting Agile and how they measure progress in Agile adoption and in general.

> Organizational Vision is important for the ProductOwner to understand. The purpose and soul of an organization is to strive to fulfill their Vision. The Vision identifies strategic, long-term direction. It defines what the organization should invest effort into and acts as a filter to sift out activities that are not within scope. (Vanderjack, 2015, p. 12)

In the R1 category, 42.42% percent of the participants somewhat agreed that their institution viewed funding IT projects as an investment, rather than an expense; 54.55% of participants somewhat agreed that leadership at multiple levels of their organization champion creating environments that promote innovation, risk-taking, and new approaches, although 28.57% indicated that they somewhat disagree that their institution invests in the latest Agile methodologies/tool training. When asked if leadership not only explicitly prioritizes innovation but establishes clear expectations and timelines as the basis for making organizational progress, 35.42% somewhat disagreed, yet 59.58% of survey participants feel empowered to design and try new approaches. R1 respondents did not show a specific pattern pertaining to organizational culture data use; results were varied.

Participants in the R2 category somewhat disagreed, at a rate of 33.33%, that their institution viewed funding IT projects as an investment, rather than an expense; 40% of participants somewhat agreed that leadership at multiple levels of their organization champion creating environments that promote innovation, risk-taking, and new approaches, although 40% indicated that they somewhat disagree that their institution invests in the latest Agile methodologies/tool training. When asked if leadership not only explicitly prioritizes innovation but establishes clear expectations and timelines as the basis for making organizational progress, 39% somewhat agreed and 56.1% of participants surveyed feel empowered to design and try new approaches. R2 respondents indicated either a neutral stance or a slightly more agreeable stance pertaining to organizational culture data use.

Participants from the R3 category somewhat agreed or neither agreed nor disagreed at a rate of 33.33% that their institution viewed funding IT projects as an investment, rather

than an expense; 50% of participants somewhat agreed that leadership at multiple levels of their organization champion creating environments that promote innovation, risk-taking, and new approaches, although 33.3% indicated that they neither agreed nor disagreed that their institution invests in the latest Agile methodologies/tool training. When asked if leadership not only explicitly prioritizes innovation but establishes clear expectations and timelines as the basis for making organizational progress, 36% neither agreed nor disagreed, and 76% of members feel empowered to design and try new approaches. R3respondents did not indicate a strongly disagree response for any of the survey questions pertaining to organizational culture data use.

Another point of interest was the similarities in responses from leadership across the three research categories. This might be a consequence of the sample: more than half of the institutions claimed to leverage Agile in some capacity. The sample provided slight evidence that research universities across the three research categories face similar challenges and use similar Agile methodologies and techniques in their operations. This is an unexpected finding, given their unique points of view and different organizational structures. The data set in this portion of the study only partially answered Research Question 2 and raised additional questions. For example, what internal university functions are being supported through Agile methods? How does organizational structure and capacity influence the department's intention to adopt or not adopt Agile methods? What role does faculty play in this process? Do students play a role? Findings from the present study suggest a need to explore other factors that may better explain Agile adoption in research universities. While the present study expanded understanding of the organizational factors that impact adoption of Agile methods in research universities and

the uses of Agile in the context of higher education, it is not without limitations. Because of these limitations, the current study benefited from conducting a qualitative study.

4. Perspectives on Agile Adoption

The literature that focuses on why and how certain organizational and leadership subjective norms impact research classification or that provide insight into understanding which factors influence intention and adoption of Agile has not advanced in the field of public administration. Qualitative research methods provide insight on the association between organizational practices and managerial strategies, on one hand, and Agile adoption within research universities, on the other hand. Due to the lack of qualitative research in this area, public administrators and higher education administrators have been unable to make fully informed recommendations regarding Agile adoption. Findings from qualitative research would provide context and provide insight that the previous quantitative research component of the current study would otherwise not be able to accomplish.

This chapter focuses on answering RQ3: Why do research universities adopt (or not adopt) Agile methods? Answering this question contributes to Agile research by providing an explanation of the organizational characteristics of universities for adopting Agile methods. RQ3 is answered through a comprehensive examination of five R1 Doctoral Universities with geographically diverse locations across the United States. Methodologically, this chapter uses semi-structured elite interviews with elite representatives from five RI institutions, as well as content analysis, to answer the research question. The interviews with elite representatives focus on how organizational factors of their university impact Agile practices and adoption, the relationships between the various units within the university, and attitudes toward adopting Agile methodologies. The

interviews provide a unique and first-hand understanding of organizational behavior, project management, and the further the understanding of why Universities adopt Agile. The findings indicate how organizational culture, human resources, and desire to innovate can impact a research university's ability to leverage Agile methodologies. Additionally, this chapter discusses the implications of such research in relation to organizational behavior, project management, and the field and practice of IT.

I conducted a content analysis of secondary documents from the various universities, including policies and memos, operating procedures, and documents related to the Agile adoption. These secondary documents were analyzed to understand the organizational processes used within the IT departments and their human capital resources. The analysis of these documents yielded insights into the factors that influence, and hinder, Agile adoption within a research university by detailing the IT departments' policies toward Agile methodology, human resources (leadership), and research needs. The combination of interviews and content analysis sheds light on the causal link between organizational and managerial characteristics and Agile methodologies.

Research Methods

Qualitative methods facilitate exploration of real-world settings and personal experiences, histories, contexts, and relationships. Given the nature of RQ3, which sought to identify the reasons why a research university adopts or does not adopt Agile methods, qualitative research methodologies were appropriate. Elite interviews with decision makers in IT departments provided understanding of the rationale of how and why university departments decide to use certain methodologies. Internal documents on processes and

operating procedures explain the organizational culture and behavioral aspects of adopting Agile methods.

Elite interview participants were identified using several criteria. The elite interviews were conducted after the quantitative data collection discussed in Chapter 3. The interviews were conducted with representatives from IT departments within R1 institutions in the fall of 2019. These interviews were semi-formal in nature. Participants of the elite interviews were provided the same written statement of consent that survey participants were provided. The elite interviews were conducted over Zoom—an Internet-based communication platform for video and audio conferencing. While the survey described in Chapter 3 was addressed to CIO or their designees, the elite interviews, used the snowball sampling technique to identify, then contact, IT department chiefs. A total of 5 elite interviews were conducted. These interviews were with high level officials (i.e., CIOs or equivalent) who are key decision makers within their respective IT departments. The elite interviewees know how and why their respective departments made management decisions and implemented them. The 5 elite interviewees were the only IT leaders that responded to the request for an interview out of a total of 69 interview requests.

The sample includes five universities. Despite the small sample size, these interviews provided valuable insights on the institutions' rationales for adopting or not adopting Agile. The largest number of interviews occurred with public universities, which is consistent with the sample of 418 institutions surveyed in the qualitative data collection process. Not all geographic regions were represented; three institutions are located in a southern region of the United States (South Atlantic and Southwest). The discussions had slightly more males than females but, overall, the sample was an accurate portrayal of the

total sample from the quantitative sample. As with the survey, interview participants were assured confidentiality. To ensure participants' confidentiality I omitted and/or concealed the names of interviewees and the names, locations, and any other uniquely identifiable information of the research universities. Each anonymized interviewee is referred by their institution using the format: University A, University B, University C, University D, University E.

Process of Selecting Interviewees

The aim was to collect supplemental information that allowed for analysis and to develop a greater understanding of Agile use in higher education. The purpose for these interviews was to build the connections that cannot be expressed by numbers, and how Agile plays a role at each University. A paired down convenience sample was used for the elite interview. After analyzing quantitative data from the survey, R1 institutions had a higher response rate of using Agile in IT departments and to the survey. This group also had a higher participation levels compared to the other two groups in the survey. All R1 institutions in the Carnegie Classification were asked to participate in the interview to further understand Agile adoption in higher education.

Individual email invitations were sent to R1 CIOs between September and December 2019; one email was sent every month. Following the email outreach, participants were also contacted by phone. By December of 2019, five university administrators—representing 7.2% of the R1 sample that participated in the survey—agreed to participate in a one-hour, semi-structured elite interview over Zoom. A second phase attempt was made to increase the sample size between March and April of 2020. The

second outreach contacted the R1 institutions again, aside from the institutions that employed the 5 participants recruited during the first outreach. Participants during this second outreach were also contacted via email and phone. The secondary outreach was not successful, and no additional participants were recruited. Public universities consisted of 80% of the sample. The discussions were not geographically distributed; the following regions were not represented: Mountain West, West South Central, East South Central, East North Central, Northeast Middle Atlantic and the Northeast New England region. The elite interviews have slightly more male participation than female, but each gender was represented at least twice.

Interviews were semi-structured with open-ended questions and probing questions. The guided semi-structured discussions allowed for questions to be reordered during the conversation; question wording is flexible and allows for clarifications to be made if necessary (Remler & Van Ryzin, 2010). A benefit of the semi-structured formatting is that it allows for additional questions to be asked beyond the questions that were preselected, creating a more natural conversation, and eliciting more information from each elite interview.

Characteristics of Interviewees

I aimed to recruit interviewees with varied demographics, experience, and education. Table 11 presents the demographics of all participants. There were 2 female and 3 male interviewees. There was 1 Hispanic interviewee and 4 White interviewees. All participants were actively employed by their institutions, serving in full time positions with an average of 10-15 years of employment within the current institution. The age of

respondents ranged from 40 to 60 years. The interview guide instrument was pilot tested via Zoom with a male individual. This individual is a CIO and Chief Security Officer for an international private organization that utilizes both Agile and waterfall methods to create inhouse software as well as outsourced software. The pilot-test was conducted to ensure clarity of questions, gain feedback, and improve the questionnaire prior to conducting the actual interviews. The interviews were conducted via Zoom and the individuals were in private office spaces in their place of work. Length of interviews ranged from approximately 35 to 70 minutes. Interview length was affected by each interviewee's responses and willingness to share information.

Table 11. Demographic information of elite interview participants

Gender	**Freq.**
Total Persons	5
Female	2
Male	3
Universities Represented	5
Public Universities	4
Private Universities	1
Region	
South Atlantic	2
Southwest	1
West North Central	1
Pacific West	1
IT Representative	
CIO	0
Other IT position	5

Interview Questions

Four types of questions were utilized: essential questions, extra questions, throwaway questions, and probing questions. The last question of the discussion was a probing question asking administrators to elaborate on how their institution's Carnegie

classification affected plays a role in their innovation style and project management style. Zero-order level of communication was utilized when creating questions for mass understanding. There was no jargon, or special language codes throughout the questions used by the researcher. Questions were arranged in the following order: Agile management, Agile adoption practices, organization, and organizational culture. The first questions were mild, nonthreatening questions, such as: does your institution practice Agile practices? As the discussion continued, organizational culture questions were asked to understand goal development, leadership support, and IT structure.

Data Collection and Analysis

The discussions were analyzed using content analysis with an interpretative approach. All interviews were audio recorded with the consent of each interviewee. The raw data collected included audio, which was then professionally transcribed. After the interviews were transcribed, transcriptions were reviewed and edited against the audio files and revised for accuracy. The verified and accurate transcriptions were uploaded to NVivo for analysis. NVivo is a qualitative data analysis software that allows for data organization, storage, and analysis. NVivo allows the researcher to work efficiently and pursue in-depth analysis of the data. The qualitative data software allows data to be imported from any source—including transcriptions, videos, pictures, notes, and voice recordings—and to be used for analysis with management, query, and visualization tools. This software was used to code, identify themes, and run queries to assess the frequency of, and relationships between, themes. Quotes that illustrate themes found throughout the data are presented in the findings section for each university.

Secondary sources were reviewed to provide background information and organizational context (Yin, 2009). These secondary sources were reviewed to enhance and verify the information gathered from the elite interviews. The review of such sources provided a means to gain more insight and background on items briefly mentioned by interviewees. Integrating the secondary sources with the data collected from the elite interviews served to triangulate data (Bowen, 2009; Patton, 2002). Triangulation is when multiple sources of information and methodologies are used to corroborate findings. Documents were assessed from the universities' websites and included institutional history, organizational charts, personnel demographics, leadership biographies, strategic plans, annual reports, and board meeting minutes. No documentation was directly provided by participants, nor was it requested during the interviews.

The data was collected through audio recordings and documents received and/or acquired. Thematic analysis and explanation building techniques were used in the present study. Both analysis techniques are used in qualitative research to identify and analyze patterns across data collected. The patterns identified are recognized as themes and causal links that can explain what is happening in each situation. Special attention was focused on interviewee responses and reasons why their institution adopts (or does not adopt) Agile methods and how their institution's Carnegie classification influences the adoption of Agile methods.

The data was organized by institution, and each interview followed the same list of questions. Questions were included within the transcription. There was no need for data reduction as the data was focused, simplified, and manageable. The data were reviewed for naturally occurring groupings of themes and characteristics. Major topics (i.e., parent

nodes) were identified and subtopics (i.e., child nodes) were paired down. Meaningful patterns were identified. Themes/concepts were used as the content analysis unit. Six nodes were identified: Agility, Agile Methodologies, Agile Techniques, Organization, Project Management, and Research. Four of the nodes had child nodes: Figure 9 presents the parent-child node relationships. The analysis showed that organizational culture and project management were high referenced nodes. Tables displaying the nodes reference frequency and the percentage coverage and referenced are included in the appendix.

Each elite interview provided insight from the viewpoint of higher education IT administration, observations, and secondary data sources. The interviews provided insight into why and how organizational factors impact Agile adoption and how each university's Carnegie classification influences the adoption of Agile methods. To address RQ3, an examination of the current organizational culture and university environment was conducted per elite interview. Interviewees often defined Agile adoption practices within their institution by describing the roles central IT and sub-unit IT play in higher education. Interviewees also suggested that there are institutional influences, including the perception of IT practices, IT overall effectiveness, and collaboration among peers. In terms of translating the current state of organizational culture, Agile organizational management, and Agile practice adoptions, interviewees suggested that there were differences in perception and practices based on the IT subgroups that compose central IT and IT leadership.

After establishing how interviewees defined Agile adoption practices within their institution and understanding the current organizational culture and university environment, important subjective norms and attitude factors were identified—following

the conceptual model—pertaining to organizational culture, collaboration, and strategy. The results contribute to building an understanding of the intentions of university leaders in regard to adopting Agile methodologies as well as how an institution's Carnegie classification influences such decisions.

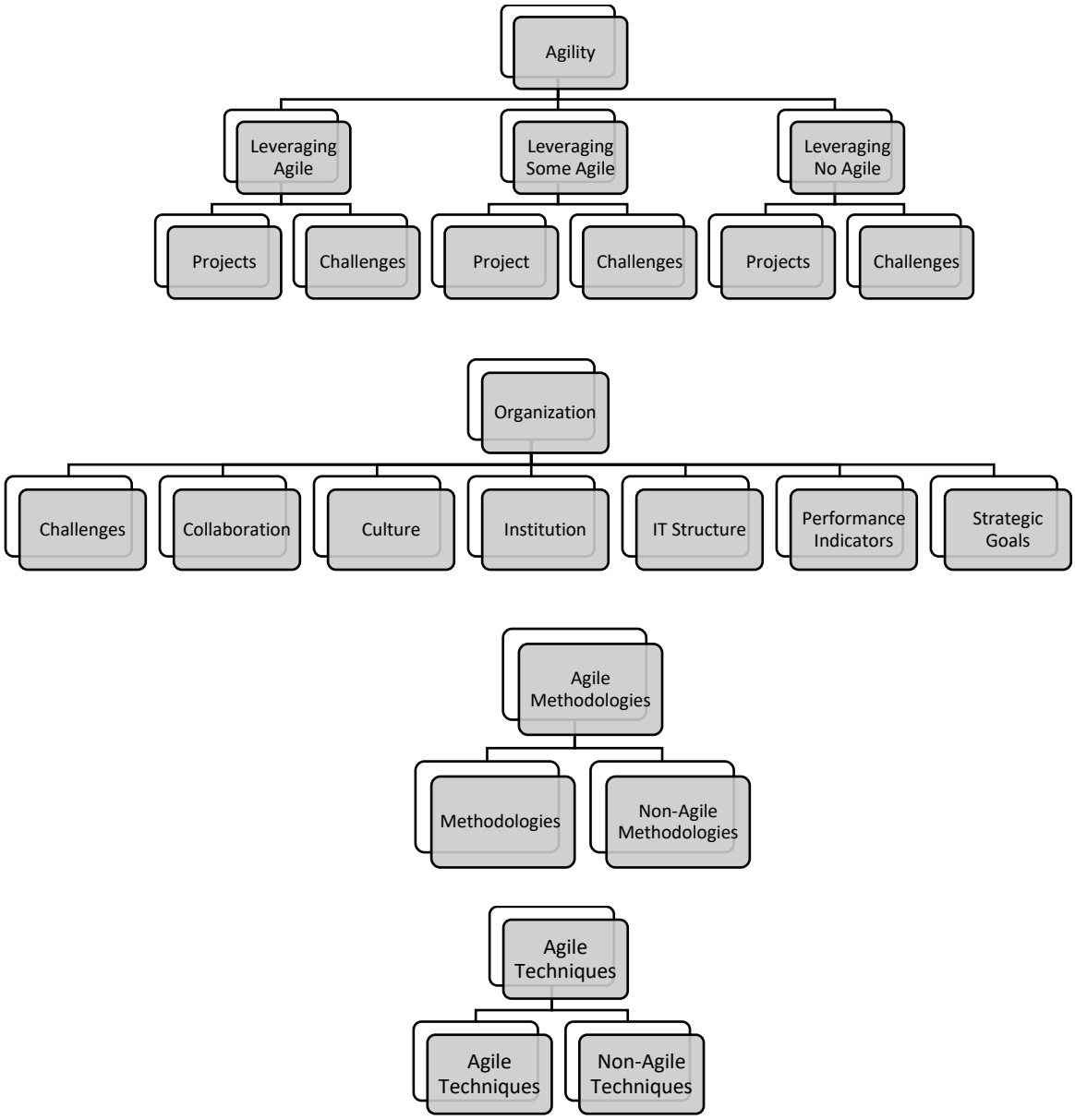

Figure 9: Parent-Child node relationships for elite interviews

University A

This is a public university in the Southwest Central region that comprises fewer than 15 colleges and schools and offers more than 200 academic programs. This R1 institution's academic programming includes approximately 250 undergraduate majors, master's degree programs, doctoral and specialist programs, and graduate certificate programs. The institution has an endowment market value of over 1 billion dollars and a research expenditure close to 200 million dollars. Student enrollment is between 25,000-35,000 with a six-year graduation rate above 50%. The institution has approximately 5,000 employees including faculty, full time staff members, and part time staff members. The institution represents itself as an entity that solves problems through innovation—where research, scholarship, and creative activities are prioritized.

The university's assistant chief information officer participated in the interview process. This individual oversees a variety of central IT areas, including portfolio and program management, organizational change management, end-user enablement, communications, and customer support. The institution identified as leveraging some agility:

> we tried to leverage and that's a very broad term in my mind. So, I'm going to going to say it depends what you're doing. We are not doing any iterative development. We are not a software development shop. We are more networking infrastructure projects which don't lend itself to iterative development. So, um, but we do try to leverage, uh, other, um, uh, can, can CI type of things that are often lumped in with agile such as, uh, looking at workflow, Kanban.

Organizational Culture and Project Management were prevalent nodes throughout the discussion, with 12.69% and 10.41% coverage, respectively. The participant described the organizational culture as maturing after experiencing significant leadership changes,

including a new Chief Information Office (CIO), Associate CIO for Infrastructure and Operations, and Chief Information Security Officer. Organizational culture was impacted by these departmental and organization changes. Sub-units within the central IT department experienced redundancies and competing requests from the overall institution, which hindered connections/collaborations. Because key personnel within the central IT unit had been recently onboarded, the IT structure and IT organizational culture have been shifting. The team had to learn and acclimate to the new CIO's vision as it relates to the campus, and to the campus leadership's direction, vision, and mission. The new CIO shared a desire to align central IT with the strategic plan for the institution and to become a leaner shared service shop.

> We're, we're really, you know, as [CIO] called it, [we are at the seeding stage] at seeding that kind of seeding the future. It's building the foundation there. The roots aren't even there yet because what we need to be and what we need to do is very, very different than, than. And I'm sure you're seeing this across higher institutions everywhere. You know, it's changed our work, how we structure, what we do and how we structure our work and how we build our teams, um, in every facet.

While University A identified as leveraging some agility, they have also utilized waterfall-like methodologies for certain projects. The institution collaborates with third party vendors for such projects, where the following are established before initiating each project: planning, project responsibilities, milestones, and timelines. With milestones and timelines, the institution leverages some Agile and incorporates the methodology. The third-party vendor does not deliver product incrementally, although the institution develops their product lifecycle.

University A is impacted by its Carnegie classification. Researchers have specific institutional goals, and faculty and staff have unique needs. Complex demands related data

by faculty, infrastructure, tools, and platforms require collaboration with IT departments. This university's IT department has a unit that exclusively focuses on meeting research needs. These needs impact IT roadmap, both hardware and software, and project wise. Research needs will drive and dictate what platforms and tools are required. Research activities have specific needs relating to security and data management. The expectation for this university is that the IT department and CIO will aid the University in executing data-driven decisions on projects collaborations so that governance prioritization occurs earlier in the process. As the division develops, they can monitor and better control the data and assess project success levels, which would then be used in the strategic planning process. Table 12 displays nodes of agility for the university that were quantified based on qualitative interview data.

Table 12. University A nodes of agility

Coding	Percentage coverage
Cases\\Semi-structured interview University A	100.00%
Nodes\\Agile Methodologies	1.14%
Nodes\\Agile Methodologies\Methodologies	1.27%
Nodes\\Agile Methodologies\Non-Agile Methodologies	0.88%
Nodes\\Agility	2.69%
Nodes\\Agility\Leveraging Some Agile	1.53%
Nodes\\Agility\Leveraging Some Agile\Challenges	4.61%
Nodes\\Organization\Challenges	4.59%
Nodes\\Organization\Collaboration	1.09%
Nodes\\Organization\Culture	12.69%
Nodes\\Organization\Institution	5.67%
Nodes\\Organization\IT Structure	8.81%
Nodes\\Organization\Performance Indicators	5.16%
Nodes\\Organization\Strategic Goals	4.61%
Nodes\\Project Management\Project Management	10.41%
Nodes\\Research	4.58%

University B:

This is a private university, in the South Atlantic region, that comprises fewer than 10 schools and an affiliated hospital. Student enrollment is approximately 10,000-20,000 undergraduate and graduate students participating in academic programs across five main locations. University B has research and development expenditures that total over 200 million dollars annually. This institution has over 400 individuals working on basic and clinical research projects. The institution awards approximately 7,000 academic degrees per academic semester. University B described its research efforts as innovative, impacting major health and science areas, tackling data to shape public policy, and understanding how society can use technological advances.

University B executed a five-year technology modernization initiative that included implementing innovative, enterprise-level academic computing systems and services that harness mobile enablement, cloud storage, and big data to enhance university operations. This institution also developed a process for submitting, reviewing, tracking, and managing IT projects. A position equivalent to that of CIO participated in the interview. This individual is responsible for various responsibilities within the Central IT department, including the overall human resources and financial systems and web services, business intelligence, and data analytics teams. Additional responsibilities include working directly with stakeholders and university leadership to develop a roadmap to execute new projects and develop dual functioning teams.

University B identified as leveraging some agility and noted that Agile practices are not uniformly used by all subunits because each team can choose how it manages projects and executes deliverables:

> I wouldn't say that like we do as a, as a blanket statement. So, there are teams within the university that practice agile. So basically, our IT project methodologies have really kind of evolved from the bottom up rather than the top down. So, for example, our web services team uses what I would consider like a pure agile approach where they have scrum masters, they set two weeks sprints and they perform development across the team with the developers grabbing different pieces of development for, for those two weeks sprints and then they'd test it and deploy according to those types of agile schedules.

The adoption of Agile practices within various teams at University B's IT department occurred in an organic manner. The web services team collectively decided to adopt Agile for their unit because several team members had used Agile at other institutions and there was an overall willingness to try Agile. University B gave deference to the institutions culture as a prevalent point of the discussion, 13.02%. Table 13 displays nodes of agility for University B that were quantified based on qualitative interview data. With the core leadership team meeting often to discuss project prioritization, it is expected by the institution's leadership that information is conveyed to the rest of the department. Monthly meetings are used to collaborate, share information, and "get on the same page" in an informal manner.

Leadership turnover occurred two years ago with a new chief operating officer, chief financial officer, chief budget officer, chief procurement officer, provost and consulting firm being onboarded. Administratively, University B experienced a significant change to its organizational culture by way of closing it project management office. This office provided the platform and structure for teams to execute projects and provided project visibility for leadership. This requires the owners of those systems and teams to consistently participate and contribute meaningful information to projects and for that team

then to be able to be conversant. The plan for the next iteration of the project management office is now aligned with portfolio management; and includes a establishing a strong intake process and developing a portfolio that melds with other core university services.

In the discussion of Agile project management, the interviewee described the various levels of collaboration and organizational culture of the institution. For a period of six months, various units within the institution collaborated using Agile methodologies and techniques to build and support research occurring outside of the United States. The group had the support of university leadership members; they utilized Agile techniques and methodologies to build a foundation for the project and described the benefits of using Agile versus the waterfall approach:

> When we started building, we didn't actually know what it was going to finally look like. We just got a project team together and we, you know, I guess you could say our first sprint was spent in scoping and designing. And then we spent two more iterative prototype months building out that functionality, and then our final month was spent, testing, validating, and then tweaking. And then once we went live, [the researcher] won a grant.
>
> I think if we had taken an old school waterfall approach, we would not have been successful because by the time we had all the requirements, it was actually the day that they needed to start operating.

The University B IT department was responsive to the mutual relationship and the impacts that being an R1 institution have on IT departments.

> In terms of infrastructure, in order to get their[researcher's] job done, we're responsive to that. It creates a feedback loop where we then build up the resources on our side, working with them, that are focused on, you know, delivering that kind of innovation. We have researchers who have certain expectations and certain needs.
>
> We wouldn't have done that for fun. It's really our researchers needs that's forcing us to kind of innovate and do new things.

Table 13. University B nodes of agility

Coding	Percentage coverage
Cases\\Semi-structured questions University B	100.00%
Nodes\\Agile Methodologies\Methodologies	3.96%
Nodes\\Agile Techniques	1.89%
Nodes\\Agility\Leveraging Some Agile	6.13%
Nodes\\Agility\Leveraging Some Agile\Challenges	4.28%
Nodes\\Agility\Leveraging Some Agile\Project	5.05%
Nodes\\Organization\Collaboration	8.55%
Nodes\\Organization\Culture	13.02%
Nodes\\Organization\Institution	7.99%
Nodes\\Organization\IT Structure	9.00%
Nodes\\Organization\Performance Indicators	4.22%
Nodes\\Organization\Strategic Goals	5.81%
Nodes\\Project Management\Project Management	10.76%
Nodes\\Research	10.36%

University C

This is a public university, in the West North Central region, with more than 10 academic schools offering over 400 degrees and certificate programs. Enrollment consists of approximately 25,000-35,000 students across various campuses with more than 10,000 employees. University C awards 5,000 to 10,000 degrees per academic year including bachelor, master's, doctoral, professional, and post-baccalaureate degrees, and graduate certificates. University C self-identifies as an institution that strives to push the boundaries of knowledge, transform the academic experience, and create solutions through innovative research. The research at this institution is mostly externally funded, with an annual budget close to 300 million dollars; the institution has 40-70 interdisciplinary research centers and institutes and various elite foundation professorships.

The Associate Director for Governance and Strategy participated in the interview. This individual reports directly to the CIO and is classified as an Associate CIO according

to the institution's organizational structure. This individual is responsible for various units/initiatives, including the review and prioritization of large technology initiatives working alongside university stakeholders and central IT. IT delivers services in support of learning, scholarship, and creative endeavors. University C identified as leveraging some agility, indicating that it is not across the institution. There are smaller IT units consisting of developers and programmers that use Agile methods. Within those individual groups, there is a developing group manager who uses the Agile practices and methodologies that best fit each deliverable.

> Historically we tried a few years ago through the project management office to develop a framework and this is at the request of the director for all of the development. [They] wanted us to look at putting together a framework that could be used across all of it. We brought together different managers from those groups and some of the individual programmers and said, okay, what does agile mean to you? What agile has have you used before? What are you using currently? And what can we put together as a framework for all of IT to generally accept in general use. The recommendation that came out of that group was that, uh, there was going to be a lot of difficulties, uh, because agile, if you're going to try to do it across the board for all of it, you need buy in from all across IT. The second thing was, is that with our institution, we don't have developers that are dedicated 100% to development for our development team.

Agile methods could not be successfully adopted and executed without a development team committed to the success of the project through Agile and prioritizing the daily operations. A challenge the institution has faced is the inability to complete certain sprint and having to move onto the next sprint without the deliverables. After completing an eight-month Agile pilot phase, leadership determined that each department could decide whether to use Agile or other methods.

> Ultimately what happened is, they find a great use out of things like task boards. So, developing a whole set of tasks and then moving them from,

> you know, phase to phase. And they can start to kind of loosely group those into, into sprints. But it's not specifically a, an agile sprint, but it's more of a, a work resourcing kind of point of view where it's, you can get this much done in this in the next three weeks and then we'll see where we're at and then we'll start working on that, uh, additional sprint after that.

Project management was the most prevalent discussion node during the interview at 7.38%. Table 14 displays the nodes of agility for the university that were that were quantified based on qualitative interview data. From the project management point of view, smaller projects often involve one developing group in which the project manager serves in the scrum master role. This allows University C to loosely employ sprint and testing phases. With larger projects, the institution faced logistically (backlog) and geographical challenges - functional users have distributed all throughout campus.

> But then just the inconvenience of, Oh Hey, it's Thursday. You need to come down here and stop all what you're doing. And that was one of the complaints from a functional user too, was it's great that you want to work this way, but every time you want me to test something every two weeks, I can't just drop what I'm doing and come down and test it and then go back. That's too much of an inconvenience to do.

The IT structure and organizational culture were impacted by leadership. The project management office was reorganized and removed the central IT and now reports to the CFO. A change in CIO occurred, the previous CIO showed preference to Business Process Improvement (BPI) and key performance indicators (KPI) at the unit, individual, and project level. There was a period of 18 months prior to the elite interview where an interim CIO was named, and BPI was not continued. The new CIO was onboarded within the last year of the interview and this CIO developed a new strategic development process with new KPI based on services and project development and the CIO established an IT governance department.

Table 14. University C nodes of agility

Coding	Percentage coverage
Cases\\Semi-structured questions University C	100.00%
Nodes\\Agile Methodologies\Methodologies	2.64%
Nodes\\Agile Methodologies\Non-Agile Methodologies	0.52%
Nodes\\Agile Techniques	0.91%
Nodes\\Agility\Leveraging Some Agile	1.67%
Nodes\\Agility\Leveraging Some Agile\Challenges	5.45%
Nodes\\Agility\Leveraging Some Agile\Project	0.84%
Nodes\\Organization\Challenges	2.00%
Nodes\\Organization\Collaboration	1.19%
Nodes\\Organization\Culture	5.61%
Nodes\\Organization\Institution	3.29%
Nodes\\Organization\IT Structure	3.83%
Nodes\\Organization\Performance Indicators	4.95%
Nodes\\Organization\Strategic Goals	3.37%
Nodes\\Project Management	0.74%
Nodes\\Project Management\Project Management	7.38%
Nodes\\Research	1.76%

University D

This is a public institution, located in the Pacific West, with an enrollment of approximately 40,000 students including 6,000-8,000 graduate students. This institution confers over 10,000 Bachelors, Master's, PhD/EdD, MD, and JD degrees during an academic year. The institution's academic programming includes more than 150 majors and minors, and its one-year retention rate is over 90%. The institution employs more than 25,000 faculty, nonteaching academics, staff and student employees. The institution has received almost 500 million dollars in funding for research. About 14% of institutions' s funding came from non-profit organizations, closely followed by for-profit organizations at nearly 13%. In total, 39.6% of external research support came from non-federal sources.

The Central IT department of University D has over 400 employees. The IT department's mission is to provide information technology leadership, services, and

innovative solutions to promote the research, education, and community service goals of the university. The office year in review provides support for faculty and research in three main areas: a research cyberinfrastructure center, a research center, and a recruitment center. The research cyberinfrastructure center provides secure data storage, high-performance computational clusters, and programming support. The research center offers grant support, grant reporting, and a method for requesting general IT support and services for research grant proposals. The recruitment center assists in recruiting, reviewing, and promoting faculty and tracking CVs. The office launched several pilots and proofs of concept (e.g., ServiceNow applications framework, Apporto/VCL, Apple/Windows desktop parity, WEPA printing).

University D's interviewee is responsible for support, sponsored projects, protocols, and compliance. University D identified are leveraging agility. The interviewee leads an IT unit, composed of 10 individuals, that uses a mix of home-grown software and vendor software, with two different sprints cycles, monthly sprints, and daily stand ups. The group hosts sprint review meetings and utilizes Jira software to track project deliverables as well as JIRA boards that indicate the status of sprints. Agile is not consistently leveraged at this university; certain groups leverage Agile more than others. When asked how Agile was adopted, the participant indicated timely deliverables were a driving force:

> We started with one sprint and/or one product that had a sprint. We did that several years ago. I guess mostly by my initiative to get it started, I saw that there were a lot of things that go delayed. We wait and wait and wait and before we release some software and I had seen it done differently. Where you wouldn't wait, you would deliver whatever you had at the time. And there was always the next sprint in case people

> wanted more and more. It was implemented a couple years ago when I wanted to communicate and convince people that the idea to switch over.

As it relates to executing Agile methods, there is a corresponding person that is a non-technical position that owns the product; the IT sub-unit supports several applications. The unit determines deadlines. The developers and business analysts determine what is included or excluded throughout the process. During the product testing phase, the tester can decide whether the product meets their needs: does it meet what was asked for, does it deliver, and does it solve the problem? University D perceived Agile as more strategic compared to traditional methodology for the day-to-day basis, how a decision is made and not when the scope of a project is changed.

Organizational culture was identified as important node with 11.14% reporting. The collaboration node had an 8.09% coverage. Table 15 displays the nodes of agility for the university that were quantified based on qualitative interview data. The Office of Information Technology at University D sets divisional goals that are aligned with the university's goals, centered around research, education, and community service at the university level. At the department level, goals are formulated to help the institution reach the university goals. For example, to support research, the division will create a data center that will support research data. Goals are presented in a top-down format to each department and each manager; goals are measured by self-assessment to indicate if the goal is on track, completed, deferred, or cancelled.

Divisional meetings occur monthly, allowing managers from other sub-units to discuss projects, challenges, and successes. The office of research IT is co-located with their customer – the division of research. At the sub-unit level, informal office meetings

occur weekly, in addition to the daily standups. Working directly with institutional research has impacted this sub-unit and driven innovation. As a research institution, leadership is derived from faculty. By providing support through data, the IT department may help researchers make informed decisions. This connects with the way the institution leverages Agile.

Table 15. University D nodes of agility

Coding	Percentage coverage
Cases\\Semi-structured questions University D	100.00%
Nodes\\Agile Techniques	7.53%
Nodes\\Agility\Leveraging Agile	3.06%
Nodes\\Agility\Leveraging Agile\Challenges	5.74%
Nodes\\Agility\Leveraging Agile\Project	1.17%
Nodes\\Organization\Challenges	0.78%
Nodes\\Organization\Collaboration	8.09%
Nodes\\Organization\Culture	11.14%
Nodes\\Organization\Institution	4.34%
Nodes\\Organization\IT Structure	7.10%
Nodes\\Organization\Performance Indicators	4.00%
Nodes\\Organization\Strategic Goals	4.15%
Nodes\\Project Management\Project Management	5.94%
Nodes\\Research	3.57%

University E

This is a public university in the South Atlantic region; research is a major component of the university's mission. The institution offers approximately 200-degree programs. Student enrollment at University E is the largest of the institutions interviewed in the present study. This institution has regional campuses and museums and includes over 10 colleges. The institution’s research and community engagement initiatives are supported by more than 40 centers and institutes and over 300 academic associations, honors and professional societies, cultural organizations, and interest groups. The

institution employs approximately 9,000-11,000 individuals, and it awarded between 15,000-20,000 degrees. The 4-year graduation rate is the lowest of the institutions interviewed, below 50%, and it has a 6-year graduate rate in the low 60th percentile. University E focuses on patent production, which drives innovation at the institution. The institution's research expenditures are over 200 million dollars.

The mission of the central IT department at University E is to support the institution in its pursuit to become a leading student-centered urban public research university that is locally and globally engaged. The department contributes to these efforts by providing leadership, consultation, services, and secure access for the use of technology. Part of the department's mission is to help faculty by providing the tools and knowledge they need to integrate technology into the curriculum. This individual is responsible for various offices and initiatives, including the Project Management Office (PMO) and assisting the Division of IT plan and execute strategic projects. This individual is also responsible for defining and managing scope, including scheduling, costs, risks, resources, and communication for the strategic projects.

University E identified as not using Agile methods. As the interviewee explained.

> I don't know that we are yet at a point where, um, we had decided to make that investment to do an analysis of how we project, how we manage projects. Another thing too is I did not see a lot of participation from higher education.

Limited resources including human capital, was identified as a possible reason that Agile was not used in the institution. The office comprises three individuals (one who focuses on infrastructure, one who focuses on security, and one who focuses on shared services) that collaborate with other offices to provide completed projects. Transitioning

to Agile would be feasible under certain circumstances; it would require team reconfiguration, distribution of responsibility, training, and a cultural shift. At an organizational level, the Central IT unit comprises 100+ individuals throughout the campus and across multiple subunits within IT. Subsequently, concerns regarding institutional culture and Agile assimilation from a project management perspective were introduced by the elite interviewee. As limited knowledge and practice of Agile was conveyed by the interviewee, the interviewee determined that a change in the overall IT methodology and execution would require a top-down approach and acceptance from those that utilize the services.

> Let’s say that we adopted here, we're working agile, but I'm working on a project with you. You've never heard of it. And I bring you into my project and I say, we'd have standup meetings every morning. I need your time for 10 minutes every day. I need you to do, you know, a retrospect, I need you and you're going to go, what? No, no, no, no. You do the project, and you call me when you're done.

Organizational culture and collaboration were identified as important nodes compared to other nodes, with 10.92% and 10.10% reporting, respectively. The Project management node had 9.61% reporting. Table 16 displays the nodes of agility for the university that were quantified based on qualitative interview data. One could postulate that these three nodes could be interrelated for the success of the office and the challenges it faces when deciding not to leverage agility. When asked about how goals or performance indicators are set and evaluated, the interviewee indicated that this is an area for improvement with a desire to move toward more measurable outcomes and using data to quantify effectiveness and efficiency. Resource management presents a challenge both within organizational culture and at the project management level. The organization may

not be able to identify when personnel are overutilized or underutilized in various projects while meeting deadlines and meeting customer needs.

The data showed that the office may have faced organizational challenges of institutional purposefulness and validity. The participant indicated that the university perception was that the office was part of the bureaucratic institutional problem that prevented projects from being completed. The office requires that potential project leads complete an intake form to indicate project specifications and goals. The organizational culture was such that the creation of the intake process was negatively received the members of the university that had to use the intake process. Subsequently, the office reviewed the intake process for improvements and made changes such as building in additional time for customer concerns, compliance questions and regulatory requirements that the customer may not have previous knowledge about. This allowed the office to work backwards from due dates and determine what resources needed to be prioritized.

Much of this institution's deliverables are based on multi-unit or multi-department collaborations. As a result, the office purchased a project management tool for internal use after evaluating 12 other tools. The tool was intended to be used to explain the project to the customer and provide updates in real time. As project management training was not provided across the institution, the tool served a universal design learning purpose and is now available across the institution. This resource aided in accountability and transparency—challenges that the department faced when completing deliverables. The tool facilitated tasks being assigned and includes a start and end date for project deliverable and gives the user the option of having a daily project status report created to inform the user of projects they are working on, all tasks assigned to them and upcoming due dates.

The IT department builds collaborations and partnerships with entities that are internal and external to the institution. The participant noted that a critical element for project success is not the methodologies utilized but rather the relationships that are nurtured and developed throughout the process.

> "[there] was a partnership between [office omitted] and the division of it. And we help role out, um, that project. So, we have to have really good relationships and that's where the soft skills of the project manager are really, really important. There are all sorts of people with all sorts of personalities, both within and within and outside and getting those people to work together. There's a generational thing sometimes and um, you know, getting everybody to work together and roll in the same direction. They often equate project management to herding cats. So, Oh, that's part of what we do, but, but the relationships, I think is one of the more critical aspects of project management, more so than the methodology or the process that you use. If you've got a great methodology but you don't know how to handle the people, that project could go wrong very quickly."

While the office prioritized interpersonal and soft skills, University E utilizes the waterfall methodology: initiation, planning, execution, monitoring, control, and closing. Project managers ensure that milestones, tasks, scope, and other deliverables are identified and communicated, and they establish roles and responsibilities for those involved in each project.

Table 16. University E nodes of agility

Coding	Percentage coverage
Cases\\Semi-structured questions University E	100.00%
Nodes\\Agile Methodologies\Non-Agile Methodologies	4.65%
Nodes\\Agile Techniques\non agile tech	0.88%
Nodes\\Agility\Leveraging No Agile	0.25%
Nodes\\Agility\Leveraging No Agile\Challenges	5.92%
Nodes\\Agility\Leveraging No Agile\Project	2.39%
Nodes\\Organization\Challenges	4.56%
Nodes\\Organization\Collaboration	10.10%
Nodes\\Organization\Culture	10.92%
Nodes\\Organization\Institution	0.19%
Nodes\\Organization\IT Structure	3.20%
Nodes\\Organization\Performance Indicators	1.83%
Nodes\\Organization\Strategic Goals	1.30%
Nodes\\Project Management\Project Management	9.61%
Nodes\\Research	1.94%

Summary Findings

The qualitative portion of the present study extends prior research on Agile adoption by providing insights from the viewpoint of elite university leaders and secondary data sources. This provides further understanding of why and how organizational factors, attitude, and Carnegie classification (i.e., R1, R2, or R3) impact Agile adoption or lack of adoption within research universities. As previously discussed within the analysis of each university, Carnegie classification and/or collaboration with researchers may drive IT innovation and efforts.

Across the five interviews, the following was mentioned 25 times: research influences how IT departments manage projects and perform work. While the number of times that research classification influences how IT departments manage projects and perform work is not significant, except for University B (10.36%), what each elite interviewee conveyed regarding the importance of research was impactful. Universities are

often driven by the complex data and infrastructure demands of its researchers and faculty/staff. The purpose of these interviews was to connect that could not be expressed by numbers through the quantitative study described in Chapter 3. R1 institutions reported a higher response rate of leveraging agility in IT departments. Institutions in the R1 category also had a higher response rate to the survey compared to the other two. The analysis of the elite interviews and secondary sources suggests that organizational culture and Carnegie classification were of importance to the institution and if they adopted Agile.

In the institutions that participated in the elite interviews, departmental and organizational changes impacted each institution's organizational culture. Sub-units within the central IT department of University A experienced redundancies and competing requests from the overall institution, collaborations were struggling. The institution leverages some Agile and incorporates the methodology throughout projects, when feasible. University A described the culture as maturing after experiencing significant leadership changes, including a new Chief Information Office (CIO), Associate CIO for Infrastructure and Operations, and Chief Information Security Officer. Similarly, University B gave deference to organizations culture as a prevalent point of the discussion of why research universities adopt (or not) Agile methods. During the timeframe in which this dissertation was developed, changes to the institution's leadership included: a new chief operating officer, a new chief financial officer, a new chief budget officer, a new chief procurement officer, and a new Provost. A consulting firm was also hired by the institution. University B noted that Agile practices are not uniformly used by all subunits because each team can choose how it manages projects.

Comparably, University C leveraged some agility, indicating that it is not occurring in all units of IT, with smaller groups made of developers and programmers who leverage agility. As with University A and University B, the organizational culture of University C was impacted by institutional turnover. The project management office moved out of central IT and now reports to the CFO instead of the CIO and there was a period of 18 months where an interim CIO was appointed. University D and E did not indicate significant leadership changes or turnover. Although University E did infer that most companies that have been successful in adopting Agile invested in the process through coaching, training, and mentorship and not just the methodology, that a culture shift is required. To adopt Agile practices and become an Agile team, the IT department would require reconfiguration, distribution of responsibility, training, and a cultural shift.

The organization's structure is another aspect of its culture. University B structured their IT department to include a specific sub-unit that focuses on researchers' needs to facilitate collaborations. University B and E recognized the synergetic relationships between the IT department and Division of Research and responded in a receptive manner that allowed both units to benefit from the collaboration. Only one institution (i.e., University B) stated that researchers' needs drove innovation. University C has utilized an innovation portfolio to track institutional projects that are at the forefront and transformative. Of the five universities that participated in the elite interviews, four indicated that they use Agile or some Agile.

The elite interviews revealed that human resources factors were important components of the three subjective norms: research level subjective norms, organizational subjective norms, and leadership subjective norms. As mentioned in previous chapters,

subjective norms refer to the social pressures that influence the individual to complete a task. Research level subjective norms refer to the social pressures related to the institution's Carnegie classification that may influence task completion. Organizational subjective norms refer to the social pressures related to the institution's organizational culture and design that influence task completion. These social pressures can include division of labor, hierarchical order, and organizational dynamics. Leadership subjective norms refer to the social pressures related to how leadership style influences task completion. Does the leader foster productive and effective work environments where employees are empowered to be creative and innovative?

The elite interviewees mentioned that effective communication and trust foster a positive attitude toward leadership and the organization within IT departments. Developing trust humanizes leadership and allows for employees to develop ties to the organization. Respect and compassion may impact behavior, which may impact perceptions and attitudes toward Agile adoption. Institutional leaders are responsible for sharing goals and vision within the institution. These leaders focus on innovation and efficiency and ensure that decisions are made to improve governance, services, and the management system in general.

Based on my observations, it was clear that there were certain IT leaders who were more active in their departments affairs and worked closely with faculty and staff. This could be one of the reasons why the elite interviewee had more positive views of the department. This research was motivated by the need to understand organizational factors internal to IT departments within research institutions and understand why these departments adopt or do not adopt Agile practices. The findings indicate that there are

factors that influence organizational aspects and at the individual IT leadership level that impact adoption or lack of adoption and of Agile.

Carnegie classification impacted the institutions' purpose and intentions from an IT perspective. Researchers/faculty have specific goals and faculty and staff have unique needs. Complex demands related to data, infrastructure, tools, and platforms require collaboration with IT to succeed. The expectation is that the IT department will work with other university departments and leadership in executing data-driven decisions on projects and that they collaborate with researchers and faculty so that governance prioritization occurs earlier in the process. IT can monitor and control the data that assess success levels of projects, which would be used in the strategic planning process by university leadership. Research motivates innovation and in turn, innovation can either facilitate or discourage research.

Conclusion

This chapter served to answer Research Question 3. Of the five universities that participated in the elite interviews, 4 indicated that they used Agile or some Agile. This study helps shed light on the range of Agile adoption and use in five higher education institutions and IT governance. For Agile to take place, higher education institutions must have capacity, in terms of time, money, and skills. The final chapter of the dissertation explores the implications of these results.

5. Summary Findings and Discussion

Empirical research is needed on Agile methodologies and the Agile adoption framework within public administration and higher education. The purpose of this dissertation was to identify—and fill—gaps in the research literature related to Agile use in public settings and explore why higher education institutions adopt or do not adopt Agile practices. Agile adoption is unique to each organization.

This concluding chapter presents a summary of the study's contributions and discusses the findings, organized by research question; the chapter also describes study limitations and strengths. The chapter concludes with implications for public administration, connecting the findings to the literature and future directions for research.

The first contribution of this study is in the form of how Agile methods have been operationalized by central IT departments within Carnegie Research institutions. This finding answers Research Question 1 (RQ1). A second contribution of this study is that it identifies challenges that institutions face when adopting and implementing Agile methodologies. This finding partially answers Research Question 2 (RQ2). A third contribution of this dissertation is that it explores Agile collaborations and opportunities in higher education. The fourth contribution is knowledge concerning how institutional culture impacts institutional innovation and project management style. The study neither supported or rejected the hypothesis that universities adopt and use Agile methods to complete internal university-wide functions, rather than faculty or student services. Findings neither support or reject the hypothesis that the adoption and use of Agile methods are influenced by leadership support, IT department's organizational capacity, and the

organizational complexity (in terms of size and funding. The data can only partially help explain what factors affect adoption. Findings neither supported or rejected the hypothesis that a university's research classification (R1, R2, or R3 status) influences the adoption of Agile methods.

Summary of the Findings

This portion of the chapter presents a summary of the findings, which are grouped by research question. The findings are discussed and interpreted. They are situated in relation to the existing literature and contributions of this study to PA and Agile practices.

Research Question 1: Use of Agile

RQ1 aimed to answer what the uses of Agile methods in research universities are given the limitation of prior research on Agile methods in higher education. Of the 418 institutions surveyed, 173 institutions responded, yielding a response rate of 41.4%. Of the 173 responses, 69 responses (52.7%) responses were from R1 institutions, 59 responses (43.7%) were from R2 institutions, and 45 responses (29.6%) responses were from R3 institutions. Of the institutions that participated in the study, 39.88% identified as levering Agile or some Agile for a period of 1 year or longer, with 10.9% of the participants indicating that they have been practicing Agile development methods for more than 5 years, and 13.8% indicated that they have been practicing Agile development methods for a period of 2-5 years. 69.5% of R1 institutions indicated leveraging Agile, 59% of R2 institutions indicated leveraging Agile and 40% of R3 institutions indicated leveraging Agile. This is a significant and is relevant because it indicates an awareness of the principles and the adoption of Agile methods in higher education. The survey allowed

respondents to indicate the following reasons for Agile adoption at their institutions: procurement, instructional software, faculty/staff evaluations, back-office operations (e.g., admissions), or other purposes. Aside from those reasons, the leading reasons for Agile adoption were; IT development, enterprise application, IT/project management, and administrative software development.

In patronage of the principles and values developed by the 2001 Agile Manifesto, research institutions indicated that accelerated software delivery, enhanced ability to manage changing priorities, and increased productivity were key motivators to adopt Agile. Institutions with a focus on research adopted Agile to improve product management and delivery. All institutions ranked accelerated software delivery as the leading reason for Agile adoption. One could postulate that this could be because it was the first option in the list of responses. The top 3 rankings were in alphabetical order and referenced the Agile Manifesto. Furthermore, there was overlap in methodologies and techniques preferred by institutions that use Agile that favored efficiency.

Technology and knowledge have enabled public administration and higher education administration to be efficient and effective in the services provide. This dissertation sheds light on the level of Agile methods and practices among research institutions, and helps organizations understand how to leverage Agile methods, which foster learning opportunities and intentional program management process within IT departments. In the public sector, Agile methods are often adopted by IT departments and project management offices. Government agencies leveraged Agile principles and methodologies to improve process deliverables and address implementation challenges. The findings from RQ1 provide additional insight into how organizations can utilize Agile

methodologies and principles in software development, governance, and IT implementation: “agile has the potential to save the government billions of dollars by delivering services more efficiently and effectively” (Government Accountability Office, 2020). For the federal government, leveraging Agile methods enhances flexibility, reduces risk, and produces deliverables more quickly.

Research Question 2

This study utilized Ajzen’s theory of planned behavior to guide the exploratory analysis undertaken by this dissertation through research level, organizational and leadership subjective norms. The central focus of this theory is understanding and predicting an individual’s intention to perform a planned behavior. RQ2 asked: What are the specific factors that affect adoption of Agile methods in research universities? This question examined the organizational and leadership subjective norms of the institutions in each research category to better understand what factors may or may not influence intention and adoption of Agile. Through qualitative and quantitative analysis, the study provided insight into what challenges institutions face when adopting and implementing Agile. A significant number of challenges were identified by each research category, which were repetitive. The findings for RQ2 suggest that institutions face significant challenges with inconsistent processes and practices across teams, lack of product owner availability, lack of skills/experience with Agile methods, pervasiveness of traditional development methods, organizational culture at odds with Agile values, general organization resistance to change, insufficient training and education, and fragmented tooling and project-related data/measurements. The survey provided respondents with the option to specify their own

responses. 142 challenges were identified by R1 institutions, 98 by R2 institutions, and 32 by the R3 institutions. Important challenges identified included: fear of failure, staff shortages – open positions, and use of Agile to hide activities. When implementing Agile in an organization or team, the greatest challenge is not understanding the Agile methodology, but rather the organization's ability to adapt and adopt the concept as a whole and not just the ceremonies. Buy-in must occur throughout the organization to reduce challenges.

Furthermore, each organization faced significant and continuous organizational culture challenges. Each experienced redundancy and competing requests, and connections/collaborations were strained among sub-units of larger central IT structures. Survey responses suggested organizational challenges at the leadership level, while the elite interviews provided additional insight as to how those challenges affected their institution. Many institutions experienced changes in leadership—the onboarding and separation of senior leadership, including chief operating officers, chief financial officers, chief budget officers, and Provosts. On more than one occasion, institutions shared that their departments and divisions were restructured and underwent a divisional reorganization where various units were moved out of the central IT department. Some of these units were shut down and others were established; for example, one university closed the project management department and established a governance office.

Organizational and structural changes can both stunt or assist innovation and how an individual responds to change. An individual's intention and ability, as well as other non-motivational factors, influence the individual's ability to decide if they will adopt a behavior or perform a task. Ajzen's hypothesis is that motivation, ability, and control

influence performance of the behavior. The concept of self-efficacy is interchangeable with perceived behavior control, where an individual's confidence in their own ability impacts their success. The individual's perception of how hard or easy it would be to accomplish a task, and their intention to accomplish the task, can predict behavior performance. The social pressures the individual may experience to perform the behavior may impact their views on the subject.

Analysis of the research level subjective norms, organizational subjective norms, and leadership subjective norms provided insight and understanding of how an organization may influence Agile adoption. The dissertation considered the individual's attitude toward the norms, including attitude toward adopting Agile methods, attitude/organization subjective norms interactions, attitude/leadership subjective norms interactions, and attitude/research level subjective norms interactions.

Agile extends beyond software delivery in public administration. While Agile principles were established in software development and engineering, public administration can integrate the principles to improve efficiencies, increase trust, and streamline services. This can be applied to government services, including project management, policy making, and human resources. Agile principles translate to policy creation and execution, where the desired outcome for the policy is known but the process requires flexibility. Policy creators can leverage iterative cycles and face-to-face communication for feedback loops, to decrease miscommunication, and to become more effective while adjusting accordingly. Agile can be linked with adaptive governance and New Public Management, New Public Service by mixing values and techniques from the private sector, creating internal audit systems where feedback can be integrated often and

people are valued, not just productivity and efficiency. Advances in technology and access to knowledge have enabled public administration and higher education administration to be efficient and effective in providing services.

Research Question 3

The data collected and analyzed in the quantitative portion of the study only partially answered RQ2, and it raised additional questions. Such questions included: what internal university functions are being supported through Agile methods? How does the organizational structure and capacity of an institution influence the department's intention to adopt or not adopt Agile methods? What role do faculty and students play in this process? These questions indicated the need to explore the deeper factors affecting Agile adoption, and the need for this exploration drove the qualitative component of this study. Additionally, the qualitative component was supplemented with secondary documents about the organizational characteristics of the IT departments.

The survey asked participants about the types of support that units receive and how their units promote innovation and prioritize projects. Survey results suggested that institutions with higher research rankings somewhat agreed that their institution viewed funding IT projects as an investment, rather than an expense, and these institutions somewhat agreed that leadership champion creating environments that promote innovation, risk-taking, and new approaches. In contrast to R1 institutions, R2 and R3 institutions indicated that their institutions were not as dedicated in funding IT projects and viewed such projects as expenses rather than investments. When asked if members of their organization feel empowered to design and try new approaches, R1 institutions somewhat agreed at almost 50% which high research institutions almost reported 54% somewhat

agreement levels. The R3 institutions had a stronger agreement consensus: respondents somewhat agreed (56%) that members of their organization feel empowered to design and try new approaches. In the R1 institutions, 42.42% of respondents somewhat agreed that their institution viewed funding IT projects as an investment, rather than an expense, and 54.55% of respondents somewhat agreed that leadership at multiple levels of their organization champion creating environments that promote innovation, risk-taking, and new approaches; however, 28.57% somewhat disagreed that their institution invests in the latest Agile methodologies/tool training. When asked if leadership not only explicitly prioritizes innovation, but also establishes clear expectations and timelines as the basis for making organizational progress, 35.42% of respondents from R1 institutions somewhat disagreed, yet 59.58% felt empowered to design and try new approaches. Respondents in this research category did not show a specific attitude pattern pertaining to organizational culture data use; results were varied.

In terms of institution size, on average, institutions in higher research categories had correspondingly larger IT departments and higher overall participation rates. Lower research categories had correspondingly smaller IT departments yet higher rates of CIO (vs. designee) involvement in the survey. This could be associated with a smaller number of individuals making up the size of the central IT teams. Among R1 institutions, CIOs represented 36.5% of participants and other senior leadership represented 25% of participants. Among R2 institutions, CIOs represented 43% of participants and other senior leadership roles represented 28.6% of participants. Among R3 institutions, CIOs represented 45.45 % of participants and other senior leadership roles represented 39.39% of participants. Among R1 institutions, IT department staffing averaged 229 people.

Among R2 institutions, IT department staffing averaged 98 people. Among R3 institutions IT department staffing averaged 49 people.

Qualitative research is needed to provide insight on how organizational practices and managerial strategies influence Agile adoption within research universities. The lack of qualitative exploration hampers the ability to make effective recommendations that promote Agile adoption and leveraging. Research Question 3 explored first-hand perspectives from elite representatives regarding why and how the organizational factors of research universities impact Agile practices and adoption, and how the relationships within the organization and attitudes toward adopting Agile methodologies impact Agile adoption. The findings infer that organizational culture, human resources, and desire to innovate impact a research university's ability to leverage Agile methodologies. The qualitative component comprised semi-structured elite interviews and a review of secondary sources. The literature review revealed that significant factors include organizational leadership, capacity, and peer collaboration. Within higher education, organizational demands are relevant for Agile adoption. Attention was devoted in the present study to understanding the organizational culture and human capital of each institution.

The elite interviews were conducted with representatives from R1 institutions. This group was approached due to higher response rate in the survey and higher levels of leveraging compared to the other two research categories. There were 2 female and 3 male interviewees. All participants were actively employed by their institutions, serving in full time positions with an average of 10-15 years of employment with the current institution. The age of respondents ranged from 40 to 60 years. The elite interviews were referred to

as University A-E. Through these interviews, as discussed in Chapter 4, the study's fourth contribution emerged: institutional culture can impact innovation and project management style The data was reviewed for naturally occurring groupings of themes and characteristics. Major topics and subtopics were identified, which were grouped into 6 nodes: Agility, Agile Methodologies, Agile Techniques, Organization, Project Management, and Research. The analysis showed that organizational culture and project management were high referenced nodes.

Interviewees often defined Agile adoption practices within their institution by acknowledging the roles that central IT and sub-unit IT departments play in higher education. Most participants described the cultures of their institution as maturing after experiencing significant organizational changes. Culture was impacted. Many of the participants acknowledged that the research classification impacts their behavior and project management/selection. Data, infrastructure, tools, and platform demands require collaboration with IT and innovation by university members.

Research is at the heart of a R1 institution, it is embedded in the mission and vision of the institution. Research can motivate innovation, and, in turn, innovation can either facilitate or discourage research. Research classification and/or collaboration with researchers has driven IT innovation and efforts. The synergetic relationships between the IT department and researchers respond in a receptive nature that allowed both units to benefit from the collaboration. Of the five representatives that participated in the elite interviews, 4 indicated that their institutions leverage Agile or some Agile. The one institution that did not leverage Agile had limited resources and knowledge on the subject. Additionally, this institution doubted their purpose and role at their institution and was

working towards cultivating positive relationships with collaborators. This study helps shed light on the Agile adoption in higher education and IT governance. To implement Agile methods, higher education institutions must have sufficient capacity, in terms of time, funding, and skills.

Organizational culture and project management were prevalent nodes throughout all the elite interviews. While University A identified as leveraging some Agile, it has also utilized waterfall-like methodologies for certain projects. Research designation impacts the culture and daily operations of University A. With researchers' goals, and faculty and staff have unique needs for innovation and support from the IT department and influence IT overall effectiveness and collaboration among constituents. University B identified as leveraging some agility and noted that Agile practices are not uniformly used by all subunits because each team can choose how it manages projects and executes deliverables. The adoption of Agile practices within various teams occurred in an organically. Research motivates innovation and, in turn, innovation can either facilitate or discourage research. University B IT department was responsive to the mutual relationship and the impacts that being an R1 institution have on IT departments.

University C identified as leveraging some agility, indicating that it is not used across all IT units. There are smaller groups made of developers and programmers, which leverage agility and employ different Agile practices and methodologies that best fit the deliverables. University C has loosely employed sprint and testing phases. With larger projects, the institution faced logistically (backlog) and geographical challenges. University D identified as leveraging agility, and it uses a mix of home-grown software and vendor software, with two different sprints cycles, monthly sprints, and daily stand

ups. When asked how Agile was adopted, University D indicated timely deliverables are a driving force. Central IT sets divisional goals that are aligned with the university's goals, centered around research, education, and community service at the university level. Working directly with researchers has impacted this sub-unit and driven innovation. As a research institution, leadership is derived from faculty. University E was the only institution that identified as leveraging no agility. Suggesting that a culture shift is required to successfully adopt Agile including investing in the process through coaching, training, and mentorship and not just the ceremonies. University E has focused on patent production, which drives innovation; the IT department works directly with faculty to facilitate the tools need so that they can integrate technology into the curriculum. Resource allocation, including human capital, was identified as a possible cause for not leveraging agility within the institution.

Limitations

The present study has several methodology limitations. The first limitation concerns the quantitative component: although the sample size was adequate, the survey was separated into research categories, and there was variation in the sample size of each category. Future studies could organize the data collection as one group instead of three research category groups. Another limitation concerns institutions with branch campuses: several institutions comprised multiple regional locations, and these locations are identified as separate and individual data points based on how the institution submitted their Carnegie application. As such, they may be counted in one or more of the research categories and survey results may not be captured multiple times to match the research categories. An alternative could be to eliminate regional campuses and reduce the sample size to main

campuses. An additional limitation relates to institutional identifying information not being collected while completing the survey, which hindered follow-up outreach. If an institution and its regional locations fall within various research categories, it is possible that the survey respondent may have selected the incorrect survey or that the incorrect link was provided to the respondent by the institution. Another limitation of the study relates to the CIOs who designated a representative to complete the survey on their behalf. Future studies could be more intentional in collecting the name of the person surveyed and the name plus location of the institution. When possible, responses were converted to numerical values. As the dissertation was experimental and sought to establish a foundation for understanding how and why institution adopt or do not adopt Agile, there were several responses that could not be converted to numerical values for example fill in the blank options. This limited the statistical analysis that could be conducted. The descriptive data set, interviews, and secondary data sources provided insights and results; however, the ability to easily translate survey responses into numerical values would have aided in assessing the research questions and conducting a regression analysis. These limitations are addressed within their respective chapters of this dissertation.

Another limitation to the study pertains to the organizational structure of each institution's IT department. Some institutions had a central IT department with the CIO providing leadership. Depending on the size of the organization, the IT department could have an average of 49 employees to an average of 230 employees. Further analysis of department size is provided in Chapter 3. Some institutions are organized so that the Chief Financial Officer oversees the central IT, while others had a CIO. Some institutions had multiple IT subunits outside of the central IT department and some may leverage agility

while others may not. Depending on who completed the survey, a different representation of the university may have been collected. One common challenge across institutions was reaching the university CIO or leadership officer of the IT department. Individual names and email addresses were often not available on the IT websites, as these websites prioritized general help desk services for the institution. Often, I would call the President's Office or the institution's IT Help Desk to identify who to contact at that institution. Some potential participants declined to participate in the survey, and they commonly cited leadership turnover as the reason. Various institutions had recently vacant CIO positions—due to turnover, retirement, or institutional reorganization. A final limitation for this study is that results are generalized to higher education institutions that are Carnegie research classified. Although the specific factors that affect adoption of Agile methods can be applied in other contexts.

Policy Recommendation and Future research

As specified in previous chapters, implementation of Agile practices originates from IT leadership. The quantitative and qualitative data indicate that strong central IT leadership support and presence are desired. While the quantitative data provided insight on the use of Agile methods and the functions for which they are used at research universities, it was unclear how Agile methods are used in other university functions outside IT such as human resources, procurement, direct student services, and other units in a university. The data analysis revealed that universities adopt Agile methods to perform certain internal university-wide functions and that Carnegie research designation may

influence the use of Agile methods. Policy implications and recommendations are presented below.

This exploratory dissertation contributes to the field of public administration, linking how Agile practices are adopted, specifically in higher education with previous studies. The dissertation creates a foundation for future research in this field and serves a practical purpose on assessing how organizations can leverage Agile in higher education where universities are bureaucratic entities and research is at the heart of the institution. The qualitative data collected from the elite interviews led to the notion that Agile adoption is more than just participating in the ceremonies. To validate Agile levels and establish a unified university Agile level, further studies would be beneficial for institutions that identify as leveraging Agile or some Agile. Leveraging Agile or some Agile does not mean an organization is Agile in its entirety. It means that certain parts of an institution have benefited from utilizing Agile methods and principles—when appropriate—to maximize efforts and outputs.

The policy implications derived from these findings include implementing a structured approach for Agile adoption. This process could include a pre- and post-Agile assessment of an organization, and an Agile measurement index for higher education institutions. This could also be utilized by public administration entities as a structured Agile adoption process. The target audience for the present study is institutions that are seeking to implement Agile practices in their organizations. Utilizing the information learned from the current study regarding the challenge's institutions faced while adopting or not adopting Agile, a pre- Agile adoption assessment could be developed as an agile audit or health check performed against the 4 manifesto values and 12 principles and could

refine the key values that an organization is trying to implement. This assessment would determine possible challenges and factors in the organization that may hinder the success of the adoption process. Agile practices and methodologies may not appropriate for every organization; a pre-assessment would help organizations determine if they can successfully leverage Agile.

The index would help an institution identify the current level and the aspirational levels of Agile. The index could be utilized at the organizational level or for individual projects. A key factor is that the process could be replicated by various subunits of the organization without impacting the whole. This aligns with the principles of Agile. A post-assessment would help identify changes to the level of Agile for an organization. The post-assessment—in combination with the pre-assessment and the index—would create levels of Agile. As mentioned in the introduction, the agile manifesto provides a framework and definition of Agile. While it can be applied to software development, the values and principles can easily be applied to the development of many types of products and uses.

These recommendations can help teams and organizations think about behaviors that enable change to be welcomed rather than feared and that are effective in initiating and driving a transformation to Agile. Developing the right vision, disseminating information across the institution, mitigating risk and changing the org culture requires collaboration, trust and common goals amongst members. For institutions that want to leverage Agile, regressing towards old behaviors, practices and processes are expected, especially if the team has not adapted and adopted them. Leaders should promote that embracing new approaches would benefit the organization. Recognizing that students a customer of higher education institutions, an additional policy recommendation is to develop strategies for

Agile assessment that include and connect these practices with student success and learning outcomes. That would create an opportunity for the institution to assess the implications of Agile on learning.

Final Remarks

Introducing, transitioning, and adopting Agile practices requires organization's structure, human capital, organizational culture, and effective leadership/management practices. While Agile is often associated with IT and computer science, there is a knowledge gap related to Agile practices and methodologies within the discipline of public administration and higher education. Agile can be linked to adaptive governance, NPM and NPS by combining values and techniques from the private sector, internal audit systems where feedback can be incorporated often, and people are valued instead of an institution focusing only on productivity and efficiency. This dissertation addresses this gap in the research literature by conducting an exploratory study.

Higher education institutions are unique in that they are bureaucratic and serve as the connecting force between the community, public administration, and the private sector. These institutions drive innovation, research, and development. The organizational structure of universities facilitates this type of development and encourages administrators to think strategically and innovate. Innovation through research can be a tool employed in pursuit of improving metrics, standing, and rankings, which universities can leverage Agile. This indicates that an organization can leverage Agile through knowledge, innovation, and dissemination of lessons learned through product delivery. While the Agile Manifesto (2001) described Agile principles within the context of software delivery, it does

not limit the scope of the practice—which can be applied to higher education. A critical component of Agile in higher education is that the environment should be dynamic and easily adaptable. It is necessary that all relevant stakeholders, at all levels, participate in moving these attitudes, policies, and practices in a positive direction.

This dissertation examined how Agile methods are adopted by IT Departments in research institutions that are designated by the Carnegie Classification of Institutions of Higher Education. The findings indicate that IT departments adopt Agile for purposes of IT development, Enterprise Application, IT/Project Management, and Administrative Software Development. The findings support that accelerated software delivery, enhanced ability to manage changing priorities, and increased productivity were of critical importance when adopting Agile methods. When implementing Agile methods in an organization or team, the findings suggest that the challenge is not Agile methodology, but rather the organization ability to have buy in. Agile methods provide institutions with the opportunity to quickly assess and respond to the changing environment of higher education.

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APPENDICES

English

SURVEY INSTRUCTION

Informed Consent

Agile Adoption in Information Technology Departments at Research Universities

Hello, my name is Sofia Trelles, a Ph.D. student of Public Affairs at the Florida International University, located in Miami, Florida. I am conducting a research on the adoption and use of Agile project management in the Information Technology (IT) departments at Carnegie Classified Research Universities for my Ph.D. dissertation. The Agile Method is a particular approach to project management that is utilized in software development. It uses incremental, iterative work sequences that are commonly known as sprints. I would very much appreciate your participation in the following survey. It will take less than 15 minutes of your time.

Your participation in this research is voluntary. There are no foreseeable risks or benefits to you for participating in this study. There is no cost or payment to you. However, the study will benefit the IT departments on the uses of Agile methods.

Your answers will be confidential. Your name will not be directly mentioned in the study.

If you have questions for one of the researchers conducting this study, you may contact Sofia Trelles at 305-348-3911 or by email at strelles@fiu.edu. If you would like to talk with someone about your rights of being a subject in this research study or about ethical issues with this research study, you may contact the FIU Office of Research Integrity by phone at 305-348-2494 or by email at ori@fiu.edu.

By clicking the button below, you acknowledge that you are consenting to be participate in the survey.

- ○ I consent, begin the study
- ○ I do not consent, I do not wish to participate

Our organization has been practicing agile development methods for:

- ○ Not practicing
- ○ < 1 year
- ○ 1-2 years
- ○ 3-5 years
- ○ 5+ years

Our organization uses Agile for the following purposes:

- ○ Procurement
- ○ Instructional software
- ○ Faculty/staff evaluations
- ○ Back-office operations (e.g., admissions)
- ○ [ ] other:

Our institution adopted agile for the following reasons (rank order):

Accelerated software delivery

Enhance ability to manage changing priorities

Increase productivity

Improve IT alignment

Enhance software quality

Enhance delivery predictability

Improve project visibility

Reduce project cost

Improve team morale

Reduce project risk

Better manage distributed teams

Other (please specify):

Our institution uses the following agile methodologies:

- [ ] Extreme Programming (XP)
- [ ] Lean Startup
- [ ] Do not Know
- [ ] Kanban
- [ ] Scrumban
- [ ] Scrum/XP Hybrid
- [ ] Other/Hybird/Multiple
- [ ] Scrum
- [ ] Iterative Development
- [ ] Other:

Our institution employs the following agile techniques:

- [ ] Daily standup
- [ ] Sprint/iteration planning
- [ ] Retrospectives
- [ ] Spring/iteration review
- [ ] Short iteration
- [ ] Planning poker/team estimation
- [ ] Kanban
- [ ] Release planning
- [ ] Dedicated customer/product owner
- [ ] Single team (integrated dev and test)
- [ ] Frequent release
- [ ] Common work area
- [ ] Product road mapping
- [ ] Story mapping
- [ ] Agile portfolio planning
- [ ] Agile/Lean UX
- [ ] Do not know
- [ ] Other (please specify):

Our institution measures progress with agile initiatives by:

- ○ Customer/user satisfaction
- ○ Business value
- ○ On-time delivery
- ○ Quality
- ○ Productivity
- ○ Predictability

- ○ Process improvement
- ○ Project visibility
- ○ Product scope

Our institution experienced the following challenges when adopting agile:

- ☐ Organization culture at odds with agile values
- ☐ General organization resistance to change
- ☐ Inadequate management support and sponsorship
- ☐ Lack of skills/experience with agile methods
- ☐ Inconsistent process and practices across teams
- ☐ Insufficient training and education
- ☐ Lack of business/customer/product owner availability
- ☐ Pervasiveness of traditional development methods
- ☐ Fragmented tooling and project-related data/measurements
- ☐ Minimal collaboration and knowledge sharing
- ☐ Regulatory compliance or government issue.
- ☐ Other: _____

Our institution uses the following agile project management tools:

- ☐ Axosoft
- ☐ Bugzilla
- ☐ Google Docs
- ☐ Hansoft
- ☐ HP Agile Manager
- ☐ HP QC/ALM
- ☐ In-house/home-grown
- ☐ Jira
- ☐ LeanKit
- ☐ Microsoft Excel
- ☐ Microsoft Project
- ☐ Microsoft TSF
- ☐ Mingle
- ☐ Pivotal Tracker
- ☐ Rally
- ☐ Rational Team Concert
- ☐ Target Process
- ☐ TeamForge
- ☐ VersionOne
- ☐ Other (please specify): _____

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
Our institution has a clear IT vision, mission, or strategy.	☐	☐	☐	☐	☐
Our IT governance process influences and enables IT strategic direction.	☐	☐	☐	☐	☐
Our IT governance process sets high-level goals for IT outcomes that are aligned with institutional strategy goals.	☐	☐	☐	☐	☐
Funding IT projects is viewed as an investment, rather than an expense.	☐	☐	☐	☐	☐
We invest in the latest Agile methodologies/tool training.	☐	☐	☐	☐	☐
Leaders at multiple levels of the organization champion creating environments that promote innovation, risk-taking and new approaches.	☐	☐	☐	☐	☐

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat S agree
Members of the organization feel empowered to design and try new approaches.	☐	☐	☐	☐
Leaders not only explicitly prioritize innovation, but they establish clear expectations and timelines as the basis for making organizational progress.	☐	☐	☐	☐
Our IT governance process prioritizes IT investment in accordance with institutional goals.	☐	☐	☐	☐
Use of data is part of our strategic plan.	☐	☐	☐	☐
We have a culture that accepts the use of data to make decisions.	☐	☐	☐	☐

How long have you been working in your current department?

- ○ < 1 year
- ○ 1-5 years
- ○ 6-10 years
- ○ 11-15 years

- ○ 15-20 years
- ○ > 20 years

What is your age group?

- ○ 25 and under
- ○ 26-29
- ○ 30-39
- ○ 40-49
- ○ 50-59
- ○ 60 or older

What is the staff size of the IT department?

What is the name of your department?

Select the title(s) of the individual(s) who completed and/or provided responses for the survey:

- ☐ Chief information officer (CIO)
- ☐ Chief technology officer (CTO)
- ☐ Chief information security officer (CISO)
- ☐ Chief information technology officer (CITO)
- ☐ Chief learning officer (CLO)
- ☐ Chief digital officer (CDO)
- ☐ Vice president
- ☐ Vice chancellor
- ☐ Vice provost
- ☐ Associate provost
- ☐ Associate vice president
- ☐ Associate vice chancellor
- ☐ Associate vice provost
- ☐ Assistant vice president
- ☐ Dean
- ☐ Executive director
- ☐ Director
- ☐ Manager
- ☐ Other (please specify)

Table 17. Agile Methodologies node reference frequency and percentage coverage

University	Reference Freq.	Coverage %
A	1	1.27
B	5	3.96
C	5	2.64

Table 18. Non-Agile Methodologies node reference frequency and percentage coverage

University	Reference Freq.	Coverage %
A	2	0.88
C	2	0.52
E	7	4.65

Table 19. Agile Techniques node reference frequency and percentage coverage

University	Reference Freq.	Coverage %
B	4	1.89
C	1	0.91
D	11	7.53

Table 20. Leveraging Some Agile node reference frequency and percentage coverage

University	Reference Freq.	Coverage %
A	1	1.53
B	8	6.13
C	4	1.67

Table 21. Organization - Challenge's node reference frequency and percentage coverage

University	Reference Freq.	Coverage %
A	6	4.59
C	4	2.00
D	1	0.78
E	8	4.56

Table 22. Organization – Collaboration node reference frequency and percentage coverage

University	Reference Freq.	Coverage %
A	2	1.09
B	11	8.55
C	2	1.19
D	6	8.09
E	16	10.10

Table 23. Organization – Culture node reference frequency and percentage coverage

University	Reference Freq.	Coverage %
A	15	12.69
B	18	13.02
C	11	5.61
D	14	11.14
E	15	10.92

Table 24. Organization- Institution node reference frequency and percentage coverage

University	Reference Freq.	Coverage %
A	9	5.67
B	12	7.99
C	7	3.29
D	5	4.34
E	1	0.19

Table 25. Organization - IT Structure node reference frequency and percentage coverage

University	Reference Freq.	Coverage %
A	12	8.81
B	17	9.00
C	9	3.83
D	6	7.10
E	6	3.20

Table 26: Organization - Performance Indicators node reference frequency and percentage coverage

University	Reference Freq.	Coverage %
A	6	5.16
B	6	4.22
C	8	4.95
D	6	4.00
E	3	1.83

Table 27. Organization – Strategic Goals node reference frequency and percentage coverage

University	Reference Freq.	Coverage %
A	7	4.61
B	8	5.81
C	6	3.37
D	4	4.15
E	2	1.30

Table 28. Project Management node reference frequency and percentage coverage

University	Reference Freq.	Coverage %
A	13	10.41
B	10	10.76
C	13	7.38
D	6	5.94
E	15	9.61

Table 29. Research node reference frequency and percentage coverage

University	Reference Freq.	Coverage %
A	4	4.58
B	12	10.36
C	3	1.76
D	5	3.57
E	1	1.84

VITA

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PUBLICATIONS AND PRESENTATIONS

Parbtani, A. & Trelles, S. (March 2019). Engaged University: Lessons learned through the Carnegie reclassification process. Presented at the American Society for Public Administration Conference, Washington, D.C.

Trelles, S. (November 2017). Making Sense of Governmental Agility. Paper presented for presentation at the Southeastern Conference for Public Administration conference. Miami, FL.

Trelles, S. C. (2015). The Great American Experiment: Developing Citizen Participation through Youth Civic Engagement and Education. International Review of Social Sciences and Humanities, 10(1)2015, 8-15. Doi: ISSN 2248-9010 (Online), ISSN 2250-0715 (Print)