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Examination of Adoption Theory on the DevOps Practice of Continuous Delivery

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This is to certify that the doctoral dissertation by

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has been found to be complete and satisfactory in all respects,
and that any and all revisions required by
the review committee have been made.

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2019

Abstract

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Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

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Abstract

Many organizations have difficulty adopting advanced software development practices. Some software development project managers in large organizations are not aligned with the relationship between performance expectancy, effort expectancy, social influence, and facilitating conditions, as moderated by experience, with intent to adopt the DevOps practice of continuous delivery. The purpose of this study was to examine the statistical relationships between the independent variables—performance expectancy, effort expectancy, social influence, and facilitating conditions, as moderated by experience—and the dependent variable of behavioral intent to adopt a continuous delivery system. Venkatesh, Morris, Davis, and Davis's unified theory of acceptance and use of technology provided the theoretical framework. A stepwise multiple linear regression analysis was performed on survey data from 85 technical project managers affiliated with LinkedIn project management groups. The analysis reflected that only performance expectancy was significant in predicting intent to adopt continuous delivery. The findings may contribute to social change by providing project managers with the information they need to support organizational change, collaboration, and facilitation. The knowledge gained may additionally help organizations develop operational efficiency, competitive advantage, and generate higher value to their clients and society.

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Dedication

I would like to dedicate this work to Daniela and Emma. Daniela, you have continued to inspire me to be a better person every day. Thank you for your understanding, encouragement, and support as you have helped me realize a lifelong goal. Words cannot express how much I love and appreciate you.

My dearest daughter, Emma, some day you will understand the world from a much bigger perspective, and I am sure when that day comes we will reconnect. I hope this work proves that goals, dreams, and persistence are the essence of life. I have learned that health, happiness, and peace comes from knowing who we are and being smart and selective with whom we associate. My hope is that you also find health, happiness, and peace. Until the day we meet again I will be waiting in the place where lost things go. I love you more than words can say and miss you more with every passing day. Wǒ ài nǐ, Daddy.

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Chapter 1: Introduction to the Study

Software development organizations work for market share and improving profitability by focusing on efficiency. For example, Internet-based application development companies like Facebook, Amazon, and Netflix have gained competitive advantages by responding to changes in user behavior by increasing their rate of product release (Parnin et al., 2017). Increasing the pace of releases has allowed companies to concentrate on automating software build, testing, and monitoring by using automatic metric collection and telemetry to measure performance and user behavior (Rose, 2013), which helps companies to visualize how customers use their applications and consequently support the creation or removal of software features and artifacts inside the products they promote or sell (Lesser & Ban, 2016). Using tools and information to improve the efficiency of development practices has become a mandatory practice for vendors seeking a competitive advantage in the software solution market (Parnin et al., 2017). Older methods of developing software may not be sufficient for achieving a competitive advantage in the marketplace (Rodríguez et al., 2018).

Traditional methods of software development, such as waterfall methodologies and associated organizational roles and responsibilities, do not allow rapid changes and releases to respond to customer feedback and may not support improved efficiency (Bishop, Rowland, & Noteboom, 2018). Traditional methods of software development involve sequential, gated methods for collecting requirements, designing, developing, and releasing new products and features, which can take months or weeks (Bishop et al., 2018). Gaining quick feedback from customers by shortening the time between releases requires a more advanced method of development and changes to managerial organizational roles and responsibilities to reduce the time between conception of changes and collection of customer feedback (Subramanian, Krishnamachariar, Gupta, & Sharman, 2018).

The reduction of cycle times to days, hours, or minutes has provided a significant competitive advantage for organizations that have adopted continuous practices. However, adopting and using continuous delivery is not easy (Laukkanen, Itkonen, & Lassenius, 2017) because it requires significant social and technical changes (Laukkanen, Paasivaara, Itkonen, & Lassenius, 2018). Social and technical challenges are managed by project managers in agile software development teams that are responsible for the planning and successful delivery of products to clients (Banerjee, 2016). But traditional project management methods conflict with methods required in agile software development (Gandomani & Nafchi, 2016). Project managers in agile software development environments are required to shift from controlling behaviors in favor of more facilitating methods to achieve their job responsibilities (Bishop et al., 2018). Project managers must focus more on leadership skills such as empowerment and encouragement as opposed to planning and controlling their team's efforts and outcomes (Drury-Grogan, Conboy, & Acton, 2017). Thus, changing management styles and the introduction of continuous practices has provided project managers with new challenges. Project manager preferences and perceptions have played a significant role in behavioral intention to adopt continuous practices such as continuous delivery (Bishop et al., 2018), the focus of this study.

This study was an examination of the perceptions of software development project managers on the practice of continuous delivery and how these perceptions affect behavioral intent to adopt continuous delivery. I selected project managers as the focus for this study because they are responsible for the daily coordination and orchestration of software development projects from inception to customer delivery (Banerjee, 2016; Bishop et al., 2018). Project managers have the option to adopt and influence the adoption of tools, practices, and processes they believe assisted them with planning and delivery of software projects (Taylor, 2016). The perceptions of project managers provided the scope necessary to view the development and operations integration required to achieve continuous delivery practices.

Chapter 1 will include the introduction and background of this study. The background section covers lean, agile principles, DevOps, continuous practices, project management, and continuous delivery. Chapter 1 will also include a definition of the problem, purpose, research questions, theoretical foundation, nature, assumptions, scope, delimitations, limitations, and significance of this study. A summary and transition to Chapter 2 is provided at the end of this chapter.

Background of the Study

Roles and responsibilities in software development organizations have mirrored those associated with product manufacturing organizations (Baydoun & El-Den, 2017). Software-intensive businesses have typically created products in a way that emulates traditionally engineered goods (Rodríguez et al., 2018), requiring occasional maintenance but not physically changing over time (Papadopoulos, 2015). However, software solutions differ from traditionally manufactured goods because they are dynamic, malleable, and limited only by creativity (Ghezzi, 2018). Roles and responsibilities in the field of software development need to change to support changing customer demands on software solutions that have increased as customers have realized they could expect more features, functionality, and quality from their investment.

As customers have expected software products to evolve into adaptable instruments to support competitive advantage (Lesser & Ban, 2016), enterprise software businesses have required a better way to innovate and serve customers in a flexible and quality-driven manner. Traditional software development methods to conceive, develop, and deploy software require months or years to reach customers (Karvonen et al., 2017) and are not flexible or capable of supporting improvements to quality. In traditional software development environments, as customers have increased demands on software capability, internal pressure has also increased as product permutations, code paths, and bug reports have increased. Project managers, responsible for converting business inputs into technical outputs, need a new way to please their customers by improving output quality while reducing time, cost, and workers (Taylor, 2016)—a case of managing uncertainty and satisfying business demands while driving technical efficiency and quality.

Lean Principles and Agile Methods

New software development practices were conceived after the introduction of agile methods, which are based on lean principles (Mäkinen et al., 2016). Agile methods define the process of creating and maintaining software, asynchronously, to collect requirements and feedback, design, develop, and release changes in days or hours (Karvonen, Behutiye, Oivo, & Kuvaja, 2017). Agile software development has replaced the sequential, gated process followed by project managers associated with traditional software development with smaller, asynchronous, iterative cycles (Serrador & Pinto, 2015). Agile software development practices provide a way for feedback from stakeholders, especially customers, to affect software product development at any stage in the development cycle, which was once considered impossible (Serrador & Pinto, 2015). Agile methods promote small iterative changes, allowing frequent releases of the software to happen whenever code changes are complete and quality is in an acceptable state (Denning, 2015). In agile development practices, each function of the development lifecycle operates autonomously and continuously where bottlenecks are significantly minimized (Mäkinen et al., 2016).

Agile methods were influenced by lean principles, which refer to ways to eliminate waste in the production process. For example, in the late 1980s, Toyota implemented a set of waste reduction processes called the Toyota Production System to help them gain a competitive advantage by achieving higher production and efficiency by eliminating waste (Rodríguez et al., 2018). Reducing waste to improve production efficiency is the focus of the lean approach (Alahyari, Gorschek, & Berntsson Svensson, 2019) ,which improves the flow of value to customers by driving down time to market and cost of goods, creating a leaner process. Focusing on making manufacturing techniques more efficient provides the added benefit of improving worker attitudes and reported job satisfaction (Fitzgerald & Stol, 2017). These methods of manufacturing physical goods can apply to engineering software because they share many of the same wasteful elements uncovered by the lean approach.

Principles influenced by the lean approach were introduced to the software engineering community when Fowler and Highsmith published the agile manifesto (2001), a new method for developing software dynamically (Serrador & Pinto, 2015). Organizations struggling with the uncertainty and resource constraints of traditional software development reviewed the agile manifesto and realized lean principles could revolutionize the software industry. Agile principles detailed in the agile manifesto (Fowler & Highsmith, 2001) described changes in the way software is developed and how organizations can interact with their customers to build a mutually beneficial relationship. Agile's purpose was defined as eliminating waste, similar to the Toyota Production System (Rodríguez et al., 2018), by (a) favoring individual interaction over tools and processes, (b) prioritizing software that works instead of large amounts of documentation, (c) personal interaction with clients instead of negotiating contracts with them, and (d) allowing constant change instead of time-intensive planning (Serrador & Pinto, 2015). The principles of agile favor increased face-to-face interaction between all roles in the software development lifecycle, especially customers (Serrador & Pinto, 2015). Agile's underpinnings of facilitating discussion and suggesting direction replaced direct command and control over the people and processes involved with software development (Taylor, 2016; Bishop et al., 2018). Organizations adopting agile principles have needed to adapt the project manager's role, responsibilities, and approach to align with agile principles to realize software development efficiencies in search of competitive advantage for themselves and their customers.

One agile software development practice is DevOps, a hybrid created in 2009 from the terms *development* and *operations* (Elberzhager, Arif, Naab, Süß, & Koban, 2017). DevOps is a set of principles and guidelines that encourage the merger of developer and operational methods and skills. Merging and managing developer and operational skills has created new practices such as continuous integration, delivery, and deployment. Continuous practices such as continuous integration, continuous delivery, and continuous deployment break down organizational barriers and allow significantly shorter time, a matter of minutes in some cases, between customer reaction and the creation of feedback-infused changes to customers, also known as cycle time (Shahin, Babar, & Zhu, 2017). Shortening cycle time between releases by implementing DevOps principles can support competitive advantage in the market place, the desired effect not achievable by managers using traditional methods of software development.

DevOps and Continuous Practices

DevOps is the embodiment of technical and social skillsets necessary to merge development and operations functions, such as automated development and deployment, and system monitoring needed to achieve continuous delivery (Ebert, Gallardo, Hernantes, & Serrano, 2016). Adoption of DevOps practices such as continuous delivery could improve cycle time 30% and decrease costs by 20% (Ebert et al., 2016), making the software development process more efficient. Some examples of organizational elements that impact DevOps practice adoption included departmental silos and lack of trust

(Leppänen et al., 2015). Additionally, organizational adoption of DevOps practices, such as continuous integration, continuous delivery, and continuous deployment, require organizational changes to roles and responsibilities responsible for all aspects of software engineering and delivery (Claps et al., 2015). The roles and responsibilities of project managers in agile software development include successful and efficient project delivery (Taylor, 2016). Project managers can choose to adopt continuous delivery to reduce their operational costs while achieving a higher degree of software delivery success.

After the introduction of the agile manifesto (Fowler & Highsmith, 2001), software development organizations began experimenting with new agile software development methods like DevOps by pushing larger volumes of updates and new features to clients. Organizations, such as Mozilla, began seeking competitive advantage in web-browsing software by adopting rapid releases (Karvonen et al., 2017), continuously adjusting and redeploying their Firefox web browser product to customers. Mozilla enabled regular updates that might consist of new features, fixes to bugs reported only weeks before, or both, which was a departure from their yearly product release cycles (Souza, Chavez, & Bittencourt, 2015). Mozilla used agile principles and methods that eliminated waste by introducing continuous practices, automating and parallelizing the steps associated with traditional software development methods that developers execute (Shahin et al., 2017). Updating software using agile methods included similar steps associated with traditional software development such as collection of requirements, designing, coding, testing, and deploying (Karvonen et al., 2017; Souza, Chavez, & Bittencourt, 2015). The agile execution of these concepts in a parallel and continuous fashion was new (Subramanian et al., 2018). Other software development organizations recognized that Mozilla was reducing cycle time by using agile methods, practices, and tools and attempted to adopt the agile principles they employed (Denning, 2015; Laukkanen et al., 2018, Parnin et al., 2017).

One example of automating software engineering steps was characterized by software developers requiring a way to keep the flow of code changes continuously available for automatic integration into their product, a practice known as continuous integration (Shahin, Zahedi, Babar, & Zhu, 2018). Continuous integration was the first continuous practice most software development organizations implemented in adopting agile development and competitive advantage (Shahin et al., 2018). Continuous integration is focused on detecting changes in source code and then automatically compiling code, testing functions and features, logging information, warning and errors, and staging output (Balalaie, Heydarnoori, & Jamshidi, 2016). Early interpretations of continuous integration excluded information technology (IT) operations testing and acceptance by nondevelopers in the software development supply chain. Continuous integration automated the process of shuttling software through various levels of automated and manual testing to ensure quality and confidence. Completion of a successful continuous integration cycle results in a new software artifact that could be manually or automatically deployed to a variety of supported platforms (Balalaie et al., 2016; Shahin et al., 2018).

To advance the software development process toward eventual release to customers, operations staff consisting of a group of nondevelopers and the last department in the software supply chain would install new versions of the developed software to measure nonfunctional requirements such as performance, network, and security elements (Chen, 2017). The separation of development and nondevelopment disciplines in software-intensive businesses was viewed as a barrier that restricted further reduction in cycle time and potentially limited competitive advantage. Organizations soon realized that this last stage of the software development and deployment process was an area that might also benefit from automation by applying agile principles (Nybom, Smeds, & Porres, 2016).

Continuous delivery, a DevOps practice, was introduced to consume the output of continuous integration and automate the steps of software developer and software operations responsibilities for always keeping a software solution in a releasable state. The continuous delivery practice includes testing and acceptance of continuous integration output yielding operational readiness (Shahin et al., 2018). As continuous practices of a software development organization have matured, an increasing number of operational tests have been merged into continuous delivery, further blending development and operational functions. Merging operational functionality into the continuous delivery practice used the *shift-left* principle whereby functions traditionally executed toward the end of a deployment cycle, by operations staff, move to an earlier stage of the overall process, shifting to the left in software engineering and deployment workflow diagrams (Fitzgerald & Stol, 2017). Shifting processes to earlier stages in the agile software development lifecycle reduce waste by identifying and focusing only on software build outputs that pass as many tests as possible (Fitzgerald & Stol, 2017), improving the possibility of efficiency in the software development process and yielding a more significant competitive advantage.

Project managers seeking alignment with agile principles need to improvise more and adapt to continuous change (Taylor, 2016). Improvising means relying less on tools and processes and increasing transparency and negotiation to affect outcomes positively. Though project managers are aware of the benefits of agile principles, research has indicated that adapting to agile software development practices is challenging for project managers in enterprise software-intensive businesses (Bishop et al., 2018; Taylor, 2016). Thus, I conducted this study on project managers' behavior and its effects on adoption of continuous delivery.

Problem Statement

Organizations make significant investments in advanced technology and practices to improve the efficiency and competitive advantage that can provide increased value to their internal and external customers (Lesser & Ban, 2016). The general problem was that many organizations have difficulty adopting advanced software development practices such as continuous delivery (Laukkanen et al., 2018). The specific problem was that some software development project managers within large organizations are not aligned with the relationship between performance expectancy, effort expectancy, social influence, and facilitating conditions, as moderated by experience, with behavioral intent to adopt continuous delivery.

The inability to adopt advanced software development practices restricts the possibility of gaining market share and competitive advantage in the marketplace.

However, in a survey on adopting new technology, 78% of organizations were not prepared to capitalize on emerging technology trends such as mobile device proliferation and cloud platforms and solutions, and only 22% of organizations used advanced practices consistently (Lesser & Ban, 2016). Additionally, 75% of software projects fail, resulting in billions of dollars of lost capital and operational investment (Bishop et al., 2018). Further research has shown that adopting software development advanced practices to address emerging markets is a challenge because changes in social and technical aspects of an organization are required (Claps et al., 2015).

Research has identified the benefits and challenges of the adoption of continuous delivery requires more study to determine the specific organizational elements that predict positive outcomes (Rodríguez et al., 2017). Although there are studies regarding benefits, challenges, and maturity of continuous delivery, there have been no quantitative studies that applied the UTAUT (Venkatesh et al., 2003) to project manager behavioral intent to adopt continuous delivery. Additionally, there is literature associating organizational change to continuous delivery exists, but there are few research studies on how to help organizations adopt continuous delivery (Chen, 2015). Further, little is known about manager preference concerning agile development methods (Bishop et al., 2018). Therefore, I addressed behavioral intention of project managers in this study to understand possible effects on continuous delivery adoption.

Purpose of the Study

The purpose of this quantitative, regression analysis study was to examine the extent to which the unified theory of acceptance and use of technology (UTAUT;

Venkatesh et al., 2003)—with the independent variables of performance expectancy, effort expectancy, social influence, and facilitating conditions—statistically relates to the behavioral intent (dependent variable) to adopt continuous delivery for software development project managers in software development organizations. The independent variables were generally defined as the software development project manager's perception after comparing expectations of continuous delivery implementation and actual continuous delivery implementation. The dependent variable, behavioral intent to adopt, was generally defined as behavioral intent to adopt continuous delivery and was statistically controlled in this study. A stepwise multiple linear regression analysis and bivariate analysis were used to determine the strength and direction of independent and dependent variable relationships.

Research Questions

The following research questions addressed the relationship between performance expectancy, effort expectancy, social influence, and facilitating conditions (independent variables), as moderated by experience, and behavioral intent to adopt continuous delivery (dependent variable).

Research Question 1: What is the relationship between performance and continuous delivery adoption?

$H_0 1$: No statistically significant relationship exists between performance expectancy and behavioral intent to adopt continuous delivery.

$H_a 1$: A statistically significant relationship exists between performance expectancy and behavioral intent to adopt continuous delivery.

Research Question 2: What is the relationship between effort expectancy and continuous delivery adoption?

$H_0$2: No statistically significant relationship exists between effort expectancy and behavioral intent to adopt continuous delivery.

H_a2: A statistically significant relationship exists between effort expectancy and behavioral intent to adopt continuous delivery.

Research Question 3: What is the relationship between social influence and continuous delivery adoption?

$H_0$3: No statistically significant relationship exists between social influence and behavioral intent to adopt continuous delivery.

H_a3: A statistically significant relationship exists between social influence and behavioral intent to adopt continuous delivery.

Research Question 4: What is the relationship between facilitating conditions and continuous delivery adoption?

$H_0$4: No statistically significant relationship exists between facilitating conditions and behavioral intent to adopt continuous delivery.

H_a4: A statistically significant relationship exists between facilitating conditions and behavioral intent to adopt continuous delivery.

Research Question 5: How does experience moderate the relationship between effort expectancy and behavioral intent to adopt continuous delivery?

$H_0$5: Experience has no moderating effect on the relationship between effort expectancy and behavioral intent to adopt continuous delivery.

H_a5: Experience has a moderating effect on the relationship between effort expectancy and behavioral intent to adopt continuous delivery.

Research Question 6: How does experience moderate the relationship between social influence and behavioral intent to adopt continuous delivery?

H_06: Experience has no moderating effect on the relationship between social influence and behavioral intent to adopt continuous delivery.

H_a6: Experience has a moderating effect on the relationship between social influence and behavioral intent to adopt continuous delivery.

Research Question 7: How does experience moderate the relationship between facilitating conditions and behavioral intent to adopt continuous delivery?

H_07: Experience has no moderating effect on the relationship between facilitating conditions and behavioral intent to adopt continuous delivery.

H_a7: Experience has a moderating effect on the relationship between facilitating conditions and behavioral intent to adopt continuous delivery.

Theoretical Foundation

The theoretical base for this study was Venkatesh et al.'s (2003) UTAUT (see Figure 1) model. The UTAUT model includes performance expectancy, effort expectancy, social influence, and facilitating conditions—as moderated by experience—and age, gender, and voluntariness of use as factors influencing the behavioral intention to adopt technology (Venkatesh et al., 2003). The UTAUT model is consistent with understanding factors that affect behavioral intention to adopt technologies.

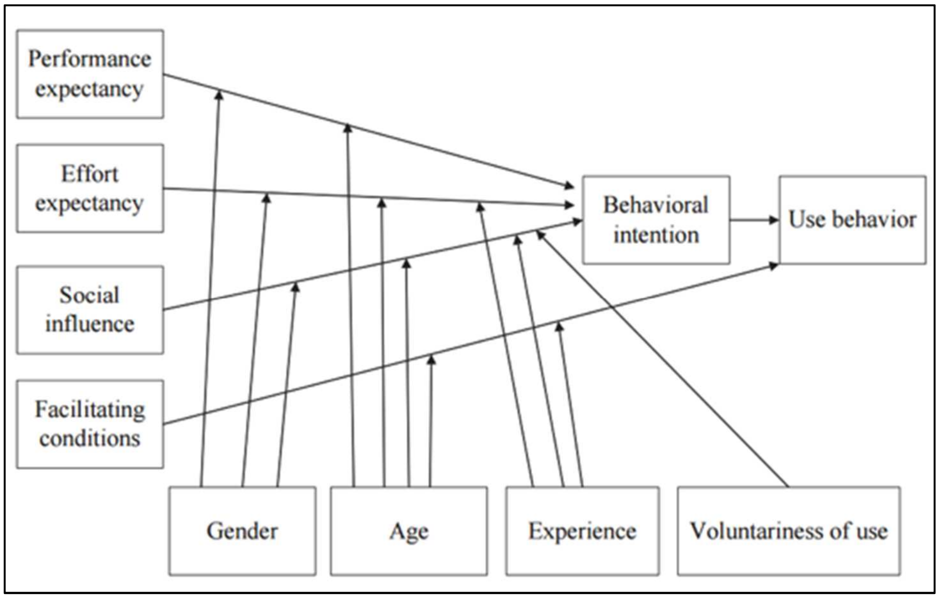

Figure 1. Unified theory of acceptance and use of technology (UTAUT). From "User Acceptance of Information Technology: Toward a Unified View," by V. Venkatesh, M. G. Morris, G. B. Davis, and F. D. Davis, 2003, *MIS Quarterly*, *27*(3), p. 447. Reprinted with permission.

Venkatesh et al. (2003) created a survey for performance expectancy, effort expectancy, social influence, facilitating conditions, and behavioral intent. In the current study, experience, as a moderator of the relationship between effort expectancy, social influence, and facilitating conditions, with behavioral intent to adopt continuous delivery, were included. Use of experience as a moderator has been supported by previous research on agile transformation (Gandomani & Nafchi, 2016). Moderators such as age, gender, and voluntariness of use were not included in this study because there was evidence that they have little or no effect on behavioral intent in studies related to continuous delivery (Alotaibi, 2016; Shahin et al., 2017). Use behavior, as a dependent variable, was also not included in this study because the property shared by all continuous practices was continuous use, and continuous delivery is continuous by definition (Shahin et al., 2018). Further, there was no need to determine actual usage once continuous delivery was adopted (Walldén, Mäkinen, & Raisamo, 2016). The removal of use behavior required changing the relationship of facilitating conditions, as an independent variable, to point to behavioral intent instead.

There is evidence that modifications of the UTAUT model can be used in different technology disciplines (Magsamen-Conrad, Upadhyaya, Joa, & Dowd, 2015). Though facilitating conditions were not indicated as a predictor of behavioral intent in the original UTAUT model (Venkatesh et al., 2003), facilitating conditions can be a predictor of behavioral intent by executing a stepwise regression (Magsamen-Conrad et al., 2015). The results of the stepwise regression indicated that facilitating conditions positively predicted 24% of behavioral intent variance concerning mobile tablet use, indicating that the change in relationship was valid for the purpose of this study. Use behavior, in the original UTAUT model did not include examples of questions, so removing it does not affect the original Cronbach alpha calculation of the model. Each survey question was used to determine the effect of each contributing factor on the phenomenon of intent to adopt continuous delivery that software development project managers experienced. Multiple regression methods were used to determine which factors affect behavioral intent to adopt continuous delivery.

Nature of the Study

The nature of this study was quantitative with regression analysis. The rationale for the selection of quantitative methods was based on limited access to professional project managers working in enterprise software-intensive companies. Quantitative methods are scientifically objective, validate constructed theory, and are suited for a large number of participants (Carr, 1994). Quantitative research helped validate the relationship between the independent variables (performance expectancy, effort expectancy, social influence, and facilitating conditions, as moderated by experience) and the dependent variable (behavioral intention to adopt continuous delivery). Performance expectancy is the degree to which a person perceives that using a specific system helps them achieve higher job performance (Venkatesh et al., 2003). Effort expectancy is the degree to which a person perceives the difficulty associated with using a specific system (Venkatesh et al., 2003). Social influence is the degree to which a person perceives that other important people encourage the use of a specific system (Venkatesh et al., 2003). Facilitating conditions is the degree to which a person perceives that technical and organizational help exists to support the use of a specific system (Venkatesh et al., 2003). Behavioral intent to adopt continuous delivery was defined as the degree to which a person intends to adopt continuous delivery practices.

The population for this study was a globally distributed group of English-speaking project managers. The target population consists of 1,485,444 members in five LinkedIn project management groups. The sample size for this study was 82 and is described in more detail in Chapter 3. Participants included project managers working with, or having worked with, continuous delivery systems in enterprise software solution companies. Simple random sampling (de Mello, Da Silva, & Travassos, 2015), targeting a random collection of project managers from organizations, was used to collect responses. To determine the effects of the independent variables, as moderated by experience, on the dependent variable, data were gathered from an online survey. Quantitative analysis of this data, using multiple linear regression analysis (Cohen, Cohen, West, & Aiken, 1983) and bivariate analysis, helped clarify how project management behavior affects continuous delivery adoption and use.

Definitions

Throughout this document, I use the terms *software development project manager* and *project manager* as well as and *continuous delivery practices* and *continuous delivery* interchangeably. The terms *continuous delivery* and *continuous deployment* are sometimes used synonymously in literature even though they are different disciplines because they only differ by changing the final step of continuous deployment, manual deployment to production, to automatic deployment to production in continuous delivery (Chen, 2015; Chen, 2017; Laukkanen et al., 2018). In this study continuous deployment and continuous delivery were used interchangeably where appropriate to point out similarities and distinctions between them. Following are the operational definitions associated with the variables identified in the hypotheses and model.

Agile software development (ASD): A contemporary software development method that addresses uncertainty during the development cycle by removing time as a factor and instead focusing on small, manageable changes that can be released iteratively and continuously to customers (Drury-Grogan et al., 2017).

Continuous deployment: A DevOps practice that extends the continuous delivery practice by automatically deploying new changes directly to production (Shahin et al., 2018). Authors in the field of continuous practices often make no distinction between continuous delivery and continuous deployment because continuous deployment only changes deployment to production, the last step, from *manual* to *automatic* triggering.

Continuous delivery: A DevOps practice focused on keeping a software solution in a releasable state at all time (Shahin et al., 2018). Again, authors in the field of continuous practices often make no distinction between continuous delivery and continuous deployment.

Continuous experimentation: A DevOps practice defined as the process of continuously testing the value of features to organically evolve a software solution (Lindgren & Münch, 2015).

Continuous integration: A DevOps practice whereby developers merge code into a versioned source control repository on a daily, or more regular, frequency. Merging new code triggers tasks that build and test using automation tools and scripts. Automating the process of building and testing helps to ensure the consistency and reliability of the code (Shahin et al., 2018)

Lean principles: A collection of principles that include (a) empowering the team, (b) building integrity in, (c) seeing the whole, (d) deciding as late as possible, (e) amplifying learning, and (f) eliminating waste (Mäkinen et al., 2016). These principles traditionally applied to product manufacturing and have been extended to software development with the introduction of agile software development.

Rapid release: The release cadence with which a software solution is released. Rapid release indicates a software solution is released in weekly, daily, or more frequent cycles (Karvonen et al., 2017).

Traditional release: The release rate for a software solution. Traditional release indicates that a software solution is released in monthly or yearly cycles (Karvonen et al., 2017).

Waterfall methodology: A software development method where each step in the software development lifecycle (requirements gathering, design, development, testing, localization, documentation, release) occurs in a sequential manner (Bishop et al., 2018).

Assumptions

The examination of a project manager's behavior to adopt continuous delivery in this study was based on several assumptions. First, the participation of all respondents was voluntary. Second, each respondent had experience with agile software development practices and continuous delivery. Third, the respondents answered each survey question honestly and objectively, without influence and bias from management or other sources. Fourth, the population of respondents was large enough to provide a statistically significant depiction of behavioral intention to adopt continuous delivery in enterprise agile software development organizations. The assumptions presented were essential to provide a common understanding of the respondent's motivations and environment. These assumptions helped ensure the credibility and dependability of this study.

Scope and Delimitations

The purpose of this quantitative, regression analysis study was to test the independent variables of the UTAUT (Venkatesh et al., 2003) with behavioral intent to adopt continuous delivery for software development project managers in large software development organizations. Small and medium software development organizations were not included. Experience was included as a moderator, and age, gender, and voluntariness were excluded moderators because of evidence suggesting that they do not have statistically significant effects (Alotaibi, 2016; Shahin et al., 2017). Use behavior was not included as a dependent variable because evidence suggested that it was redundant and was a subjective self-measurement (Shahin et al., 2018; Walldén et al., 2016). The removal of use behavior required changing the relationship of facilitating conditions, as an independent variable, to point to behavioral intent. Facilitating conditions have positively predicted 24% of behavioral intent variance concerning mobile tablet use (Magsamen-Conrad et al., 2015), indicating that the change in relationship was valid for the purpose of this study. Project managers for domains other than software development were also excluded. Responses from project managers participating in open-source projects may be included in the results due to the prevalence of open-source projects in large enterprise organizations.

A survey was adapted from Venkatesh et al. (2003) to suit the purpose and participant pool of this study. Project-specific information such as size, duration, and location were also collected. The quantitative survey instrument utilized to collect data from project managers may be used by other researchers studying human and technical factors involved with technology adoption. The survey was distributed online to LinkedIn project management group members over the age of 18 for 4 weeks to maximize participation.

In addition to the survey that was used in this study, peer-reviewed literature on continuous delivery adoption and agile project management from the past 5 years was gathered and analyzed to help analyze the data collected and produce a conclusion. Research in the area of agile project management as it relates to continuous delivery was limited. However, project management in the broader spectrum of agile software development was widely researched and provided support where necessary.

Limitations

The online survey was offered in English-only, which may prevent participation from project managers located in specific regions. Given the globally distributed nature of most large enterprise agile software development organizations and the communicative aspects of a project manager's roles and responsibilities, English-only participation was a limitation but not a prohibitive factor. The language limitation may reduce the generalization of survey results to some degree.

The online survey targeted enterprise software solution project managers, which exclude project managers in small and medium businesses and open-source projects associated with entrepreneurs and non-profit organizations. The limitation of enterprise software solution project managers was intended to attract professional project managers with varying levels of experience in their domain. Similar to the English-only restriction of the survey, the project manager scope limitation may also reduce the generalization of findings.

Significance of the Study

The significance of this study includes adding to the existing body of knowledge on adopting continuous delivery as it pertains to a single organizational role, project managers. Project managers may use the findings of this study to help them adopt continuous delivery and further achieve improvements such as increased project predictability, increased customer satisfaction, and improved software release reliability and quality (Laukkanen et al., 2017), increasing project efficiency. Research has reflected that project managers who increased project efficiency realized a 20% software development cost savings (Ebert et al., 2016). There is also evidence that continuous practices can affect project efficiency, so this study may provide the knowledge and support for project managers to more effectively adopt continuous delivery to impact project efficiency, improve profitability, and gain competitive advantage.

Significance to Practice

Organizational structure affects behavioral intention to adopt continuous delivery (Chen, 2017; Lustenberger, 2016). It is important to create a collaborative organizational culture in place of a traditional hierarchal structure (Chow & Cao, 2008; Stankovic, Nikolic, Djordjevic, & Cao, 2013). After organizations have adopted continuous delivery, they have experienced improved software quality, improved collaboration, better lines of communication, and an increase in the number of implemented features per software product release, among many other benefits (Riungu-Kalliosaari, Mäkinen, Lwakatare, Tiihonen, & Männistö, 2016). Evidence-based information regarding how performance expectancy, effort expectancy, social influence, and facilitating conditions, as moderated by experience, affect behavioral intent to adopt continuous delivery holds significance to practice, as it may improve awareness, alignment, and reduce the time and cost associated with adopting a continuous delivery system (Chen, 2017). Studying the effects of these factors may improve project managers' awareness of how they influence continuous delivery adoption efforts, which may provide greater project efficiency and increase the competitive advantage of their companies.

Significance to Theory

The UTAUT has been implemented over 1,200 times in more than 50 different journals and has been integrated with other models or extended more than 60 times (Venkatesh, Thong, & Xu, 2016). Yet there are no studies that apply the theory to behavioral intention to adopt continuous delivery. For example, Laukkanen et al. (2017) suggested that organizational and human challenges, within the context of continuous delivery adoption, could be analyzed with general theories of organizational change like Venkatesh et al.'s (2003) UTAUT model. Studying the constructs of the UTAUT with behavioral intent to adopt continuous delivery practices holds significance to theory because it will add to the body of knowledge concerning the validity of the UTAUT model (Venkatesh et al., 2003).

Significance to Social Change

Software solutions empower people to make social change by providing users with tools to solve complex problems in a faster, more efficient way. Determining how differences in performance expectancy, effort expectancy, social influence, and facilitating conditions, as moderated by experience, affect behavioral intent to adopt continuous delivery may provide software development project managers with the information needed to promote organizational change. The knowledge has significance to social change, as it may help organizations develop operational efficiency, effectiveness, and generate greater value to their clients and society.

Summary and Transition

Chapter 1 introduced the background of continuous delivery and problem that some project managers are not aligned with the relationship between performance expectancy, effort expectancy, social influence, and facilitating conditions and behavioral intent to adopt continuous delivery. Research on continuous delivery and project management reflects a lack of research in agile project managers' attitudes and behaviors on introducing continuous delivery practices. This chapter also included the research questions, theoretical foundation, definitions of terms, assumptions, scope, limitations, and significance of the study.

Chapter 2 contains a literature review of peer-reviewed journal articles over the previous 5 years to add support to the methods used to examine continuous delivery and project management. In addition to information on continuous delivery and project management, the literature search strategy and an explanation of the theoretical foundation are presented. Chapter 3 presents the research design and rationale, explanation of methods used to collect and analyze participant responses, and discussion of validity considerations. Chapter 4 is focused on reporting of survey data results, analysis of data collected, and discussion of validity. Chapter 5 includes the interpretation of findings, limitations of the study, future research considerations, and a conclusion.

Chapter 2: Literature Review

Introduction

This study addressed the problem that some software development project managers in large organizations are not aligned with the relationship between performance expectancy, effort expectancy, social influence, and facilitating conditions, as moderated by experience, with behavioral intent to adopt continuous delivery. The purpose of this quantitative, regression analysis study was to examine the statistical relationships between the independent variables from the UTAUT (performance expectancy, effort expectancy, social influence, and facilitating conditions, as moderated by experience) and the dependent variable (behavioral intent to adopt continuous delivery) for software development project managers at large software development organizations. I used the UTAUT because although it has been applied in many studies, it has not been applied to behavioral intent to adopt continuous delivery (Venkatesh et al., 2003). This choice was also supported by previous research indicating that traditional technology acceptance models like the information system development acceptance model (Hardgrave & Johnson, 2003) and the UTAUT (Venkatesh et al., 2003) could be adapted, extended, and applied to contemporary practices such as continuous delivery (Laukkanen et al., 2017; Masombuka & Mnkandla, 2018).

This study addressed several gaps in the knowledge regarding continuous delivery adoption. Organizations that have adopted continuous delivery have reported benefits such as accelerated time to market, effective feature creation, and improved efficiency and productivity (Chen, 2015). Additionally, findings have indicated that continuous delivery is beneficial to improving project efficiency and project managers have influence over continuous delivery adoption (Banerjee, 2016; Bishop et al., 2018; Chen, 2015, 2017; Taylor, 2016; Shahin et al., 2018). Further, project efficiency has been associated with lower cost and may lead to improved software quality (Parnin et al., 2017), which may promote competitive advantage (Rodríguez et al., 2017). However, challenges need to be addressed with control over continuous delivery adoption, which is primarily management related (Chen, 2017). A review of research related to project management and adoption of continuous delivery reflected project manager behavioral intent to adopt continuous delivery lacked research. Thus, this study was necessary to examine adoption of continuous delivery by software delivery teams and its effect on project efficiency that may lead to competitive advantage.

Chapter 2 includes the literature search strategy, a discussion of the theoretical foundations, and a comprehensive literature review. The literature review includes a summary and synthesis of the research in the areas of the UTAUT, traditional and agile project management, and continuous delivery from the past 5 years. Chapter 2 concludes with a chapter summary and a transition to Chapter 3.

Literature Search Strategy

Articles selected for this literature review were related to project mangers' behavioral intent to adopt continuous delivery within large, agile software development organizations. The keywords searched were *continuous delivery*, *continuous integration*, *continuous deployment*, *agile project management*, *project management*, *agile software development*, *DevOps*, and *adoption* as well as application of Venkatesh et al.'s (2003)

UTAUT model in the databases ACM Digital Library, IEEE Xplore Digital Library, Computers and Applied Sciences Complete, SpringerLink, Science Direct, EBSCO Academic Search Premier, Google Scholar, ProQuest Dissertations & Theses Global, a Thoreau multi-database search, and a search through peer-reviewed engineering and project management related journals. The search included peer-reviewed journal articles, conference proceedings, seminal literature, books, and dissertations from 2014 to 2019.

Most of the literature discovered surrounding continuous delivery adoption was focused on qualitative case study research, which was not the design of this study. The literature search for articles focused on the application of Venkatesh et al.'s (2003) UTAUT model in the field of agile software development yielded more than 400 results. However, fewer than 10 articles of the 400 were focused on continuous delivery in the field of IT, and the UTAUT was mentioned seldom in the articles found. The lack of quantitative, peer-reviewed articles addressing the application of UTAUT to behavioral intent to adopt continuous delivery by project managers in large enterprise organizations was one reason why a quantitative study on this subject was essential. During the literature search process, it was necessary to go back further than 5 years to discover why the number of UTAUT-related studies in the field of agile software development were lacking. I also altered the literature search strategy to include peer-reviewed articles related to combining UTAUT with additional independent variables and moderators such as quality of service and education (Alotaibi, 2016), convenience from online access (Chauhan & Jaiswal, 2016), competitive advantage (Wagaw, 2017), hindrances such as perceived security (Alsmadi & Prybutok, 2018), and articles related to unaltered use of

TAM-based methods to gain further understanding of the deficiency (Davis, 1989; Magsamen-Conrad et al., 2015; Walldén et al., 2016).

Theoretical Foundation

The theoretical base for this study was Venkatesh et al.'s (2003) UTAUT. The UTAUT includes performance expectancy, effort expectancy, social influence, and facilitating conditions, as moderated by experience, as factors influencing the behavioral intent to adopt technology. The UTAUT model was consistent with understanding factors that affect behavioral intention to adopt technologies.

Venkatesh et al. (2003) based the UTAUT model on a review and synthesis of eight previously defined acceptance models, which include:

- Theory of reasoned action (Fishbein & Ajzen, 1975),
- TAM (Davis, 1989) and TAM2 (Venkatesh & Davis, 2000),
- Theory of planned behavior (Ajzen, 1991),
- Motivational model (Davis, Bagozzi, & Warshaw, 1992),
- Combined TAM (Davis, 1989) and theory of planned behavior (Ajzen, 1991; Taylor & Todd, 1995),
- Model of PC utilization (Thompson, Higgins, & Howell, 1991),
- Innovation diffusion theory (Rogers, 1995) developed and introduced in 1962 and then applied to individual technology acceptance by Moore and Benbasat (1991), and
- Social cognitive theory (Bandura 1986) as applied to computer utilization by Compeau and Higgins (1995).

Venkatesh et al. (2003) executed a 6-month longitudinal study collecting information from four different organizations at three different intervals. The UTAUT was constructed using the four major determinants of behavioral intention and use behavior common to the eight models analyzed, which accounted for 17 to 53% of variance found in a user's behavioral intent to adopt IT (Venkatesh et al., 2003). Venkatesh et al. included four moderators: (a) age, (b) gender, (c) experience, and (d) voluntariness of use. I applied the UTAUT to examine the behavioral intention to adopt continuous delivery by project managers in software intensive organizations.

It was necessary to make modifications to the UTAUT used in this study. Research indicated a decline in the use of methods derived from the technology acceptance model (TAM; Davis, 1989) like UTAUT due to the diametric alignment of behavioral intent and use behavior of IT (Walldén et al., 2016). For example, Turner, Kitchenham, Brereton, Charters, and Budgen (2010) stated that behavioral intent based on perceived usefulness and perceived ease of use did not align with actual use behavior. Turner et al. also posited that TAM-based instruments like the UTAUT were not good predictors of actual use behavior because these models use subjective, self-reported measurement of use behavior without the support of objective measurement validation (see also Walldén et al., 2016). Objective measurement includes items such as application logs to validate actual use of IT (Turner et al., 2010). Further, because the UTAUT is a general technology acceptance theory, the use of the model in environments where mandatory use of technology is implicit reduces predictive strength (Evwiekpaefe & Haruna, 2018). In the current study, although adoption of continuous delivery was not mandatory, use behavior of continuous delivery is implicit because it is continuous by nature, so it was possible that the UTAUT would not offer effective predictions. Therefore, I made modifications to the UTAUT in this study based on suggestions in the research (Dwivedi, Rana, Jeyaraj, Clement, & Williams, 2017; Evwiekpaefe & Haruna, 2018). Evwiekpaefe and Haruna (2018) suggested combining the UTAUT model with other domain-specific models to improve the explanation of variances.

One example of altering the UTAUT was proposed by Dwivedi et al. (2017), who resynthesized the UTAUT by adding attitude as an independent variable and relating facilitating conditions to behavioral intent and use behavior (see Figure 2).

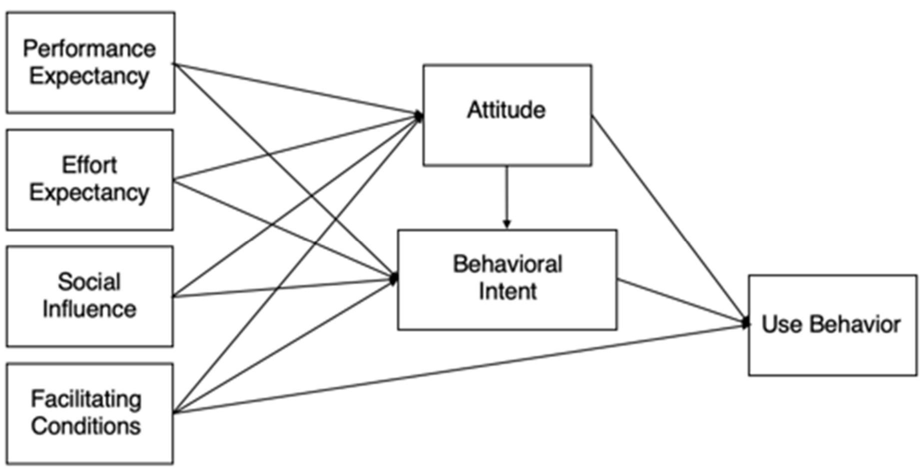

Figure 2. Augmented technology acceptance model . From “Re-examining the Unified Theory of Acceptance and Use of Technology (UTAUT): Towards a Revised Theoretical Model,” by Y. K. Dwivedi, N. P. Rana, A. Jeyaraj, M. Clement, and M. D. Williams, 2017, *Information Systems Frontiers*. Reprinted with permission.

Preceding technology acceptance models such as theory of reasoned action (Fishbein & Ajzen, 1975) and theory of planned behavior (Ajzen, 1991) also included attitude as an independent variable; however, suggesting relationships between facilitating conditions and behavioral intent was a new alteration to the UTAUT. In addition to the inclusion of attitude as a construct, Dwivedi et al. proposed other changes to the UTAUT by relating performance expectancy, effort expectancy, social influence, and facilitating conditions, as moderated by experience, to attitude as well as relating attitude to use behavior, which meant that attitude and behavioral intent were similar constructs.

Assumptions

An additional assumption that was necessary in modifying the use of the UTAUT was that actual use, also known as use behavior, specific to continuous delivery was not a property that required objective measurement such as inspection of continuous delivery access logs, because once adopted, continuous delivery is continuously used. The property shared by all continuous practices was the basic continuous use required, and continuous delivery is continuous by definition (Shahin et al., 2018). Thus, there was no need to determine usage once continuous delivery was adopted (Walldén et al., 2016). Use behavior, as a dependent variable, was therefore not included in this study.

Similar Applications

The research on UTAUT application to technologies created for specific disciplines has included many examples similar to this study's examination of project management adoption of continuous delivery. The disciplines of mobile tablets (Magsamen-Conrad et al., 2015), document workflow management systems (Mosweu, Bwalya, & Mutshewa, 2016), and mobile technologies use in knowledge transfer by employees (Kuciapski, 2017) contained a resurgence of nonaugmented UTAUT. The disciplines of enterprise resource planning (ERP) software training (Chauhan & Jaiswal, 2016), homegrown ERP systems (Wagaw, 2017), and Software as a Service (Alotaibi, 2016) contained augmented UTAUT models. These studies were focused on domains requiring continuous change and improvement to store or communicate emergent and relevant information that are similar to continuous delivery. The Literature Review section of this chapter includes several examples of applying modified and unmodified UTAUT models to technology acceptance in specific domains of research.

Model Selection Rationale

The UTAUT measures human and technical factors that affect technology adoption and use (Venkatesh et al., 2003). The UTAUT was a suitable method for studying an enterprise software-intensive business project manager's behavioral intent of adopting continuous delivery because it was consistent with examining changes in software development team structure and objectives that depend on human factors (Amrit, Daneva, & Damian, 2014). The research indicated an interest in understanding the technical and social drivers behind technical adoption and use in the field of software development to support the intersection of the UTAUT and project management behavior (Amrit et al., 2014).

Agile software development was another area of significant research in the peer-reviewed literature that supports the purpose and selected model of this study. For example, Fowler and Highsmith (2001) stipulated that agile software development principles encourage collaboration over documentation. Subramanian et al. (2018) expanded on Fowler and Highsmith by contending that agile software development principles reinforce self-forming, self-managing, continuously evolving teams to conceive, produce, and support continuous improvement of software solutions collaboratively. There are also many obstacles that come with nonagile principles, as organizations charged with designing systems are constrained to design systems that emulate the communication structure of the organization, which can lead to communication gaps in noncollaborative environments like those defined by traditional software management methods (Conway, 1968). However, agile software development principles encourage collaboration over documentation (Fowler & Highsmith, 2001; Subramanian et al., 2018). Project managers in enterprise software development businesses facilitate the human interaction within a software development team, using systems, tools, and methods to build collaboration, trust, and culture (Kukreja, Ahuja, & Singh, 2018). Project managers' behavioral intent to adopt continuous delivery may affect the adoption of a continuous delivery system, may overcome organizational constraints, provide greater project efficiency, and support gains in competitive advantage. Thus, I used the UTAUT as the theoretical foundation of this study.

Research Question Importance

The UTAUT includes constructs such as performance expectancy, effort expectancy, social influence, and facilitating conditions, as moderated by experience, and their relationship to behavioral intent to adopt technology (Venkatesh et al., 2003). The research questions and hypotheses in this study embodied the scope required to examine the effects each of the four independent variables, as moderated by experience, have on behavioral intent to adopt technology such as continuous delivery by project managers in enterprise software solution intensive businesses. Recent studies have indicated that the UTAUT alone was not an accurate predictor of IT acceptance and use (Walldén et al., 2016). Thus, I used an augmented UTAUT to answer the research questions by examining behavioral intent to adopt continuous delivery, which will add to the body of knowledge on the effects of technical and social factors on continuous delivery adoption. Answering the research questions of this study may provide support to future use of the UTAUT to examine new technologies such as continuous delivery.

Literature Review

I examined the behavioral intentions of project managers to adopt continuous delivery using measurement of the independent variables of the UTAUT (Venkatesh et al., 2003). The following literature review provides information regarding peer-reviewed articles and studies related to UTAUT, continuous delivery, and traditional and agile project management. The constructs and methodology of each reviewed study are broken down separately and then synthesized to provide the rationale for the approach and analysis used in this study.

Unified Theory of Acceptance and Use of Technology (UTAUT)

In 2003 Venkatesh et al. published the UTAUT. The UTAUT model (see Figure 1) uses performance expectancy, effort expectancy, social influence, and facilitating conditions, as moderated by experience, as independent variables. The following analysis provides information regarding the relationships between the independent and dependent variables of the UTAUT. Performance expectancy, effort expectancy, facilitating conditions, and social influence effect behavioral intention and behavioral intent and facilitating conditions effect use behavior (Venkatesh et al., 2003). Performance expectancy is the degree to which a person perceives that using a specific system helps them achieve higher job performance (Venkatesh et al., 2003). Effort expectancy is the degree to which a person perceives the difficulty associated with using a specific system (Venkatesh et al., 2003). Social influence is the degree to which a person perceives that other important people encourage the use of a specific system (Venkatesh et al., 2003). Facilitating conditions is the degree to which a person perceives that technical and organizational support exists to support the use of a specific system (Venkatesh et al., 2003). The dependent variables, behavioral intent and use behavior, are the degree to which a person intends to use and uses a system respectively.

UTAUT moderators. UTAUT includes four moderators: (a) gender, (b) age, (c) experience, and (d) voluntariness of use (Venkatesh et al., 2003). The following analysis provides more information on how the moderators interact with the independent variables of the UTAUT model. Gender can moderate the effects of performance expectancy, effort expectancy, and social influence as they relate to behavioral intention. An example of how gender differences can inform the independent variables of the UTAUT model was evidenced by young males who tend to be more interested in how technology can help them perform in a job or at a task. Gender was not a significant influence in the body of knowledge concerning adoption of technology and therefore was not included as a moderator in this study.

Age can also moderate the effects of performance expectancy, effort expectancy, and social influence as they relate to behavioral intention and facilitating conditions, as moderated by experience, as it relates to use behavior (Venkatesh et al., 2003). The influence of age on certain constructs of the UTAUT model was demonstrated by older individuals that may be less likely to accept new technologies. Age was not included as a moderator in this study because there are recent studies such as Alotaibi (2016) that indicated generation gaps are not a factor in influencing behavioral intent to adopt technology.

Experience was another factor that can moderate effort expectancy, as moderated by experience, and social influence, as moderated by experience, as they relate to behavioral intention and facilitating conditions, as moderated by experience, as it relates to use behavior (Venkatesh et al., 2003). Experience was included as a moderator in this study as evidence exists in the body of knowledge suggesting it effects predictive strength of the UTAUT model as it relates to effort expectancy, social influence, and facilitating conditions.

In this study use behavior was not included as a dependent variable, therefore, facilitating conditions, as moderated by experience, was related to behavioral intent to adopt continuous delivery. Magsamen-Conrad et al. (2015) acknowledged that facilitating conditions was also not used as a predictor of behavioral intent in the original UTAUT model (Venkatesh et al., 2003). Magsamen-Conrad et al. indicated facilitating conditions positively predicted 24% of behavioral intent variance. In addition to the findings by Magsamen-Conrad et al., evidence of experience informing certain constructs of the UTAUT model was shown when experience increases, individuals are more likely to accept new technologies.

In addition to age, gender, and experience, voluntariness of use may demonstrate a moderating effect on social influence as it relates to behavioral intention (Venkatesh et al., 2003). According to Venkatesh et al., when individuals are not mandated to use new technology, they are more likely to accept it. Continuous delivery use was a requirement of participants in this study and therefore voluntariness of use was not examined as a moderator herein.

This study used only one of the dependent variables, behavioral intention, as it related to the adoption of continuous delivery in large enterprises by project managers. Use behavior was not used in this study because once adopted, continuous delivery runs continuously, therefore it was not necessary to measure its use subjectively or objectively. Experience, as a moderator, was also examined and analyzed for the moderating effects on the independent variables as they affect their relationship to the dependent variable. The following sections contain analysis and synthesis of the current, peer-reviewed literature in the body of knowledge related to UTAUT (Venkatesh et al., 2003), continuous delivery, and traditional and agile project management.

UTAUT Research in Information Technology

The literature review included five different studies that applied the UTAUT model (Venkatesh et al., 2003) to specific areas of study within the technology acceptance domain. All five studies focused on technologies used in inter-related domains and were analyzed and synthesized in this section to gain a greater understanding of the similarities and differences in the application and outcomes derived from the application of the UTAUT model. The first and second study analyzed contained research concentrated on information and communication technology. Information and communication technology was ubiquitous in society, becoming a fundamental part of many individual's lives (Magsamen-Conrad et al., 2015). Some studies in the area of information and communication technology have reported increased complexity in communication environments prohibited the use of new technology, such as smartphones and mobile tablets in research by Magsamen-Conrad et al. and ERP solutions in research by Chauhan and Jaiswal (2016).

The first article on information and communication technology was authored by Magsamen-Conrad et al. The study by Magsamen-Conrad et al. contained an examination of the effects of age on the use of mobile tablets based on prior research indicating a *digital divide* existed in the use of information and communication technology between older and younger generations of users (Magsamen-Conrad et al., 2015). Magsamen-Conrad et al. analyzed the responses of 899 participants in the 19 to 99-year age range to determine if age, or other independent variables or moderators included in the UTAUT model (Venkatesh et al., 2003), played a role in adoption of mobile tablets.

Multiple regression analysis of the survey responses revealed the UTAUT's (Venkatesh et al., 2003) effort expectancy and facilitating conditions constructs were the strongest predictors of intent to use mobile tablets using multiple regression analysis, controlling for tablet use, gender, and age (Magsamen-Conrad et al., 2015). Multiple regression analysis was also the method used in this study. It was interesting to note that

Magsamen-Conrad et al. diverged from Venkatesh et al., Chauhan and Jaiswal's (2016) study on ERP training adoption, and this study's design by using facilitating conditions as a predictor of behavioral intent. The suggested change in the relationship between facilitating conditions to behavioral intent instead of facilitating conditions to use behavior conceived by Magsamen-Conrad et al. provided evidence that modifications of the UTAUT model can be used in different technology disciplines. Magsamen-Conrad et al. acknowledged that facilitating conditions was not indicated as a predictor of behavioral intent in the original UTAUT model and cited prior research that discovered facilitating conditions can be a predictor of behavioral intent by executing a stepwise regression. The results of the stepwise regression indicated facilitating conditions positively predicted 24% of behavioral intent variance concerning mobile tablet use, indicating that the change in relationship was valid for the purpose of their study and this study.

In addition to facilitating conditions, performance expectancy and social influence were found not to be significant predictors of behavioral intent to use mobile tablets (Magsamen-Conrad et al., 2015). Magsamen-Conrad et al. concluded that differences in intention to use tablets existed between older generations, referred to as *builders*, and younger generations, referred to as *boomers*. The study reflected that age significantly moderated the effects of the independent variables on behavioral intent to use mobile tablets and was interpreted to mean *boomers* were more intent on using mobile tablets as compared with *builders*.

Magsamen-Conrad et al.'s study was important because it validated age as a moderator in the examination of behavioral intent to use technology, however, this study does not address generation gaps and therefore does not include age as a moderator. Magsamen-Conrad et al.'s study was significant because it may help develop training targeting the reduction of the *digital divide* phenomenon, that different generations experience, by lowering the barrier to entry required to use mobile tablets. Digital divide was not evidenced in the body of knowledge pertaining to continuous delivery and therefore age may not moderate the behavioral intent to adopt continuous delivery examined in this study.

The study by Magsamen-Conrad et al. (2015) was also important because they acknowledged that cited studies reported use behavior of technology was not always applicable in cases where technology was created for a specific use case such as mobile tablets. Continuous delivery may also be viewed as a technology that was created for a specific use case and this study does not include use behavior, however, Chauhan and Jaiswal (2016) did not report this as a factor. In addition removing use behavior as a dependent variable, Magsamen-Conrad et al. also explained that limitations such as non-longitudinal duration and network quota sampling might have affected their findings and were also identified as a limitation of this study. Magsamen-Conrad et al.'s research additionally supports this study because they did not add independent variables to the application of the UTAUT model (Venkatesh et al., 2003).

The second study in the area of information and communication technology that was analyzed was executed by Chauhan and Jaiswal (2016) that examined adoption of

ERP software training in India business schools using Venkatesh et al.'s UTAUT model (2003). Chauhan and Jaiswal differed from Magsamen-Conrad et al.'s (2015) conceptual framework by preserving the relationship between facilitating conditions and use behavior found in the original UTAUT model. This study did not preserve the relationship between facilitating conditions and use behavior.

Chauhan and Jaiswal posited that training on ERP systems in India business schools assisted individual's pursuit of a profitable career, however, there may be a problem in realizing this aspiration as evidenced by employers that have raised concerns regarding a university's capability to adequately train students in ERP concepts that align with industry expectations (Chauhan & Jaiswal, 2016). Chauhan and Jaiswal applied the UTAUT model (Venkatesh et al., 2003) to a quantitative survey of 324 business students using multi-group structured equation modeling in an attempt to determine the causes of perceived misalignment of expectations between ERP education and the ERP industry.

Unlike Magsamen-Conrad et al.'s (2015) conceptual framework, Chauhan and Jaiswal (2016) supplemented the UTAUT model (Venkatesh et al., 2003) by including convenience from online access and innovativeness in IT as independent variables that may affect behavioral intention. Inclusion of the two new constructs was validated by testing with Cronbach's alpha on a piloted, 25 question survey. Cronbach's alpha ranges were acceptable for the addition of convenience from online access and innovativeness in IT independent variables and were therefore included for analysis and interpretation (Chauhan & Jaiswal, 2016). Chauhan and Jaiswal also included gender and experience as moderators, which differed from Magsamen-Conrad et al.'s study by excluding age as a moderator, arguing that age was within a fixed range inside a university setting. Age was not fixed in enterprise software development, however, there was no evidence that there was a difference in continuous delivery implementation across generation gaps in the body of knowledge and therefore it is not be examined in this study. The inclusion of experience by Chauhan and Jaiswal, as a moderator, was a reason why it was included in this study. Chauhan and Jaiswal also diverted from the original UTAUT model by not including voluntariness as a moderator because the students are matriculated into a university and therefore are already complicit in the consumption of offered educational programs. The following discussion reflects the detailed information concerning the findings included in the Chauhan and Jaiswal study.

Chauhan and Jaiswal reported that convenience from online access, innovativeness in IT, performance expectancy, and effort expectancy positively predicted a student's behavioral intent to use ERP training software. Performance expectancy and effort expectancy had the strongest relationship with behavioral intent to use ERP training software and facilitating conditions and behavioral intent were predictors of use behavior of ERP training software (Chauhan & Jaiswal, 2016). Unlike Magsamen-Conrad et al. (2015), Chauhan and Jaiswal discovered social influence was the only construct that was not a predictor of behavioral intention to use ERP training software among business school students, which was contrary to existing literature in the e-learning body of knowledge. In addition to the independent variables, analysis of moderators such as gender differences reflected female's behavioral intent to use ERP training software was higher than males when measuring the effects of convenience from online access and effort expectancy; whereas social influence and performance expectancy remained unaffected (Chauhan & Jaiswal, 2016). Experience moderated effort expectancy, revealing those with some experience had stronger behavioral intent to use ERP training systems that required less effort as compared to individuals with more experience (Chauhan & Jaiswal, 2016). This study was not focused on continuous delivery training and therefore gender was not included as a moderator, however, moderation by experience was a factor supported by Shahin et al. (2017) and Alotaibi (2016) that may moderate the behavioral intent to adopt continuous delivery examined.

Chauhan's and Jaiswal's study was an important contribution to the body of knowledge because students invest time and money into university programs hoping to secure gainful employment upon graduation, trusting that programs are aligned with industry expectations. Individuals may not qualify for employment if programs centered on training business students to use ERP systems are not aligned with industry requirements (Chauhan & Jaiswal, 2016). Investing time and money into project manager training to improve social skillsets, which can therefore support technical advancements such as continuous delivery adoption was a similar concept researched in this study. The study concluded that improving course content and focusing on areas of online access and effort expectancy may help business schools and vendors produce better-qualified candidates for careers in ERP (Chauhan & Jaiswal, 2016). One interesting reflection on Magsamen-Conrad et al. (2015) and Chauhan and Jaiswal was the difference in their conceptual frameworks and methods of analysis, however, both works collectively extend the information and communication technology body of knowledge in the same direction by suggesting the need for additional training to overcome adoption impediments in the information and communication technology domain and demonstrating the adaptability and applicability of the UTAUT model (Venkatesh et al., 2003). Submitting this study to the body of knowledge concerned with continuous delivery adoption may help support other researchers in a similar manner.

Chauhan and Jaiswal (2016) differed from Magsamen-Conrad et al. (2015) in ways other than moderators and relationships. Chauhan and Jaiswal explained limitations, different than Magsamen-Conrad et al., existed in generalizing findings due to constraints such as English-only participants and disqualification of participants from schools unrelated to business. This study included an English-only survey and therefore had have similar constraints. Chauhan and Jaiswal's study was otherwise well constructed but lacked enough peer-reviewed citation to explain and interpret results thoroughly.

In a study similar to Chauhan and Jaiswal (2016) on ERP training, Wagaw examined a different aspect of ERP systems by examining the adoption of homegrown ERP systems in Ethiopia using Venkatesh et al.'s UTAUT model (2003). ERP systems provide a combined view of all functions and processes a business performs using one software solution (Wagaw, 2017). According to Wagaw, commercial off-the-shelf ERP systems do not consistently align with all business data, processes, and functions vital for all businesses, internally developed, or homegrown, ERP systems can be a better fit in some cases, another alignment challenge. Wagaw included a population of 324 participants, assumed Ethiopian, ranging between 31 to 40 years of age. Wagaw utilized the UTAUT model and the Pearson product-moment correlation coefficient to analyze the participant's responses and therefore provided support to the use of Pearson product-moment correlation coefficient in this study.

Similar to Chauhan and Jaiswal (2016), but different from Magsamen-Conrad et al. (2015), Wagaw (2017) adapted the UTAUT model (Venkatesh et al., 2003) to their domain of study by adding constructs such as competitive advantage and cost-effectiveness. The following analysis describes how all the included variables and moderators predicted the dependent variable. Wagaw reported performance expectancy, effort expectancy, social influence, facilitating conditions, competitive advantage, and cost-effectiveness independent variables were strong predictors of homegrown ERP system acceptance in Ethiopia. Moderators such as experience exhibited moderating effects on performance expectancy, effort expectancy, social influence, competitive advantage, and voluntariness revealed moderating effects on social influence and facilitating conditions. Wagaw found that experience had a significant moderating effect on predicting behavioral intention to adopt and use homegrown ERP systems, which was similar to findings by Chauhan and Jaiswal with respect to the moderating effects of experience on ERP training system adoption. Wagaw explained individuals with more experience were more likely to accept and use homegrown ERP systems that required less effort (effort expectancy) and resulted in more benefits (performance expectancy), whereas individuals with less experience used the systems when they perceived peer workers expected them to do so (social influence). Wagaw's inclusion of experience, as a moderator, was a reason why it was included in this study.

Wagaw's study was important because it may assist businesses in developing countries, such as Ethiopia, with compliance to changing regulations by enabling the use of customized, homegrown ERP systems, instead of attempting to force existing commercial off-the-shelf ERP systems to fit their requirements. Continuous delivery systems are similar to homegrown ERP systems because they require flexibility and modularity to address the specific needs of an organization (Fitzgerald & Stol, 2017; Wagaw, 2017). Improving use of homegrown ERP systems may reduce cost and time associated with application support, modifying functions, and adapting business processes to commercial off-the-shelf ERP solutions (Wagaw, 2017). Reducing the project manger's anticipated support effort associated with continuous delivery may also affect the behavioral intent to adopt continuous delivery practices, which was the focus of this study. Wagaw's study was essential to advancing the body of knowledge concerning application of the UTAUT model (Venkatesh et al., 2003) to technology adoption, however, limitations and repeatability of the study were not explicitly documented even though questionnaire reliability was reasonably tested (Wagaw, 2017).

ERP systems can also be delivered as services over the internet, which hides the complexity of installing and maintaining the application from the user, and is referred to as Software as a Service (Alotaibi, 2016). Continuous delivery, the focus of this study, can be used to support the building and maintenance of Software as a Service services. Continuously delivering IT, such as web applications, produced a tremendous opportunity for revenue from the development of new technology platforms like Software as a Service (Alotaibi, 2016). Alotaibi investigated the beliefs and perceptions that affect the acceptance and use of Software as a Service (Alotaibi, 2016). Alotaibi made assumptions by stating there were incumbent risks associated with the deployment of Software as a Service solutions without elaborating on which specific risks were targeted. Findings and conclusions were based on responses to an online questionnaire representing 785 participants ranging from 25 to 34 years in age (Alotaibi, 2016), which was similar to this study, which utilized an online survey to collect responses from participants. Alotaibi indicated that the examination of UTAUT (Venkatesh et al., 2003) constructs affecting the adoption and use of Software as a Service would be significant for developing countries, such as Saudi Arabia.

As previously reflected in research by Wagaw (2017) and Chauhan and Jaiswal (2016), in addition to the constructs and moderators in the original UTAUT model by Venkatesh et al. (2003), Alotaibi added domain specific constructs such as Quality of Service (QoS) as an independent variable related to behavioral intention. Unlike Wagaw, Chauhan and Jaiswal, and Magsamen-Conrad et al. (2015), Alotaibi added education as a moderator of effort expectancy, social influence, and facilitating conditions. Alotaibi reported that most independent variables and moderators affected the adoption of Software as a Service. Performance expectancy, effort expectancy, social influence, QoS had a significant effect on behavioral intent to use Software as a Service (Alotaibi, 2016). Facilitating conditions had a significant effect on use behavior of Software as a Service (Alotaibi, 2016). Age had a moderative effect on performance expectancy, effort expectancy, social influence, and facilitating conditions (Alotaibi, 2016), which was similar to research by Magsamen-Conrad et al. Gender exhibited a significant moderating effect on performance expectancy and effort expectancy (Alotaibi, 2016), similar to research by Chauhan and Jaiswal. Education, not included in the original UTAUT model, Chauhan and Jaiswal, Magsamen-Conrad et al., and Wagaw, exhibited a significant moderative effect on effort expectancy, social influence, and facilitating conditions. Alotaibi reported gender as a moderator of social influence was the only model element that was not significant. Lack of gender significance related to social influence in the study by Alotaibi was a reason why it was not included as a moderator in this study. Similar to Magsamen-Conrad et al., Alotaibi's did not include Venkatesh et al.'s UTAUT voluntariness of use moderator because mandatory use of Software as a Service concepts was an inclusion criterion for respondent participation. Continuous delivery system use was also a requirement for all participants in this study and therefore voluntariness of use was not included as a moderator. In addition to excluding voluntariness as a moderator, Alotaibi contended, without peer-reviewed citations, experience and education can be used interchangeably as moderators in the application of Venkatesh et al.'s UTAUT model, as was in the case in Chauhan and Jaiswal, Magsamen-Conrad et al., and Wagaw. Alotaibi noted that two of the six hypotheses were rejected based on their analysis. The findings reflected effort expectancy and social influence effects on behavioral intent as moderated by age, in this case elderly individuals, were not supported (Alotaibi, 2016), which was unlike findings in the study by Magsamen-Conrad et al. concerning mobile tablet adoption. In addition to lack of support for age differences, gender moderation of social influence effect on behavioral intent to use Software as a Service technologies by Women was not supported (Alotaibi, 2016), which was unlike Chauhan and Jaiswal findings concerning adoption and use of ERP training software. Lack of support for age and gender differences in Alotaibi was a reason why they were not included as moderators in this study.

Alotaibi's (2016) study was advanced the body of knowledge because it extended the UTAUT model (Venkatesh et al., 2003) to include QoS as an independent variable as it related to behavioral intent. The pattern of adding constructs to the conceptual framework was similar and consistent with research by Chauhan and Jaiswal (2016) and Wagaw (2017), but different from Magsamen-Conrad et al. (2015) and this study, which does not include additional independent variables. Alotaibi noted the voluntariness of participants and single execution as the main limitations of the study. This study was also limited by single execution and did not include voluntariness of use as a moderator.

The findings in Alotaibi's (2016) study supported the application of UTAUT (Venkatesh et al., 2003) in subsequent research on Software as a Service -related technologies such as continuous delivery researched in this study. It was therefore feasible to test the UTAUT in the examination of project manager behavioral intent to adopt continuous delivery. Alotaibi's study was a good contribution to the body of knowledge, however, it may have benefited from better explanations of findings, diversity of age in survey participation, simplified hypotheses, and stronger incorporation of Saudi Arabia's role in the study. The study also does not adequately represent the elderly population when it includes participants ranging in age from 25 to 34 years old. There was strong evidence of UTAUT application, however, Alotaibi's study was weak in terms of structure and execution.

Software as a Service product offerings such as ERP may use cloud computing to deliver services to customers (Fitzgerald & Stol, 2017). Cloud computing services covers a wide range of online computing disciplines such as social networking, information sharing, and file storage (Alsmadi & Prybutok, 2018). Services offered on cloud computing environments may use continuous delivery, the focus of this study, as a means of developing and testing software (Fitzgerald & Stol, 2017). One specific area of the cloud computing services discipline that was often scrutinized was in privacy and compliance concerns for information sharing and storage (Alsmadi & Prybutok, 2018). Vendors in the information sharing and storage software domain have argued that previous privacy and compliance violations should not concern potential users because stronger security and privacy mechanisms are implemented (Alsmadi & Prybutok, 2018). Alsmadi and Prybutok examined the relationship between the independent variables of the UTAUT model (Venkatesh et al., 2003) and information sharing and storage behavior. Alsmadi and Prybutok used the UTAUT model and included an analysis of responses from 129 professionals working with information sharing and storage behavior to determine how constructs related with cloud computing services adoption and use.

Alsmadi and Prybutok (2018) utilized the original UTAUT model (Venkatesh et al., 2003) independent variables, which include: performance expectancy, effort expectancy, social influence, and facilitating conditions, and added adoption hindrances such as perceived security and perceived privacy. The addition of constructs by Alsmadi and Prybutok was consistent with research by Wagaw (2017), Chauhan and Jaiswal (2016), and Alotaibi (2016), however, it differs from the approach taken by Magsamen-

Conrad et al. (2015). The inclusion of perception-based independent variables in the study by Alsmadi and Prybutok was reminiscent of the attitude, motivations, and perceived behavioral control constructs available in the theory of reasoned action (Fishbein & Ajzen, 1975), theory of planned behavior (Ajzen, 1991), TAM (Davis, 1989), motivational model (Davis et al., 1992), combined TAM and theory of planned behavior (Taylor & Todd, 1995), and extensions by Dwivedi et al. (2017). Counter to Wagaw, Chauhan and Jaiswal, Magsamen-Conrad et al., and Alotaibi, Alsmadi and Prybutok did not examine behavioral intent in the relationship of performance expectancy, effort expectancy, and social influence to use behavior of information sharing and storage, which differs from the original UTAUT model, which stipulated performance expectancy, effort expectancy, and social influence are related to behavioral intent.

Alsmadi and Prybutok's findings reflected performance expectancy, effort expectancy, and facilitating conditions, as independent variables, were not reliable predictors of using information sharing and storage solutions. The additional independent variables, perception of security and privacy were not significant predictors of use behavior of information sharing and storage behavior (Alsmadi & Prybutok, 2018). Social influence was the only independent variable that strongly predicted the use of information sharing and storage solutions (Alsmadi & Prybutok, 2018), which was consistent with social influence predictive influence reported by Alotaibi (2016), but inconsistent with findings by Chauhan and Jaiswal (2016). Alsmadi and Prybutok concluded that the majority of information sharing and storage solution vendors are confident in the technical expertise that were developing and supporting their products, working towards reducing security and privacy threats. Existing peer-reviewed literature cited by Alsmadi and Prybutok asserted that the regularity and consistency with which users of information sharing and storage solutions became accustomed to may have made reliability less of a concern and instead made peer influence (social influence) more relevant. In addition to the influence of social influence, age, as a moderator of performance expectancy, effort expectancy, social influence, and facilitating conditions, had no significant moderating effect on information sharing and storage behavior among the population of respondents, which was counter to the findings of Magsamen-Conrad et al. (2015) in their study on mobile tablet adoption. Lack of support for the use of age as a moderator in Alsmadi and Prybutok was one reason why age was not included as a moderator in this study.

Alsmadi and Prybutok's study was essential because the findings reflected peer influence (social influence) as the strongest predictor of information sharing and storage behavior use, which was interpreted as reputation and customer perception are critical to information sharing and storage solution vendors. Social influence may also have an effect on project manager's behavioral intent to adopt continuous delivery. Alsmadi and Prybutok also warned that their study findings may drive reduced vigilance in security and privacy innovation because vendors may prioritize marketing and reputation management to address social influence instead of code quality, lowering the priority on technical innovation (Alsmadi & Prybutok, 2018). Alsmadi and Prybutok additionally acknowledged limitations regarding small sample size, which can lead to lack of generalizability of the study's findings, a limitation that also affects this study. In addition to the importance of social influence and small sample size limitation, augmenting the UTAUT model (Venkatesh et al., 2003) to remove behavioral intent as a dependent variable implied that a model that includes perceptions and attitudes, such as TAM (Davis, 1989), might be a better fit, which was similar to observations reported by Evwiekpaefe and Haruna (2018).

Five different studies applied the UTAUT model (Venkatesh et al., 2003) where one or more independent variables had a significant predictive effect on adoption and use of the subject matter. Effort expectancy effect on behavioral intent and facilitating conditions effect on use behavior were the most common predictors. All studies included some of the UTAUT model moderators such as age, gender, and experience. Four out of the five studies reviewed included independent variables and mediators not included in the original UTAUT model by Venkatesh et al. One of the studies removed behavioral intent altogether suggesting there may be a better fit with a different theoretical model such as TAM (Davis, 1989). Conceptual models based on the UTAUT appeared to be prevalent methods of validating and adapting, keeping the work by Venkatesh et al. current and relevant, however, there was evidence that the base UTAUT model remains effective. The findings in Alotaibi's (2016) study supported the application of UTAUT in subsequent research on Software as a Service-related technologies such as continuous delivery in this study. It was therefore feasible to test the UTAUT in the examination of project manager behavioral intent to adopt continuous delivery in this study. Researchers such as Evwiekpaefe and Haruna (2018) and Dwivedi et al. (2017) submitted guidance, evidence, and potential modifications of the UTAUT model, which provided support to extended models and alternative relationships between independent and dependent variables. This study does not add constructs or moderators to the original UTAUT model because it was not yet clear if other related independent variables exist in the continuous delivery domain. This study also shares limitations and constraints similar to those reported in the reviewed literature.

Project Management Research

Research in the domain of project management included studies concerning the technical and business factors that can influence project success. Software application project success traditionally relied on understanding the relationship between business constraints such as time, money, and resources (Hornstein, 2015). Theories and models such as the theory of constraints (Goldratt & Cox, 1984) and the *iron triangle*, which depicted quality at the center of a triangular interrelationship between time, cost, and scope of objectives, became accepted methods for describing the interrelationship of constraints that commonly existed in all projects (Cullen & Parker, 2015). The PMI notably mapped the definition of the *iron triangle* to the term *triple constraints* (PMI, 2013). Both iron triangle and triple constraints (PMI, 2013) are models that explain spending more time on quality may increase cost and might require additional time, which therefore decreases the scope of objectives (Cullen & Parker, 2015), rebalancing the sides of the *iron triangle* to preserve the fixed volume (Goldratt and Cox, 1984). Researchers such as Araújo and Pedron (2015) expanded on triple constraints by enumerating additional competencies such as (a) resource utilization, (b) time management, (c) risk management, (d) scope management, and (e) alignment were most relevant to experienced, mid-level analysts and managers in large multinational companies. Araújo and Pedron asserted that traditional constraints of time, resource, and scope still exist, however, constraints such as risk management and alignment are equally important when evaluating project success predictors.

Cullen and Parker (2015) supported the work of Araújo and Pedron (2015) by combining existing project success constraint theories in a new approach to the problem of project success as a function of resource management. Cullen and Parker conceptualized the theory of constraints (Goldratt & Cox, 1984), resource-based view (Wernerfelt, 1984), and resource-dependence theory (Pfeffer & Salancik, 2003) could be combined and applied in project success studies, defined by independent variables cost, time, and scope, and the dependent variable quality. To create a better understanding of the work by Cullen and Parker, the following is a description of each of the three theories included in their study:

- theory of constraints: related constraints are a part of every manageable system and therefore identifying, exploiting, and mitigating them was central to project success (Goldratt & Cox, 1984).
- resource-based view (Wernerfelt, 1984) described knowledge-based, intangible resources as a source of competitive advantage because they are reflections of the organizational structure, culture, and causal ambiguity of a company, unique to the business that created the resource (Cullen & Parker, 2015).

- resource-dependence theory was defined by Pfeffer and Salancik (2003) as the reduction of uncertainty and dependency by forming strategic relationships that limit external power over an organization.

The construction of London's Heathrow airport terminal 5 (T5), as reported in the study by Cullen and Parker (2015), utilized theory of constraints (Goldratt & Cox, 1984), resource-based view (Wernerfelt, 1984), and resource-dependence theory (Pfeffer & Salancik, 2003). Cullen and Parker posited British Airport Authority completed an extensive review of previously executed, large-scale projects and concluded combining theory of constraints (Goldratt & Cox, 1984), resource-based view (Wernerfelt, 1984), resource-dependence theory (Pfeffer & Salancik, 2003) and other project management theories may increase the probability of project success. The following was a discussion of how each of the three theories contributed to the study conclusions:

- theory of constraints (Goldratt & Cox, 1984) was utilized to identify more than 700 constraints, improve partner collaboration, and mitigate risks by implementing pre-fabrication and testing of components (Cullen & Parker, 2015). Mitigating risks by identifying and pro-actively addressing constraints improved timeliness, which reduced cost and improved quality (Araújo & Pedron, 2015; Cullen & Parker, 2015).
- resource-based view (Wernerfelt, 1984) was applied when British Airport Authority introduced standard designs and leveraged homegrown project management competencies (Cullen & Parker, 2015). Utilizing standards and in-house cultivated resources created competitive advantage and

unique customer experience, improving quality by reducing time, inconsistency, and uncertainty inherent to external resources (Cullen & Parker, 2015), which was also regarded as risk by Araújo and Pedron (2015).

- Cullen and Parker (2015) reported that resource-dependence theory (Pfeffer & Salancik, 2003) was demonstrated by British Airport Authority when long-term partnerships and first-tier suppliers were selected. Reducing the power and risk of external dependencies by actively delineating contracts to include mutually beneficial outcomes may lower long-term cost and improve the overall quality of a project (Cullen & Parker, 2015).

Cullen and Parker's study was vital to the field of project management because it underscored the necessity to mitigate risks and optimize internal project resources and dependencies through the use of combined approaches, however, the study was non-empirical, providing little quantitative or qualitative evidence. The use of combined theories and approaches to examining project success was supported by Walldén et al. (2016) and Evwiekpaefe and Haruna (2018). Using combined approaches to manage interdependencies was similar to project management practices such as continuous delivery, the focus of this study, which integrates several methods and tools to improve the efficiency of software engineering and maintenance (Fitzgerald & Stol, 2017). Cullen and Parker's study was also important because it focused on aligning performance management with strategic outcomes that may increase project success rates, similar to this study's examination of performance expectancy as an independent variable in the UTAUT model (Venkatesh et al., 2003). Adoption of technology that provides competitive advantage can improve project success by reducing risks represented by external dependencies, eliminating time wasted on routine tasks, and improving quality (Cullen & Parker, 2015). Improving quality may improve reputation, which was essential when measuring use behavior such as in the study by Alsmadi and Prybutok (2018), which positively related social influence to acceptance of information sharing and storage solutions using UTAUT. Social influence may affect behavioral intent to adopt continuous delivery in this study because one goal of continuous practices was to improve quality of software.

As Cullen and Parker (2015) and Araújo and Pedron (2015) observed, traditional business constraints such as resources, time, budget and quality are elements project managers must consider during all phases of a project, however, there are others worthy of consideration. Carvalho, Patah, and de Souza Bido (2015) reported that human factors, such as those project managers (PM) oversee, may affect project success as it relates to margins, cost, and scheduling. This study also includes an examination of human factors related to project managers and their effect on continuous delivery adoption. Carvalho et al. used a longitudinal, 3-year, field survey with participants in 10 different industries, spread out across three countries, and data from 1387 projects to analyze how project managers affect project success in national business environments. This study crosses industries and projects in a manner similar to Carvalho et al.

Carvalho et al. used structural equation modeling to measure the effects of the independent variables: project management areas and project management enablers (PMEn), on the dependent variable of project success represented by cost variation (Y_1), schedule variation (Y_2), and margin variation (Y_3), while controlling for country of origin (C_1), industry (C_2), and project complexity (C_3). Carvalho et al. defined PMEn as (a) PM process roles, (b) PM web portal, (c) benchmarking and implementation status, (d) PM assessment, and (e) small project size. Project management areas were defined as (a) contract management, (b) people management, (c) quality management, (d) knowledge management, (e) procurement management, and (f) project control (Carvalho et al., 2015). Frequency distribution, bivariate analysis, descriptive statistics, and partial least squares path modeling (PLS-PM) were used to analyze data from 1387 projects. The use of bivariate analysis in Carvalho et al. was the same as the method used in this study.

Country of origin (C_1) had a significant effect on project success (Carvalho et al., 2015). Brazil, the country with the most significant number of study participants, has experienced a high density of PMI and IPMI certified professionals (Carvalho et al., 2015), however, unlike this study, the population was confined to three countries and therefore may reduce generalization of results. Study findings supported literature that stated complexity (C_3) and industry (C_2) had a substantial effect on project performance (Carvalho et al., 2015). Cost (Y_1) and margin (Y_3) were not affected by independent variables PMEn and project management areas, which validated prior research suggesting less mature projects, those falling below capability maturity model integration level three, may not experience significant cost reductions or margin improvements (Carvalho et al., 2015). PMEn or project management areas did have a significant effect on schedule variation (Y_2) linked to increased agile project manager training and capabilities development, which are considered soft skill improvements (Carvalho et al., 2015), which was similar to skills required to socially influence adoption and use of processes, methods, and tools examined in this study. In a similar study, Masombuka and Mnkandla (2018) proposed a collaboration and acceptance model, which compared the reported maturity level, similar to capability maturity model integration, of DevOps principles and practices in a software development organization to factors like social influence and tool integration.

Carvalho et al.'s study was important because the findings reflected investment in soft-skills, which affects human factors of agile project management such as those examined in this study, improved project success rates. Human factors, in addition to business factors, such as project management training, have a significant effect on project performance (Carvalho et al., 2015) and was one of the elements of this study. Amrit et al. also found that human factors such as coordination, collaboration in the development process, trust, expert recommendation, and culture amongst the most studied subjects in software development literature. Cullen and Parker (2015) and Araújo and Pedron (2015) similarly stated that factors other than time, money, scope, and quality are important considerations in determining project success. The UTAUT (Venkatesh et al., 2003) measures independent variables that represent human factors (Amrit et al., 2014, Cullen &Parker, 2015) and therefore can be used to measure effects of project managers on adoption of agile practices, such as continuous delivery in this study. UTAUT human-related constructs such as performance expectancy, effort expectancy, and social influence are elements that project managers may use to affect behavioral intent to adopt continuous delivery.

Carvalho et al. (2015), Cullen and Parker (2015), Araújo and Pedron (2015), and Amrit et al. (2014) researched human factors and the impact they had on project success. Another way that project managers may improve project success was by addressing technical and human factors with the adoption of Agile principles and methods. Agile project management is a method for dividing large projects into small, manageable tasks, which may potentially increase project success rates (Hornstein, 2015). Agile project management also promoted using soft-skills, which are difficult to standardize, are essential to project success, and have an effect on collaboration, mentoring, and facilitation (Hornstein, 2015). Combining human and technical factors to examine adoption of technology is a key component of the UTAUT model (Venkatesh et al., 2003) used in this study because it combines human elements such as performance expectancy, effort expectancy, social influence, and experience with technical factors such as facilitating conditions.

Proponents of agile software development practices such as those conveyed by Hornstein (2015), believed that agile principles increase project success rates (Serrador & Pinto, 2015). Project success can be measured using critical success factors (CSF) to identify and measure individual elements that may affect project success rates (Hornstein, 2015). Serrador and Pinto measured efficiency and overall stakeholder satisfaction effects on organizational goals, as part of a study on project success, using an online survey of

1002 projects spread across multiple countries and industries by contacting PMI members of LinkedIn project management groups with an online survey from surveymonkey.com, which was similar to the method of recruitment and survey used in this study.

The degree of effort in agile planning was the independent variable in the study by Serrador and Pinto, which supported previous assumptions made by Conforto, Salum, Amaral, da Silva, and de Almeida (2014). Overall project success, project efficiency, and stakeholder satisfaction were the dependent variables, as moderated by the quality of the vision or goals, project complexity, and team experience (Serrador & Pinto, 2015). Serrador and Pinto discovered increased adoption of agile practices in projects reflected a statistically significant effect on all dimensions of project success, such as stakeholder satisfaction, efficiency, and overall project performance. Quality of vision and goals for the project were strong moderators of the effect of agile practice maturity on project success (Serrador & Pinto, 2015). Project complexity and team experience did not moderate the effect of agile practice maturity on agile project success (Serrador & Pinto, 2015). Individual experience, not team experience, was one of the moderators included in this study and was examined for its effects on effort expectancy, social influence, and facilitating conditions contributing to a project manager's behavioral intent to adopt continuous delivery.

Serrador's and Pinto's study was important because it validated project success research by Conforto et al. (2014), Cullen and Parker (2015), and Carvalho et al. (2015), however, research quality factors such as non-response errors, incomplete responses, and issues related to environment were not discussed (Serrador & Pinto, 2015). Serrador and

Pinto was also important because many studies have assessed team structure and teamwork for traditional development, however, there were no studies that examined the effect of teamwork on agile development suggested by Fowler and Highsmith (2001). Serrador's and Pinto's work was essential to this study because it examines human and technical factors related to project success and supports the methodology and approach to creating, distributing, collecting, and analyzing survey data as outlined in Chapter 3. This study included a distributed survey whereby project managers entered responses using surveymonkey.com. Chapter 3 contains detailed information regarding methods used in the design of this study.

The work of Serrador and Pinto (2015) and Conforto et al. (2014) are underpinned by the agile principles that originated in the agile manifesto by Fowler and Highsmith (2001), which declared self-organizing, self-directed teams are essential to innovation and development of good software design and requirements. Lindsjørn, Sjøberg, Dingsøyr, Bergersen, and Dybå expanded the body of knowledge when they studied the differences in the effects of traditional and agile teamwork quality on team performance and work satisfaction. Traditional development was based on limited customer interaction, large team size, specialized skills, decisions made by managers, and individual work (Lindsjørn et al., 2016). Unlike traditional development methods, agile development focuses on multi-skilled team members, collaboration, small team size, increased customer interaction, and decisions made by many (Hornstein, 2015; Lindsjørn et al., 2016). Lindsjørn et al.'s study included a structural equation modeling analysis of

71 agile software teams comprised of 477 participants in 26 companies to examine some of the differences between traditional and agile software development practices.

Lindsjørn et al.'s conceptual framework was based on Hackman's input-process-output model on group behavior and effectiveness (Hackman, 1987), which includes the following independent variables: (a) communication, (b) coordination, (c) balance of member contribution, (d) mutual support, (e) effort, and (f) cohesion. Lindsjørn et al. included team performance and team member's success as dependent variables, representing project success. Two surveys, one for traditional teams and one for agile teams, were created and tested satisfactorily for Cronbach's alpha (Lindsjørn et al., 2016) similar to the method used to validate the UTAUT (Venkatesh et al., 2003) questionnaire used in this study. The agile survey was distributed during the November 2011 Norwegian Agile Conference and the traditional survey distribution and compared to analysis covered in a previously published study (Lindsjørn et al., 2016). Survey respondents included team leaders, project leaders, and team members, such as architects, testers, support staff, developers, and configuration managers (Lindsjørn et al., 2016). The findings of Lindsjørn et al. reflected that teamwork quality significantly affects team performance and team member's success as rated by team members. Agile teams reported minor differences in effects of teamwork quality on performance and team member's success when compared with previously analyzed traditional team survey results (Lindsjørn et al., 2016). Effects of teamwork quality on project success were the same between surveys, however, the traditional survey echoed equal rating distribution for teamwork quality independent variables across team roles whereas the agile survey findings revealed significant differences in team leaders, project leaders, and team members rating distribution (Lindsjørn et al., 2016).

Lindsjørn et al.'s study was an essential contribution to the body of knowledge concerning peer-reviewed project management research because it reflected significant differences between traditional and agile project management highlighting alignment of management and individual contributor priorities and objectives. The accentuation of management alignment was captured in the social influence independent variable of the UTAUT model (Venkatesh et al., 2003) used in this study. Traditional team product owners, team leaders, and team members equally regarded teamwork quality effects on team performance and team member's success, however, agile teams reported differences in client requirements-related priorities between product owners and the collective group of team members and team leaders (Lindsjørn et al., 2016), which extends the examination of project success factors by Carvalho et al. (2015), Cullen and Parker (2015), Araújo and Pedron (2015), and Amrit et al. (2014). The differences found by Lindsjørn et al. indicated a closer alignment between team leaders, such as project managers, and team members in agile teams when compared with traditional teams, resulting in agile team leaders having more influence on agile team members than from other mid-level agile management positions. The observed closeness between project managers and team members provided the foundational support for this study's examination of the influence project managers have over adoption of automated processes that may benefit a team's ability to be successful. Lindsjørn et al. indicated a healthy separation of duties existed in agile teams, evidenced by advocacy for the customer requirements by product owners, business and human factors by team leaders, code quality by team members, and customer satisfaction by all, however, limitations concerning generalizing findings outside of Norwegian companies.

Lindsjørn et al. (2016) and Serrador and Pinto (2015) provided evidence that implementing Agile principles can potentially improve project success rates, however transitioning from traditional development methods, such as waterfall, to agile methods, such as scrum, was difficult because of procedural, organizational, and human factors (Gandomani & Nafchi, 2016). Transitioning from traditional development methods to agile development methods was called the agile transformation process (Gandomani & Nafchi, 2016). Gandomani and Nafchi examined human-related agile transformation process factors using grounded theory to qualitatively analyze responses from 49 agile practitioners in 13 countries. A collection of human-related agile transition challenges were the dependent variables in the study by Gandomani and Nafchi. Participants qualified for inclusion if they had experience with one agile transformation (Gandomani & Nafchi, 2016), which was similar to the qualifying factor of having experience with one continuous delivery project in this study and was a reason why experience was included as a moderator. Impediments to agile transition were (a) lack of knowledge, (b) cultural issues, (c) resistance to change, (d) wrong mindset, and (e) lack of effective collaboration; and perceptions about the change process were defined as (a) worried, (b) enthusiastic but misguided, (c) lack of belief in change, (d) indifferent, and (e) unrealistic expectations; emerged as independent variables after completion of coding analysis of participant responses (Gandomani & Nafchi, 2016).

Gandomani and Nafchi (2016) posited that investment in pre-transition organizational education about agile principles and expected outcomes may decrease the effect of the following independent variables: lack of knowledge, worry, enthusiastic but misguided, and unrealistic expectations. Examination of investment in education reflected by Gandomani and Nafchi was similar to the studies on homegrown ERP implementations in Ethiopia by Wagaw (2017) and ERP training in India universities by Chauhan and Jaiswal (2016).

The population of project managers surveyed in the study by Gandomani and Nafchi (2016) played a significant role in reducing the effect of the wrong mindset, cultural, and lack of effective collaboration and was a supporting factor in examining project manager behavioral intent in this study. Gandomani and Nafchi observed command and control management methods that are preferable in traditional management contributed to the wrong mindset in the population of project managers, which aligns with the findings of Carvalho et al. (2015), Cullen and Parker (2015), Araújo and Pedron (2015), and Amrit et al. (2014) on agile project management success factors. Gandomani and Nafchi asserted that facilitative management style, suggested in agile project management, can reduce the effects of the wrong mindset in the agile transition process.

Gandomani and Nafchi's research was a significant contribution to the body of knowledge because it exposed fine-grained causes of human factors involved with the agile transformation process. Previous studies by Carvalho et al. (2015), Cullen and Parker (2015), Araújo and Pedron (2015), and Amrit et al. (2014) only captured general impediments, however, the research did not contain quantitative evidence to support the degree to which negatively impacting sentiment, such as unrealistic expectations, enthusiastic but misguided, indifference to change, and lack of belief in change, affected the agile transformation process. Project managers attitudes, beliefs, and actions can affect human-related agile transition challenges through impediments and perceptions (Gandomani and Nafchi, 2016). Examining the antecedents of a project manager's intent to adopt continuous delivery, which was the purpose of this study, would extend the study by Gandomani and Nafchi.

Lindsjørn et al. (2016), Serrador and Pinto (2015), Conforto et al. (2014), and Gandomani and Nafchi (2016) agreed with the principles of the agile manifesto (Fowler & Highsmith, 2001), however, some researchers have interpreted the manifesto's (Fowler & Highsmith, 2001) references to small-sized teams as a reason that large, globally distributed teams, may not be able to adopt agile methods (Papadopoulos, 2015). Papadopoulos extended the body of knowledge in a study of the effects of large agile teams on the dependent variables: (a) quality as a benefit to using agile, (b) customer perception of the product, (c) intra-team collaboration, (d) intra-team communication, and (e) employee satisfaction. Papadopoulos used a combination of a survey instrument, observations, and defect log data to perform a case study analysis and present the findings on two projects inside one business. The use of a defect log was important because it was used to determine actual usage or use behavior of agile methods instead of solely relying on respondent answers, boosting validity of results. In this study on continuous delivery it was unnecessary to use logging to validate usage because once implemented, continuous delivery, by definition, automatically executes continuously.

Papadopoulos asserted that embracing agile practices, the readiness of system and UI design, handling of meetings, demonstrating team results, and reducing continuous integration effort, the independent variables, may affect a large agile team's ability to benefit from agile methods, the dependent variable. Organizational factors such as organizational design, decision making, collaboration and coordination, and agile culture, as well as scaling factors: multi-team backlog, multiple meetings, infrastructure scalability, and organizational agility, were selected as moderators of the independent variable effects on the ability to benefit from agile methods (Papadopoulos, 2015). Many of the same moderators were also found in the studies by Lindsjørn et al. (2016), Serrador and Pinto (2015), and Gandomani and Nafchi (2016). Papadopoulos observed project managers can facilitate cross-linked teams to influence collaboration, communication, and decision making as it relates to dependent sub-constructs: embracing agile practices, handling of meetings, and reducing continuous integration effort. Cross-team collaboration, communication, and decision-making are some of the key elements required in the adoption of continuous delivery, the focus of this study. Papadopoulos observed that projects that are large and distributed benefited from using agile methods by increasing quality, allowing late changes to requirements, and elevating employee satisfaction, which was supported by Lindsjørn et al., Serrador and Pinto, and Gandomani and Nafchi. The study contained evidence that agile culture and following agile practices are essential areas that adopters should address in addition to the transformation process (Papadopoulos, 2015).

Papadopoulos' study was a significant contribution to the body of knowledge because it related human-factors, such as agile project managers adopting a facilitative style of management instead of traditional command and control, and their effect on adopting agile practices, which was the same properties required for successful continuous delivery adoption discussed in this study. Facilitating collaboration between remote teams and reducing continuous integration effort allowed agile project managers time to address quality and customer interaction (Papadopoulos, 2015). The study findings add to the body of knowledge concentrated on agile transformation researched by Lindsjørn et al. (2016), Serrador and Pinto (2015), and Gandomani and Nafchi (2016), however, the results are limited in terms of generalizability because there was a single case study, which may not represent the larger population of agile projects.

This study included an analysis and synthesis of six peer-reviewed studies reporting evidence on human-related factors:

- Collaboration, facilitation, education, culture, and teamwork have a substantial effect on agile transformation (Gandomani & Nafchi, 2016; Papadopoulos, 2015),
- project performance and project success (Carvalho et al., 2015; Cullen & Parker, 2015; Lindsjørn et al., 2016; Serrador & Pinto, 2015).
- Human factors depicted in the UTAUT model (Venkatesh et al., 2003) and project manager behavioral intent to adopt the agile practice of continuous delivery, which is the focus of this study.

Four studies focused on project performance and project success:

- Cullen and Parker (2015) synthesized existing theories on project success and conceptualized that reducing time on repetitive tasks as one way to gain competitive advantage, strengthening intellectual property and promoting the delivery of quality products, which improved reputation and social influence. Cullen and Parker postulated project management involves more than cost, time, scope, and quality considerations.
- Carvalho et al. (2015) studied project management effects on project success using cross-country and cross-industry moderators and asserted that investment in agile project manager soft-skills has significant effects on schedule variation, which affected project performance through making time constraints more predictable.
- Serrador and Pinto (2015) reported the effects of agile effort on project success and determined agile practice effort, moderated by the quality of vision and goals, influenced project success, as conveyed to teams through the voice of project managers.
- Lindsjørn et al. (2016) examined the effects of teamwork quality on project success and theorized project managers are closest to team members and therefore influence teamwork quality constructs, such as communication, coordination, and cohesion. Lindsjørn et al. did not show evidence of significant differences between outcomes of teamwork quality when transitioning from traditional to agile project management methods. Lindsjørn et al. reflected differences in priorities and objectives for team

members, team leads, and product owners existed between traditional and agile project management methods. Lindsjørn et al. supported the research of Cullen and Parker (2015), Serrador and Pinto (2015), and Carvalho et al. (2015).

Two studies focused on the agile transformation process:

- Gandomani and Nafchi (2016) examined human-related challenges and their effect on agile method adoption and posited that attention to project management soft-skills has a significant effect on the agile transformation process
- Papadopoulos (2015) studied aspects of agile transition as moderated by organization size and team member disbursement and explained that large, globally distributed organizations that attempted transition to agile methods experienced positive results when agile project managers were trained in soft-skills, such as facilitation, and technical understanding, such as influencing the automation of repetitive tasks.

Gandomani and Nafchi (2016) and Papadopoulos (2015) agreed that focusing on soft-skill development in agile project managers has a significant effect on the agile transformation process and future research in the area of agile transformation process may benefit from a focus on quantitative examination to empirically support the qualitative work of Gandomani and Nafchi, and Papadopoulos. As evidenced by Carvalho et al., Cullen and Parker, Gandomani and Nafchi, Lindsjørn et al., Papadopoulos, and Serrador and Pinto project management soft-skills have a significant effect on project success, project performance, and agile transformation. Studies indicated improving collaboration, reducing time on repetitive tasks, communicating great vision and goals, and building cross-organizational relationships are ways project managers can affect project success (Carvalho et al., 2015; Cullen & Parker, 2015; Gandomani & Nafchi, 2016; Lindsjørn et al., 2016; Papadopoulos, 2015; Serrador & Pinto, 2015). Agile project managers may also affect behavioral intent to adopt time reduction of repetitive tasks (Carvalho et al., 2015; Cullen & Parker, 2015; Gandomani & Nafchi, 2016; Lindsjørn et al., 2016; Papadopoulos, 2015; Serrador & Pinto, 2015) such as those included in continuous delivery systems, which was the focus of this study.

DevOps and Continuous Delivery Adoption History

DevOps includes practices such as continuous integration, continuous delivery, and continuous deployment. DevOps prescribes lessening of organizational barriers, both social and technical, for the purposes of information sharing and cross-pollination of skills and principles (Gupta, Kapur, & Kumar, 2017). Removing barriers encourages unification of individual and department goals, creating a harmonious environment with the use of common nomenclature, standard tools, and standard practices to achieve the same overarching organizational goals (Pinto, Castor, & Reboucas, 2018). DevOps can be organizationally represented by integrating development and operations department's personnel, physically, into one group, by virtual matrix reporting structures or some combination of physical and virtual arrangement. DevOps organizations contain roles and responsibilities stretching beyond typical software development management and engineering types such as product managers, project managers, architects, developers, and testers. DevOps roles incorporated many of the operational subject matter expertise, that traditionally resided in operations departments, directly into the development environment. DevOps roles assigned to a software development project can include infrastructure engineers, platform engineers, site reliability engineers, release engineers, and data scientists. DevOps engineers that take on the work of multiple roles in an organization can exist as well.

Continuous practices, that are part of DevOps, such as integration, deployment, delivery, and experimentation are the tools and processes that work together to automate the operations of standard software delivery cycles such as build, test, stage, release, and monitor. Continuous integration, typically the first continuous practice that organizations adopt, focuses on detecting changes in source code and then automatically compiling code, testing functions and features, logging information, and errors, and staging output (Shahin et al., 2018). Continuous integration threads software through various levels of automated and manual testing to ensure quality and confidence. Upon completion of a successful continuous integration attempt, the resulting artifact can be deployed to a variety of supported platforms (Shahin et al., 2018).

Continuous delivery, one of the next continuous practices most organizations adopt, ensures the latest code, test cases, or server configurations are always utilized to create the next version of a working software application. Continuous delivery is defined as the practice of keeping a software solution in a releasable state at all times, which includes operational readiness, consisting of testing, and acceptance of continuous integration output (Shahin et al., 2018). Continuous delivery and continuous deployment are sometimes used synonymously in literature even though they are distinctly different (Chen, 2017; Rodríguez et al., 2017). In this study continuous delivery and continuous deployment were equally researched to avoid missing inter-related concepts. Continuous deployment changes the continuous delivery deployment (see Figure 3) to production step from manual to automatic (Chen, 2015; Chen, 2017; Laukkanen et al., 2018). This study contains continuous delivery and continuous deployment peer-reviewed articles.

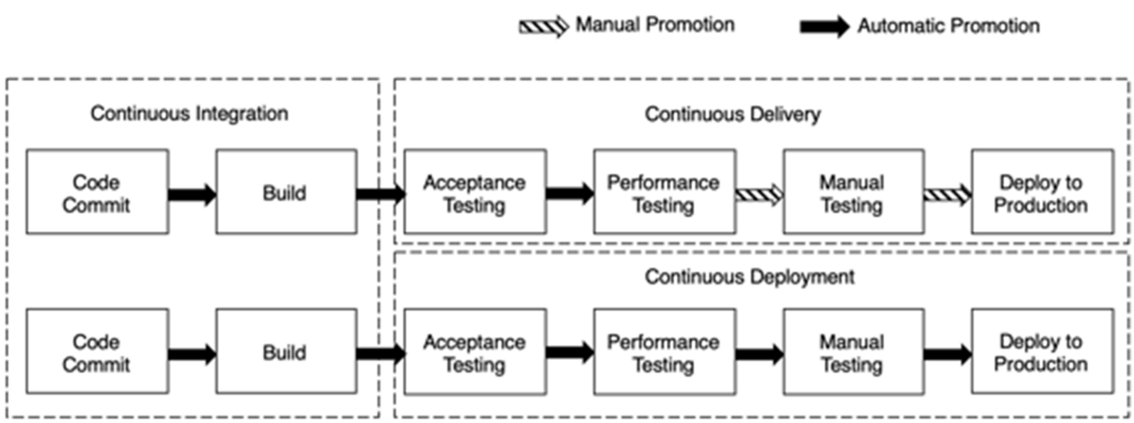

Figure 3. Continuous integration, continuous delivery, and continuous deployment operations. Original figure adapted from text in "Continuous integration, continuous delivery, and continuous deployment operations," by L. Chen, 2015, *IEEE Software*, *32*(2). Copyright 2015 by IEEE.

The peer-reviewed body of knowledge concerning continuous delivery adoption focused on the current state of the practice, challenges, and benefits. Researchers such as Leppänen et al. executed a qualitative survey with 15 participants, in Finnish software development intensive businesses, to determine the degree of continuous deployment implementation, perceived benefits, and anticipated challenges. Individuals believed quicker feedback, faster releases, higher quality, effort efficiency, and better collaboration served as benefits derived from continuous deployment (Leppänen et al., 2015). UTAUT model (Venkatesh et al., 2003) constructs such as performance expectancy and effort expectancy used in this study, map to the benefits of continuous delivery and continuous deployment reported by Leppänen et al. Participants indicated that automating the deployment to production was not a goal, however, it was a requirement to have the option to deploy a product manually such as in continuous delivery examined in this study. Leppänen et al. observed companies did not automate the last step, deployment to production, of continuous deployment even though they had developed automated pipelines, opting instead for continuous delivery.

Leppänen et al. supported Claps et al. (2015) by reporting several participants indicated management did not view continuous delivery and continuous deployment as a priority, providing a significant obstacle to implementation. Customer preference, domain constraints, developer attitude, code age, and environmental differences posed a significant threat to implementing continuous delivery and deployment (Leppänen et al., 2015). Telecommunications and network software development organizations, which can lose remote device update capability if an automated update causes a firmware runtime error, experienced resistance to the idea of automated production deployment. Leppänen et al. advanced the research in continuous delivery and continuous deployment by reporting automation of tasks may be feasible, however, it was not encouraged in many cases, which gives support to this study on continuous delivery.

Chen (2015) detailed the continuous delivery and continuous deployment similarities and differences exposed studies such as Leppänen et al. (2015) in a case study that concentrated on continuous delivery adoption at Paddy Power corporation. Chen, L. conveyed that quicker time to market, product market alignment, release reliability, as well as improvements in productivity, efficiency, quality, and customer satisfaction, are benefits of adopting continuous delivery. UTAUT model (Venkatesh et al., 2003) constructs used in this study such as performance expectancy, effort expectancy, and experience relating to the benefits of continuous delivery reported by Chen. Paddy Power experienced organizational, process, and technical challenges. Chen and Leppänen et al. agreed on many of the benefits and challenges of continuous delivery.

Claps et al. (2015) expanded research by Chen (2015) and Leppänen et al. (2015) by identifying social and technical adoption challenges experienced by organizations through an explorative case study, at Altassian corporation, involving detailed interviews of software practitioners. Claps et al. utilized a survey conceived by Vavpotic and Bajec (2009) that included questions regarding social and technical obstacles confronted during software development methodology adoption. Thematic analysis revealed 20 social and technical adoption challenges and mitigation strategies (Claps et al., 2015). Adjustments in role responsibilities can affect continuous delivery adoption. Claps et al. observed cross-organizational communication and collaboration, fostered by management, affected adoption of continuous delivery. Claps et al. added to research from Chen and Leppänen et al. by reporting changes delivered to their clients through continuous delivery can cause a lack of feature awareness. Features that are delivered to customers regularly may go unnoticed or cause confusion, especially changes to user interfaces (Claps et al., 2015).

Claps et al.'s (2015) study was an essential contribution to continuous delivery adoption body of knowledge because it validated findings by Chen (2015) and Leppänen et al. (2015), making their results generalizable. Claps et al. chose a different response collection strategy than Chen and Leppänen et al. by using a proxy, or gate-keeper, to manage communication between interviewer and interviewee. The use of a gate-keeper made Claps et al.'s study subject to selection bias limitations. This study uses an online, quantitative survey to collect responses and therefore differs from the qualitative analysis offered in Chen, Leppänen et al., and Claps et al. The use of an online survey allows for broader participation, which was suggested as a limitation and the reason Claps et al. suggests future research.

Chen (2017) acknowledged the challenge of gaining support from a broad set of organization representatives when adopting continuous delivery as observed and reported by Chen (2015), Claps et al. (2015), and Leppänen et al. (2015). Chen (2017) extended the peer-reviewed continuous delivery adoption literature by constructing strategies to overcome challenges in a follow-up case study performed at Paddy Power corporation. Chen (2017) leveraged four years of continuous delivery implementation experience as the source of information to assert that accelerated time to market, product to market alignment, improved efficiency and productivity, release reliability, improved customer satisfaction, and improved product quality are the benefits of adopting and using a continuous delivery system. Chen (2017) extended Chen (2015) and supported findings by Claps et al., and Leppänen et al. by suggesting six strategies to mitigate challenges such as:

- Chen (2017) observed including continuous delivery experts from other parts of the organization, also known as expert drop, was useful in extending a team's technology acceptance and experience by sharing knowledge and experience from other areas of the organization,
- continuous delivery pipeline visualization promotes a consistent understanding of continuous delivery efforts and current product development, testing, and release status (Chen, 2017),
- starting with simple but important examples reduces barriers to entry associated with sophisticated continuous delivery systems (Chen, 2017),
- continuously delivering continuous delivery increases reliability and confidence in product development (Chen, 2017),
- Chen (2017) posited selling continuous delivery as a painkiller positions automation as an answer to many of the challenges facing customer satisfaction,
- and multi-disciplinary teams such as those suggested by DevOps principles and practices.

Chen's (2017) study was essential because it validated his previous work (see Chen, 2015) and the contributions of Leppänen et al. and Claps et al. on challenges of adopting continuous delivery. Chen (2017) extended peer-reviewed body of knowledge on continuous delivery adoption by conceptualizing six strategies for improving adoption success. Chen (2017) further suggested empirical testing of organizational structures and process design that support continuous delivery adoption like the examination in this study. The studies synthesized in the literature review in this study reflected that excessive documentation, lengthy processes, architectural limitations, tools, non-functional requirements, and legacy platforms reported by Fowler and Highsmith (2001) are still hampering adoption of continuous delivery in many organizations and deserve closer examination (Chen, 2017). Organizations that choose to adopt continuous delivery may experience many of the same challenges and benefits (Chen, 2015; Chen, 2017; Claps et al., 2015; Leppänen et al., 2015). In addition to documenting the challenges and benefits of adoption, all peer-reviewed studies in this section emphasized that future continuous delivery adoption empirical research should be conducted with broader populations (Chen, 2015; Chen, 2017; Claps et al., 2015, Leppänen et al., 2015). Canvasing broader populations using existing adoption models was evidenced by Chen (2015), Chen (2017), Claps et al. and Leppänen et al., who reported the effects similar to performance expectancy, effort expectancy, and facilitating conditions, as moderated by experience, on continuous delivery adoption using the UTAUT model (Venkatesh et al., 2003), which was the theoretical foundation of this study. There was direct support for future research by Chen (2017) in the area of continuous delivery enablement tools, which statistically related to facilitating conditions and are part of the UTAUT model by Venkatesh et al. (2003).

Continuous Delivery Research

Continuous delivery research efforts have not kept pace with the explosion of new terms and concepts created by the software development community (Gupta et al., 2017). Numerous attributes influence DevOps implementation such as those found in maturity models like the continuous delivery model for continuous delivery and release management (Humble & Farley, 2010) and the capability maturity model integration. Maturity models help organizations internally measure and improve software development practices against industry standards (Fitzgerald & Stol, 2017). Gupta et al. developed a DevOps maturity model, using a key set of independent attributes, that could be used to focus future research on the maturity of DevOps practices such as continuous delivery. Gupta et al. analyzed DevOps practices by executing a two-step method to determine the effects of 18 independent attributes on maturity and investigate the relationship between them. Most of the attributes were previously reported by Chen (2015), Chen (2017), Claps et al. (2015) and Leppänen et al. (2015). Gupta et al. surveyed 300 senior professionals, working for multi-national software development organizations, in the field of DevOps, with at least 15 years of enterprise application experience, regarding the relevance of 18 independent DevOps attributes in support of their proposed model. Gupta et al. created their model to explain the relationships between the 18 key attributes. Exploratory and confirmatory factor analysis was used to confirm the underlying factors for the 18 named attributes (Gupta et al., 2017). Gupta et al. named continuous delivery, source control, cohesive teams, and automation as latent variables that serve in a parent relationship to the 18 independent variables.

Similar to Chauhan and Jaiswal (2016), Lindsjørn et al. (2016), and Carvalho et al. (2015), Gupta et al. (2017) used structural equation modeling to validate the connectivity between the attribute's peer and parent relationships in the resulting model. Child attributes of automation and source control were found to be the most influential factors in adopting and maturing DevOps practices efficiently and key independent child attributes included: (a) feature toggle, (b) branching scatter, (c) automated code review, (d) branching changes, (e) automated deployment, (f) automated testing, (g) branching depth, (h) automated monitoring tools, (i) branching pattern, and (j) infrastructure as code (Gupta et al., 2017). Gupta et al. executed the two-way assessment inside an enterprise software development organization to confirm their findings. The organization used Gupta et al.'s DevOps maturity model to identify and mitigate four lagging attributes and discovered a 40% increase in maturity level.

Gupta et al.'s (2017) study was an essential contribution to the literature because project success was statistically related to process maturity (Carvalho et al., 2015). As reported by Gupta et al. a 40% increase in process maturity may lead to increases in project success rates. The maturity of software process improvement effects project success and therefore effects cost, schedule variance, resource availability, and quality (Carvalho et al., 2015). Gupta et al. asserted maturity model assessment allows organizations to self-assess and rapidly improve their software development process, increasing the probability of project success. Project managers influence the use of the key attributes identified in Gupta et al.'s research and may be able to use this study to improve adoption of continuous delivery and project success.

Laukkanen et al. (2018) agreed with Gupta et al. (2017) that advanced agile software development practices, such as continuous delivery, are difficult to adopt. Related software development literature such as Papadopoulos (2015) argued that small organizations may experience a more natural and more beneficial agile transformation process than large organizations. Agile development focused on multi-skilled team members, collaboration, small team size, increased customer interaction, and decisions made by many (Lindsjørn et al., 2016; Hornstein, 2015). Small team size can be interpreted to indicate large teams, co-located or globally distributed, may not be able to adopt agile methods (Papadopoulos, 2015).

Laukkanen et al. executed a case study of one small, 50-member, startup software-intensive company and one large, 180-member, mature software-intensive organization to determine the effects of organizational context on advanced release engineering practice adoption. Laukkanen et al. performed 18 interviews among organization members with different roles and responsibilities, a total of nine interviews per business. Laukkanen et al.'s interview incorporated themes such as organizational structure, software development process, organizational differences, metrics, product differences, continuous integration, and background information. The organization roles of Interviewed participants ranged from team member to executive leadership (Laukkanen et al., 2018). In a similar manner, this study surveyed a single participant role, technical project manager, to examine the effect they have on behavioral intent to adopt continuous delivery.

Laukkanen et al. observed that release engineering included six distinct focus areas: (a) infrastructure-as-code, (b) build systems, (c) deployment pipeline, (d) version control or branching and merging, (e) deployment, and (f) release. Gupta et al. similarly reported unified teams, source control, automation, and continuous delivery as high-level attributes. Laukkanen et al.'s study was similar to Gupta et al. 2017), however, Gupta et al. focused DevOps adoption instead of release engineering. DevOps is a superset of release engineering and organizational concerns (Gupta et al., 2017). Laukkanen et al. synthesized the relationship between the release engineering driving forces applicable in both case organizations. The release engineering driving forces model by Laukkanen et al. shows how the independent variables positively or negatively affect each other. Laukkanen et al. posited that the number of customers, number of production environments, available resources, and degree of control over production environment affect release capability through internal quality standards. Organization size and distribution influenced release capability through continuous integration, elements related to source control management (Laukkanen et al., 2018), which was similar to findings in Papadopoulos (2015).

Laukkanen et al. reported several differences. Small organizations that have relatively low organization size can substitute internal testing with customer testing to avoid decreases in intrinsic quality (Laukkanen et al., 2018). Customer testing was related to making customers a priority as mentioned in research by Serrador and Pinto (2016). Small organizations experienced faster release cadence, achieved by continuous delivery, however, large organizations may achieve faster release cadence by increasing collaboration between departmental roles, facilitated by project managers (Laukkanen et al., 2018). Laukkanen et al. balanced their statement on faster release cadence by determining faster release cadence was not a predictor of higher quality standards and improved reputation, which was the focus of research on information sharing and storage by Alsmadi and Prybutok (2018).

Laukkanen et al.'s (2018) study on the effects of organizational context on advanced release engineering practice adoption was an essential contribution to the aims of this study because it provided validation that project managers have an effect on continuous delivery. Laukkanen et al. also supported Papadopoulos (2015) who explained, large, globally distributed organizations that attempt transition to agile methods experience positive results when agile project managers are trained in soft-skills such as facilitation, and technical understanding such as influencing the increase of automation of repetitive tasks. Laukkanen et al. additionally concurred with Serrador and Pinto (2015) that quality, one element of project success, was not moderated by team experience and project complexity. Many of the constructs and moderators used in this study are supported by Laukkanen et al. and provided support for selecting the UTAUT model (Venkatesh et al., 2003). However, the generalizability of Laukkanen et al.'s study was limited because it was a small case study and they did not have access to all of the large organization's members. Laukkanen et al. reported interpretations that may not be common knowledge reduced study reliability and repeatability. Laukkanen et al. suggested future research may examine how to measure internal quality standards and how organizational size and distribution affect release capability through continuous integration.

Release engineering techniques described by Laukkanen et al. (2018) such as creating rapid releases of software may distract software-intensive businesses from the effort to innovate and stay competitive in the software solutions marketplace. Systems that support rapid releases such as continuous delivery and continuous deployment consist of tools connected via a workflow, an automated toolchain (Mäkinen et al., 2016). Mäkinen et al. researched why 18 Finnish software development intensive organizations chose not to use automated toolchains in certain phases of continuous delivery and deployment and examined the effect this choice may have on delivery speed. Dissimilar to this study, Mäkinen et al. used qualitative, semi-structured surveys to gather information regarding tooling used in the requirements, development, operations, testing, quality, and feedback phases of continuous delivery by different members of software development organizations. Mäkinen et al. used thematic analysis to code and produce results. Background information from other studies such as Claps et al. (2015) and Leppänen et al. (2015) provided moderators such as industry, organization size, team size, code platform, primary coding technology, and release cadence. The independent variable, tool selection, was used to predict delivery speed, the dependent variable (Mäkinen et al., 2016). Mäkinen et al. did not use or provide a theoretical or conceptual model for their study, which differs from this study.

Mäkinen et al. discovered release cadence was not affected by variances in the number of tools implemented. Organizations that lacked tool coverage were able to deliver equally as fast as organizations that implemented tools in most phases, however, they noted that absence of tool implementation for a given phase was not necessarily indicative of disregard for the operation performed in the phase (Mäkinen et al., 2016). Deployment and monitoring tools were the least implemented in the 18 Finnish organizations surveyed (Mäkinen et al., 2016). An example of a place where continuous delivery and deployment toolchains were not heavily leveraged was in the industry of mobile gaming due to the manual testing required for gaming applications (Mäkinen et al., 2016). The study by Mäkinen et al. invalidated toolchain coverage as a predictor of release cadence, however, constraints such as the number of participants lead to lack of generalizability and reliability of findings. Leppänen et al. (2015) and Claps et al. (2015) did not investigate the linkage between release cadence and toolchain coverage and therefore Mäkinen et al.'s study served as support for further research to determine why continuous delivery adoption might be affected by other factors.

Similar to continuous delivery practices studied by Mäkinen et al. (2016), continuous integration is a sub-practice of continuous delivery that characterized the source control mechanisms used to absorb developer's code changes and compile code into binary format (Pinto, Castor, & Reboucas, 2018). As evidenced by Mäkinen et al. on continuous delivery benefits and challenges of continuous integration can also be unclear and lead to technology adoption problems (Pinto et al., 2018). Pinto et al. utilized qualitative and quantitative measurement to synthesize the attitudes of 158 open-source developers using the Travis continuous integration platform. Pinto et al. used a survey containing a mixture of closed and open-ended questions relating to areas such as reasons for build breakage, benefits and challenges of continuous integration systems, personal background information, experience with continuous integration, and continuous integration fundamentals. The quantitative, closed-ended survey method used by Pinto et al. was similar to the method used in this study, however, the open-coding and axial-coding used to distill themes from the participant responses by Pinto et al. was qualitative in nature and did not apply to this study.

Pinto et al. (2018) discovered several reasons preceded the adoption of continuous integration, which included:

- improving communication,
- improving transparency,
- best practices,
- credibility,
- cross-platform testing,
- personal needs,
- enforcement of automated software testing, and
- detecting regressions or bugs.

Pinto et al. discovered builds broke during continuous integration for technical reasons such as version changes, dependency management, the intricacy of code, inadequate testing, time-zone differences, missed edge cases, and git misuse (Pinto et al., 2018). Social reasons for build breakage include: (a) time pressure, (b) lack of testing culture, (c) lack of domain knowledge, (d) carelessness, (e) lack of communication, and (f) acceptable build breakage in agile development (Pinto et al., 2018). Many of the social reasons were studied in project management research such as Araújo and Pedron (2015), Lindsjørn et al. (2016), Serrador and Pinto (2015), Conforto et al. (2014), and Gandomani and Nafchi (2016), however, they were not referenced and might have provided additional support for the findings of the study. Pinto et al. reported the benefits of using a continuous integration system included: (a) catching problems early, (b) automation, (c) software quality, (d) fast development cycles, (e) cross-platform testing, and (f) build confidence. Challenges of using a continuous integration system comprised: (a) configuring the build environment, (b) false sense of confidence, (c) discipline, (d) additional effort, (e) multiple environments, and (f) monetary costs. The benefits and challenges from research by Chen (2015), Chen (2017), Claps et al., (2015), and Leppänen et al. (2015) on continuous practices were not referenced in Pinto et al. and may have provided more support for their findings. Unlike Pinto et al., this study reached across continuous practices and project management disciplines to ensure inclusion and synthesis of related subject matter material to provide strong evidence and support for findings.

Pinto et al.'s (2018) study was an essential contribution to the continuous practices body of knowledge because it defined the need for education and guidance as facilitated by effective project management, however, non-commercial open-source projects do not typically include project managers and as a result only four of the respondents were project managers. Pinto et al. posited continuous integration was an important skill and educators play a significant role in transferring knowledge from continuous integration experts to developers that had little or no continuous integration experience. Pinto et al.'s findings on education support Alotaibi's (2016) application of UTAUT (Venkatesh et al., 2003), with education as a moderator, on adoption of Software as a Service, and Gandomani's and Nafchi's (2016) observations surrounding the importance of project management's facilitation of education during the agile transformation process. Pinto et al. did not include participants from commercial continuous integration projects and excluded users of other popular continuous integration platforms, which was the opposite of the population inclusion criteria of this study.

As Chen (2015), Chen (2017), Claps et al., (2015), and Leppänen et al. (2015) have documented, continuous practices like continuous delivery can be challenging to adopt for a variety of reasons such as lack of automation skills, organizational structure, and, as Mäkinen et al. (2016) supported, tool selection (Shahin et al., 2017). Shahin et al. (2017) investigated how architectural design and implementation of software may affect continuous delivery adoption and use. Shahin et al. executed an empirical mixed-methods study that included a survey of 91 respondents in the professional software field, and interviews with 21 participants in the software industry to examine their research question. Interviews were coded using thematic analysis and then combined with a descriptive statistical analysis of the survey responses (Shahin et al., 2017). Background information, such as job role, experience, organization size, and organization domain, was collected from the participants, which could be used as moderators. Shahin et al.'s inclusion of experience was a reason for examining it as a moderator in this study.

Shahin et al. (2017) created a theoretical framework of independent variables consisting of strategies that influence continuous delivery adoption such as monoliths, small and independent deployable units, operational aspects, and quality attributes.

- Avoiding monolithic design, and implementing small independent deployable units have the most potent effect on adopting continuous delivery practices (Shahin et al., 2017).
- Quality attributes such as the ability to deploy, log, monitor, test, modify, and avoid failure are all positively influenced by decomposing monolithic architects into smaller deployable units (Shahin et al., 2017).
- Reusability of code was negatively affected because decomposing monoliths increased interdependencies between code and organizational structures (Shahin et al., 2017).
- Delaying architectural decisions, standardizing log output, increasing test coverage, designing for failure, and prioritizing operational concerns were ways software architects can improve continuous delivery adoption rates (Shahin et al., 2017).

Shahin et al. (2017) contributed to the continuous delivery literature by validating architecture of software applications can affect continuous delivery adoption, and software architects should be included in the process of selecting and implementing a continuous delivery practice. Project managers, such as those participating in this study, can work with architects to understand the technical challenges affecting the adoption of continuous delivery and share the strategies to mitigate barriers with local teams and the broader organization. Sharing and embodying the architectural strategies characterized by Shahin et al. agreed with efforts to improve collaboration and communication posited by Carvalho et al. (2015), Cullen and Parker (2015), Gandomani and Nafchi (2016), Laukkanen et al. (2018), Lindsjørn et al. (2016), and Papadopoulos (2015). Similar to Claps et al. (2015), Shahin et al. encouraged future research on changes to the organizational structure but acknowledged their study was limited to architectural concerns and a small number of participants.

Summary and Conclusions

The literature of the body of knowledge concerning technology acceptance, project management, and continuous delivery research suggested an overlap between the subjects and a need to execute more studies to interrelate them. Literature reviewed included in this study indicated project success was an area of research where problems exist and success rates reported by businesses are not acceptable (Carvalho et al., 2015, Cullen & Parker, 2015; Gandomani & Nafchi, 2016; Papadopoulos, 2015). There are concerted efforts being made by governing bodies such as PMI, IPMI, and APM to advance the body of knowledge required for project managers to have a positive effect on project and agile transformation success (Hornstein, 2015; Seymour & Hussein, 2014), however, project management research reflects soft-skills related to human factors required more study (Carvalho et al., 2015).

In addition to the problems concerning project success rates, continuous delivery research was primarily qualitative and suffered from a lack of generalizability. Continuous delivery and continuous delivery adoption studies included in this study did not use formal acceptance models to examine the behavior of populations. Semi-structured interviews provided a way to identify common challenges and benefits thematically, however, there was still a need to empirically validate results to extend research (Chen, 2015; Chen, 2017; Claps et al., 2015; Leppänen et al., 2015). Studies in Software as a Service (Alotaibi, 2016), ERP (Chauhan & Jaiswal, 2016; Wagaw, 2017), tablets (Magsamen-Conrad et al., 2015), and online information and file sharing services (Alsmadi & Prybutok, 2018) have each made significant contributions to research by examining the acceptance of new technology using the UTAUT (Venkatesh et al., 2003) Continuous delivery adoption, which is the focus of this study, may be examined using UTAUT. Evidence of support to use a model such as UTAUT was found in studies by Chen (2015), Chen (2017), Claps et al., and Leppänen et al. that revealed elements related to performance expectancy, effort expectancy, and facilitating conditions, as moderated by experience, affect continuous delivery adoption.

The UTAUT (Venkatesh et al., 2003) provides a validated model for understanding the effects of social and technical factors on project success. This study examines the possibility that project managers may affect the behavioral intent to adopt continuous delivery. Studies such as Laukkanen et al. (2018) and Papadopoulos (2015) provided the project management, agile development, large enterprise, and continuous delivery support required for the objectives of this study. Chen (2015, 2017) reported elements closely related to performance expectancy, effort expectancy, and facilitating conditions affect continuous delivery adoption, which provided support for using the UTAUT model in this study to examine continuous delivery adoption. This study was designed to provide a contribution to the project management and continuous delivery body of knowledge and help to fill the gap of knowledge identified by Chen (2015, 2017), Laukkanen et al., and Papadopoulos, through the examination of project manager behavioral intent to adopt continuous delivery, testing the UTAUT model.

Chapter 2 included a restatement of the problem and purpose of this study, a summary of the research gap to be studied, the literature search strategy used, a discussion of the theoretical foundations, and a comprehensive and exhaustive literature review in the project management, UTAUT (Venkatesh et al., 2003), and continuous delivery fields of study. Chapter 3 focuses on the research method used for this study. Chapter 3 includes an introduction to the research design and rationale, study population and sampling procedure details, plans for analysis, an explanation of threats and ethical concerns, and a summary.

Chapter 3: Research Method

Introduction

The purpose of this study was to address software development project managers' perceptions on behavioral intent to adopt continuous delivery. The objective was to test the UTAUT—which relates performance expectancy, effort expectancy, social influence, and facilitating conditions with behavioral intent to adopt continuous delivery—regarding software development project managers at large software development organizations. Chapter 3 is separated into three parts. The first part includes an introduction to the research design and rationale, detail concerning the study population and sampling procedures, and a description of plans for analysis. The second part contains an explanation of threats and ethical concerns, and a review of trustworthiness. Chapter 3 concludes with a summary.

Research Design and Rationale

The independent variables for this study included UTAUT's (Venkatesh et al., 2003) performance expectancy, effort expectancy, social influence, and facilitating conditions, as moderated by experience. Experience was the only moderator because research has indicated that it can have a statistically significant effect on effort expectancy, social influence, and facilitating conditions. Age, gender, and voluntariness of use as moderators have not reflected statistically significant effects and therefore were excluded from this study. UTAUT's behavioral intent was the dependent variable. Use behavior was not included as a dependent variable because research has indicated that it is redundant and is a subjective self-measurement (Shahin et al., 2018; Walldén et al., 2016). The removal of use behavior led to looking at facilitating conditions as an independent variable affecting behavioral intent. Research has indicated that facilitating conditions positively predicted 24% of behavioral intent variance concerning mobile tablet use (Magsamen-Conrad et al., 2015), meaning that the change in relationship was valid for the purpose of this study.

Due to the augmentation of the UTAUT model used in this study, it was necessary to assemble an expert panel to provide content validity by evaluating the survey questions (Appendix E), research questions, problem statement, and purpose statement. The panel consisted of three industry subject matter experts in enterprise software development, project management, and continuous delivery. I invited the members to the expert panel via e-mail by providing them with the survey questions (Appendix E), research questions, problem statement, purpose statement, original model, proposed model, and a request for their participation. The first panel member was a 30-year industry veteran with expertise in enterprise software architecture, design, and implementation. This expert panel member has expertise in project management and mathematics, was a guest lecturer and adjunct associate undergraduate computer science professor at a university. The second panel member was an enterprise software solution expert with 35 years of experience working with continuous delivery of services for major financial organizations around the world. This expert panel member has held the title of CTO for an organization specialized in architecture, design, and implementation of enterprise-level and project-level software development lifecycles. The third panel member was a 28-year enterprise software development industry veteran with specific expertise in DevOps. This expert panel member holds an honors management and computer science, a master's in business administration, and has been a multi-year honorary teaching fellow for two universities and one company in the area of IT architecture and data science.

The questions for the survey in this study were adapted directly from the original UTAUT study (Venkatesh et al., 2003). The expert panel members individually evaluated the survey questions, research questions, problem statement, purpose statement, original model, and proposed model for this study. I asked the panel members to review the removal of use behavior, as a dependent variable, and the reassignment of the facilitating conditions independent variable to the behavioral intent dependent variable as indicated in Magsamen-Conrad et al. (2015). All three expert panel members agreed that the changes made to remove one of the independent variables (use behavior) and adjust the independent variable (facilitating conditions) relationship to the remaining dependent variable (behavioral intent) were acceptable for the purpose of this study. No additional changes were suggested by the expert panel members.

After the survey questions were reviewed by the panel, I used a modified version of Venkatesh et al.'s (2003) survey for performance expectancy, effort expectancy, social influence, facilitating conditions, experience, and behavioral intention. In addition to the independent and dependent variable constructs, experience as a moderator was represented by a question in the demographic section of the survey included in this study. Each survey item was used to determine the effect of each contributing factor on the behavioral intent to adopt continuous delivery that software development project managers experienced. Multiple regression analysis and bivariate correlation was used to determine if any constructs affect behavioral intent to adopt continuous delivery.

The research design was consistent with the UTAUT literature on technology adoption. The UTAUT measures independent variables that represent technical and social factors (Amrit et al., 2014) and therefore can be used to measure effects of project managers on adoption of agile practices, such as continuous delivery. Studies have validated the use of the UTAUT model to examine the effect of human and technical factors on technology adoption (Alotaibi, 2016; Alsmadi & Prybutok, 2018; Chauhan & Jaiswal, 2016; Magsamen-Conrad et al., 2015; Wagaw, 2017). The research design aligned with the gaps of knowledge identified in continuous delivery challenges by Laukkanen et al. (2018); organization size, project management, and agile transformation by Papadopoulos (2015); and continuous delivery adoption challenge mitigation strategies by Chen (2015, 2017). The research design may advance knowledge in continuous delivery through the examination of project manager's behavioral intent to adopt continuous delivery by testing the UTAUT model (Venkatesh et al., 2003).

The research design required access to individual project managers. Project manager groups are available through LinkedIn. LinkedIn is a career professional social media platform where project management groups exist and that allow permission and access to their membership. This study was intended to include project management professional members from the PMI, participants from a national database, and participants from SurveyMonkey; however, permission to use and cost of acquiring an e-mail list of project management professionals from the PMI or a list of project managers from national databases, or a participant pool from SurveyMonkey was prohibitive and therefore was a constraint.

Methodology

Population

The general population for this study was all English-speaking project managers over the age of 18 who have worked for professional software intensive businesses. The target population was recruited from LinkedIn project management groups. The LinkedIn group PMI Project, Program and Portfolio Management contains 239,330 members (PMI Project, Program and Portfolio Management, n.d.), Project Manager Community - Best Group for Project Management has 379,275 members (Project Manager Community - Best Group for Project Management. (n.d.), The Project Manager Network - #1 Group for Project Managers includes 865,903 members (The Project Manager Network - #1 Group for Project Managers, n.d.), PMI NYC Chapter has 936 members (PMI NYC Chapter, n.d.), and PMI Long Island Chapter has 1,708 members (PMI Long Island Chapter, n.d.).

I sent LinkedIn connection invitations to random members of LinkedIn project management groups. The LinkedIn connection invitation included a recruitment statement that asked if they would like to participate in this study as a project management professional and include a link to the SurveyMonkey survey (Appendix E). The SurveyMonkey survey included a consent form on the first page that the respondent must accept before participating. The total target population covered by all LinkedIn groups was 1,487,152. The target sample size for this study was 82 based on an a priori power analysis. If 1% of the target population took the survey, there would be 14,871 responses, 181 times the number of responses needed to satisfy the calculated sample size required for this study. I sent connection requests to random individuals in targeted population groups in the following order:

1. PMI Project, Program and Portfolio Management
2. Project Manager Community - Best Group for Project Management
3. The Project Manager Network - #1 Group for Project Managers
4. PMI NYC Chapter
5. PMI Long Island Chapter

Submitting posts to one target population at a time allowed a contingency plan in case fewer than 82 survey responses were collected. The survey was created and distributed with SurveyMonkey. Online surveys provide an easy method to access questionnaires by study participants and access to results by surveyors (Rea & Parker, 2014).

Sampling and Sampling Procedures

Simple random sampling (de Mello et al., 2015) was used to collect responses. Simple random sampling was consistent with targeting a random collection of English-speaking, project managers from LinkedIn professional project management groups. The survey link was distributed to professional project management LinkedIn members over the age of 18 through direct message after they accept my initial connection invitation.

An a priori power analysis was performed using Faul, Erdfelder, Buchner, and Lang's (2009) G*Power 3.1.9.4 application using a two-tail, point biserial model correlation, medium effect size of 0.30, power of 0.80, and .05 error probability

(Khechine, Lakhal, & Ndjambou, 2016). According to G*Power (Faul et al., 2009), a sample size of 82 participants was required to achieve reliable results. The medium effect is aligned with previous UTAUT studies completed (Khechine et al., 2016).

Procedures for Recruitment, Participation, and Data Collection

An online, English-only, self-administered, cross-sectional survey consisting of six sections was constructed using SurveyMonkey to collect primary data. After approval from the Walden University Institutional Review Board (IRB; approval no. 06-25-19-0199742) was granted and permission from the LinkedIn members was granted, the survey link was given to the LinkedIn member through direct message. LinkedIn participants were recruited by sending a connection invitation that included the purpose of this study, information regarding qualification criteria and confidentiality, Walden's IRB contact information, and a link to the SurveyMonkey questionnaire.

The SurveyMonkey survey consisted of an introduction; informed consent section; one qualification section; one demographic section, which includes a question on experience; a Likert Scale (Joshi, Kale, Chandel, & Pal, 2015); closed-ended question sections; and a disqualification page. The introduction included an explanation that the term *system* refers to the continuous delivery system they experienced. In the informed consent section, if the participant agreed to informed consent, they were redirected to the qualification section; if they did not agree, they were redirected to the disqualification page and were no longer able to participate in the survey. In the qualification section, if the participant acknowledged that they are, or were, a project manager, over the age of 18, for an organization responsible for software development they were redirected to the demographic section of the survey; if they did not indicate this criteria, they were redirected to the disqualification page. The first section of the survey collected nonidentifying background information such as business revenue, business industry, participant experience, and length of the project. The survey questions from Venkatesh et al. (2003) were used in the closed-ended sections two through six.

Participants had the option to go to previous sections by clicking *back* to adjust their responses and to the next section by clicking *next*. A progress bar was provided to indicate the current survey page and the percentage complete. The survey was marked complete when the participant clicked *submit* on the final page of the closed-ended question section. There were no debriefing procedures or requirements for follow-up interviews. No identifying information was collected from the participants of the survey. Aggregate results of the survey were shared with the targeted LinkedIn groups upon the publishing of this study.

Instrumentation and Operationalization of Constructs

This study was designed to capture the perceptions of project managers as it relates to adoption of continuous delivery systems. Understanding the effect of performance expectancy, effort expectancy, social influence, and facilitating conditions, as moderated by experience, perceived by project management on continuous delivery may help businesses adopt continuous delivery more efficiently. I used the UTAUT, which was supported by previous research on project management and continuous delivery. For example, Laukkanen et al. (2018) and Papadopoulos (2015) indicated project management characteristics that affect the adoption of technology. Additionally, Chen (2015, 2017) reported that individual expectations concerning performance and effort, facilitating conditions, and experience affect the adoption of continuous delivery. Further, Venkatesh et al.'s UTAUT has been applied to many technologies including Software as a Service (Alotaibi, 2016), ERP training (Chauhan & Jaiswal, 2016), homegrown ERP (Wagaw, 2017), internet sharing and file storage (Alsmadi & Prybutok, 2018), and mobile tablets (Magsamen-Conrad et al., 2015).

Measurements of reliability such as internal consistency are assessed using Cronbach's alpha, Split-half correlation, and the Spearman-Brown prediction formula. Reliability testing for Venkatesh et al.'s (2003) UTAUT model was sufficient for this study because the survey questions are reused from the UTAUT. Cronbach's alpha for the four independent variables of Venkatesh et al.'s UTAUT model scored .70 or higher, exceeding the threshold needed for testing (Lescevica, Ginters, & Mazza, 2013). Use behavior, in the original UTAUT model did not include examples of questions (Venkatesh et al., 2003), so removing it does not affect the original Cronbach alpha calculation of the model used in this study. Split-half correlation and the Spearman-Brown formula for the UTAUT model constructs approach 1.0, indicating acceptable conditions for use in this study (Lescevica et al., 2013). The publisher (see Appendix B) and one author (see Appendix A) of the UTAUT model (Venkatesh et al., 2003) provided permission to use the figures, tables, and survey questions in this study. External and internal validity are addressed later in Chapter 3 as part of the Threats to Validity section.

Operationalization of constructs. Five constructs and one moderator of the UTAUT model (Venkatesh et al., 2003) were measured in the closed-ended survey questions. The participants were informed in the introduction page of the survey that each question uses the term *system* to refer to the continuous delivery system they experienced. A 5-point Likert Scale that ranged from *strongly disagree* to *strongly agree* was used to collect participant responses to all items. A Likert scale is a psychometric technique that was designed to measure attitude (Joshi et al., 2015) and is consistent with measuring UTAUT model constructs and moderators (Venkatesh et al., 2003). Participants were presented with a series of statements representing each of the five constructs and one question on experience. Only one response could be selected for each statement representing each construct and moderator. For each construct and moderator measured an operational definition, related items, scoring calculation, score representation, and examples of use were provided. Pearson's product-moment correlation coefficient, or bivariate correlation (*r*), was used to measure the weighted numeric values associated with the responses for each of the closed-ended items. Using Pearson's product-moment correlation coefficient was validated by Wagaw's (2017) research on homegrown ERP systems using the UTAUT model (Venkatesh et al., 2003). After the weighted numeric values were calculated, a stepwise multiple linear regression analysis was used to determine if there was a relationship between the multiple independent variables and the dependent variable. A narrative was constructed around the regression results based on acceptance or rejection of the null hypothesis for each research question.

Performance expectancy is the degree to which a person perceives that using a specific system helps them achieve higher job performance (Venkatesh et al., 2003). Performance expectancy was measured with responses to four items:

1. I would find the system useful in my job.
2. Using the system enables me to accomplish tasks more quickly.
3. Using the system increases my productivity.
4. If I use the system, I will increase my chances of getting a raise.

A score was assigned to performance expectancy by calculating the bivariate correlation (r) of the weighted numeric values associated with the responses for each of the four items. Once the numeric weight was calculated it was used in a stepwise multiple linear regression analysis to determine the strength and direction of the relationship between performance expectancy and behavioral intent. The resulting score for performance expectancy represents how the adoption of a continuous delivery system affected the project manager's ability to complete their tasks with more or less personal benefit. If a project manager strongly disagrees that *using a continuous delivery system would increase his or her productivity*, then performance expectancy is likely to have a weaker effect on the project manager's behavioral intent to adopt continuous delivery.

Effort expectancy is the degree to which a person perceives the difficulty associated with using a specific system (Venkatesh et al., 2003). Effort expectancy was measured with responses to four items:

1. My interaction with the system would be clear and understandable.
2. It would be easy for me to become skillful at using the system.
3. I would find the system easy to use.
4. Learning to operate the system is easy for me.

A score was assigned to effort expectancy by calculating the bivariate correlation (*r*) of the weighted numeric values associated with the responses for each of the four items. Once the numeric weight was calculated it was used in a stepwise multiple linear regression analysis to determine the strength and direction of the relationship between effort expectancy and behavioral intent. The resulting score for effort expectancy represents how the adoption of a continuous delivery system affected the project manager's ability to complete their tasks with more or less effort. If a project manager strongly agrees that *using a continuous delivery system would be easy to use*, then effort expectancy is likely to have a stronger effect on the project manager's behavioral intent to adopt continuous delivery. Experience, as a moderator, was included to determine if it has any effect on the relationship between effort expectancy and behavioral intent.

Social influence is the degree to which a person perceives that other important people encourage the use of a specific system (Venkatesh et al., 2003). Social influence was measured with responses to four items:

1. People who influence my behavior think that I should use the system.
2. People who are important to me think that I should use the system.
3. The senior management of this business has been helpful in the use of the system.
4. In general, the organization has supported the use of the system.

A score was assigned to social influence by calculating the bivariate correlation (*r*) of the weighted numeric values associated with the responses for each of the four items. Once the numeric weight was calculated it was used in a stepwise multiple linear regression analysis to determine the strength and direction of the relationship between social influence and behavioral intent. The resulting score for social influence represents how the project manager's peers view their use of the continuous delivery system. If a project manager strongly disagrees that *people who are important to him or her think that he or she should use the system*, then social influence is likely to have a weaker effect on the project manager's behavioral intent to adopt continuous delivery. Experience, as a moderator, was included to determine if it has any effect on the relationship between social influence and behavioral intent.

Facilitating conditions is the degree to which a person perceives that technical and organizational support exists to support the use of a specific system (Venkatesh et al., 2003). Facilitating conditions was measured with responses to four items:

1. I have the resources necessary to use the system.
2. I have the knowledge necessary to use the system.
3. The system is not compatible with other systems I use.
4. A specific person (or group) is available for assistance with system difficulties.

A score was assigned to facilitating conditions by calculating the bivariate correlation (r) of the weighted numeric values associated with the responses for each of the four items. Once the numeric weight was calculated it was used in a stepwise multiple linear regression analysis to determine the strength and direction of the relationship between facilitating conditions and behavioral intent. The resulting score for facilitating conditions represents the resources available to assist the use of a continuous delivery system by a project manager. If a project manager strongly agrees that *there are resources in place to help them use the system*, then facilitating conditions is likely to have a stronger effect on the project manager's behavioral intent to adopt continuous delivery. Experience, as a moderator, was included to determine if it has any effect on the relationship between facilitating conditions and behavioral intent.

Behavioral intent is the degree to which a person believes they will use a system in the future (Venkatesh et al., 2003). Behavioral intent was measured with responses to three items:

1. I intend to use the system in the next 3 months.
2. I predict I would use the system in the next 3 months.
3. I plan to use the system in the next 3 months.

A score was assigned to behavioral intent by calculating the bivariate correlation (*r*) of the weighted numeric values associated with the responses for each of the three items. The score for behavioral intent represents the project manager's intention to adopt a continuous delivery system. If a project manager has strongly disagreed that they *plan to use a system in the next 3 months*, then behavioral intent to adopt continuous delivery is likely to be weaker.

Data Analysis Plan

An a priori power analysis was performed that indicated a minimum of 82 participants was required for this study. The survey was available until 82 or more responses are collected. Incomplete surveys were discarded. 85 surveys were collected after 17 days of survey availability. A weighted numeric value represents the Likert Scale ranging from strongly disagree to strongly agree: 1 for strongly disagree, 2 for disagree, 3 for neither agree or disagree, 4 for agree, 5 for strongly agree (Joshi et al., 2015). Data was downloaded from SurveyMonkey and imported into IBM's Statistical Package for Social Sciences (SPSS) v25. SPSS was used to analyze the weighted numerical value data collected from the respondents using multiple regression.

Research questions. The following research questions were used to guide this study:

Research Question 1: What is the relationship between performance and continuous delivery adoption?

$H_0$1: No statistically significant relationship exists between performance expectancy and behavioral intent to adopt continuous delivery.

H_a1: A statistically significant relationship exists between performance expectancy and behavioral intent to adopt continuous delivery.

Research Question 2: What is the relationship between effort expectancy and continuous delivery adoption?

$H_0$2: No statistically significant relationship exists between effort expectancy and behavioral intent to adopt continuous delivery.

H_a2: A statistically significant relationship exists between effort expectancy and behavioral intent to adopt continuous delivery.

Research Question 3: What is the relationship between social influence and continuous delivery adoption?

$H_0$3: No statistically significant relationship exists between social influence and behavioral intent to adopt continuous delivery.

H_a3: A statistically significant relationship exists between social influence and behavioral intent to adopt continuous delivery.

Research Question 4: What is the relationship between facilitating conditions and continuous delivery adoption?

$H_0$4: No statistically significant relationship exists between facilitating conditions and behavioral intent to adopt continuous delivery.

H_a4: A statistically significant relationship exists between facilitating conditions and behavioral intent to adopt continuous delivery.

Research Question 5: How does experience moderate the relationship between effort expectancy and behavioral intent to adopt continuous delivery?

$H_0$5: Experience has no moderating effect on the relationship between effort expectancy and behavioral intent to adopt continuous delivery.

H_a5: Experience has a moderating effect on the relationship between effort expectancy and behavioral intent to adopt continuous delivery.

Research Question 6: How does experience moderate the relationship between social influence and behavioral intent to adopt continuous delivery?

$H_0$6: Experience has no moderating effect on the relationship between social influence and behavioral intent to adopt continuous delivery.

H_a6: Experience has a moderating effect on the relationship between social influence and behavioral intent to adopt continuous delivery.

Research Question 7: How does experience moderate the relationship between facilitating conditions and behavioral intent to adopt continuous delivery?

$H_0$7: Experience has no moderating effect on the relationship between facilitating conditions and behavioral intent to adopt continuous delivery.

H_a7: Experience has a moderating effect on the relationship between facilitating conditions and behavioral intent to adopt continuous delivery.

Regression analysis was used to measure the statistical significance of relationships between the independent variables: performance expectancy, effort expectancy, social influence, and facilitating conditions, as moderated by experience, and the dependent variable behavioral intent. According to Halinski and Feldt (1970), multiple regression analysis can be used to calculate a single value that represents multiple predictors. The value associated with the strength of a relationship between multiple independent variables and a single dependent variable was consistent with the use of multiple regression analysis techniques. The bivariate correlation (r) calculated for a relationship between significant independent and dependent variable ranges from -1.0 to +1.0. A calculated value closer to -1.0 indicates a weak correlation, and a value closer to +1.0 represents a stronger correlation to a dependent variable from the independent variable.

Threats to Validity

Threats to validity include external, internal, construct and statistical conclusion. Examples of external validity threats include: multiple-treatment interference, reactive effects of experimental arrangements, and specificity of variables (Reio, 2016). External validity is concerned with the degree to which research findings can be generalized to populations outside a study's participant pool (Alahyari et al., 2019). Multiple-treatment interference is described as the different treatment that participants may be exposed to when engaging and therefore affecting the respondent's responses in the future (Kourea & Lo, 2016). This study included a one-time study whereby participants are not able to take the survey multiple times. Multiple-treatment interference was not a concern in this study. Reactive effects of experimental arrangements are defined as the effect a pre-test may have on a participant's responses (Campbell & Stanley, 1963). Reactive effects of experimental arrangements are not a concern in this study because there was no pre-test. Specificity of variables is described as the generalizability of the operationalized variables (Kourea & Lo, 2016). UTAUT (Venkatesh et al., 2003) has been applied to a variety of technologies, and therefore its operationalized variables are well known and are generalizable. This study was not affected by the specificity of variables as a threat to external validity.

The population of this study was small compared to the total population of project managers. Small populations can incur a threat to external validity because the findings may not be generalizable. Simple random sampling and statistical power of .80 in the power analysis performed was used to reduce the threat to external validity.

Examples to internal validity include: maturation, history, instrumentation, and statistical regression (Reio, 2016). Maturation refers to participants maturity related to the subject matter being research (Gage & Stevens, 2018). Project manager skill sets are likely to mature with years of experience and number of projects managed. Project manager adoption of continuous delivery may mature, and therefore maturation was a threat to internal validity for this study. History is defined as the passage of time between participant testing (Yilmaz, O'Connor, Colomo-Palacios, & Clarke, 2017). This study was non-longitudinal and therefore does not incur history as a threat to internal validity. Instrumentation refers to the changes in elements of a study such as a survey and scoring that may affect the outcome of the experiment (Reio, 2016). This study requires Walden University IRB approval, which stipulates all elements must not be changed before a survey was distributed and taken by willing participants. Instrumentation was not a threat to internal validity for this study. Statistical regression is defined as the biased selection of high or low scoring responses to guarantee an outcome (Campbell & Stanley, 1963) and was applied in this study. Simple random sampling was used to prevent selection bias and was therefore not a threat to internal validity for this study (de Mello et al., 2015).

Threats to the statistical conclusion or construct validity for this study may arise because there has been no prior UTAUT (Venkatesh et al., 2003) research that examines project managers perceptions as they relate to continuous delivery adoption and use. Assumptions concerning the responsibility of the project manager as it relates to continuous delivery adoption were made based on an exhaustive literature review, however, this may not be enough evidence to substantiate a real relationship exists. The execution of this study may encourage testing of the UTAUT model (Venkatesh et al., 2003) with individuals holding other roles in an agile organizational structure. Future research in the area of continuous delivery adoption may reduce statistical conclusion or construct validity.

Ethical Procedures

The purpose of this study was to examine the extent to which the Venkatesh et al.'s (2003) UTAUT relates the independent variables, performance expectancy, effort expectancy, social influence, and facilitating conditions, as moderated by experience, to the dependent variable of behavioral intent to adopt continuous delivery as perceived by project managers in enterprise software-intensive businesses. Before a survey to collect responses was issued, and responses were collected, the Walden University Institutional Review Board (IRB, Approval No. 06-25-19-0199742) approved the study proposal. The Walden University IRB is responsible for minimizing the risk that participants may be subject to by participating in this study. Walden University's IRB approval ensures that all United States federal guidelines are followed.

No relationship exists with the participants, and therefore there are no perceived ethical concerns. All participants received notice that their responses are anonymous and confidential. All data was collected anonymously and confidentially because no identifying information was requested from the participants. Potential respondents were required to acknowledge informed consent, and they were able to cancel the survey at any time without risk of inclusion. The data collected was encrypted and stored by SurveyMonkey. Data will be kept for a period of at least 5 years, as required by Walden University.

Summary

Chapter 3 included an introduction, research design, and rationale, detailed method information concerning population and sampling procedures, data collection details, explanation of operationalization of constructs used, threats to validity, and ethical procedures. Chapter 4 will include detailed information concerning data collection and study results. Chapter 5 will include an interpretation of findings, limitations of the proposed study, implications for change, and a conclusion.

Chapter 4: Results

Introduction

This study was focused on the problem that some software development project managers in large enterprise organizations are not aligned with the relationship between performance expectancy, effort expectancy, social influence, and facilitating conditions, as moderated by experience, and behavioral intent to adopt continuous delivery. The purpose of this quantitative, regression analysis study was to test the UTAUT (Venkatesh et al., 2003) independent variables (performance expectancy, effort expectancy, social influence, and facilitating conditions, as moderated by experience) with the dependent variable (behavioral intent to adopt continuous delivery) for software development project managers at large software development organizations. Chapter 4 is divided into two parts. The first part includes information on the data collection, recruitment, and response rates using demographic and descriptive characteristics. Differences between the plan presented in Chapter 3 and the actual collection are explained in addition to a discussion of how the collected data represents the larger population of possible respondents. The second part of Chapter 4 contains a narrative to explain the results through descriptive statistics organized by research questions and hypotheses using tables and figures. Chapter 4 concludes with a summary and transition to Chapter 5.

Data Collection

The recruitment statement and a link to the SurveyMonkey survey were sent as LinkedIn connection requests to 1,521 randomly selected members of five different LinkedIn software development project management focus groups:

- PMI Project, Program and Portfolio Management
- Project Manager Community - Best Group for Project Management
- The Project Manager Network - #1 Group for Project Managers
- PMI NYC Chapter
- PMI Long Island Chapter

The survey included a consent form, which contained background information regarding the UTAUT and the constructs tested in this study, survey instructions, sample questions, risks and benefits, privacy, and important contact information. Table 1 reflects the survey response rates based on LinkedIn group name, the number of members, the number of invites send, and the number of responses.

Table 1

Group Survey Response Rates

Group(s)	Campaign	Members	Invites Sent	Accepts	Response Rate	Completion Rate
PMI Project, Program and Portfolio Management	1	239,330	342	16	0.047	0.029
Project Manager Community - Best Group for Project Management	2	379,275	313	25	0.080	0.064
The Project Manager Network - #1 Group for Project Managers	3	865,903	351	26	0.074	0.051
PMI NYC Chapter	4	936	358	34	0.095	0.059
PMI Long Island Chapter	5	1,037	157	5	0.032	0.019
Reminder to participate (All Groups)	6		291	18	0.062	0.045

The overall response rate of 5.5% was based on 1,521 connection invitations and 85 completed surveys. There were 291 LinkedIn invitation acceptances out of 1,521 invitations sent using six different SurveyMonkey collection campaign links. Of the 291 accepted invitations, 124 (43%) clicked on the survey link. Of the 124 surveys started, 85 completed the survey (69%). The sample target of 82 participants for this study was exceeded in 17 days, which was less than the proposed estimate of 4 weeks. A reminder to participate was sent out during the second week of the survey to encourage participation from those who accepted the invitation but had not completed the survey. The low response rate may be attributed to disinterest in the subject matter or caution with respect to clicking on links from a survey company. The reduced amount of time needed to conduct the survey may be attributed to the reminder to participate.

The plan for data collection detailed in Chapter 3 was followed carefully. The recruitment statement and survey link were sent to members of the five groups, and the SurveyMonkey survey remained open for 2-and-a-half weeks. Most responses occurred within the first 24 hours of sending the link to participants. One reminder notice was sent to the randomly selected group members who had accepted the invitation to participate. Every participant utilized the SurveyMonkey link to submit their responses. All responses were exported from SurveyMonkey after the survey participation was satisfied. SurveyMonkey will retain and secure the survey results for a period of 5 years.

Baseline Descriptive Statistics

Table 2 contains the central tendency, as calculated by mean scores, and variance, as calculated by standard deviation, for all independent and dependent variables. The mean scores for all variables ranged between 3.37 and 3.90. The small spread between the mean scores indicated scoring was in roughly the same range for all independent variables and the dependent variable. Variances for all variables were not equal as indicated by the standard deviations ranging from .58 to 1.15.

Table 2

Tendency and Variance of Independent and Dependent Variables

Variables	*M*	*SD*
Performance expectancy (IV)	3.68	.91
Effort expectancy (IV)	3.90	.86
Social influence (IV)	3.49	.70
Facilitating conditions (IV)	3.37	.58
Behavioral intent (DV)	3.50	1.15

Demographics

A sample of 1,487,152 from five LinkedIn groups was targeted. From the sample frame, a total of 1,521 were used in the survey. The sample frame of 1,487,152 included members who were not technical project members and were not qualified to participate. Of the 1,521 invitations sent to project management group members, only 291 members accepted the invitation to connect, and 124 opened the survey linked provided. Table 3 shows the frequency distribution, across the five LinkedIn project management groups, of the 85 participating members who completed the survey.

Table 3

Frequency of Participants by Group

Group Name	Frequency of Group	Frequency %	Cumulative %
PMI Project, Program and Portfolio Management	10	11.8	11.8
Project Manager Community - Best Group for Project Management	20	23.5	35.3
The Project Manager Network - #1 Group for Project Managers	18	21.2	56.5
PMI NYC Chapter	21	24.7	81.2
PMI Long Island Chapter	3	3.5	84.7
Reminder to participate (All Groups)	13	15.3	100.0
Total	85		

From the 85 participants, 91% were from the United States. Canada, India, Panama, and Singapore were represented by 1 participant each. There was a total of four participants who came from countries not listed in the survey selection list. Based on the frequency of participant location shown in Table 4, this study was concentrated primarily on behavior of project managers based in the United States. The 85 participants accounted for less than 1% of the target population.

Table 4

Frequency of Participant Location

Country	Frequency of Country	Frequency %	Cumulative %
United States	77	90.6	90.6
Canada	1	1.2	91.8
India	1	1.2	92.9
Panama	1	1.2	94.1
Singapore	1	1.2	95.3
Other	4	4.7	100.0
Total	85		

The sample consisted of participants working in at least 18 different industry sectors. Table 5 shows financial services (21.2%) lead the frequency distribution, followed by health, pharmaceuticals, and biotech (11.8%), and e-commerce software (12.9%). The variety of industries represented supported that technical project management was present in traditionally nontechnical business sectors.

Table 5

Frequency of Company Industry

Company Industry	Frequency of Industry	Frequency %	Cumulative %
Business Services	2	2.4	2.4
Computer and Electronics	5	5.9	8.2
Education	1	1.2	9.4
Energy and Utilities	3	3.5	12.9
Financial Services	18	21.2	34.1
Government	3	3.5	37.6
Health, Pharmaceuticals, and Biotech	10	11.8	49.4
Manufacturing	1	1.2	50.6
Media and Entertainment	4	4.7	55.3
Non-Profit	2	2.4	57.6
Other	7	8.2	65.9
Retail	1	1.2	67.1
Software – Data Analytics and Management	8	9.4	76.5
Software – E-Commerce and Internet Business	11	12.9	89.4
Telecommunications	5	5.9	95.3
Transportation and Storage	1	1.2	96.5
Travel Recreation and Leisure	1	1.2	97.6
Wholesale and Distribution	2	2.4	100.0
Total	85		

Most participants worked for organizations with 5,000 or more employees (51.8%), and over $100 million in annual revenue (62.4%). Table 6 shows frequency distribution of organization size amongst participants, and Table 7 shows frequency distribution of organization revenue. Small (24.7%) and medium (23.5%) businesses made up roughly one quarter of the sample (24.7%) each. Gender, age, and voluntariness of use were not collected in this survey. Table 8 shows the variety of agile methods used by participants. More than half (56.5%) of the participants used Scrum as their agile method. Kanban was the only other method used by more than 10 (11.8%) participants.

Table 6

Frequency of Organization Size

Number of Employees	Frequency of Organization	Frequency %	Cumulative %
1-100	10	11.8	11.8
100-500	11	12.9	24.7
500-2000	9	10.6	35.3
2000-5,000	11	12.9	48.2
5,001+	44	51.8	100.0
Total	85		

Table 7

Frequency of Revenue Size

Revenue ($)	Frequency of Revenue	Frequency %	Cumulative %
0-10 million	13	15.3	15.3
10-20 million	5	5.9	21.2
20-50 million	5	5.9	27.1
50-100 million	9	10.6	37.6
100+ million	53	62.4	100.0
Total	85		

Table 8

Frequency of Agile Method Used

Agile Method	Frequency of Use	Frequency %	Cumulative %
Adaptive Software Development	4	4.7	4.7
Agile Modeling	6	7.1	11.8
Disciplined Agile Delivery	3	3.5	15.3
Feature-Driven Development	4	4.7	20.0
Lean Software Development	4	4.7	24.7
Kanban	10	11.8	36.5
Rapid Application Development	1	1.2	37.6
Scrum	48	56.5	94.1
Scrumban	3	3.5	97.6
Test-Driven Development	2	2.4	100.0
Total	85		

Table 9 shows the years of experience reported by the survey participants. Many of the participants had 9 or more years (40%) of project management experience. Most participants had 8 or fewer years of project management experience (60%). Table 10 shows that most participants reported an even distribution of project counts; however, many have managed over nine projects (40%). Table 11 reflects the length of projects managed by participants was more than 10 months (60%). The variance in experience was necessary to answer the research questions in this study concerning the effect of experience on the relationships between effort expectancy, social influence, facilitating conditions, and behavioral intent to adopt continuous delivery. Information regarding the effect of experience as a mediator on the UTAUT constructs is later in this analysis. The terms *mediator* and *covariate* are used interchangeably throughout this study.

Table 9

Frequency of Years of Experience

Years of Experience	Frequency of Experience	Frequency %	Cumulative %
1-2	5	5.9	5.9
3-4	21	24.7	30.6
5-6	13	15.3	45.9
7-8	12	14.1	60.0
9+	34	40.0	100.0
Total	85		

Table 10

Frequency of Counts of Agile Projects

Agile Project Count	Frequency of Projects	Frequency %	Cumulative %
1-2	12	14.1	14.1
3-4	14	16.5	30.6
5-6	14	16.5	47.1
7-8	11	12.9	60.0
9+	34	40.0	100.0
Total	85		

Table 11

Frequency of Project Duration

Duration of Project (Months)	Frequency of Duration	Frequency %	Cumulative %
1-3	5	5.9	5.9
4-6	14	16.5	22.4
7-9	15	17.6	40.0
10-12	20	23.5	63.5
13+	31	36.5	100.0
Total	85		

Construct Descriptive Statistics

Each of the five constructs were measured using a 5-point Likert scale. The 5-point Likert scale ranged from *strongly disagree* (1) to *strongly agree* (5). Each construct was represented by several statements in the survey for this study. Performance expectancy, effort expectancy, social influence, and facilitating conditions were represented by four individual statements. Behavioral intent required the rating of three statements. Experience was represented by two different questions regarding number of years' experience and number of projects.

Study Results

Statistical Analysis of the Findings

This study was created to gain a better understanding of which factors influenced project managers' behavioral intent to adopt continuous delivery. Research questions and hypotheses included in this study were created from the constructs and mediating factors prescribed by the UTAUT (Venkatesh et al., 2003). The constructs and mediators included items such as performance expectancy, effort expectancy, social influence, facilitating conditions, and experience as it affects the relationship between effort expectancy, social influence, facilitating conditions, and behavioral intent to adopt continuous delivery. Stepwise multiple linear regression was facilitated to analyze the data resulting from the online distributed survey. An equation was formulated from the use of the stepwise multiple regression to predict behavioral intent based on the constructs and mediators of significance. All hypotheses were tested for significance and strength of their relationship to behavioral intent.

Research Questions

The following research questions and hypotheses guided this study:

Research Question 1: What is the relationship between performance and continuous delivery adoption?

$H_0$1: No statistically significant relationship exists between performance expectancy and behavioral intent to adopt continuous delivery.

H_a1: A statistically significant relationship exists between performance expectancy and behavioral intent to adopt continuous delivery.

Research Question 2: What is the relationship between effort expectancy and continuous delivery adoption?

$H_0$2: No statistically significant relationship exists between effort expectancy and behavioral intent to adopt continuous delivery.

H_a2: A statistically significant relationship exists between effort expectancy and behavioral intent to adopt continuous delivery.

Research Question 3: What is the relationship between social influence and continuous delivery adoption?

$H_0$3: No statistically significant relationship exists between social influence and behavioral intent to adopt continuous delivery.

H_a3: A statistically significant relationship exists between social influence and behavioral intent to adopt continuous delivery.

Research Question 4: What is the relationship between facilitating conditions and continuous delivery adoption?

$H_0$4: No statistically significant relationship exists between facilitating conditions and behavioral intent to adopt continuous delivery.

H_a4: A statistically significant relationship exists between facilitating conditions and behavioral intent to adopt continuous delivery.

Research Question 5: How does experience moderate the relationship between effort expectancy and behavioral intent to adopt continuous delivery?

$H_0$5: Experience has no moderating effect on the relationship between effort expectancy and behavioral intent to adopt continuous delivery.

H_a5: Experience has a moderating effect on the relationship between effort expectancy and behavioral intent to adopt continuous delivery.

Research Question 6: How does experience moderate the relationship between social influence and behavioral intent to adopt continuous delivery?

$H_0$6: Experience has no moderating effect on the relationship between social influence and behavioral intent to adopt continuous delivery.

H_a6: Experience has a moderating effect on the relationship between social influence and behavioral intent to adopt continuous delivery.

Research Question 7: How does experience moderate the relationship between facilitating conditions and behavioral intent to adopt continuous delivery?

$H_0$7: Experience has no moderating effect on the relationship between facilitating conditions and behavioral intent to adopt continuous delivery.

H_a7: Experience has a moderating effect on the relationship between facilitating conditions and behavioral intent to adopt continuous delivery.

Multiple Linear Regression Analysis

A stepwise multiple linear regression analysis was executed using SPSS v25 to determine the validity of the hypotheses set forth in this study by determining which of the independent variables were predictors of the behavioral intent dependent variable. Strength of prediction, if any, was also assessed for each independent variable using the statistics available from running the analysis. The goal of the analysis was to establish the predictors, the strength of the predictors, and an explanation of the variance of the behavioral intent dependent variable. The alternative hypotheses of this study assumed all four independent variables such as performance expectancy, effort expectancy, social influence, and facilitating conditions, and experience, as a moderator, could be integrated into a multivariate model capable of predicting and explaining the variance in the behavioral intent dependent variable. The null hypotheses of this study asserted that all variables and moderators could not be used in a multivariate equation to explain the variance in behavioral intent.

In this study it was necessary to execute a backward stepwise multiple linear regression to remove each of the independent variables that were not significant to expose the significant predictors. A forward stepwise multiple linear regression was used initially because I assumed all independent variables would be significant. When the statistics for enter and forward stepwise multiple linear regression reflected insignificance for most independent variables, I decided to see if backward stepwise would be a better fit for the analysis. The backward stepwise automated analysis from SPSS v25 was capable of finding the best-fit linear regression for validation of pre-existing multivariate models such as the UTAUT (Venkatesh et al., 2003) used in this study.

The backward stepwise analysis executed four times removing one independent variable at a time. An insignificance level of $\alpha = .05$ was used to determine which independent variables should be removed at each execution. A summary of the execution steps is found in Appendix F. Table 12 shows the results of the backward stepwise multiple linear regression analysis for the behavioral intent dependent variable.

Table 12

Stepwise Multiple Linear Regression Analysis of Behavioral Intent and Independent Variables

Model	*SS*	*df*	*MS*	*F*	Sig.
Regression	26.79	1	26.79	26.19	.000
Residual	84.90	83	1.02		
Total	111.69	84			

Note. N=85

The backward stepwise multiple linear regression analysis determined the behavioral intent model was significant ($p < .001$) and that only the performance expectancy beta coefficient was significant. Performance expectancy was found to be the only significant independent variable and it was positively related to the behavioral intent dependent variable. Effort expectancy, social influence, and facilitating conditions were found to be insignificant. Table 13 exhibits the unstandardized beta coefficients (β) and associated *p* values. The significance and inclusion of only one of the UTAUT (Venkatesh et al., 2003) constructs as a significant factor in the prediction of behavioral intent to adopt continuous delivery by project managers demonstrated parsimony using the minimum number of predictors to explain the model efficiently.

Table 13

Backward Stepwise Beta Coefficients for the Behavioral Intent Equation

Model	Predictor	Unstandardized coefficients (β)	Sig. (*p*)
1	Performance expectancy	.586	.002
	Effort expectancy	-.108	.529
	Social influence	.268	.139
	Facilitating conditions	.035	.866
2	Performance expectancy	.592	.001
	Effort expectancy	-.107	.530
	Social influence	.273	.126
3	Performance expectancy	.521	.000
	Social influence	.272	.126
4	Performance expectancy	.619	.000

The moderator of experience was analyzed for its effects on the relationships between effort expectancy and behavioral intent, social influence and behavioral intent, and facilitating conditions and behavioral intent. To perform this analysis the survey results data was filtered to segregate lower experienced individuals and higher experienced individuals from each other. Experience was measured using two different questions. The first question used to gauge experience captured the number of years of project management experience the participant had. The survey results included 39 participants (45.9%) with six or fewer years of experience, and 46 participants (54.1%) with seven or more years of project management experience. Table 14 and 15 illustrate the unstandardized beta coefficients (β) and associated *p* values of two backward stepwise multiple regression analyses that reflect the independent variables of effort expectancy, social influence, and facilitating conditions as insignificant with relationship to the behavioral intent dependent variable. It was interesting to note that performance expectancy was not significant for those project managers with six or fewer years of experience, however, the relationship between performance expectancy and behavioral intent is not moderated by experience in the UTAUT model (Venkatesh et al., 2003).

Table 14

Backward Stepwise Beta Coefficients for the Behavioral Intent Equation for Six or Fewer Years of Experience

Model	Predictor	Unstandardized coefficients (β)	Sig. (*p*)
1	Performance expectancy	.831	.047
	Effort expectancy	-.183	.497
	Social influence	.100	.786
	Facilitating conditions	-.304	.347
2	Performance expectancy	.906	.004
	Effort expectancy	-.210	.396
	Social influence	-.303	.342
3	Performance expectancy	.770	.003
	Social influence	-.309	.330
4	Performance expectancy	.635	.003

Table 15

Backward Stepwise Beta Coefficients for the Behavioral Intent Equation for Seven or More Years of Experience

Model	Predictor	Unstandardized coefficients (β)	Sig. (*p*)
1	Performance expectancy	.230	.018
	Effort expectancy	.248	.689
	Social influence	.239	.233
	Facilitating conditions	.304	.385
2	Performance expectancy	.173	.005
	Effort expectancy	.231	.251
	Social influence	.300	.389
3	Performance expectancy	.169	.003
	Social influence	.229	.205
4	Performance expectancy	.158	.000

The second question used to gauge experience captured the number of projects that the project manager had experienced. The survey results included 40 participants (47.1%) with six or fewer projects of experience, and 45 participants (52.9%) with seven or more projects of project management experience. Table 16 and 17 illustrate the unstandardized beta coefficients (β) and associated *p* values of two backward stepwise multiple regression analyses that reflect the independent variables of effort expectancy, social influence, and facilitating conditions as insignificant with relationship to the behavioral intent dependent variable.

Table 16

Backward Stepwise Beta Coefficients for the Behavioral Intent Equation for Six or Fewer Projects of Experience

Model	Predictor	Unstandardized coefficients (β)	Sig. (*p*)
1	Performance expectancy	.418	.103
	Effort expectancy	.278	.934
	Social influence	.335	.639
	Facilitating conditions	.288	.213

2	Performance expectancy	.296	.028
	Effort expectancy	.319	.606
	Social influence	.283	.207
3	Performance expectancy	.191	.000
	Social influence	.277	.173
4	Performance expectancy	.176	.000

Table 17

Backward Stepwise Beta Coefficients for the Behavioral Intent Equation for Seven or More Projects of Experience

Model	Predictor	Unstandardized coefficients (β)	Sig. (*p*)
1	Performance expectancy	.254	.048
	Effort expectancy	.300	.695
	Social influence	.265	.532
	Facilitating conditions	.327	.445
2	Performance expectancy	.188	.003
	Effort expectancy	.251	.433
	Social influence	.320	.467
3	Performance expectancy	.186	.002
	Social influence	.245	.349
4	Performance expectancy	.167	.000

Research Assumptions

Assumptions such as homoscedasticity, linear relationship, multivariate normality, and multicollinearity can be made with the support of additional statistical analysis. Scatterplots and histograms can be used to visually and empirically detect assumptions. SPSS v25 makes it possible to automatically generate scatterplots and histograms to help with the analysis of assumptions.

Linear relationship. Linearity was tested using SPSS v25 by using a scatterplot to visualize the relationship between the regression standardized residual and regression standardized predicted values. Figure 4 illustrates an approximate balance between error term points above and below the regression line centered on zero. The shape of the error terms resembles a diamond shape, which was due to the symmetry of the Likert Scale values plotted. A balanced number of error terms above and below the regression line indicates that a linear relationship does exist for the behavioral intent dependent variable.

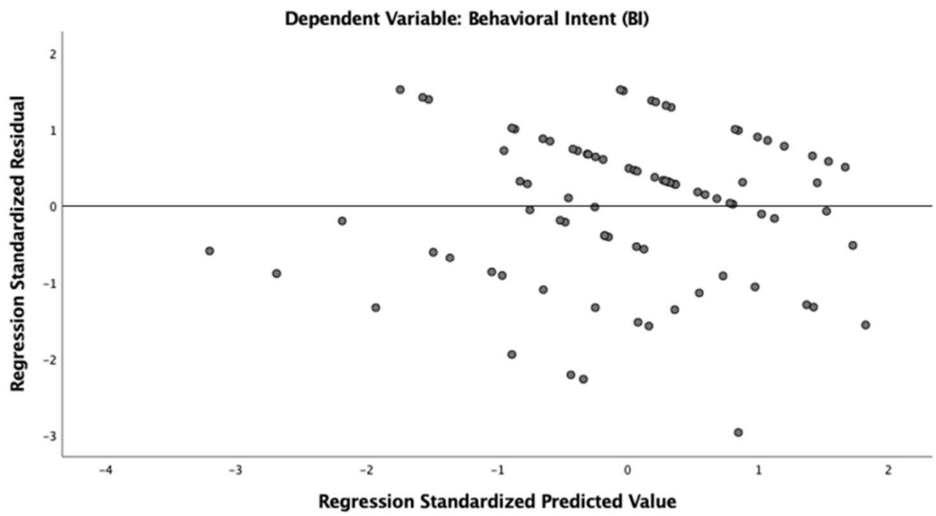

Figure 4. Scatterplot of regression standardized residual versus regression standardized predicted value for behavioral intent.

Multivariate normality. Figure 5 shows the results of a probability-to-probability plot between expected and observed probabilities of regression standardized residual for the behavioral intent dependent variable. In a p-p plot the diagonal line represents normality and the points represent probabilities. In the p-p plot of regression standardized residual for the behavioral intent dependent variable there was a small deviation in the plot against the normality line due to the high number of participants (N=85) in this study.

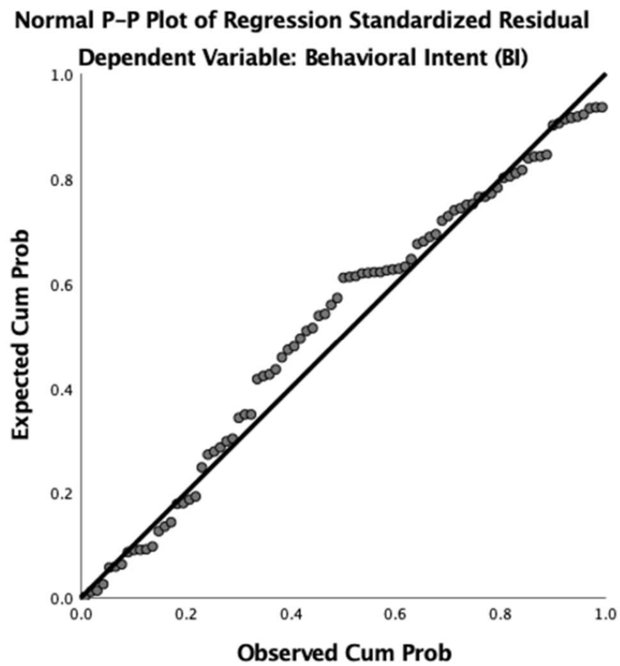

Figure 5. Normal P-P plot of expected cumulative probability versus observed cumulative probability for behavioral intent.

Histogram plots may also be used to detect and validate multivariate normality assumption. Figure 6 illustrates a histogram plot for the frequency of regression standardized residual for the behavioral intent dependent variable. A slightly negative bias was observed in the frequency; however it was within an acceptable range and supports the assumption of multivariate normality.

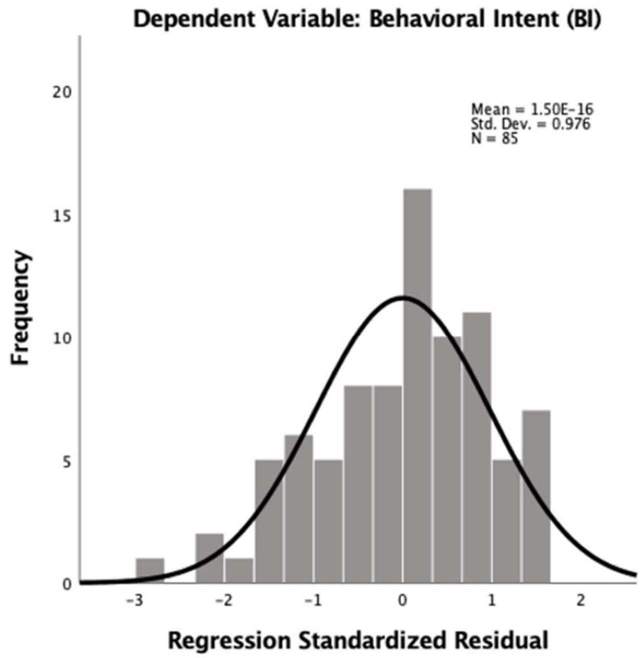

Figure 6. Histogram of frequency versus regression standardized residual for behavioral intent.

Homoscedasticity. The assumption of homoscedasticity can be determined using a residual data plot of error terms. Figure 4 illustrated the scatterplot of regression standardized residuals against regression standardized predicted values as they compare with a 0-value regression line. The appearance of an even number of points above and below the centerline reflected that the behavioral intent dependent variable met the assumption of homoscedasticity and had no indication of heteroscedasticity.

Multicollinearity. The research assumption of multicollinearity can be determined by observing the variance inflation factor values found in the coefficients table of the SPSS v25 output. A variance inflation factor value below 10 indicates the assumption of multicollinearity in a multiple linear regression was not violated. Table 14 contains all variance inflation factor values for the coefficients included in this study. All values were 2.2 or lower, which indicated there was no multicollinearity with the survey responses.

Table 18

Variance Inflation Factor for Behavioral Intent

Coefficients	Collinearity statistic (variance inflation factor)
Performance expectancy	2.2
Effort expectancy	1.9
Social influence	1.3
Facilitating conditions	1.2

Correlation Analysis

Table 19 includes the Pearson bivariate correlation coefficients of all four hypothesized predictors of the behavioral intent dependent variable. Pearson bivariate correlation coefficient measures the strength and direction of a relationship, if one exists, by calculating a value between -1 and 1. In Table 19 the Pearson bivariate correlation coefficient for all predictors was above zero, however only performance expectancy had a p value < .001. Performance expectancy was the only predictor that held a relationship with the behavioral intent dependent variable. The correlation coefficient for performance expectancy was moderately positive because the value was greater than .40 but less then .70. A value greater than .70 would be classified as strong, and a value below .40 would be classified as a weak relationship.

Table 19

Pearson Bivariate Correlation Coefficients and p Values of Behavioral Intent

Model	Predictor	Correlation coefficient (*r*)	*p*
1	Performance expectancy	.490	.002
	Effort expectancy	.292	.529
	Social influence	.358	.139
	Facilitating conditions	.214	.866
2	Performance expectancy	.490	.001
	Effort expectancy	.292	.530
	Social influence	.358	.126
3	Performance expectancy	.490	.000
	Social influence	.358	.126
4	Performance expectancy	.490	.000

Summary

Based on the research questions, hypotheses and the analysis of frequencies and a backward stepwise multiple linear regression of the survey results in this study an equation was developed to explain the variance of behavioral intent based on the significant predictors.

Behavioral Intent = 1.219 + .619 x Performance Expectancy + E

Random error attributed with the variance equation for behavioral intent in this study is represented by the variable E. The multiple correlation coefficient (*R*) associated with the backward stepwise multiple linear regression was .490 for behavioral intent as predicted by one significant independent variable, which indicates the strength of the equation as moderate. A multiple correlation coefficient (*R*) lower than >.4 is classified as weak, *R* > .4 is classified as moderate, and *R* > .7 is classified as strong.

Experience, as a moderator, was also found to be insignificant in having an effect on associated predictors. Performance expectancy was the only significant factor captured in the mathematical equation. Of the participants that participated in this study, project managers' behavioral intent to adopt continuous delivery was moderately and positively related to performance expectancy. The behavioral intent equation represented 24.0% of the variance in how behavioral intent to adopt continuous delivery by project managers could be explained by the stepwise multiple linear regression predictors.

Chapter 4 included detailed information concerning data collection and a backward stepwise multiple linear regression analysis of the survey data. The data collected in this study was used to determine support for or against the hypotheses set forth as well as the strength each independent variable served. A predictive model was derived from the quantitative methods used to explain the variance in the behavioral intent dependent variable. Chapter 5 will include an interpretation of findings, limitations of the proposed study, implications for change, and a conclusion.

Chapter 5: Conclusion

Introduction

The purpose of this quantitative, regression analysis study was to test the UTAUT that relates independent variables performance expectancy, effort expectancy, social influence, and facilitating conditions, as moderated by experience, with the dependent variable behavioral intent to adopt continuous delivery for software development project managers at large software development organizations. Research questions and hypotheses were developed to guide the study in researching the key elements such as project management, continuous delivery, DevOps, and the UTAUT model.

The study yielded one mathematical equation consisting of variables and weights derived from a stepwise multiple linear regression analysis:

$$\text{Behavioral Intent} = 1.219 + .619 \times \text{Performance Expectancy} + E$$

The multivariate equation explains the relationship between the significant predictor independent variable of performance expectancy, the random error that may be encountered, and the constant with the behavioral intent dependent variable. Performance expectancy was shown to have a moderately positive relationship with behavioral intent in this study. The results reflected that the equation explains 24.0% of the variance in behavioral intent to adopt continuous delivery by project managers participating in this study. Furthermore, experience expressed in years and number of projects did not have any moderating effect on the relationships of effort expectancy, social influence, and facilitating conditions on behavioral intent to adopt continuous delivery.

Interpretation of the Findings

The findings of this study disconfirm that the independent variables of effort expectancy, social influence, and facilitating conditions have any influence on the adoption of continuous delivery by participating project managers. The results confirmed that performance expectancy was a predictor of behavioral intent to adopt continuous delivery by project managers included in this study. Furthermore, experience as measured in number of years and number of projects was disconfirmed as a moderator of the relationship between effort expectancy, social influence, and facilitating conditions with behavioral intent; there was no significant effect.

The results show that project managers included in this study perceived that adopting continuous delivery would be useful in their job, would help them accomplish tasks more quickly, would increase their productivity, and increase their chances at getting a raise. Project manager attitudes toward behavioral intent to adopt continuous delivery did not change with the number of years or projects experienced. In the case of project managers included in this study with 6 or less years of experience, performance expectancy was not significant. The insignificance of project manager experience on some predictors of behavioral intent was also supported by findings in Laukkanen et al. (2018) and Serrador and Pinto (2015). These statements are derived by associating the moderately positive relationship that performance expectancy had with behavioral intent, literature reviewed, and the statements associated with the performance expectancy survey sections collected from the project management participants of this study.

Relating the findings to previous research, the research reflects that many businesses are deriving a benefit from automation and continuous practices such as continuous delivery. The findings of this study may indicate that project managers, with respect to behavioral intent to adopt a continuous delivery system, are not influenced socially to be complicit, feel there was an undue effort required to utilize, or believe they must be concerned with support of the automated practice. Thus, this study shows that project managers are most concerned with performance of the continuous delivery system automation and how it’s adoption benefited them personally.

Though the results support previous research, the findings of this study also slightly diverge from the literature. Research has indicated that project success has relied on the efficient management of time, cost, and scope of objectives (Cullen & Parker, 2015). Researchers such as Carvalho et al. (2015), Amrit et al. (2014), and Hornstein (2015) have also studied how additional human factors contributed to the success of projects. Although this study supports the assertion that performance is the indicator of project success, there was a deviation in the focus on the project manager’s own benefit rather than external influence or supportive resources in the case of continuous delivery adoption. Project managers surveyed in this study may believe continuous delivery is a technology that should operate as advertised and provide a means to reflect the progress made in all other responsibilities of their job description. In other words, continuous delivery may be a tool to promote the achievements of the project manager and the team they lead. Based on the results of this study, continuous delivery may have realized the potential of visualizing and improving success rates through quantification of impact of project management decisions in near real time (Chen, 2017; Lindsjørn et al., 2016; Serrador & Pinto, 2015).

Further, the insignificance of facilitating conditions in this study suggested that the agile transition process reduces the effect of requiring direct control by the project manager in the decision process (see Gandomani & Nafchi, 2016). Agile emphasizes increased teamwork through autonomy, reducing reliance on a dedicated project manager to navigate the complexities associated with organizations. Self-forming and self-directed teams that rely on automated practices such as continuous delivery are possible due to the distributed nature of the agile methods employed such as scrum and kanban. The participants in this study communicated that they focused on personal performance and less on experience, influence, and other resource constraints. The self-empowerment and autonomy associated with agile practices is prescribed in new organization and workflow patterns such as the Scaled Agile Framework. New frameworks prescribe larger teams with fewer project managers. In frameworks such as the Scaled Agile, portfolio and product managers act as project managers, however, they oversee a greater number of projects, have increased financial responsibilities, and focus on business objectives (Dingsoeyr, Falessi, & Power, 2019; see also Papadopoulos, 2015). Portfolio and product managers are not responsible for delivery of a project, as the teams themselves are trusted to do so, which removes overhead. As a result of this trend, traditional project managers may either increase their skillset and responsibility to become a portfolio or product manager, or they may opt to take smaller roles such as supporting the maintenance of nonagile, legacy system development projects within an organization.

The UTAUT was the theoretical framework for this study, which includes predictors such as performance expectancy, effort expectancy, social influence, and facilitating conditions (Venkatesh et al., 2003). The model also includes moderators such as age, gender, experience, and voluntariness of use. In this study use of experience as a moderator was supported by previous research (Gandomani & Nafchi, 2016). Moderators such as age, gender, and voluntariness of use were not included in this study. Use behavior, as a dependent variable, was also not included in this study. In relation to the framework, this study supports the findings of Walldén et al. (2016) and Turner et al. (2010) because the multiple linear regression was only able to explain 24% of the variance in behavioral intent by project managers to adopt continuous delivery.

Limitations of the Study

The online survey was offered in English-only, which may have prevented participation from project managers located in specific regions. The study results reflected 91% of participants were located in the United States. Generalizability of this study was reduced by the English-only survey limitation.

Participants were also limited to technical project managers who were members of five specific LinkedIn groups. The project management focused LinkedIn groups included a large number of nontechnical project managers and members who held positions unrelated to project management such as recruiters and operational managers. Similar to the English-only restriction of the survey, the project manager scope limitation might have reduced the generalization of findings; however, the focus of this study was on technical project managers.

The population of this study was small compared to the total population of technical project managers. Small populations can incur a threat to external validity because the findings may not be generalizable. Simple random sampling, to avoid selection bias, and a statistical power of .80 in the power analysis performed was used to reduce the threat to external validity.

Finally, the survey used in this study was not used in a time-series and instead was issued at one point in time. Although this collection method avoids multiple-treatment interference, it may have reduced the reliability of results by not comparing results over a period because the UTAUT can be used to explain variances over a time-series. A longitudinal study may have increased reliability of results.

Recommendations

Prior to the completion of this study, there has been no prior UTAUT research on project managers perceptions as they relate to continuous delivery adoption and use. Assumptions concerning the responsibility of the project manager as it relates to continuous delivery adoption were made based on an exhaustive literature review; however, this was not enough evidence to substantiate a real relationship exists. The execution of this study may encourage testing of the UTAUT with individuals holding other roles in an agile organizational structure such as scrum managers or architects. Future research in the area of continuous delivery adoption may reduce statistical conclusion or construct validity.

As agile methods such as scrum and kanban increase in prevalence, and automated continuous practice such as continuous delivery increase in adoption the study of behavior of people in supporting roles may change from technology adoption to process maturity. A study that examines the attitudes of all agile-related roles inside a specific or set of scalable agile frameworks may help managers select the most efficient organizational workflow available. There are many competing frameworks documented in the literature (Dingsoeyr, Falessi, & Power, 2019), which may complicate the process of deciding which one is the best-fit for an organization's structure and culture. The endless combination of role definitions, organizational structure, personality types, culture, and project delivery methods may fuel the literature for decades to come.

Agile maturity is coming in the form of new DevOps models such as DevSecOps and AIOps. Automating tasks in an autonomous way, using artificial intelligence to predict human input using metrics available from open source data models, defines the next generation of DevOps. It may be beneficial to research the role that humans play in making AIOps a reality. It may prove interesting to see if behavioral intent continues to matter given the increase in autonomy. Will behavioral intent of an organizational member matter when a process is automated and does not require their input?

Implications

The significance of this study was to add to the existing body of knowledge related to adopting continuous delivery as it pertains to a single organizational role, project managers. Project managers may use the findings of this study to help them adopt continuous delivery and further achieve improvements such as increased project predictability, increased customer satisfaction, and improved software release reliability and quality, and increasing project efficiency and success.

Significance to Practice

Riungu-Kalliosaari, Mäkinen, Lwakatare, Tiihonen, and Männistö (2016) reported that after organizations adopted continuous delivery, they experienced improved software quality, improved collaboration, better lines of communication, and an increase in the number of implemented features per software product release, among many other benefits. A large body of peer-reviewed material suggested that organizational structure affects behavioral intention to adopt continuous delivery (Chen, 2017; Lustenberger, 2016). Arguably, one of the most important factors in adopting continuous delivery is creating a collaborative organizational culture in place of a traditional hierarchal structure (Chow & Cao, 2008; Stankovic, Nikolic, Djordjevic, & Cao, 2013). The findings of this study indicated performance expectancy was the strongest predictor of behavioral intent to adopt continuous delivery by participating project managers. These findings may hold significance to practice as it may improve awareness, alignment, and reduce the time and cost associated with adopting a continuous delivery system (Chen, 2017), which further may provide greater project efficiency and possibly increase a company's competitive advantage.

Significance to Theory

UTAUT (Venkatesh et al., 2003), introduced in 2003, was implemented over 1200 times in more than 50 different journals (Venkatesh, Thong, & Xu, 2016). The UTAUT model (Venkatesh et al., 2003) was integrated with other models or extended more than 60 times (Venkatesh et al., 2016) yet there were no studies that apply the theory to behavioral intention to adopt continuous delivery. Laukkanen et al. (2017)

conducted a systematic literature review, which acknowledged organizational and human challenges, within the context of continuous delivery adoption, could be analyzed with general theories of organizational change, such as Venkatesh et al.'s (2003) UTAUT model. This study contributed to the UTAUT model (Venkatesh et al., 2003) body of knowledge and illustrated a parsimonious equation for predicting behavioral intent of participating subjects. The ability to continue to test the UTAUT model (Venkatesh et al., 2003) more than 15 years after its introduction is proof of the resilience of the technology adoption research community.

Significance to Social Change

Software solutions have empowered people to make social change by providing users with tools to solve very complex problems in a faster and more efficient way. Determining how differences that performance expectancy of project managers participating in this study affects behavioral intent to adopt continuous delivery may inform changes necessary to make problem solving more efficient. The knowledge gained regarding the insignificance of effort expectancy, social influence, facilitating conditions, and experience may help society deemphasize these constructs. The analysis and findings of this study demonstrate the need to continue research into societal norms and assumptions to determine the actual motivations behind an individual's behavior. Understanding the real motivations of individuals can improve communication, reduce conflict, and support societal advancement.

Conclusion

The purpose of this quantitative, regression analysis study was to examine the extent to which the UTAUT (Venkatesh et al., 2003), which includes measurements of independent variables performance expectancy, effort expectancy, social influence, and facilitating conditions, as moderated by experience, predicted the dependent variable behavioral intent to adopt continuous delivery for software development project managers in software development organizations. The UTAUT model (Venkatesh et al., 2003) constructs, moderators, and dependent variables were the foundation of the research questions and hypotheses in this study. The results of this study provided a mathematical, multivariate model that included one of the constructs and explained 24% of the variance in behavioral intent to adopt continuous delivery by participating project managers.

A survey adapted from the original UTAUT (Venkatesh et al., 2003) theory development was distributed to technical project managers that were members of five specific social media groups. A sample of 85 project managers participated over the course of 17 days. A stepwise multiple linear regression analysis and Pearson's bivariate correlation was executed using the IBM SPSS v25 statistical analysis package. The results of the statistical analysis were presented in Chapter 4.

The analysis of the frequencies, assumptions, correlation coefficients, and significance yielded an equation for explaining the variance of behavioral intent to adopt continuous delivery. Performance expectancy emerged as the only moderately strong significant predictor of behavioral intent. All other constructs, as well as experience as a moderator, were deemed insignificant. The resulting predictive mathematical equation was able to predict 24% of the variance in participating project manager's behavioral intent. This study supports the findings of Walldén et al. (2016) and Turner et al. (2010) whereby the decrease in research studies using technology acceptance methods due to the diametric alignment of behavioral intent and use behavior of IT present in introspective studies such as Turner, Kitchenham, Brereton, Charters, and Budgen (2010). Turner et al. (2010) analyzed TAM-based (Davis, 1989) studies in the field of IT and stated behavioral intent based on perceived usefulness and perceived ease of use did not align with actual use behavior. Although it is important to study the behavioral intent of organization members, the UTAUT model (Venkatesh et al., 2003) may not be an effective tool in predicting outcomes in the field of IT based upon the findings of this study. The study may have focused on the wrong target population and may be executed with another population with different results.

Improving competitive advantage will continue to be a focus for organizations worldwide. Searching for the most effective combination of skills, processes, organizational structure, personality types, and culture continues to be a difficult task. This study contributes to the body of knowledge by illustrating performance was the most important consideration for project managers when it comes to the automation of tasks such as continuous delivery of projects. The insignificance of effort expectancy, social influence, facilitating conditions, and experience may be conceived as positive because a parsimonious model may be preferred. If there are fewer variables in the prediction of behavioral intent to adopt an automated continuous delivery system, this may indicate that adoption is less complicated at this period in time and effort to research the maturity of a continuous delivery system is more appropriate.

Maturity and scalability of automated systems such as continuous delivery is now the focus of artificial intelligence in the next iteration of DevOps called AIOps. Every member of an organization will likely interact with an automated system powered by some form of artificial intelligence in the near future. Competitive advantage as defined by project success may be one area of automation that becomes possible as a result of continuous practice maturity. Automatically determining the most important features to be developed, automatically coding the features, and automatically releasing a product are all possible outcomes of incorporating human-like inputs to the process. The parsimonious model yielded by this study may indicate that less human intervention is necessary and even less is expected in the future.

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Appendix A: Permission of UTAUT Author to Use Model, Instrument, and Images

Re: Permission to use instrument and images in UTAUT published work.

Gordon Davis [redacted]

Sent: Mon 1/7/2019 2:40 PM

To: Andrew J Anderson [redacted]

The instrument is in the public domain. You may use it.

Gordon B Davis

--

Gordon B Davis, Professor Emeritus of Information Systems

Carlson School of Management - University of Minnesota

On January 7, 2019, at 11:12 AM, "Andrew J Anderson" [redacted] wrote:

Dr. Morris, Dr. Davis, Dr. Davis,

I am a PhD student at Walden University. I am writing a dissertation on the adoption of DevOps in large enterprises. I would like to use the Unified Theory of Acceptance and Use of Technology to study my topic. May I have your permission to use the instrument and images contained in your published work:

Venkatesh, Morris, Davis, & Davis. (2003). User Acceptance of Information Technology: Toward a Unified View. MIS Quarterly, 27(3), 425. https://doi.org/10.2307/30036540

Thank you for your consideration in advance, Andrew Anderson

Appendix B: Permission of UTAUT Publisher to Use Model, Instrument, and Images

MIS Quarterly

MIS Quarterly
Carlson School of Management
University of Minnesota
Suite 3-306 CSOM
321 19th Avenue South
Minneapolis, MN 55455

January 9, 2019

Andrew Anderson
Walden University

Permission to use material from
MIS Quarterly in doctoral dissertation

Permission is hereby granted for Andrew Anderson to use material from "User Acceptance of Information Technology: Toward a Unified View," V. Venkates h, M. Morris, G. B. Davis, and F. D. Davis, *MIS Quarterly* (27:3), September 2003, pp. 425-478, specifically instrument, Figures 1 and 3 (and additional material as needed), in his doctoral dissertation, "Examination of Adoption Theory on the DevOps Practice of Continuous Delivery," being completed at Walden University.

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Title: Re-examining the Unified Theory of Acceptance and Use of Technology (UTAUT): Towards a Revised Theoretical Model

Author: Yogesh K. Dwivedi, Nripendra P. Rana, Anand Jeyaraj et al

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Appendix E: Survey Instrument

Continuous Delivery Adoption and Use

You are invited to take part in a research study about enterprise project manager adoption of continuous delivery practices as it relates to behavioral intent to adopt. The researcher is inviting professionals who have project managed at least one software development project involving continuous delivery to be in the study. Your name and contact info were obtained using via LinkedIn. This form is part of a process called "informed consent" to allow you to understand this study before deciding whether to take part.

This study is being conducted by a researcher named Andrew J. Anderson, who is a doctoral student at Walden University.

Background Information:

The purpose of this study is to test the Unified Theory of Acceptance and Use of Technology (UTAUT; Venkatesh, Morris, Davis, & Davis, 2003) that relates performance expectancy, effort expectancy, social influence, and facilitating conditions, as moderated by experience, with behavioral intent to adopt continuous delivery for software development project managers at large software development organizations.

Procedures:

If you agree to be in this study, you will be asked to:

- Confirm that you agree to collection and aggregation of the anonymous information you will be asked to provide,
- Confirm that you are, or were, a project manager, over the age of 18, working for a software development organization,
- Answer 11 questions concerning you and your organization's background (about 5-7 minutes),
- Rate 19 statements concerning your experiences related to continuous delivery system adoption and use (about 5-7 minutes).
- Submit your survey by clicking *submit* to the last set of rating statements.

Here are some sample questions:

- Size of the project (number of project team members):
- Length of the project (in months):
- The number of agile software development projects you have experienced:
- Using the system enables me to accomplish tasks more quickly. (rated strongly disagree, disagree, neither agree or disagree, agree, strongly agree)
- If I use the system, I will increase my chances of getting a raise. (rated strongly disagree, disagree, neither agree or disagree, agree, strongly agree)

Voluntary Nature of the Study:

This study is voluntary. You are free to accept or turn down the invitation. No one at LinkedIn will treat you differently if you decide not to be in the study. If you decide to be in the study now, you can still change your mind later. You may stop at any time.

Risks and Benefits of Being in the Study:

Being in this type of study involves some risk of the minor discomforts that can be encountered in daily life, such as fatigue, stress or becoming upset. Being in this study would not pose risk to your safety or wellbeing.

This study may provide a benefit to project management practices by improving awareness, alignment, and reducing the time and cost associated with adopting a continuous delivery system. This study may make a social contribution by providing software development project managers with the specific information needed to promote organizational change. The knowledge gained holds significance to social change as it may help organizations develop operational efficiency, effectiveness, and generate greater value to their clients and society.

Payment:

No payments will be made to participants.

Privacy:

Reports coming out of this study will not share the identities of individual participants. Details that might identify participants, such as the location of the study, also will not be shared. Even the researcher will not know who you are. The researcher will not use your personal information for any purpose outside of this research project. Data will be kept secure by data encryption. Data will be kept for a period of at least 5 years, as required by the University. Aggregate results of the survey will be shared with the targeted LinkedIn groups upon the publishing of this study.

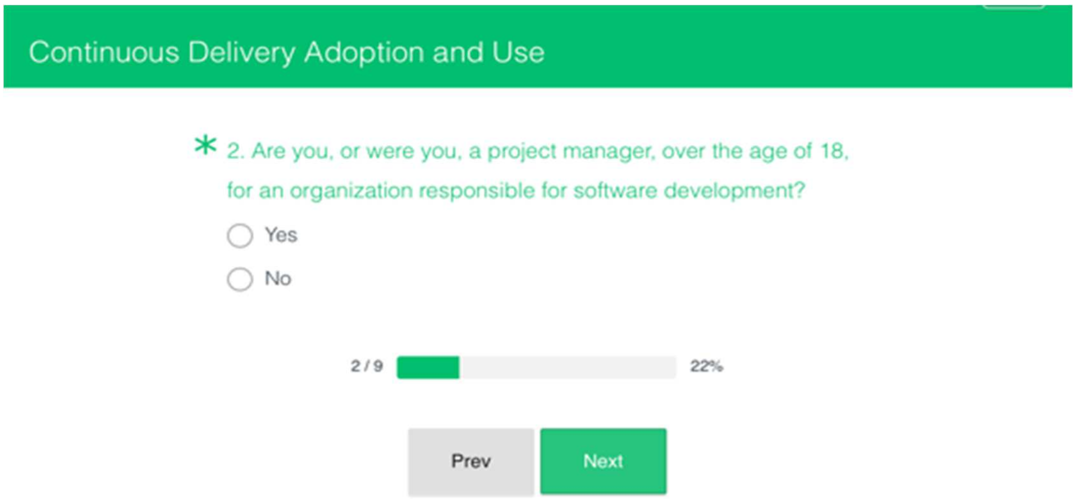
Contacts and Questions:

You may ask any questions you have now. Or if you have questions later, you may contact the researcher via andrew.anderson@waldenu.edu. Your legal rights are preserved and if you would like to talk privately about your rights as a participant, you can call the Research Participant Advocate at my university at 1-800-925-3368 ext. 312-1210 from within the USA, 001-612-312-1210 from outside the USA, or email address irb@mail.waldenu.edu. Walden University's approval number for this study is ***TODO: IRB will enter approval number here*** and it expires on ***TODO: IRB will enter the expiration date.***

* 1. Do you agree to allow collection and aggregation of the information you provide within this survey.

◯ Yes

◯ No



Continuous Delivery Adoption and Use

* 2. Are you, or were you, a project manager, over the age of 18, for an organization responsible for software development?

- Yes
- No

2 / 9 22%

Prev Next

Continuous Delivery Adoption and Use

Section 1.1

For the following questions, please provide some information regarding the agile project.

3. Project description (i.e., what problem was the software intended to solve):

[ ]

* 4. The Agile method used:

Adaptive Software Development (ASD)

* 5. Size of the project (number of project team members):

1-5	6-10	11-15	16-20	21+
✔	○	○	○	○

* 6. Length of the project (in months):

1-3	4-6	7-9	10-12	13+
✔	○	○	○	○

* 7. Location of the project (country):

United States of America (USA)

3 / 9 33%

Prev Next

Section 1.2

For the following questions, please provide some information regarding your organization and yourself.

* 8. Company size (number of employees):

1-100	100-500	500-2000	2000-5000	5000+
○	○	○	○	○

* 9. Company revenues (annual sales dollar amounts):

0-10 million	10-20 million	20-50 million	50-100 million	100+ million
○	○	○	○	○

* 10. Company industry:

* 11. Your level of experience with agile software development projects (in years):

1-2	3-4	5-6	7-8	9+
○	○	○	○	○

* 12. The number of agile software development projects you have experienced:

1-2	3-4	5-6	7-8	9+
○	○	○	○	○

* 13. Do you have any of the following project management certifications:

- [ ] Associate in Project Management
- [ ] Certified Associate in Project Management (CAPM)
- [ ] Certified Project Director
- [ ] Certified Project Manager (IAPM)
- [ ] Certified Project Management Practitioner (CPMP)
- [ ] Certified ScrumMaster (CSM)
- [ ] CompTIA Project+
- [ ] IPMA Level A: Certified Projects Director
- [ ] IPMA Level B: Certified Senior Project Manager
- [ ] IPMA Level C: Certified Project Manager
- [ ] IPMA Level D: Certified Project Management Associate
- [ ] Other (please specify)
- [ ] Master Project Manager (MPM)
- [ ] PMI Agile Certified Practitioner (PMI-ACP)
- [ ] PMI Professional in Business Analysis (PMI-PBA)
- [ ] PMI Risk Management Professional (PMI-RMP)
- [ ] PMI Scheduling Professional (PMI-SP)
- [ ] Portfolio Management Professional (PfMP)
- [ ] PRINCE2
- [ ] Professional in Project Management (PPM)
- [ ] Program Management Professional (PgMP)
- [ ] Project Management in IT Security (PMITS)
- [ ] Project Management Professional (PMP)

4 / 9 44%

SECTION II - PERFORMANCE EXPECTANCY

* 14. This section includes questions relating to your performance expectancy of the continuous delivery system.

	strongly disagree	disagree	neither agree or disagree	agree	strongly agree
I would find the system useful in my job.	○	○	○	○	○
Using the system enables me to accomplish tasks more quickly.	○	○	○	○	○
Using the system increases my productivity.	○	○	○	○	○
If I use the system, I will increase my chances of getting a raise.	○	○	○	○	○

5 / 9 56%

SECTION III - EFFORT EXPECTANCY

* 15. This section includes questions relating to your effort expectancy of the continuous delivery system.

	strongly disagree	disagree	neither agree or disagree	agree	strongly agree
My interaction with the system would be clear and understandable.	○	○	○	○	○
It would be easy for me to become skillful at using the system.	○	○	○	○	○
I would find the system easy to use.	○	○	○	○	○
Learning to operate the system is easy for me.	○	○	○	○	○

6 / 9 67%

SECTION IV - SOCIAL INFLUENCE

* 16. This section includes questions relating to the social influence you experienced with the continuous delivery system.

	strongly disagree	disagree	neither agree or disagree	agree	strongly agree
People who influence my behavior think that I should use the system.	○	○	○	○	○
People who are important to me think that I should use the system.	○	○	○	○	○
The senior management of this business has been helpful in the use of the system.	○	○	○	○	○
In general, the organization has supported the use of the system.	○	○	○	○	○

7 / 9 78%

SECTION V - FACILITATING CONDITIONS

* 17. This section includes questions relating to the facilitating conditions you experienced with the continuous delivery system.

	strongly disagree	disagree	neither agree or disagree	agree	strongly agree
I have the resources necessary to use the system.	○	○	○	○	○
I have the knowledge necessary to use the system.	○	○	○	○	○
The system is not compatible with other systems I use.	○	○	○	○	○
A specific person (or group) is available for assistance with system difficulties.	○	○	○	○	○

8 / 9 89%

SECTION VI - BEHAVIORAL INTENT

* 18. This section includes questions relating to the behavioral intention, to use the continuous delivery system, you experienced.

	strongly disagree	disagree	neither agree or disagree	agree	strongly agree
I intend to use the system in the next 3 months.	○	○	○	○	○
I predict I would use the system in the next 3 months.	○	○	○	○	○
I plan to use the system in the next 3 months.	○	○	○	○	○

9 / 9 100%

Appendix F: Model Summary for Behavioral Intent

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics: R Square Change	F Change	df1
1	.515[a]	.265	.228	1.01288	.265	7.218	4
2	.515[b]	.265	.238	1.00679	.000	.029	1
3	.511[c]	.261	.243	1.00308	-.004	.397	1
4	.490[d]	.240	.231	1.01141	-.021	2.384	1

Model Summary

Model	Change Statistics: df2	Sig. F Change
1	80	.000
2	80	.866
3	81	.530
4	82	.126

a. Predictors: (Constant), Facilitating Conditions, Effort Expectancy, Social Influence, Performance Expectancy

b. Predictors: (Constant), Effort Expectancy, Social Influence, Performance Expectancy

c. Predictors: (Constant), Social Influence, Performance Expectancy

d. Predictors: (Constant), Performance Expectancy